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NOTAS DE APLICACIONES

Explore the future

LAQUA

HORIBA

GENERAL

Determination of pH in Non-Aqueous Solutions

A simple extraction procedure using water is recommended for measuring the pH of non-aqueous solutions containing water-immiscible solvents. Water is added and mixed thoroughly with the sample. After reaching equilibrium, the solvent phase is separated and the pH of the water phase is then measured.

Introduction

Liquids can serve as solvents to dissolve solutes (i.e., solid, liquid or gaseous) to form solutions. The most common solvent is water. Solvents other than water are called non-aqueous solvents. Some examples of non-aqueous solvents are hexane, alcohol, oil, etc. These are often mixed with water or some other non-aqueous solvents to form mixed solvents appropriate for certain applications in chemical research or industrial processes. Non-aqueous solvents that tend to mix with water to form homogeneous mixture are called water-miscible (e.g., methanol, acetone) while those which separate or form a layer when mixed with water are water-immiscible (e.g., oil, hexane, toluene).

pH measurement in non-aqueous and mixed solutions poses a number of issues such as dissociation of the solvent, different pH scale, and liquid junction potential to name a few. The typical problems encountered during measurement with pH electrodes are slow response time, unstable readings, and erroneous results. According to Frant[2], the electrode should have an adequate outward flow from the junction and the junction design should permit easy cleaning for optimum performance. These two key features prevent memory effects at the junction and minimize liquid junction potential.

The Sleeve ToupH 9481-10C electrode (PN 3200611631) is our recommended product for pH measurement in non-aqueous and mixed solutions. It is a refillable, double-junction, glass-body, combination pH electrode. The cable length is 1m and the connector is BNC, compatible with any pH meter that has BNC input. The movable glass sleeve allows easy cleaning of the liquid junction and prevents clogging. The applications include testing of non-aqueous solvents, viscous solutions, and samples containing non-aqueous solvent (e.g., cosmetics, paints, etc). If a combination pH electrode with built-in temperature sensor is desired, the Sleeve ToupH 9681S-10D electrode (PN 3200585463) meets this requirement. This electrode is compatible with HORIBA pH meters only.

Solvent Miscibility and Solubility

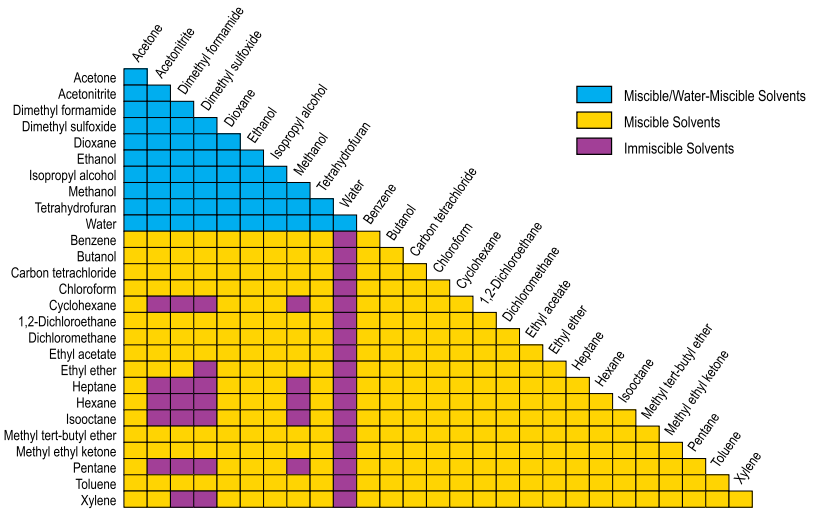

Figure 1: **Solvent Miscibility and Solubility**
(Source: Restek http://www.restek.com/techtips/Solvent-Miscibility-and-Solubility)

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Method

Calibrate the meter and electrode system according to manufacturer's instructions with at least two pH buffers that bracket the expected sample pH.

Sample Preparation And Measurement

The method described below is based on US EPA Method 9045D.

1. Add 20ml of water to 20g sample in a beaker or container. Cover and stir for 5 minutes.
2. Let the solution stand for 15 minutes or centrifuge it to allow the sample and water to separate.
3. Measure the pH of water phase. Record the pH value and the temperature.

To obtain accurate results, standard buffer solutions and samples should be measured at the same temperature. If the electrode is coated with oily material from a sample, clean it with detergent and warm water.

Results And Benefits

As non-aqueous solvents have very low conductivity and can dehydrate the glass membrane, it is difficult to use glass electrodes in measuring pH directly. There must be some electrical conductivity through the solution and glass membrane must be hydrated to function well.

For water-immiscible non-aqueous solvents and non-aqueous solutions with water-immiscible solvents, this measurement can be accomplished by adding water as described in the method above. Pure water with very low buffering capacity and no dissolved salts should be mixed thoroughly with the solvent. Once the two phases are in equilibrium with each other, the activity of any dissolved species should be the same in both phases. After separating the solvent phase, the pH of water phase is then measured.

For water-miscible non-aqueous solvents and mixed aqueous/water-miscible non-aqueous solutions (e.g., water and methanol), a reproducible measurement process can be achieved if the solvent background is known and constant. To do this, it is important to describe the choice of pH electrode, calibration standards, sample preparation, and electrode conditioning.

1. pH electrode

A glass-body electrode resists chemical attack. A flowing reference should be used to eliminate or minimize liquid junction problem. An aqueous filling solution may be used, but most often develops a large or unstable junction potential. This can be reduced by changing the filling solution so that it is compatible with the sample (e.g., methanol saturated with KCl, 90% glacial acetic acid plus 10% saturated aqueous LiCl).

2. Calibration Standards

Ideally, the calibration standards should have the same background as the sample. A constant solvent background may be used in testing the measuring system. A "check" standard made with dry buffer and same solvent background can be measured after calibrating the electrode/meter system in aqueous pH buffers. Its reproducibility is a good test although the reading will be different from the aqueous values. In pH measurement of non-aqueous and mixed solutions, only relative readings can be obtained.

3. Sample Preparation

The ionic strength of non-aqueous solvents can be increased by adding a neutral electrolyte such as a quarternary ammonium salt.

4. Electrode Conditioning

When measuring pure solvents or samples with less than 20% water, the contact time of the electrode to the sample should be kept to a minimum as solvents may dehydrate the glass membrane. Between measurements and after use, it should be soaked in buffer or KCl solution to hydrate the glass membrane. Dried electrodes can be drifty and sluggish.

References And Suggested Readings

1. US Environmental Protection Agency Method 9045D Soil and Waste pH, Revision 4 November 2004
2. Frant, Martin. How to Measure pH in Mixed and Non-Aqueous Solutions. American Chemical Society. 1995
3. C. Westcott. pH Measurements. Academic Press Inc. New York, USA. 1978

REV 1.0, 9 September 2015

LAQUA pH Combination Electrodes Lineup

9415-10C	9425-10C	9481-10C	9418-10C	9480-10C	6069-10C	6061-10C
ToupH Standard	Field plastic	ToupH Sleeve	ToupH Micro	ToupH Long	Long	Flat

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IMS
HORIBA Group is operating Integrated Management System (IMS)
ISO9001 JOA-0298 / ISO14001 JOA-E-90039 / ISO13485
JOA-MD0010 / OHSAS18001 JOA-OH0068

Application Note

Determination of pH as Quality Control Test in Culture Media

pH affects the physical appearance of culture media and their ability to grow microorganisms. Most bacteria grow in pH 6.5 - 7.0 while animal cells thrive in pH 7.2 – 7.4. Measure the pH value of culture media sample in final form at room temperature with a 6261-10C flat glass pH electrode or 0040-10D ISFET pH electrode and pH meter to ensure the quality of each batch.

Introduction

In laboratories, microorganisms such as bacteria, yeast, fungi, animal cells, and plant cells are cultivated in favourable growth environments known as culture media or growth media for various microbiological tests. Culture media contain nutrients, growth promoting factors, energy sources, buffer salts, minerals, metals, and sometimes solidifying or gelling agents (agar) to support the growth and survival of microorganisms. They can be prepared in-house by mixing individual components or purchased commercially as complete dehydrated media and may form as liquid (broth), semi-solid, or solid (agar plate, slant, or deep tube) depending on the solidifying or gelling agent content. Different types of culture media are designed for different types of microorganisms and applications.

Apart from complete nutritional composition, right and stable pH is another important requirement for optimum microbial growth in culture media. The pH of a culture medium should be suitable to the microorganisms that will be grown. Most bacteria grow in pH 6.5 - 7.0 while most animal cells thrive in pH 7.2 – 7.4. As certain microorganisms like bacteria tend to release acidic products that can interfere with their growth, buffers are added in culture media to stabilize the pH. Media manufacturers adjust the pH values of dehydrated media so that the final pH values of the finished culture media conform to the specifications on the product labels when cooled to 25°C.

Prior to use, each batch of culture media must undergo quality control tests. The most important chemical test is pH measurement as pH influences the performance of culture media. If the pH of the finished culture medium is outside the recommended range, not only the growth of the microorganisms that the culture medium is intended to grow is inhibited, but also physical changes such as precipitation of components or soft gelling of agar may occur. Routine pH checks in liquid, semi-solid, or solid culture media can be simply carried out with pH meter and pH electrode after proper calibration with pH buffers.

Flat pH electrodes, also called flat bottom pH electrodes, flat tip pH electrodes, and flat surface pH electrodes, are commonly used in measuring pH of culture media, especially for agar plates. Both the sensing membrane and reference junction of the flat pH electrode are constructed on the flat surface tip of the electrode body. This tip configuration is perfect for measuring pH of single drop or small volume of liquid samples as well as moist surfaces of soft solid or semi-solid samples such as meat, paper, skin, cloth, cheese, leaves, leather, bread dough, and culture media.

HORIBA offers two types of flat pH electrodes which are based on two different electrode technologies, the 6261-10C combination flat glass pH electrode and 0040-10D ion sensitive field effect transistor (ISFET) pH electrode. The pH sensitive part of the former is a glass membrane based on pH glass electrode technology while that of the latter is a miniature semiconductor-based sensor using pH transistor technology. The 6261-10C is a refillable combination pH electrode with glass body that is resistant to chemical attack and sleeve junction that prevents clogging because of its relatively high flowrate compared to conventional ceramic junction. The 0040-10D is designed with ISFET chip and non-glass body, which make it rugged, unbreakable, low maintenance, and waterproof. The advantages of 0040-10D over 6261-10C are as follows:

Features of 0040-10D ISFET pH electrode:

- The sensor is replaceable, easy to clean with soft toothbrush, and can be stored dry.
- The robust epoxy body is ideal for applications and environments where glass material is unacceptable.

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Continued from the front

- It is integrated with temperature sensor for automatic temperature compensation (ATC) and accurate pH reading.
- It has improved electrostatic protection circuit for reduction of static electricity effect.
- It gives fast response and reduces acidic or alkaline errors in extreme pH conditions.
- It shuts off automatically when not in use.

Model	 6261-10C	 0040-10D
Description	Combination Flat glass pH Electrode	Ion Sensitive Field Effect Transistor (ISFET) pH Electrode
pH Range	0 – 12	0 – 14
Temperature Range (°C)	0 – 50	0 – 60
Reference Junction	Sleeve	Porous sintered polyethylene
Reference Electrode	Ag/AgCl	Ag/AgCl
Temperature Sensor	—	Built-in
Replacement Sensor	—	0141
Material	Glass	Epoxy
Dimensions (mm)	150 x 12	190 x 10
Cable length	1m	1m
Connector(s)	BNC	BNC & phono jack
Fill Solution	3.33M KCl	—
Power	—	CR2032 x 2
Part No.	3014081807	3200367925
 Scan the QR code for more information		

Method

Meter Set-Up And Calibration

Since pH is temperature-dependent, use a pH meter with ATC capability. If 6261-10C pH electrode is used, measure the temperature of pH buffers using a calibrated thermometer and enter the value into the pH meter. This will allow the pH meter to compensate the temperature effect in the calibration.

1. Prepare the pH electrode according to the instruction manual.
2. Set the pH buffer group (e.g. USA or NIST) and resolution (e.g. 0.01 pH) in the pH meter and connect the pH electrode.
3. Select at least two pH buffers (usually, pH 4.01, 7.00, and 10.01 USA buffers are used) that bracket the expected pH value of the culture medium. Pour small amount of fresh pH buffers in beakers for calibration.
4. Rinse the tip of pH electrode with distilled or deionized water and blot dry with soft tissue.
5. Calibrate the pH electrode / meter system with pH buffers according to manufacturer's instructions.

After calibration, each slope should be within 95 – 105%. If slope is not within this range, change the pH buffers and clean, drain / refill (only applicable for 6261-10C), and condition the pH electrode according to instruction manual.

Sample Preparation And Measurement

Measure the pH of culture media at room temperature (20 – 25°C) unless otherwise specified by the media manufacturer. To obtain accurate results, pH buffers and samples should be at the same temperature.

Laboratory-prepared media should be checked for pH and adjusted with 1M NaOH or 1M HCl (if necessary) before dispensing for sterilization. Verify pH after sterilization as changes in pH may occur. In contrast, commercially available dehydrated media usually require no pH adjustment if properly prepared, so a single sample of sterilized finished culture media can be checked for pH. For agar-based culture media, take the pH of the solidified sample.

1. Place the tip of the flat pH electrode on the surface of the culture medium sample to measure the pH. Make sure that the tip touches the culture medium and no gap between them.
2. Record the pH and temperature displayed on the meter once stable.
3. Refer to literature for the desired pH range of the culture medium. For commercially purchased dehydrated media, refer to the product label to check whether the pH is within the stated range. If not, follow the media manufacturer's recommendations.
4. Before measuring another sample, rinse the tip of pH electrode with distilled or deionized water and blot dry with soft tissue.
5. Discard samples after testing.

Always store the pH electrode clean. To remove protein residues from pH electrode, use HORIBA 250 cleaning solution and warm water. For more information on cleaning and maintenance, refer to the electrode instruction manual.

References And Suggested Readings

1. Baird, R., Denyer, S. & Hodges, N. Handbook of Microbiological Quality Control in Pharmaceuticals and Medical Devices, p. 27.
2. Control of Microbiological Culture Media by Nordic Committee on Food Analysis. Retrieved from http://www.nmkl.org/dokumenter/prosedyrer/sk/PROC10_no.pdf on 25 September 2016.

6 October 2017, Rev. 0

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MONITORES DE LA SALUD

Nota de aplicación

Medición de sodio en sudor de atleta

LAQUAtwin es un rango de medidores de bolsillo de electroquímica. Los medidores de iones usan un electrodo selectivo, para medir el potasio, el calcio, los nitratos y el sodio este rango también incluye medidores de pH y de conductividad. Con tan solo una gota de muestra, el sensor plano LAQUAtwin mide rápidamente y con precisión las concentraciones de parámetros químicos en el campo o en laboratorio.

Introducción

Es importante de determinar la cantidad de sodio presente en el sudor porque el reemplazo de sodio (Na +) perdido en el sudor tiene un impacto importante en la prevención de los desequilibrios de líquidos y electrolitos. Conocer la cantidad de sodio perdida permite de entender como reemplazar efectivamente los electrolitos después del esfuerzo.

En general, el contenido de sodio en el sudor es medido por técnicas de laboratorio de análisis como cromatografía de iónica y el tiempo de entrega de resultado es 2 semanas. Pero la mayoría de los atletas no tienen fácil acceso a este tipo de instalaciones y necesitan conocer la perdida directamente después de esfuerzo. El medidor de iones HORIBA puede ser utilizado en lugar de la cromatografía iónica tradicional con el fin de determinar la cantidad de sodio en el sudor.

El medidor LAQUAtwin Na + se utiliza por realizar mediciones simple para determinar el contenido de iones de sodio en el sudor para poder reemplazar adecuadamente los electrolitos después de una actividad intensa. Este es un método fácil, rápido utilizado para comprobar la cantidad de sodio presente en el sudor.

Método

Cuando el deportista ha empezado a sudar, limpiar la píele con agua desionizada y se secarla y luego aplicar parches estériles sobre el muslo, la pantorrilla, los omoplatos, debajo de la espalda, los brazos y la frente. El deportista debería entonces proceder a su actividad física y luego al fin del entrenamiento tirar los parches.

Extraer el sudor del parche, exprimiéndolo en una jeringa. Colocar la pequeña cantidad de muestra de sudor extraída en el sensor del medidor LAQUAtwin Na + y medirla. Para repetir el muestreo, lavar el sensor con agua del grifo y secarlo con un pañuelo de papel.

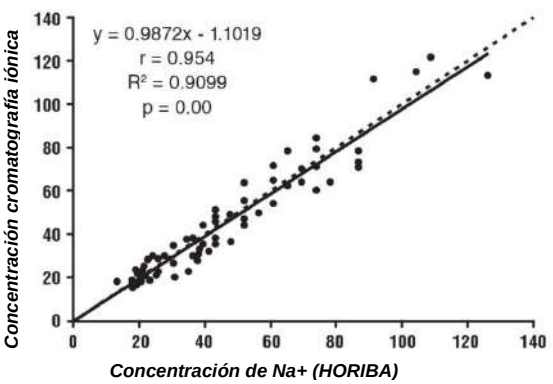
Resultado y Beneficios

Gracias a la prueba precisa de iones de sodio en el sudor de atletas, podemos determinar el desequilibrio de electrolitos y de esta manera los atletas pueden optimizar la recuperación de los electrolitos por el consumo de bebida enérgica durante y después la actividad física.

Aunque la cromatografía iónica es el laboratorio la técnica es considerada como referencia, los resultados obtenidos por método alternativo como los medidores de iones de HORIBA no sólo son más fáciles de adquirir y de usar pero también son muy preciso y rápido.

De acuerdo con un estudio realizado por Gatorade Sports Science Institute, hay una fuerte correlación entre los resultados de muestra medidas con los medidores LAQUAtwin y la cromatografía iónica.

El metro bolsillo LAQUAtwin Na + es pequeño y compacto; practico para llevar a todas partes para facilitar las pruebas en cualquier lugar. Su fácil de usar interfaz permite a cualquier persona de realizar mediciones precisa con medidor de bolsillo LAQUATwin Na +.



Medidor de bolsillo

LAQUAtwin

Características únicas

Realice calibraciones y mediciones con tan solo pulsar un botón; le indicará que ya puede leer el resultado.

La sencilla calibración automática con tan solo unas gotas de solución de calibración, le garantiza la exactitud de la medición. También se puede realizar la calibración en dos puntos y hasta 3 y 5 puntos con los modelos pH33 y EC33.

LAQUAtwin es totalmente a prueba de agua y polvo.

El medidor y el sensor son totalmente resistentes al agua y al polvo, por lo que puede llevarlo donde quiera.

1 IP67: no da errores al sumergirse en agua a una profundidad de un metro durante treinta minutos. Sin embargo, el producto no puede usarse bajo el agua

LAQUAtwin: Tecnología única de sensor plano ISE y pH

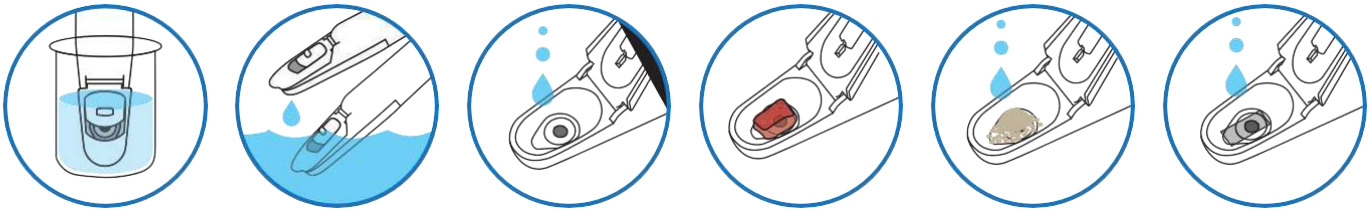
La tecnología HORIBA de sensor plano de alta sensibilidad abre nuevas posibilidades para medir diferente tipos de muestras. Puede hacer una medición a partir de un volumen de 0.1 ml y no necesita vaso para calibrar o medir, solo punga unas gotas directamente en el sensor.

Incluye un estuche para transportarlo de forma práctica.

El estuche compacto contiene todo lo que necesita para las mediciones, incluyendo las soluciones de calibración y una pipeta de plástico.

1 X 6 Un medidor, seis métodos de medición

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



1 Inmersión

Cuando se encuentre en un laboratorio, puede analizar la muestra en un vaso de precipitados. Asegúrese que la tapa deslizante que protege el sensor esté abierta.

2 Muestreo

Utilícelo como una pala para analizar el agua, por ejemplo, de un río.

3 Gotas

Los medidores LAQUAtwin pueden medir volúmenes de muestra de tan solo 0.1ml. Coloque una gota de la muestra en el sensor con una pipeta.

4 Muestras sólidas

Los alimentos que contengan cierta humedad pueden analizarse si coloca un trozo pequeño directamente en el sensor.

5 Polvos

Los medidores LAQUAtwin también pueden analizar polvos secos. Simplemente, coloque la muestra de polvo en el sensor y versa encima el volumen definido de agua desionizada.

6 Papel y tejidos

Si desea analizar hojas de papel y tejidos, corte la muestra en trozos pequeños y colóquelo directamente en el sensor. Versa encima un volumen definido de agua desionizada.

Rango

pH

Medición precisa de pH directamente a partir de una sola gota. El pH del agua varía en función al ambiente y un ligero cambio a menudo puede tener un gran impacto. Tanto si debe mantener el pH de un acuario dentro de niveles estrictos, comprobar la acidez del agua de lluvia o la calidad de producto alimenticio (carnes, pescados…), los medidores de pH de bolsillo LAQUAtwin son la solución perfecta. No importa dónde o cuándo debe realizar un análisis.

COND

Determine la conductividad con tan solo una muestra de 0.12 ml. La conductividad del agua de lluvia es una referencia fiable para determinar la pureza atmosférica. En agricultura, la medición de la conductividad del suelo permite a los agricultores establecer el uso óptimo de fertilizantes y comprobar la «salud» del suelo tras el daño provocado por el agua salada. Los medidores de conductividad LAQUAtwin hace que el análisis de la conductividad sea una tarea sencilla que se puede realizar en

Na+

Único medidor de bolsillo para medir rápidamente y con precisión el sodio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 23 a 2300 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

K+

Único medidor de bolsillo para medir rápidamente y con precisión el potasio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 39 a 3900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

NO3–

Único medidor de bolsillo para medir rápidamente y con precisión el nitrato con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 30 a 9900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

Ca2+

Único medidor de bolsillo para medir rápidamente y con precisión el calcio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 40 a 4000 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

CE RoHS

IMS

HORIBA Group is operating Integrated Management System (IMS)
ISO9001 JOA-0298 / ISO14001 JOA-E-90039 / ISO13485
JOA-MD0010 / OHSAS18001 JOA-OH0068

Application Note

Measuring Sodium and Potassium Concentrations in Athlete's Sweat

Sweat testing carried out by regional patch sweat collection, syringe sweat extraction, and LAQUAtwin analysis is the simplest and most practical method to assess electrolyte losses of athletes in the field for electrolyte replacement recommendations. During exercise or training, athlete's sweat is collected with absorbent patches applied on skin sites and subsequently extracted with a syringe for rapid determination of sodium (Na^+) and potassium (K^+) concentrations with LAQUAtwin Na-11 and K-11 pocket meters, respectively. Baker et al. (2014) compared the results of this field method with those obtained from laboratory-based centrifuge-HPLC and found that they were significantly correlated.

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LAQUAtwin Na-11 Product Page

LAQUAtwin K-11 Product Page

07-2017

Introduction

Sweating allows the body to regulate its temperature. It causes a decrease in temperature through evaporative cooling at the skin surface. When individuals are in hot weather or their muscles heat up due to physical activity, more sweat is produced in order to cool down. Sweat is mostly water with small amounts of electrolytes, which include sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), and magnesium (Mg^{2+}). As sweating increases, electrolyte composition in the body decreases. The concentrations of electrolyte loss can vary among individuals.

Measuring the electrolyte losses from athletes' sweat could assist health professionals in planning personalized water and electrolyte replacement strategies. This would prevent water/electrolyte imbalances and heat-related whole-body muscle cramps in sports that could impair athletes' performance. While Na^+ loss is primarily measured since it is the electrolyte lost in the greatest quantities and has the most significant impact on body fluid balance, K^+ loss measurement can also provide valuable information. Both sweat sodium concentration [Na^+] and potassium concentration [K^+] are needed to predict changes in serum [Na^+] from mass balance equations. Furthermore, sweat [K^+] can serve as quality control check of sweat sample. A sweat sample with very high [K^+] can indicate quality issues such as sample evaporation, contamination, or leaching of electrolytes from skin that would not have been detected from measuring sweat [Na^+] alone.

To perform sweat testing in the field, sweat can be easily sampled with absorbent patches placed on clean skin of anatomical sites after the athlete established steady-state sweating during exercise or training. The sweat sample is then extracted from each absorbent patch with syringe for immediate analysis with LAQUAtwin Na-11 and K-11 pocket meters.

The LAQUAtwin Na-11 and K-11 waterproof pocket meters measure sodium concentration [Na^+] and potassium concentration [K^+], respectively, in microvolume samples and display results in just a few seconds. The sensors are replaceable and each has sample well embedded with flat ion selective electrode paired with a reference electrode. With this unique design, the sensors are capable of measuring samples as little as 0.3ml with direct application or 0.05ml with sampling sheet. The reading in the backlit digital LCD can be expressed as ppm, mg/L, or mmol/L unit.

Method

Meter set-up and calibration

Calibrate the LAQUAtwin Na-11 and K-11 pocket meters according to manufacturer's instructions using their respective 150 and 2000ppm standard solutions.

Sample collection and measurement

Sweat tests with athletes should be conducted during exercise or training and in conditions representative of their sport.

1. After the onset of exercise or training (~10 mins), clean the following athlete's anatomical skin sites with alcohol wipe or deionized / distilled water rinse and dry with sterile gauze or towel: right anterior mid thigh, right posterior mid forearm, left posterior mid forearm, upper chest, right scapula, left scapula, and forehead.
2. Attach one sterile patch at each site.
3. Remove each patch with sterile tweezers after absorbing sufficient sample but before complete saturation.
4. Place each patch inside the barrel of a 5-ml syringe. Depress the plunger to compress the patch and expel sweat directly onto the sensors of pocket meters or vial for later analysis.
5. Record the stable readings.

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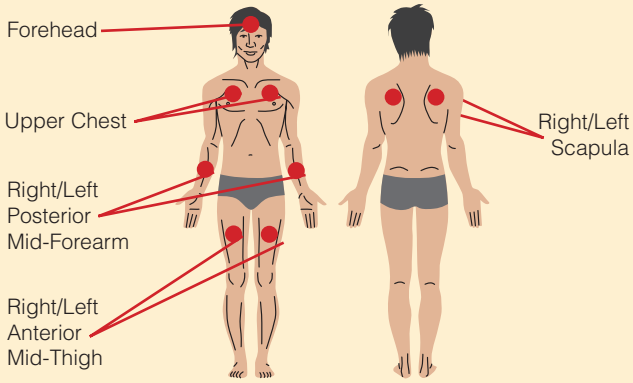
To obtain accurate results, a uniform temperature should be maintained for the standard solutions and samples. If sweat sample volume is not enough to cover the flat sensor, a sampling sheet can be used to disperse the sample on the sensor surface. After measurement, rinse the sensor, tweezer, and syringe with distilled or deionized water and blot dry with soft tissue. For more information on maintenance, refer to **Technical Tip 2: LAQUAtwin Ion Sensor Maintenance Procedures**.



Results And Benefits

To maintain water and electrolyte balance during prolonged exercise or training, it is recommended to drink water and/or sports drink to replace the water and Na^+ loss from profuse sweating. Thus, having a rapid, low-cost method and user-friendly, portable instrument to measure athlete's sweat in the field could assist health professionals in tracking changes in sweat [Na^+] and planning water and electrolyte replacement strategies.

Baker et al. (2014) conducted a study comparing a field versus reference laboratory method for extracting (syringe vs. centrifuge) and analysing sweat [Na^+] and [K^+] (LAQUAtwin vs. HPLC) collected with regional absorbent patches during exercise in a hot-humid environment. They found that the sweat [Na^+] and [K^+] obtained with the syringe-LAQUAtwin field method were significantly correlated to those of centrifuge-HPLC laboratory method (See Table 1 for the results). The LAQUAtwin Na-11 and K-11 pocket meters (superseded the B-722 and B-731 models used in the study) have been proven practical and useful tools in delivering rapid, cost-effective, and highly reliable measurements of athletes' sweat [Na^+] and [K^+], respectively, in field studies.

Table 1: Validity of field technique using syringe extraction of sweat and LAQUAtwin analysis: SYRINGE LAQUAtwin vs. CENTRIFUGE HPLC for sweat [Na^+] and [K^+].

	Sweat [Na^+]	Sweat [K^+]
Mean Difference ± SD (mEq/L)	3.97 ± 10.87*	0.50 ± 0.48*
95% CI of mean difference (mEq/L)	2.49-5.45	0.42-0.59
ICC	0.93*	0.84*
SEE (mEq/L)	8.68	0.44
TEM (mEq/L)	7.68	0.34
CV (%)	12.54	8.48

n = 210 for sweat [Na^+] and 116 for sweat [K^+]. CV, coefficient of variation; CI, confidence interval; HPLC, ion chromatography using the Dionex ICS-3000; HORIBA, HORIBA B-722 for sweat [Na^+] and HORIBA B-731 for sweat [K^+]; ICC, interclass correlation coefficient (based on two-way mixed ANOVA, absolute agreement, average measures); SD, standard deviation; SEE, standard error of the estimate; TEM, typical error of measurement; *P < 0.001.

Source: Baker et al. (2014). Validity and reliability of a field technique for sweat Na^+ and K^+ analysis during exercise in a hot-humid environment.

Sweat [Na^+] determined from anatomical sites can be used to predict whole-body sweat [Na^+] with regression equations. Sweat [Na^+] can vary considerably among individuals and typically ranges from approximately 10 to 90 mmol/L. Unlike [Na^+], sweat [K^+] is considerably lower and less variable despite changes in sweating rate. For this reason, sweat [K^+] can serve as quality control check in sweat electrolyte testing. If the sweat [K^+] is > 10 mmol/L, the potential issues are sample evaporation, contamination, or leaching of electrolytes from skin. Sweat samples that do not fall within these normal ranges: [Na^+] =10 – 90 mmol/L, [K^+] = 2 – 10 mmol/L should be flagged. Initial sweat may have high concentrations due to minerals trapped in sweat pore. To avoid this, clean skin surface and collect sample after 10 minutes of training or exercise or when steady-state sweating is achieved.

To convert ppm or mg/L reading to mEq/L or mmol/L, divide the reading by the molar mass of the ion (Na^+ = 22.989, K^+ = 39.098). Alternatively, refer to **Technical Tip 7: Procedure for Setting mmol/L Unit in LAQUAtwin Ion Pocket Meters** to set the meter to display the reading in mmol/L unit. Callibration in mmol/L unit can also be performed on the LAQUAtwin ion pocket meters.

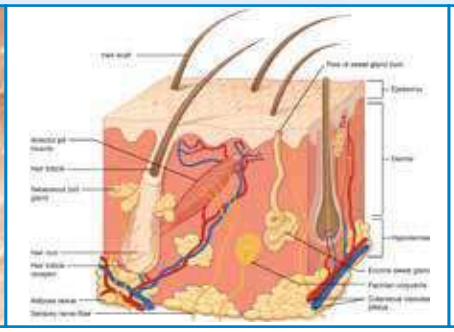
References And Suggested Readings

1. Perspiration. Wikipedia https://en.wikipedia.org/wiki/Perspiration
2. Baker, L., Ungaro, C., Barnes, K., Nuccio, R., Reimel, A., & Stofan, R. (2014). Validity and reliability of a field technique for sweat Na+ and K+ analysis during exercise in a hot-humid environment. Physiological Reports. Volume 2, Issue 5.
3. Baker, L. (2017). Sweating Rate and Sweat Sodium Concentration in Athletes: A Review of Methodology and Intra/Interindividual Variability. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5371639/ on 29 August 2017.

REV 0, 6 September 2017

Measurement of Skin Surface pH

Human skin is covered with an acid mantle making it slightly acidic – pH 4.8 to 6.0. The apparent pH value of skin can be measured by applying 1 or 2 drops of DI water or physiological saline and placing a 6261-10C flat glass pH electrode or 0040-10D ISFET pH electrode on the moistened surface. The results may vary for test sites within an individual and between individuals.



Introduction

The skin is the outer covering of the body which serves primarily as protection against pathogens and excessive water loss. The other functions of skin include insulation, temperature regulation, sensation, synthesis of vitamin D, and the protection of vitamin B folates. The skin is composed of three primary layers: the epidermis (outermost), the dermis, and the hypodermis (innermost). The epidermis consists of five layers and the outermost layer is the stratum corneum. On top of the stratum corneum is a very fine, slightly acidic film called acid mantle that acts as barrier to bacteria, viruses, and other potential contaminants that might penetrate the skin.[1] The normal values of pH in intact skin range from 4.8 to 6.0 due to presence of the acid mantle, while the interstitial fluid is characterized by neutral values.[2]

The skin hydrogen potential (pH) is a measure of the hydrogen ion concentration [H^+] in the watery solution present on the surface. This solution is obtained by adding water to the skin surface, which is a hydrophobic layer comprising of lipids. Some of the lipids (the free fatty acid) are amphiphilic. These amphiphilic free fatty acids release their H^+ ions into the added water. The pH is therefore the measurement of their dissociation within the water applied on the skin surface.[3] Since the skin is not an aqueous solution, the measured skin surface pH values are referred to as apparent pH values due to the extraction of water-soluble components of the stratum corneum into the liquid interface between the skin and the pH measuring system.[4]

The skin surface pH can provide an indication of the skin condition and health. In the past, measurement of skin surface pH has been used to assess the barrier properties of the stratum corneum and also to evaluate the relationship between changes in superficial skin microflora and the development of skin irritation. Researchers have noted that a relationship exists between the acidity of the skin surface and its antimicrobial activity. Currently, skin pH measurements are used in assessing the effects of various materials such as acid or alkaline products and environmental factors on the skin surface and in assessing the state of acute or chronic cutaneous diseases.[2]

Flat pH electrodes, also called flat bottom pH electrodes, flat tip pH electrodes, and flat surface pH electrodes, were developed for measuring pH of surface skin. The use of flat pH electrode connected to a pH meter provides not only excellent contact with the skin but also measurement accuracy within ± 0.1 pH. This measurement is non-invasive and produces only small electric current causing no skin damage. Both the sensing membrane and reference junction of a flat pH electrode are constructed on the flat surface tip of the electrode body. This tip configuration is perfect for measuring pH of single drop or small volume of liquid samples as well as moist surfaces of soft solid or semi-solid samples such as meat, paper, skin, cloth, cheese, leaves, leather, bread dough, and culture media.

HORIBA offers two types of flat pH electrodes which are based on two different electrode technologies, the 6261-10C combination flat glass pH electrode and 0040-10D ion sensitive field effect transistor (ISFET) pH electrode. The pH sensitive part of the former is a glass membrane based on pH glass electrode technology while that of the latter is a miniature semiconductor-based sensor based on pH transistor technology. The 6261-10C is a refillable combination pH electrode with glass-body that is resistant to chemical attack and sleeve junction that prevents clogging because of its relatively high flowrate compared to conventional ceramic junction. The 0040-10D is designed with ISFET chip and non-glass body, which make it rugged, unbreakable, low maintenance, and waterproof. The advantages of 0040-10D over 6261-10C are as follows:

Features of 0040-10D ISFET pH electrode:

- The sensor is replaceable, easy to clean with soft toothbrush, and can be stored dry.
- The robust epoxy body is ideal for applications and environments where glass material is unacceptable.
- It is integrated with temperature sensor for automatic temperature compensation (ATC) and accurate pH reading.
- It has improved electrostatic protection circuit for reduction of static electricity effect.
- It gives fast response and reduces acidic or alkaline errors in extreme pH conditions.
- It shuts off automatically when not in use.

Continued at the back

Continued from the front

Method

Meter Set-up and Calibration

Since pH is temperature-dependent, use a pH meter with ATC capability. If 6261-10C pH electrode is used, measure the temperature of pH buffers using a calibrated thermometer and enter the value into the pH meter. This will allow the pH meter to compensate the temperature effect in the calibration.

1. Prepare the pH electrode according to the instruction manual.
2. Set the pH buffer group (e.g. USA or NIST) and desired resolution (e.g. 0.1 pH) in the pH meter and connect the pH electrode.
3. Select at least two pH buffers (usually pH 4.01 and 7.00 buffers) that bracket the expected skin pH. Pour small amount of fresh pH buffers in beakers for calibration.
4. Rinse the tip of pH electrode with distilled or deionized water and blot dry with soft tissue.
5. Calibrate the pH electrode / meter system with pH buffers according to the manufacturer's instructions.

After calibration, slope should be within 95 – 105%. If slope is not within this range, change the pH buffers and clean, drain / refill (only applicable for 6261-10C), and condition the pH electrode according to the instruction manual.

Sample Preparation And Measurement

This method is based on the European Group on Efficacy Measurement of Cosmetics and Other Topical Products (EEMCO) guidance for the in vivo assessment of skin surface pH.[4]

During 24 hours before the measurement, sweating and washing the test site should be avoided. Practical considerations are as follows:

- Keep the room temperature under 23°C (e.g. 20 – 22°C) and the relative humidity between 40 and 60% to to minimize sweat production.
- Let the volunteers acclimatized to the measuring environment for at least 20 mins before measurements are performed.
- Avoid cleaning, even with pure water, as it can greatly affect pH measurements.
- Allow minimum period of time to elapse between the personal hygiene procedures of the volunteers and the measurements. For tap water, a period of 2 - 3 hours should be enough. After the use of synthetic cleansers and alkaline soaps, periods of 5 and 10 - 24 hours are recommended, respectively.
- Measurements should be made 12 hours after application of creams.[2]
- Remove cosmetic residues and excessive sebum on the skin by dry wiping.
- Refer to the instruction manual for the proper preparation, maintenance, cleaning, and storage of the pH electrode.
- To obtain accurate results, calibration and measurement should be carried out at the same temperature.

To measure pH on skin surface, perform the following:

1. Moisten the skin surface or pH electrode[3] by applying one or two drops of distilled / deionized water or physiological saline.
   - For comparative measurements, the volume of water used should be standardized (e.g. 20 µl) as the result of pH measurements could be affected by a surplus of water on the electrode.
2. Place the flat pH electrode on the moist skin surface with a slight pressure to measure pH. Make sure that the tip touches the skin surface and no gap between them.
   - Avoid excessive pressure on the electrode because this could influence the extraction of material from epidermis' stratum corneum and may exclude water between the skin and the pH electrode membrane.
3. Record the pH and temperature displayed on the meter once stable.
4. After measurement, rinse the tip of pH electrode with distilled or deionized water and blot dry with soft tissue.

The pH values of surface skin may vary for each test site within an individual and between one individual to another as a result of a number of factors. As such, report results of skin surface pH measurements as difference or percent change in pH values (rather than absolute values) using a measure of central tendency and variability (i.e., arithmetic mean and standard deviation).[5]

Model	 6261-10C	 0040-10D
Description	Combination Flat glass pH Electrode	Ion Sensitive Field Effect Transistor (ISFET) pH Electrode
pH Range	0 – 12	0 – 14
Temperature Range (°C)	0 – 50	0 – 60
Reference Junction	Sleeve	Porous sintered polyethylene
Reference Electrode	Ag/AgCl	Ag/AgCl
Temperature Sensor	—	Built-in
Replacement Sensor	—	0141
Material	Glass	Epoxy
Dimensions (mm)	150 x 12	190 x 10
Cable length	1m	1m
Connector(s)	BNC	BNC & phono jack
Fill Solution	3.33M KCl	—
Power	—	CR2032 x 2
Part No.	3014081807	3200367925
 Scan the QR code for more information		

References And Suggested Readings

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2. Maibach, H. & Rovee, D. The Epidermis in Wound Healing, p.133 – 135.
3. Agache, P. & Humbert, P. Measuring the Skin, p. 84.
4. Korting, H.C. & Schmid-Wendtner, M-H., pH and Skin Care, pp. 8 – 13.
5. Stefaniac, A., du Plessis, J., John, S., Eloff, F., Agner, T., Chou, T-Z., Nixon, R., Steiner, M., Kudla, I., and Holness, D.L. International guidelines for the in vivo assessment of skin properties in non-clinical settings: part 1. pH. Skin Research Technology, 2013; 19: pp. 59-68.

23 October 2017, Rev. 0

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PROCESO DE FABRICACIÓN

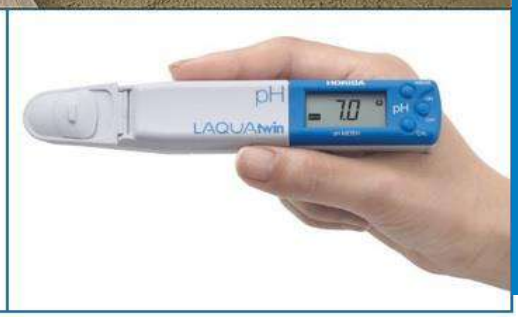
HORIBA

LAQUAtwin pH

Nota de aplicación

Medición de pH en cemento

LAQUAtwin es un rango de medidores de bolsillo de electroquímica. Los medidores de iones usan un electrodo selectivo, para medir el potasio, el calcio, los nitratos y el sodio este rango también incluye medidores de pH y de conductividad. Con tan solo una gota de muestra, el sensor plano LAQUAtwin mide rápidamente y con precisión las concentraciones de parámetros químicos en el campo o en laboratorio.



Introducción

Cuando se instalan las baldosas, es muy importante que el nivel del subsuelo tenga un nivel correcto de pH. Cuando la alcalinidad del subsuelo de cemento es alta, puede impedir una buena adhesión del pavimento con el cemento. Este es un problema que sólo recientemente se ha descubierto y el nuevo estándar australiano para la instalación de pisos flexibles (AS 1884-2012) dice ahora que una prueba de pH debe ser realizada en un subsuelo de cemento como parte de la evaluación antes a la instalación del suelo.

El cemento fresco es generalmente muy alcalino, generalmente superior a pH 11. Como la norma 1884 le indica el nivel del pH de la superficie del concreto debe estar entre pH 9 y pH10 antes que el suelo se pueda instalar.

El medidor de pH HORIBA LAQUAtwin se utiliza para determinar el pH del cemento para preparar las instalaciones del piso. Este es un método fácil y rápido que se utiliza para garantizar que el cemento está en el pH óptimo.

Método

Lijar de una pequeña sección de la superficie del concreto con papel de lija de grano 200 y limpie y quita el polvo.

Ponga varias gotas de agua destilada o desionizada sobre la superficie preparada.

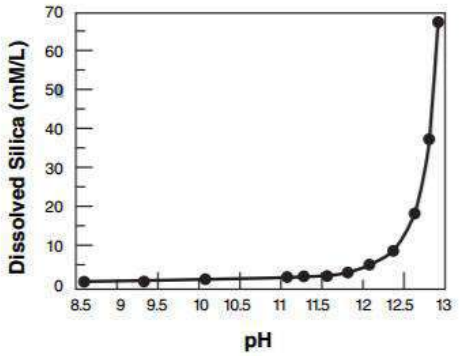
Dejar las gotas durante 60 segundos y luego recoger las gotitas de agua con una pipeta.

La solución se coloca sobre el sensor del medidor de pH LAQUAtwin y se mide. Para repetir el muestreo, lave el sensor con agua del grifo y séquela con un pañuelo de papel.

Resultado y Beneficios

El uso del medidor de pH HORIBA LAQUAtwin para asegurarse que el pH del cemento esta entre pH 9 y pH 10, permitirá que el adhesivo que cubre el suelo se adhiera correctamente al cemento. El uso del medidor de pH HORIBA en comparación con el uso de tiras de prueba de pH permite la determinación de resultados precisos y confiables.

El medidor de pH LAQUAtwin es pequeño y compacto; muy práctico para llevar en su bolsillo para realizar mediciones fácilmente en sitio. Su interfaz fácil a usar es accesible para cualquiera que quiere usar



Effect of pH on Dissolution of Amorphous Silica (Tang and Su-fen, 1980)[2]

[1] Australain Standard AS 1884-2012 Standard report
[2] Alkali-Silica Reaction, United States Department of Transportation - Federal Highway Administration Publication Number FHWA-RD-03-047 July 2003

Medidor de bolsillo

LAQUAtwin

Características únicas

Realice calibraciones y mediciones con tan solo pulsar un botón; le indicará que ya puede leer el resultado.

La sencilla calibración automática con tan solo unas gotas de solución de calibración, le garantiza la exactitud de la medición. También se puede realizar la calibración en dos puntos y hasta 3 y 5 puntos con los modelos pH33 y EC33.

LAQUAtwin es totalmente a prueba de agua y polvo.

El medidor y el sensor son totalmente resistentes al agua y al polvo, por lo que puede llevarlo donde quiera.

1 IP67: no da errores al sumergirse en agua a una profundidad de un metro durante treinta minutos. Sin embargo, el producto no puede usarse bajo el agua

LAQUAtwin: Tecnología única de sensor plano ISE y pH

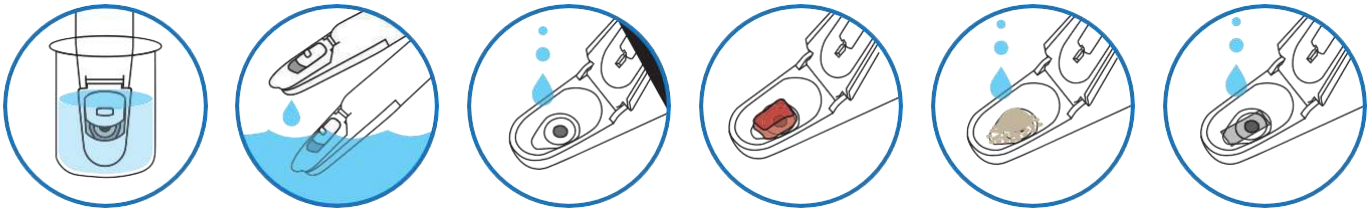
La tecnología HORIBA de sensor plano de alta sensibilidad abre nuevas posibilidades para medir diferente tipos de muestras. Puede hacer una medición a partir de un volumen de 0.1 ml y no necesita vaso para calibrar o medir, solo punga unas gotas directamente en el sensor.

Incluye un estuche para transportarlo de forma práctica.

El estuche compacto contiene todo lo que necesita para las mediciones, incluyendo las soluciones de calibración y una pipeta de plástico.

1 X 6 Un medidor, seis métodos de medición

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



1 Inmersión

Cuando se encuentre en un laboratorio, puede analizar la muestra en un vaso de precipitados. Asegúrese que la tapa deslizante que protege el sensor esté abierta.

2 Muestreo

Utilícelo como una pala para analizar el agua, por ejemplo, de un río.

3 Gotas

Los medidores LAQUAtwin pueden medir volúmenes de muestra de tan solo 0.1ml. Coloque una gota de la muestra en el sensor con una pipeta.

4 Muestras sólidas

Los alimentos que contengan cierta humedad pueden analizarse si coloca un trozo pequeño directamente en el sensor.

5 Polvos

Los medidores LAQUAtwin también pueden analizar polvos secos. Simplemente, coloque la muestra de polvo en el sensor y versa encima el volumen definido de agua desionizada.

6 Papel y tejidos

Si desea analizar hojas de papel y tejidos, corte la muestra en trozos pequeños y colóquelo directamente en el sensor. Versa encima un volumen definido de agua desionizada.

Rango

pH

Medición precisa de pH directamente a partir de una sola gota. El pH del agua varía en función al ambiente y un ligero cambio a menudo puede tener un gran impacto. Tanto si debe mantener el pH de un acuario dentro de niveles estrictos, comprobar la acidez del agua de lluvia o la calidad de producto alimenticio (carnes, pescados…), los medidores de pH de bolsillo LAQUAtwin son la solución perfecta. No importa dónde o cuándo debe realizar un análisis.

COND

Determine la conductividad con tan solo una muestra de 0.12 ml. La conductividad del agua de lluvia es una referencia fiable para determinar la pureza atmosférica. En agricultura, la medición de la conductividad del suelo permite a los agricultores establecer el uso óptimo de fertilizantes y comprobar la «salud» del suelo tras el daño provocado por el agua salada. Los medidores de conductividad LAQUAtwin hace que el análisis de la conductividad sea una tarea sencilla que se puede realizar en

Na+

Único medidor de bolsillo para medir rápidamente y con precisión el sodio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 23 a 2300 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

K+

Único medidor de bolsillo para medir rápidamente y con precisión el potasio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 39 a 3900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

NO3–

Único medidor de bolsillo para medir rápidamente y con precisión el nitrato con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 30 a 9900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

Ca2+

Único medidor de bolsillo para medir rápidamente y con precisión el calcio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 40 a 4000 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

CE RoHS

IMS

HORIBA Group is operating Integrated Management System (IMS)
ISO9001 JOA-0298 / ISO14001 JOA-E-90039 / ISO13485
JOA-MD0010 / OHSAS18001 JOA-OH0068

Residual Sodium Check During Clean-in-Place Process

Caustic soda or sodium hydroxide (NaOH) is the chemical commonly used in alkaline cleaning solution for clean-in-place (CIP) in process plants. Measuring the sodium ion concentration on the water rinse or swab can indicate whether residual chemical has been removed properly from the process equipment.

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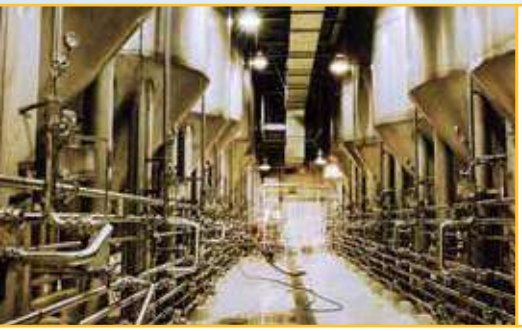


Introduction

Clean-in-place (CIP) is a method of cleaning the interior surfaces of pipes, vessels, process equipment, filters and associated fittings without disassembly. The CIP system is run by digital computer called programmable logic controllers (PLCs) to control the flow, temperature, and time for the chemical solutions, which could be acidic, alkaline or sometimes both, to achieve maximum cleaning. The chemical solutions are circulated through a circuit of tanks and/or lines to eliminate contaminants or product residues and are rinsed out with water. Depending on the CIP system, chemical solutions may flow back to a reservoir so that they can be re-used or drained immediately after they have been used.

After CIP, the equipment should be visibly clean and free from chemical residues. The final water rinse must ensure that chemical residues are removed properly. Chemical residues from cleaning solutions can be monitored by specific or non-specific analytical method. Specific methods that detect the individual ingredients of cleaning solutions are ion selective electrode (ISE), high performance liquid chromatography (HPLC), thin layer chromatography (TLC), flame photometry, and ultraviolet spectroscopy. Non-specific methodsthat detect the presence of blend of ingredients are pH, conductivity, and total organic carbon (TOC). Specific methods are usually preferable by regulatory agencies, but they may accept non-specific methods with adequate rationales for their use.

As CIP offers fast, repeatable, and effective cleaning without chemical exposure risk to people, it is utilized in industries that require high levels of hygiene such as dairy, beverage, processed foods, pharmaceutical, and cosmetics. CIP is typically employed for cleaning bioreactors, fermenters, mix vessels and other equipment in manufacturing facilities and many CIP systems use alkaline cleaning solutions containing 0.5 to 2% (by weight) caustic soda or sodium hydroxide (NaOH) to remove fats and proteins.

The LAQUAtwin B-722 sodium ion meter can be used to measure and monitor residual sodium ion (Na^+) concentration during CIP in process plants. The meter analyses as little as 0.3 ml sample and delivers result in just few seconds. This fast, easy, and accurate measurement complements the cleaning efficiency of CIP.

Method

Calibrate the LAQUAtwin B-722 sodium ion meter according to manufacturer's instructions using the 150ppm and 2000ppm sodium ion standards included in the kit.

Sample Measurement

Rinse water sampling and wipe sampling are two sampling methods for measuring cleaning chemical residues. Combination of these is desirable.

Rinse water sampling involves taking a sample of an equilibrated water rinse (usually water for injection or pure water) that has been recirculated over all surfaces. To measure, place drops of rinse water sample onto the

Continued at the back

Continued from the front

sodium ion sensor using a pipette. Alternatively, open the sensor guard and soak the sensor into a beaker containing rinse water.

Swab or wipe sampling is done directly on equipment surfaces. This is performed in order to assure that the residues are being adequately detected and not simply sitting on the surface and not being dissolved into the equilibrated rinse water. Before wiping begins, moisten the sampling sheet included in the meter kit with water for injection or pure water and allow the equipment to dry after the cleaning procedure. To measure, wipe the surface with a moistened sampling sheet then place it onto the sensor. A blank preparation is required for this sampling method.

Refer to Technical Tip 2: LAQUAtwin Ion Sensor Maintenance Procedures for detailed information on conditioning, cleaning, and storing the sodium ion sensor. The technical tip can be downloaded from the support section of our website www.horiba-laqua.com.

Table 1: LAQUAtwin B-722 Sodium Ion Meter Measurement Results

Solution	Na^+ Concentration (ppm)	Result (ppm)	Recovery	Error
0.01% (100ppm) NaOH	57.5	54	94%	< 10%
0.001% (10ppm) NaOH	5.75	4*	NA	NA
Pure Water (Blank)	0	0-1*	NA	NA

*Values are outside the meter measurement range of 23 to 23,000ppm and are shown for reference only.

Results and Benefits

Cleaning validation is a critical part of current good manufacturing practice to ensure that production materials that come in contact with equipment surfaces are not contaminated. The pre-rinse, alkali circulation, and other steps must take place in correct order. Checks on the identity, purity and strength of cleaning chemicals and on quality of water used for rinsing are needed. Also, the validation protocol must include testing for the residual cleaning chemical to ensure that cleaning chemical used is properly removed. The analysis must be quantitative and the acceptance criteria are determined according to regulatory guidelines and company policy. The table above shows the measurement results of LAQUAtwin B-722 sodium ion meter.

References And Suggested Readings
1. Batt, C.A., Modern Systems of Plant Cleaning. Encyclopedia of Food Microbiology, pp 194-199.
2. Chan, C.C., Lam, H., Zhang X., Practical Approaches to Method Validation and Essential Instrument Qualification.

Revision 1.0, 7 September 2016

GANADERÍA

HORIBA

Compact Bovine Blood iCa Checker

MIDA FACILMENTE LA HIPOCALCEMIA EN SANGRE BOVINA

El calcio es un elemento importante para las vacas lecheras. La medición con el iCa puede ser de gran valor para los veterinarios y productores.

Un instrumento innovador y económico que le ayudará a la toma de decisiones en tiempo real que mejorará la salud de su animal.

Con una sola gota de sangre podrá conocer el estado de salud de su vaca

Procedimiento de medición

Calibración y medición en 3 minutos.

Gota de sangre → Puesta en marcha del iCa Checker → 2 puntos calibración → Medición → Diagnóstico del veterinario

Encendido

Ponga sólo una sola gota

¡El muestreo y la medición in situ es posible con este medidor de bolsillo!

Especificaciones

Modelo	LAQUAtwin-Ca-11C
Referencia	3200772940
Objetivo	Calcium ions (Ca^{2+})
Principio de medición	Método del electrodo iónico
Volumen mínimo de muestra	Más de 0.3 mL
Rango de medición	0.1 a 5.0 mmol/L
Resolución	0.1 mmol/L *1
Calibracion	2 puntos de calibración (1.25 mmol/L, 2.50 mmol/L)
Exactitud *2	±20% de valor de lectura
Protección	IP67(no falla cuando se sumerge en agua a una profundidad de 1 m durante 30 min)*3
Pantalla	LCD digital personalizado (monocromo) con luz de fondo
Entorno operativo	Temperatura: 5°C a 40°C Humedad: 85% de humedad relativa o menos(sin condensación))
Energía	CR2032 baterías (x2)
Vida de la batería	Approx. 150 horas *4
Material	ABS epoxy (principal material)
Dimensiones	164×29×20 mm (excluyendo proyecciones)
Peso	Approx. 50 g (excluyendo baterias)

1 Es posible cambiar la resolución a 0.01 mmol / L. (Este valor es el valor de referencia).
Consulte la página 3 de este manual para conocer la configuración de resolución.
2 La precisión del acuerdo entre un valor medido y un valor real del material de referencia estándar después de la calibración de 2 puntos utilizando soluciones estándar Y052L e Y052H. Se obtiene bajo las siguientes condiciones.

* ·Se usaron electrolitos NIST en suero humano congelado SRM 956d como material de referencia estándar.
· La calibración y la medición se realizan a la misma temperatura.
* · El error de las soluciones estándar y el error de redondeo (± 1 dígito) no están incluidos.
*3 El medidor no puede usarse bajo el agua.
*4 Cuando se utiliza la luz de fondo, la duración de la batería se acortará.

Productos del maletín

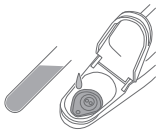
Productos	Cantidad
Sensor	1
Medidor	1
Baterías	2
Solución estándar 1.25mmol/L	25 mL×2 botellas
2.50mmol/L	25 mL×2 botellas
Solución limpiadora	250 mL×3 botellas
Botella para solución limpiadora	1
Manual de instrucciones (Operación)	1
Manual de instrucciones (antes del uso)	1
Guía rápida	1
Maletín	1

Los consumibles se venden por separado

Productos	Especificaciones	Part No.
Sensor S051	—	3200772945
Kit solución estándar Y053	1.25 mmol/L, 25 mL×2 botellas	3200774921
	2.50 mmol/L, 25 mL×2 botellas	
	Solución limpiadora #251 250 mL×3 botellas	

Rápida y fácil medición

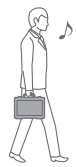
(1) olo ue una ota de muest a cie e la cu ie ta



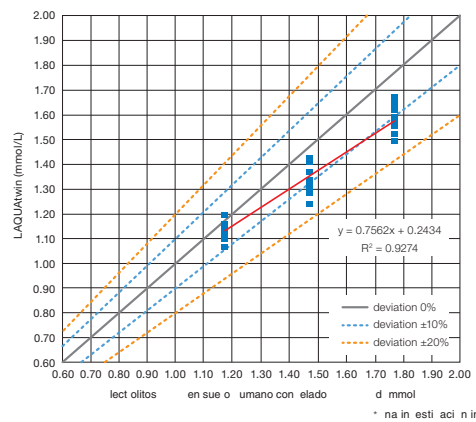
(2) P esione el ot n MEAS

(3) a medici n se completa cuando se ilumina☺

Portátil y resultados en segundos



Los resultados de la medición muestran alta correlación con el estándar NIST.



* na in esti aci n inte na

n ap n solo una pe sona cali icada puede e t ae la san e a ue el acto en s mismo se conside a una o ma de p ctica m dica

Nitrate Measurement in Hybrid Sudangrass and Pearl Millet Hays

Application Note

06-2016

Determining the nitrate concentrations of sudangrass and pearl millet before feeding them to livestock prevents nitrate toxicity. Plant sap testing with LAQUAtwin B-743 nitrate ion meter offers fast and accurate nitrate in-field analysis. Generally, the maximum nitrate concentrations considered safe for all cattle are 820 ppm and 700 ppm for sudangrass sap and pearl millet sap, respectively.

Introduction

Hybrid Sudangrass and pearl millet have high potential for accumulating nitrate. Pearl millet has been noted to accumulate significantly higher quantities of nitrate than does sudangrass. These high nitrate plants, either standing in the field or fed as hay, can cause abortion in pregnant cattle or death if consumed in great quantities. Factors that contribute to nitrate accumulation in plants are excessive use of nitrogen fertilizers and stressful environmental conditions that restrict plant growth such as drought, reduced sunlight, low growing temperatures and acidic or phosphorus-deficient soil.

The LAQUAtwin B-743 nitrate ion meter provides the easiest way to measure nitrate concentration in fresh plant sap. The sensor requires only few drops of sap, which can be quickly extracted using a garlic press. The meter analyses the sap in just few seconds and displays reading expressed as either nitrate (NO_3^-) or nitrate-nitrogen (NO_3-N) ppm. Nitrate results can be obtained immediately in the field with much less effort and relatively low cost. These advantages are useful for farmers and ranchers who are managing livestock and forage crops.

Method

Calibrate the LAQUAtwin B-743 nitrate ion meter according to manufacturer's instructions using the 150ppm and 2000ppm nitrate ion standards included in the kit. Make sure that the unit of measurement set in the meter is nitrate (NO_3^-) ppm.

Sample Collection and Measurement

1. Select five plants randomly from each sample and cut them with a pruner at a similar height to that of harvest.
2. Cut the plant samples into 6-inch long pieces. Then, cut again to shorter 1/3-inch pieces.
3. Mix the pieces thoroughly into a small pile.
4. Transfer a portion of the 1/3-inch pieces consisting of leaves and stems to a garlic press.
5. Squeeze the garlic press and collect the sap into a container.
6. Place drops of sap onto the nitrate ion sensor using a dropper. See Notes.
7. Record the nitrate reading once it is stable.
8. Rinse the sensor with deionized or distilled water and blot dry before testing another sample.
9. Re-check the reading of a standard after testing 10 samples.

Notes:

a. If very small amount of sap is extracted from the plant sample (i.e., sap volume is not enough to cover the flat sensor), use sampling sheet in calibration as well as in sample measurement. To do this, place a sampling sheet onto the sensor and then place drops of standard solution or sap to saturate the sampling sheet.

b. Another way to saturate the sampling sheet with sap is to place it over the holes of garlic press before loading plant sample and squeezing the press. Transfer the sap-saturated sampling sheet onto the sensor using a tweezer.

c. Allot one sampling sheet for each standard solution type and sap sample and discard all used sheets after testing.

Refer to Technical Tip 2: LAQUAtwin Ion Sensor Maintenance Procedures

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for detailed information on conditioning, cleaning, and storing the nitrate ion sensor. The technical tip can be viewed and downloaded from the support section of our website www.horiba-laqua.com.

Results and Benefits

To interpret the LAQUAtwin B-743 nitrate ion meter results with sudangrass and pearl millet plants, refer to the established guidelines in Table 1.

The sap nitrate results measured with LAQUAtwin B-743 nitrate ion meter are highly correlated with those dry-weight based nitrate results obtained from conventional laboratory procedures. As shown on Figures 1 and 2, the correlation coefficients for hybrid sudangrass and pearl millet are 0.88 and 0.89, respectively. To convert the sap nitrate concentration to dry-weight based concentration, use the following equations:

Hybrid Sudangrass:
Nitrate(Dry Weight) = 3.64 x Nitrate(Sap)
Pearl millet:
Nitrate(Dry Weight) = 4.4 x Nitrate(Sap)

Table 1: Guidelines for Interpreting Nitrate Analysis Results with Plant Sap and Dry Hay

Sudangrass Sap (ppm)	Pearl millet Sap (ppm)	Dry Hay (ppm)	Interpretation
0 - 820	0 - 700	0 – 3000	Generally safe for all cattle
820 - 1380	700 - 1140	3000 – 5000	Generally safe for non-pregnant beef cattle. Low risk of reduced breeding performance and early term abortions. Total ration for dairy cattle should be less than 2500 ppm.
1380 - 2750	1140 – 2270	5000 – 10000	Some risk for all cattle. May cause mid to late term abortions and weak newborn calves. May decrease growth and milk production.
> 2750	> 2270	> 10000	Potentially toxic for all cattle. Can cause abortions, acute toxicity symptoms, and death.

Source: Zhang, H., 1999. Quick Nitrate Test for Hybrid Sudangrass and Pearlmillet Hays.

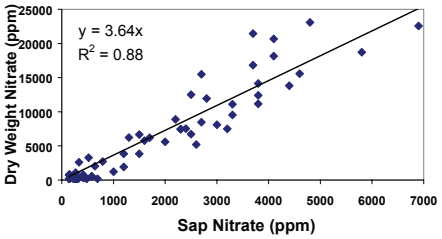

Figure 1: Correlation between sorghum-sudangrass sap nitrate measured with LAQUAtwin B-743 nitrate ion meter and sorghum-sudangrass dry-weight based nitrate obtained from laboratory.

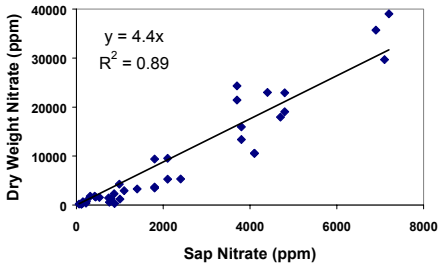

Figure 2: Correlation between pearl millet sap nitrate measured with LAQUAtwin B-743 nitrate ion meter and pearl millet dry-weight based nitrate obtained from laboratory.

References and Suggested Readings
1. Zhang, H., 1999. Quick Nitrate Test for Hybrid Sudangrass and Pearlmillet Hays. Oklahoma Cooperative Extension Service [online]. Available from: http://www.specmeters.com/assets/1/7/nitrate_sorghum3.pdf [Accessed on 18 October 2016].
2. Selk, G., Step, DL., Strickland, G., Zhang, H., 1999. Nitrate Toxicity in Livestock. Oklahoma Cooperative Extension Service [online]. Available from: http://extension.oregonstate.edu/douglas/sites/default/files/documents/lf/faqf/pss2903.pdf [Accessed on 18 October 2016].

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AGUAS POTABLES
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RESIDUALES

Determination of Potassium in Sea Water

Seawater has high ionic strength. To eliminate matrix effect in measuring potassium (K+) concentration, standard solutions made with the same background as the seawater sample are recommended for calibration. The result of measurement using the LAQUAtwin Potassium Ion meter is within ±10% of typical seawater concentration.

05-2015

Introduction

Seawater is a complex solution of different ions with different charges. Matrix effect can be eliminated or reduced by either standard addition method or standard calibration solutions made with the same background matrix as the sample. The former technique is challenging in onsite testing.

It has been known that the composition of sea water throughout the mass of the oceans is relatively constant, and that, whatever the degree of concentration or dilution, the ratios between the concentrations of the major components vary, if at all, between narrow limits. Potassium (K) is one of the major components in seawater. The concentration is 380mg/L K+ in typical seawater.

The pocket-sized LAQUAtwin Potassium Ion meter can be used directly in seawater to measure the potassium (K+) concentration. This compact meter provides quick result with just a few drops of sample, a suitable alternative for laboratory methods such as gravimetric and atomic absorption spectrometry.

Method

Calibration

Calibrate the LAQUAtwin Potassium Ion meter according to manufacturer's instructions using two HORIBA's standard solutions that bracket the concentration of potassium in seawater samples.

For more accurate measurement, standard solutions with the same background matrix as the sample are recommended for calibration. These solutions can be prepared as follows:

Option 1: One-point calibration with 1000ppm Potassium Standard with 2.5% NaCl. Mix 2000 ppm potassium standard solution (Y031H) and 5% NaCl solution (514-50) in 1:1 ratio. The resulting solution is 1000 ppm potassium standard with 2.5% NaCl.

Prior to calibration, set the low calibration value of the meter from 150ppm (default value) to 1000ppm. Refer to the Low Calibration Value Setting of the meter's instruction manual.

Option 2: Potassium Standards with synthetic ocean water background.

Prepare synthetic ocean water without potassium according to ASTM D1141 to closely match the background of seawater sample. Add known amount of potassium chloride (KCl) salt to the prepared synthetic ocean water.

Example: If 2-point calibration is to be performed, prepare two standards with concentrations that are ten-fold apart (e.g., 200ppm and 2000ppm; set the low calibration value of the meter to 200ppm). To prepare standards, follow the below table or perform serial dilution (e.g., First, prepare 200ml of 2000ppm (see below table). Take 10ml from this and dilute to 100ml using synthetic ocean water. The resulting solution is 200ppm standard.)

Potassium Standard (K+ ppm)	Weight of KCl (mg) per 100ml Synthetic Ocean Water
150	28.6
200	38.2
1000	190.8
2000	381.6

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Sample Measurement

Samples should be measured at the same temperature as the standard solutions used in calibration. Using the pipette that comes with the LAQUAtwin Potassium Ion meter, place a few drops of seawater sample into the sensor. Alternatively, open the slide cap of the sensor and scoop sample directly from source or container. Record the reading once stable. Rinse the sensor with DI water and blot dry with soft tissue.

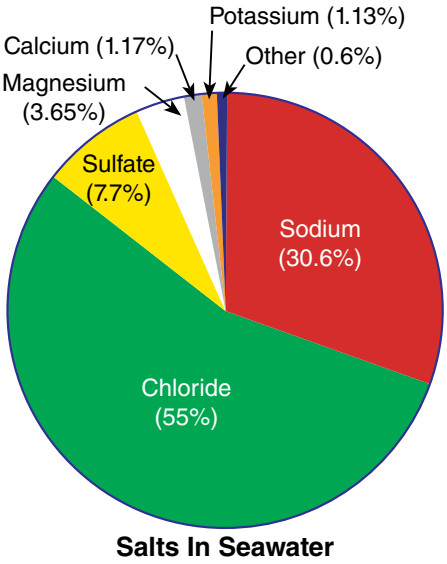
If the sensor response becomes sluggish, rinse the sensor with DI water and then leave a few drops of 150ppm potassium standard for a few hours. If this failed to restore the sensor response, replace the sensor.

Results And Benefits

The result of potassium determination in seawater using LAQUAtwin Potassium Ion meter and HORIBA's standard solutions is within ±10% of typical seawater concentration. For more accurate measurement, sodium chloride (NaCl) can be used to adjust the ionic strength of a standard solution. It is the major salt component in seawater. Alternatively, prepare standard solutions that closely match the background matrix of sample. This can be accomplished by using synthetic ocean water.

Supplementary Information

- Ionic strength – the quantity used to characterize the aqueous solutions that contain different concentrations of ions.
- Matrix effect – the matrix, which refers to the components of the sample other than the analyte of interest, can have a considerable effect on the way the analysis is conducted and the quality of the results obtained
- Standard addition method – Measure the sample mV then add a known amounts of the standard. Record the mV values after each addition. Plot mV values (y-axis) against concentration (x-axis). Set the sample mV at 0 concentration. Extrapolate the line connecting the measured mV values to 0 mV. Read the sample concentration at the intersection of the line and x-axis.



Salts In Seawater

(Source: Ocean Health - http://oceanplasma.org/documents/chemistry.html)

References And Suggested Readings

1. Test and Evaluation of Potassium Sensors in Fresh and Saltwater. United States Environment Protection Agency. March 1979
2. ASTM D1141-98 (2013) Standard Practice for the Preparation of Substitute Ocean Water. www.astm.org
3. Richard E. Zeebe and Dieter Wolf-Gladrow. CO2 in Seawater: Equilibrium, Kinetics, Isotopes. First Edition. The Netherlands: Elsevier Science B.V., 2001
4. D.A. Webb, Ph.D. The Sodium and Potassium Content of Seawater. Department of Zoology. Cambridge University. 15 November 1938

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HORIBA

LAQUAtwin Ca^{2+}

Application Note

Measurement Of Calcium In Drinking Water

LAQUAtwin is a series of pocket ION meters. Using Ion Selective Electrode (ISE) technology, they are available for measuring Conductivity, Calcium, Nitrate, Potassium, Sodium, Salt concentration and pH measurement. Using just a tiny amount of sample, the LAQUAtwin proprietary flat sensors can quickly and accurately measure the values of the chemical parameters in the field.

Introduction

It is helpful to determine the amount of calcium contained in water, since this will enable one to ascertain whether the water is hard, or if the water (if drinking water) has minerals. This can be determined using atomic absorption spectroscopy (AA) or inductively coupled plasma atomic emission spectroscopy (ICP). However, a much simpler way is by ionizing acid-bound calcium using acidizing pretreatment. The LAQUAtwin Ca2+ can be used to measure the total amount of calcium.

The LAQUAtwin Ca2+ meter is used as check to determine the Calcium content of water products before selling to consumers. This is an easy, quick method used to check the amount of calcium present in water.

Method

Pretreatment procedure

1. Place 5 mL of sample solution in a 100 ml beaker.
2. Add 10 to 40 µL of 5M hydrochloric acid to the sample solution and confirm that it has a pH of around 2 Return the sample solution to the beaker.
3. Add 15 to 20 mL of tris-hydroxy-aminomethane buffer solution with a pH of 6.95 to the solution created in step 2 (thereby diluting it by a factor of 4 to 5) and confirm its pH has changed to around 6 using LAQUAtwin pH.

A small sample of this solution is placed on the sensor of the LAQUAtwin Ca2+ and measured. To repeat sampling, wash with tap water and pat dry with a paper tissue.

Results and Benefits

The use of accurate Calcium ion testing in controlling the quality and calcium content of water products ensures that consumers are accurately able to gauge their calcium intake. It also enables one to determine whether or not scaling will occur with boiling of their water.

The LAQUAtwin Ca2+ pocket meter is small and compact; convenient to carry around for on-site testing. Its easy-to-use interface is simple for anyone to use the LAQUATwin Ca2+ pocket meter.

[1]For each type of sample, the following table shows the labeled value, together with the values measured by various methods. Figure 1 shows the correlation between LAQUAtwin Ca2+ data and that from ion chromotography for pretreated and non pretreated samples. Figure 2 shows the correlation between LAQUAtwin Ca2+ data and that from other methods for a pretreated sample. Calcium rich mineral water contains calcium sulfate and calcium carbonate, and these were ionized by pretreatment. The data for total Ca amount obtained by LAQUAtwin Ca2+ shows better correlation with other methods when the sample has been pretreated.

Fig. 1 Correlation of Calcium concentration between LAQUAtwinCa^{2+} and IC method

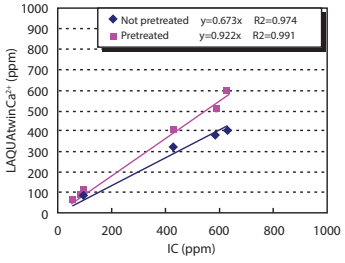
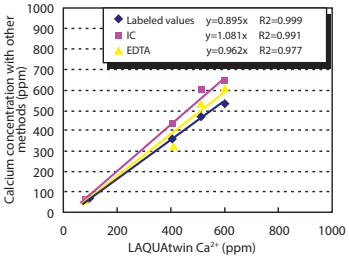


Fig. 1 Correlation of Calcium concentration between LAQUAtwinCa^{2+} and other methods



[1] Internal study by HORIBA labs, 2013

Pocket ION Meter

LAQUAtwin

Unique Features

Calibrate and measure at the touch of a button—the smiley face will tell you when the result can be read.

Hassle-free automatic calibration with a few drops of standard solution reassures you of your measurement accuracy. Two-point calibration is also possible.*1

*1 Except for B-711

LAQUAtwin is fully waterproof and dustproof.

The meter and sensor are fully waterproof*3 and dustproof, so you can take it anywhere.

*3 IP67 rated. Will withstand immersion for 30 minutes at 1 m. Not suitable for underwater use.

LAQUAtwin: the only meters with flat sensor technology.

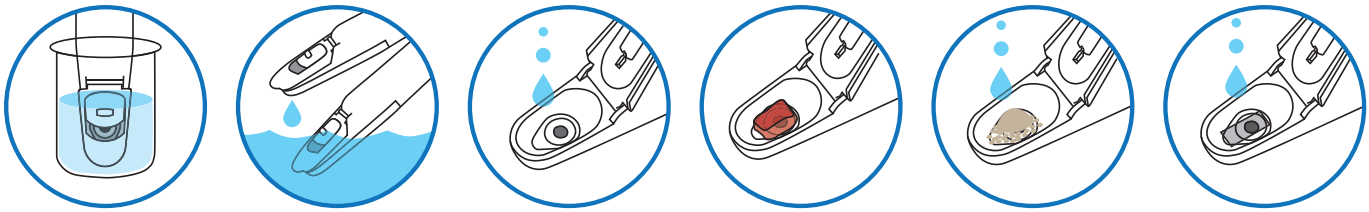
HORIBA's highly-sensitive, flat sensor technology opens up new possibilities for sampling and sample types. Only a small amount of sample is required, so you can easily sample in situ without the need for beakers or other labware. Sensors are easily replaced as required.

Carry case comes as standard for handy portability.

The compact carry case contains everything you need for your measurements, including the standard solution and sampling sheets.

1 X 6 One meter, six methods.

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



01 Immersion

When you're in the lab, you can test the sample in a breaker. Ensure the sensor guard sliding cap is open.

02 Scoop

Use as a scoop to test water eg from a river. A vertical scoop for an aquarium is also available with a unique sensor guard.

03 Drops

Place a drop of the sample onto the sensor with a pipette. Laquatwin meters can measure sample volume as low as 0.1mL

04 Solid Samples

Foods containing some moisture can be tested by placing a small piece directly onto the sensor.

05 Powders

Laquatwin meters can also test dry powders. Simply place the powder sample onto the sensor and drop on your defined volume of pure water.

06 Paper and textiles

To test sheets of paper and textiles, cut up the sample into small pieces and place directly onto the sensor. Drop on your defined volume of pure water.

Lineup

pH

Accurate pH measurements in a few seconds, from a single drop.

Water pH varies in different environments, and a slight change can often have a major effect.

Whether you need to keep the pH of an aquarium within tight limits, are checking for the acidity of rain water or for the quality of meat and fish products, LAQUAtwin compact pH meters are ideal for you. No matter where and when you need to test.

COND

Determine water conductivity with as little as 0.12 mL of sample.

The conductivity of rain water is a trusted guide to determining atmospheric purity. In agriculture, measuring the conductivity of soil allows farmers and agronomists to determine optimum fertilizer usage and check the 'health' of soil after salt water damage. The LAQUAtwin meter makes conductivity testing simple, anywhere.

Na+

Only compact meter for a quick and reliable measurement of sodium ion at the scene using ion selective membrane.

K+

Only compact meter for a quick and reliable measurement of potassium ion at the scene using ion selective membrane.

NO3–

Only compact meter for a quick and reliable measurement of nitrate ion at the scene. Special application packages for crop (B-741) and soil (B-742) are also available.

Ca2+

Only compact meter for a quick and reliable measurement of ionized calcium at the scene using ion selective membrane.

http://www.horiba.com/laquatwin

IMS

HORIBA Group is operating Integrated Management System (IMS)
ISO9001 JOA-0298 / ISO14001 JOA-E-90039 / ISO13485 JOA-MD0010 / OHSAS18001 JOA-OH0068

CE RoHS COMPLIANT

Measuring Salinity of Water

Measuring the salinity or the dissolved salt content of water is important as aquatic organisms, livestock, and crops thrive at different salinity levels. Freshwater has a salinity value of less than 0.5 ppt while seawater has an average salinity of 35 ppt.

Introduction

Salinity is the measure of the amount of dissolved salts in water. It is usually expressed in parts per thousand (ppt) or percentage (%). Freshwater from rivers has a salinity value of 0.5ppt or less. Within the estuary, salinity levels are referred to as oligohaline (0.5-5.0 ppt), mesohaline (5.0-18.0 ppt), or polyhaline (18.0-30.0 ppt). Near the connection with the open sea, estuarine waters may be euhaline, where salinity levels are the same as the ocean at more than 30.0 ppt.[1]

Salinity varies from place to place in the oceans, but the relative proportions of the most major dissolved constituents remain virtually constant. Even though there are smaller quantities of other ions in seawater (e.g., K^+, Mg^{2+}, SO_4^{2-}), sodium (Na^+) and chloride (Cl^-) ions represent about 91% of all the seawater ions. Freshwater has much lower levels of salt ions.[2]

Salinity is often derived from electrical conductivity (EC) measurement. EC is measured by passing an electric current between two metal plates or electrodes in the water sample and measuring how readily current flows between the plates. The use of EC measurements to estimate the ionic content of seawater led to the development of Practical Salinity Scale 1978 (PSS-78).[3]

The PSS-78 has been considered by the Joint Panel on Oceanographic Tables and Standards and recommended by all oceanographic organizations as the scale in which to report future salinity data. The practical salinity of a sample of seawater is defined in terms of the ratio of the electrical conductivity of the seawater sample at the temperature of 15°C and the pressure of 1 standard atmosphere, to that of a potassium chloride (KCl) solution containing a mass of 32.4356 g KCl in a mass of 1 kg of solution at the same temperature and pressure. A ratio equal to 1 corresponds to a practical salinity 35 (standard seawater).[4] As the definition is a ratio, practical salinity is expressed as dimensionless number.

The LAQUAtwin Salt 11 pocket meter measures the conductivity value of a sample then converts it to salinity value based on the salinity standard curve selected. The sensor has two titanium metals coated with platinum black that resist corrosion and temperature sensor for accurate measurement. The meter is programmed with two standard calibration curves—seawater and sodium chloride (NaCl). The former

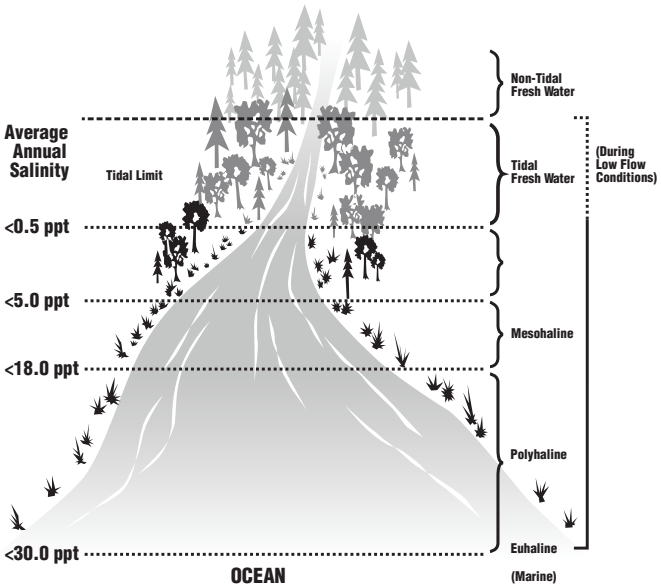


Figure 1: Estuarine salinity slowly increases as one moves away from freshwater sources and toward the ocean.
Source: Chapter 14 Salinity. Voluntary Estuary Monitoring Manual.

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follows the PSS-78 equation while the latter follows the equation in Figure 2.

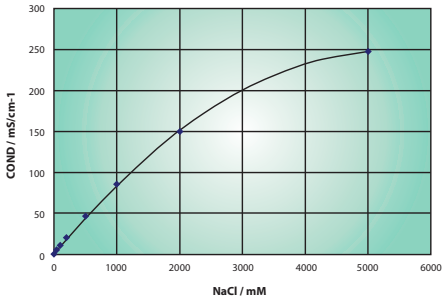

Figure 2: NaCl Curve

Method

Calibrate the LAQUAtwin Salt 11 pocket meter according to manufacturer's instructions using the 0.5% (5ppt) and 5.0% (50ppt) NaCl standard solutions included in the kit.

Prior to calibration, make sure to select the standard calibration curve (either NaCl or Seawater) and the unit (either ppt or %) depending on your application and reporting unit requirement. If both seawater curve and ppt unit are selected, calibrate the meter with 5ppt NaCl standard. It is best to use 5ppt and 50ppt seawater standards, if available. Note that if ppt is set as the measurement unit, the meter will display only the salinity reading without the unit (dimensionless).

Sample Collection and Measurement

Place drops of water onto the sensor using the pipette included in the kit. Make sure that sample well is completely filled-up with sample and that there are no bubbles formed. Record the salinity reading once it is stable.

Before testing another sample, rinse the sensor with DI (distilled or deionized) water or with the next sample to be tested and dab a soft tissue to remove remaining water trapped inside the sample well.

Refer to Technical Tip 3 for detailed information on conditioning, cleaning, and storing the salt sensor. The technical tip can be viewed and downloaded from the support section of our website www.horiba-laqua.com.

Results and Benefits

Salinity is an important measurement in seawater or in estuaries where freshwater from rivers or streams mixes with salty ocean water since aquatic organisms have varying abilities to survive and thrive at different salinity levels. Saltwater organisms survive in salinity levels up to 40 ppt, yet many freshwater organisms cannot live in salinity levels above 1 ppt.[2]

Salinity affects the dissolved oxygen levels in water. The solubility of oxygen in water decreases as salinity increases. The solubility of oxygen in seawater is about 20% less than it is in fresh water at the same temperature.[5]

The table below shows the salinity values of different types of water and their uses.

Table 1: Water Salinity

Salinity Status	Salinity (%)	Salinity (ppt)	Use
Fresh	< 0.05	< 0.5	Drinking and all irrigation
Marginal	0.05 – 0.1	0.5 – 1	Most irrigation, adverse effects on ecosystems become apparent
Brackish	0.1 – 0.2	1 – 2	Irrigation certain crops only; useful for most stock
Saline	0.2 – 1.0	2 – 10	Useful for most livestock
Highly Saline	1.0 – 3.5	10 – 35	Very saline groundwater, limited use for certain livestock
Brine	> 3.5	> 35	Seawater; some mining and industrial uses exist

Source: Department of Water. Government of Western Australia.

References and Suggested Readings

1. Chapter 14 of the Volunteer Estuary Monitoring Manual, A Methods Manual, Second Edition, EPA-842-B-06-003. https://www.epa.gov/sites/production/files/2015-09/documents/2009_03_13_estuaries_monitor_chap14.pdf
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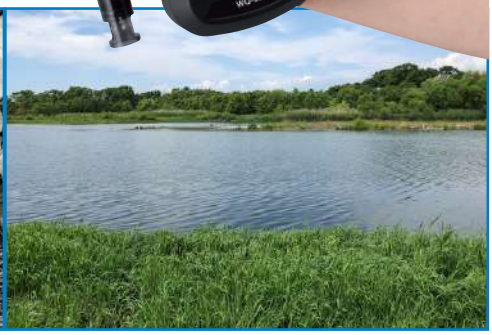
Revision 1.0, 28 October 2016

Water Quality Assessment of Inukami River in Japan

Application Note

03-2019

Six sites in Inukami River were selected and measured with LAQUA WQ-330 handheld meter and sensors for pH, conductivity, dissolved oxygen, and temperature to determine the water quality. Waters in spring area, which originate from underground, were found with lower pH, DO, conductivity, and temperature compared to waters from mainstream and downstream.



Introduction

The Inukami River in Shiga Prefecture, Japan is 27.1-km long and flows from the Suzuka Mountains to Lake Biwa. It is known not only for its clean water, but also for its underground flow and numerous springs in its riverbed. In order to preserve the Inukami River water, it is essential to determine the water quality and understand the effect of its ecosystem and surrounding areas.

Method

Six sites in Inukami River were selected for pH, conductivity (EC), dissolved oxygen (DO) and temperature measurements (See Figure 1). These four water quality parameters have important interactions between each of them. For example, conductivity measurement is typically conducted in checking the cleanliness of water. Conductivity increases as temperature and dissolved charged ions (e.g. Na^+, Cl^-, NO_3^-) from inorganic substances (e.g., minerals, salts) in water increases. pH is also affected by temperature and minerals dissolved in water. Unlike conductivity, dissolved oxygen concentration decreases as water salinity and temperature increases.

The new LAQUA WQ-330 triple-channel multi-parameter handheld meter was used to simultaneously measure the pH, conductivity, dissolved oxygen, and temperature of Inukami River. Prior to river water measurements, the 300PH-2 / 300-P-C pH sensor, 300-C-2 / 300-4C-C 4-cell conductivity sensor, and 300-D-2 optical DO sensor connected to the meter were calibrated with NIST pH buffers (pH 4.01, 6.86, and 9.18), 84µS/cm conductivity standard, and ambient air, respectively.

Results

Measurement in the Mainstream

As shown in Table 1, the water at confluence point of Inukami River and Ota River ② has higher temperature, pH, conductivity, and dissolved oxygen compared to the waters before ① and after ③ the confluence point. As the tributary Ota River is situated along residential area, it is believed that human activities in the area may have contributed to the slightly elevated water temperature and conductivity obtained at the confluence point. Dissolved inorganic substances (e.g., minerals, salts) coming from sewage may pollute water. The conductivity value of underground flow before the confluence point is affected by geological conditions.

Dissolved oxygen (DO) is free oxygen present in water from atmosphere and photosynthetic production by aquatic plants and algae. There is more dissolved oxygen in cold, flowing water with many rocks or obstacles, and moderate amount of aquatic plants and algae but generally less at the bottom of river. Although the water at confluence point ② is warmer than ① and ③, higher DO was observed which could be due to the merging water flows, aquatic plants, algae, and rocks in the area.

Measurement in the Spring Area

Spring water ⑤ is pumped out from underground and utilized as drinking water in the residential area. The water was found having lower temperature, pH, conductivity, and dissolved oxygen than mainstream water. The riverbed water ④ was found having close results to the

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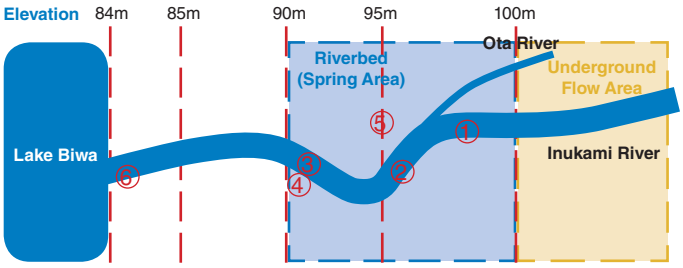

Figure 1: **Six sites in Inukami River were selected for water quality determination**

spring water ⑤. Due to numerous springs in the riverbed, it is believed that the measured riverbed water ④ originated from the springs.

The temperature of water in river is normally affected by the ambient temperature and changes with the seasons. On the other hand, spring water temperature is almost stable since it is not affected by the ambient temperature. Groundwater tends to maintain a relatively long-term average temperature of its aquifer so flow from a spring may be cooler than a summer day but remain unfrozen in the winter.[1] This explains the temperature of spring water ⑤ being lower than mainstream water. In stagnant area of a river, sunlight may raise the temperature. This makes the temperature of riverbed water ④ slightly higher than spring water ⑤.

Many springs have naturally low oxygen due to the length of time the water has been underground where no photosynthesis can occur. After leaving the spring vent, gas exchange with atmosphere and photosynthesis from aquatic plants and algae increases the oxygen level as the water flows down the spring run.[2] The DO results in spring and riverbed waters were lower than mainstream and estuary waters.

The pH of groundwater is affected by the rocks and chemicals beneath the ground, as well as the quality of the water being recharged or percolating down into the aquifer from the surface. In some places, limestone in aquifer is made mostly of calcium carbonate ($CaCO_3$). Acidic water will react with the carbonate in the limestone, dissolving the limestone, and neutralizing the acid to a pH around 7.[3] This could be the reason for the pH values obtained in ④ and ⑤.

Measurement in the Downstream

Water in estuary ⑥ gently flows around while getting good exposure to sunlight. The measured water pH, DO, and temperature in estuary were the highest results obtained. An area with good exposure to sunlight and water is a conducive environment for aquatic plants to grow. Plants take up carbon dioxide for photosynthesis and release oxygen. This could be the reason for high DO.

Table 1: **Results of Inukami River Water Quality Determination**

Inukami River Water		Temp (°C)	pH	EC (µS/cm)	DO (%)
①	Before confluence	21.9	8.56	188	120
②	Confluence point	26.4	8.99	248	143
③	After confluence	19.9	8.11	206	125
④	Riverbed	15.7	7.63	203	88
⑤	Spring	15.4	7.72	171	99
⑥	Estuary	27.1	9.21	218	152

The aquatic plants growing in the water also play a role in affecting the pH. During the day, plants photosynthesize producing both oxygen and bicarbonate ions which shift the pH upward. At night, those same plants respire and release carbon dioxide which lowers the pH.[3] This could be the reason for high pH in mainstream and estuary waters at the time of measurement.

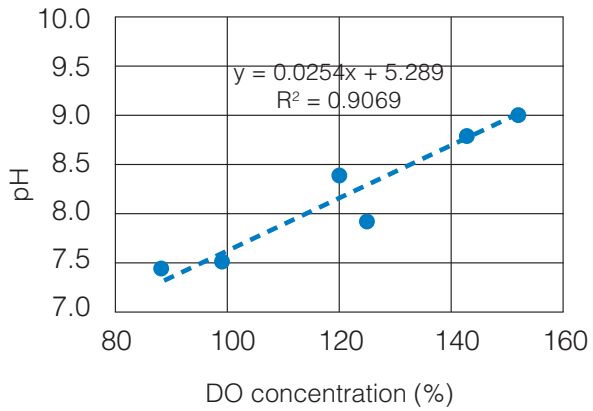

Figure 2: pH vs DO measured at Inukami River

Conclusion

Simultaneous pH, conductivity, DO, and temperature measurements provided data that help us understand the Inukami river condition and its water quality. In addition, the measurement results for the different sites selected were as expected considering the factors such as locations, surroundings, and aquatic plants in the Inukami river and also proven that LAQUA WQ-330 is suitable for river water measurements.

References and Suggested Readings

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3. pH - http://www.srwmd.state.fl.us/423/pH

12 November 2019, Rev. 0

ACUICULTURA

Aquarium Water Testing

Testing aquarium water such as freshwater and saltwater (either natural or artificial seawater) with reliable instruments is necessary to create a clean and safe environment for your aquatic species. The LAQUAtwin pocket meters require only few drops of water and deliver the results in just few seconds.

Introduction

Aquarium water chemistry is of vital importance to the health of fishes and other aquatic species. Aquariums may have freshwater or saltwater. Saltwater, either natural or artificial seawater, is used in fish-only, fish-only with live rock (FOWLR) and reef tanks while freshwater is used in planted, biotope, cichlid, brackish and predator tanks. In general, the former is more expensive and more difficult to maintain as additional equipment and frequent testing is needed.

To ensure good water quality, maintenance (filtration, water changes, and testing) is required on a regular basis. For testing, the saltwater parameters for reef aquarium, taken from Reefkeeping Online Magazine, are summarized in Tables 1 and 2 and some of them are explained below.

Calcium

Calcium is an essential element for coral health in a saltwater aquarium. It is used by corals to form their skeletons, composed primarily of calcium carbonate. When calcium level drops below 360ppm or depleted in water, it becomes difficult for corals to collect calcium for their growth. In this instance, calcium chloride ($CaCl_2$) can be added to water to raise the calcium level.

Alkalinity

Alkalinity, also called carbonate hardness, is caused by carbonate (CO_3^{2-}) and bicarbonate (HCO_3-) anions.

It is expressed as either parts per million (ppm or mg/L) or degree KH (dKH). One dKH is equal to 17.848 ppm $CaCO_3$. Like calcium, alkalinity is also essential for the skeletons of corals. It is believed that corals take up the bicarbonate, convert it to carbonate then use that to form calcium carbonate skeletons. Balanced calcium and alkalinity additive system like limewater, calcium carbonate, and the two-part additive systems are recommended for routine maintenance while baking soda or washing soda is recommended for quick alkalinity correction.

Salinity

Salinity is the measure of all the salts dissolved in water. It is related to the concentration of dissolved salts in seawater. The main difference between fresh water and salt water is the salinity content. Fresh water contains only small amount of salts. Too much or too little salt will adversely affect the health of fishes. The recommendation is to target the natural seawater salinity value, which is 35 ppt. To create this natural environment, add more fresh water if salinity is high or increase the amount of salt mixture if salinity is low.

Salinity can be measured directly with a salt meter or indirectly with a conductivity meter. The 35 ppt salinity value (specific gravity = 1.025) of seawater is equivalent to 53 mS/cm conductivity.

Temperature

The best water temperature depends on the species in the aquarium. In general, tropical fishes are healthy in the range of 24 – 28°C. Cold water fishes, like goldfish, enjoy water below that temperature range. Ensure a stable temperature as rapid, drastic and frequent temperature changes throughout the day are stressful for fishes.

Another important factor to note is the oxygen availability to fishes. Oxygen is less soluble in water at higher temperature.

pH

pH, stands for power of hydrogen, is the measurement of hydrogens ions in a solution. This gives us the acidity or alkalinity of water from a scale of 0 to 14. The carbonate hardness and calcium level in water affect the pH value. The optimal pH also depends on the species in the aquarium. For most species to survive, the pH of water should be close to pH 8.2 of natural seawater.

There are several ways to adjust the pH. To raise pH, add crushed corals, limestones, or baking soda or perform aeration. To lower pH, add driftwood or peat. Remember to adjust the pH slowly as rapid, drastic and frequent pH changes could kill your species.

Magnesium

Magnesium is another element used by corals for growing their calcium carbonate skeletons and coralline algae for their calcium carbonate deposits. This ion is abundant in natural seawater. Magnesium should be measured, particularly if the aquarium's calcium and alkalinity levels seem difficult to maintain. The magnesium concentration should be close to 1280ppm of natural seawater.

Phosphate

High level of phosphates inhibits calcification or building-up of calcium carbonate skeletons of coral and coralline algae. Above 0.03 ppm, algae growth is uncontrollable. Thus, keeping the phosphate concentration below 0.03ppm will deter algae growth.

To maintain low levels of phosphate, apply phosphate export mechanisms, such as growing and harvesting macroalgae or other rapidly growing organisms. Another way is to use limewater, phosphate binding media, or foods without excessive phosphate.

Ammonia

Ammonia is excreted by all aquatic animals and is considered toxic to them even as low as 0.2ppm. The ammonia level in water increases as the pH level rises. In this instance, transfer the fishes to cleaner water or treat the aquarium with ammonia-binding product.

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The LAQUAtwin pocket meters are used to measure and monitor freshwater or saltwater in aquarium. The meters have flat sensors for quick, direct and accurate measurement of micro volume water samples without adding any chemicals.

Method

Calibrate the LAQUAtwin pocket meters according to manufacturer's instructions using the standard solutions included in each kit.

Sample Measurement

Place a sample of aquarium water onto the sensor by using a pipette or by opening the sensor cap and scooping water directly from the aquarium. Alternatively, perform direct measurement by opening the sensor guard and immersing the sensor into the aquarium. Rinse the sensor with DI water and blot dry with soft tissue between samples.

When measuring sample, you may allow the meter to lock the stable reading by pressing MEAS button. This activates the auto-hold function—MEAS will blink until the reading is stable and ☺ will appear. Press MEAS button again to deactivate auto-hold function. Note: For pH, salt, and conductivity meters, make sure to set auto-hold (AH) in the meter settings prior to measurement.

Refer to Technical Tip nos. 1, 2 and 3 for detailed information on conditioning, cleaning, and storing the sensors. The technical tips can be viewed and downloaded from the support section of our website www.horiba-laqua.com.

Results and Benefits

Table 3 shows the results of LAQUAtwin pocket meters in artificial seawater measurement. The results were compared against the values indicated in the product label.

pH

The pH 11, 22 or 33 meters have temperature compensation function, but only pH33 meter displays the temperature reading. For accurate measurement, calibrate the meter with at least two pH buffers that bracket the expected sample pH. If the expected pH is 8.0, select USA buffer setting and calibrate the meter using pH 7.00 and 10.01 buffers or select NIST buffer setting and calibrate using pH 6.98 and 9.18 buffers.

Table 1: **Critical Parameters for Reef Aquarium Water**

Parameter	Recommended Value	Typical Ocean Value
Calcium	380 - 450 ppm	420 ppm
Alkalinity	7 - 11 dKH 125 – 200 ppm $CaCO_3$ equivalents 2.5 - 4 meq/L	7 dKH 125 ppm $CaCO_3$ equivalents 2.5 meq/L
Salinity	34-36 ppt	35 ppt
Temperature	24 – 28 °C / 76 – 83 °F	Variable
pH	7.8 – 8.5 Good 8.1 – 8.3 Better	8.0 – 8.3 (can be lower or higher in lagoons)
Magnesium	1250 – 1350 ppm	1280 ppm
Phosphate	< 0.03 ppm	0.005 ppm
Ammonia	< 0.1 ppm	Variable (typically < 0.1 ppm)

Source: Reefkeeping Online Magazine (http://reefkeeping.com/issues/2004-05/rhf/)

Table 2: **Non-Critical Parameters for Reef Aquarium Water**

Parameter	Reef Aquaria Recommended Value	Typical Ocean Value
Silica	< 2 ppm, much lower if diatoms are a problem	< 0.06 – 2.7 ppm
Iodine	Control not recommended	0.06 ppm total of all forms
Nitrate	< 0.2 ppm	Variable (typically below 0.1 ppm)
Nitrite	< 0.2 ppm typically	Variable (typically below 0.0001 ppm)
Strontium	5 – 15 ppm	8 ppm
ORP	Control not recommended	Variable
Boron	< 10 ppm	4.4 ppm
Iron	Below detection limit	0.000006 ppm

Source: Reefkeeping Online Magazine (http://reefkeeping.com/issues/2004-05/rhf/)

Table 3: **Artificial Seawater Measurement Results using LAQUAtwin Pocket Meters**

Parameter	Expected Value*	Result	Error
Conductivity (EC)	——	49 mS/cm	——
Salinity	——	32.0 ppt	——
pH	8.1 - 8.2	8.0	< 10%
Calcium Ion (Ca^{2+})	416 ppm	380 ppm	< 10%
Sodium Ion (Na^{+})	9651 ppm	9800 ppm	< 10%
Potassium Ion (K^{+})	366 ppm	400 ppm	< 10%

*According to product label

Table 4: **Practical Salinity of 1978 (PSS-78) Conversion Table**

Conductivity (mS/cm)	Seawater Salinity (ppt)
45	29.1
46	29.8
47	30.5
48	31.3
49	32.0
50	32.7
51	33.5
52	34.2
53	35.0
54	35.7
55	36.4

Salinity and Conductivity

The Salt 11 meter is programmed with sodium chloride (NaCl) and seawater curves. For this application, seawater curve is suitable. The meter displays both salinity and temperature readings.

The EC 11, 22, or 33 conductivity meters can be used to determine salinity indirectly. After obtaining the conductivity value, refer to Table 4 to check the corresponding salinity value.

Calcium, Sodium, Potassium, and Nitrate Ions

The B-722 meter, B-731 meter, and B-751 meter measure the free sodium ion, potassium ion, and calcium ion, respectively. All the results obtained in artificial seawater measurement have less than 10% error.

In nitrate ion measurement, chloride ion in seawater is one of the interfering ions. The chloride ion concentration in seawater is around 20,000ppm and will affect the nitrate ion concentration. The target nitrate concentration in aquarium water is less than 0.2ppm, but the B-743 meter measures nitrate in 62 to 6200 ppm range.

References and Suggested Reading

1. Saltwater Versus Freshwater Aquariums by Katherine Barrington http://www.ratemyfishtank.com/blog/saltwater-versus-freshwater-aquariums
2. Reef Aquarium Water Parameters by Randy Holmes-Farley http://reefkeeping.com/issues/2004-05/rhf/
3. AquariumDetective.com http://aquariumdetective.com/articles/watertest.php

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ARTES

pH and Conductivity for Testing Acrylic Paint Films and Paper Supports and Formulating Aqueous Cleaning Solutions

New aqueous cleaning system for acrylic paint films on paper supports has been developed. Isotonic aqueous cleaning solutions that match the pH and conductivity readings of acrylic paint films and paper supports obtained from agarose gel pellets have been shown to be effective in reducing or removing dirt, dust, active mold growth and associated stains, tide line stains, and discoloration.

Introduction

Acrylic paint is fast-drying paint made of pigment suspended in acrylic polymer emulsion. The composition varies from brand to brand, and even from pigment to pigment. The typical ingredients of wet acrylic emulsions are water (around 65% volume), acrylic polymer, pigments, surfactants, dispersants, biocides, thickeners, and inorganic components, as well as other materials added by artists. Acrylic paints are water-soluble, but become water-resistant when dry. After aging and during cleaning, the colors of various acrylic paint films react differently.

Acrylic works of art on paper are sensitive to aqueous cleaning methods. The two primary risks are paint film swelling and surfactant or pigment disruption. New aqueous cleaning system that use LAQUAtwin pH and conductivity pocket meters to mitigate the above-mentioned risks was demonstrated at the 2011 Cleaning of Acrylic Painted Surfaces (CAPS) workshop. The LAQUAtwin pH and conductivity meters were used to test acrylic paint surfaces and to formulate customized aqueous cleaning solutions.

In CAPS aqueous cleaning system, pellets of agarose gel are prepared and applied to evaluate the surface pH and conductivity of acrylic paint films and paper supports. The readings are then used to formulate isotonic aqueous cleaning solutions, which are adjusted to the approximate pH and conductivity of the acrylic paint films and paper supports.

The LAQUAtwin pH and conductivity meters have flat sensors that analyse micro volume samples in just few seconds. These waterproof pocket meters are programmed with automatic buffer recognition function for automatic calibration and automatic temperature compensation (ATC) function for accurate measurement. Both meters come in three different models and each is packed with two standard solutions for calibration.

Method

A. Preparation of 2% (w/v) Agarose Pellets

Ingredients:

- 100 ml distilled or deionized water
- 2.0 g Agarose Type VII, low gelling temperature
- 2 drops Germaben II, preservative for longer shelf-life (optional)

1. Heat 100 ml of DI water to 198°F (92°C).
2. Remove from heat and stir in 2.0 g of agarose powder.
3. Stir for 5-10 minutes until there are no lumps. Replace on hot plate as needed to keep the temperature constant.
4. Cool to approximately 140°F (60°C), then stir in 2 drops of Germaben II.
5. Immediately pour the mixture into 4 sterilized petri dishes.
6. Allow the petri dishes to cool until gelling is complete, approximately 20 minutes.
7. Extract cylindrical pellets from the cooled gel using a 3 mm biopsy punch.

For tide line stains on paper supports, increase the weight of agarose to make a 4% or 5% (w/v) gel and use pre-mixed pH- and conductivity-adjusted water solutions, instead of DI water. Highly concentrated gel delivers moisture at a significantly reduced rate, consequently mitigating or eliminating the formation of tide lines around the test area. By increasing ionic activity at the stain site via appropriate water adjustment, paper swelling is limited and absorbency controlled.

B. Sampling of Acrylic Paint Films or Paper Supports

At room temperature, apply individual agarose pellets to acrylic paint films or paper supports (See Figure 1).

Figure 1: An agarose pellet resting on the surface of an acrylic paint film.

For sampling paint films, select colors that represent 80% of the pure colors and color mixtures. Allow the pellets to rest on the surface for 45 to 60 seconds. For sampling paper supports with tide line stains, apply 3 pellets with different conductivities and leave for 2-10 minutes.

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Figure 2: Paula Rego, In the Garden, 1986, acrylic on paper lined to canvas.

C. Calibration of Meters

Calibrate the LAQUAtwin pH and conductivity meters according to manufacturer's instructions using their respective standard solutions included in kits.

D. Conductivity Analysis of Agarose Pellets

Place the 3-mm agarose pellet onto the well of the conductivity sensor using blunt tweezers. The pellet must be carefully pushed to the back of the meter to allow direct contact with the two titanium/platinum black metals. The tweezers must not touch the metals to avoid damaging them. Record the conductivity reading once it is stable. Rinse the sensor with DI water before testing another pellet.

E. pH Analysis of Agarose Pellets

After conductivity analysis, place the same 3-mm agarose pellet onto the pH sensor using blunt tweezers. Moisten the pellet with a drop or two of DI water to release the soluble components into the flat glass sensor. Make sure that the whole flat glass sensor is covered with mixture of agarose gel and DI water. Record the stable pH reading after 1 minute equilibration time. Rinse the sensor with DI water before testing another pellet.

F. Formulation of Aqueous Cleaning Solutions

Prepare aqueous cleaning solutions that match the pH and conductivity of the readings taken from acrylic paint films or paper supports by following the procedure below. Each solution should be within a few tenths of the pH reading, and within approximately 500 µS of the conductivity reading.

Tables 1 and 2 show the ingredients for pH-adjusted waters at 1000µS/cm and 6000µS/cm, respectively. If solutions in these tables will be prepared, follow the indicated volumes of acetic acid, DI water, and ammonium hydroxide for steps 1 and 2.

Table 1: Volume of Ingredients for pH-Adjusted Water at 1000 µS/cm

pH	Volume of CH_3CO_2H (ml)	Volume of DI Water (L)	Volume of 10% NH_4OH (ml)
5.0	0.5	0.5	5
5.5	0.5	0.5	8
6.0	0.5	0.5	9
6.5	0.5	0.5	10
7.5	0.5	0.5	12

Table 2: Volume of Ingredients for pH-Adjusted Water at 6000 µS/cm

pH	Volume of CH_3CO_2H (ml)	Volume of DI Water (ml)	Volume of 10% NH_4OH (ml)
5.0	1	100	6-7
5.5	1	100	10
6.0	1	100	11
6.5	1	100	12

Ingredients:

- distilled or deionized water
- glacial acetic acid
- ammonium hydroxide

1. Add drops of acetic acid (CH_3CO_2H) to DI water and mix.
2. Set pH by adding 10% ammonium hydroxide (NH_4OH). Mix the solution.
3. Test pH and conductivity by placing drops of the prepared solution onto the pH and conductivity sensors. Make sure that the conductivity sample well and flat pH glass sensors are covered with the solution.
4. If necessary, add 10% NH_4OH in 0.5ml increments or dropwise to raise the pH or dilute with DI water to reduce conductivity. Dilution example: To reduce the conductivity by half without a significant change in pH, dilute the final solution with DI water in 1:1 ratio.

To preserve the aqueous cleaning solutions, add a drop of Germaben II in each batch and store in sanitized, airtight containers inside a refrigerator. Discard the solutions when mold growth appears.

To clean a paint film, lightly moisten a hand-rolled cotton swab with aqueous cleaning solution and apply 3-4 passes. Less than 3 passes is required for paper support to prevent swelling of surface.

Refer to Technical Tip nos. 1 and 3 for detailed information on conditioning, cleaning, and storing the pH and conductivity sensors. The technical tips can be viewed and downloaded from the support section of our website www.horiba-laqua.com.

Results and Benefits

During sampling, the agarose pellets absorb the soluble components on the surface of paint films or paper supports by diffusion and capillary action. This causes the pH and conductivity of agarose pellets to shift closer to that of the paint films or paper supports. Although it is faster to perform the sampling with droplets of DI water, this method often results in aggressive localized swelling at the test site. The agarose pellets may be slower-acting, but they hold moisture in check and prevent swelling.

Aqueous cleaning solutions are prepared by first adding acetic acid (a weak acid) to DI water, then ammonium hydroxide (a weak base). The latter reacts with the former to produce salt, which sets the conductivity. Further addition of ammonium hydroxide raises the alkalinity and therefore the pH value of the solution.

Table 3: pH and Conductivity Readings from In the Garden by Paula Rego, July 12, 2012

Color	pH	Conductivity (µS/cm)
Control pellet	5.5	40
Deionized water droplet (on black)	6.3	1750
Black	5.6	1330
Dark green	6.2	780
Light green	6.2	130
Red	6.2	380
Orange	6.0	380
Blue	5.8	1120
Brown (A)	6.0	80
Brown (B)	6.0	90

Using aqueous cleaning solutions whose conductivity and pH most closely matched that of the colors of acrylic paint films and surface of paper support on which they were applied resulted in the least pigment transfer and swelling while maximizing cleaning efficiency. The solutions harmonize with the paint films or paper supports achieving near chemical equilibrium at the surface.

References and Suggested Readings

1. Acrylic Paint. Wikipedia. https://en.wikipedia.org/wiki/Acrylic_paint
2. Hughes, A., and Keynan, D. Testing the Waters: New Technical Applications for the Cleaning of Acrylic Paint Films and Paper Supports. The Book and Paper Group Annual 32 (2013) pp 43-51.

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INDUSTRIA AGROALIMENTARIA

HORIBA

LAQUAtwin Salt

Application Note

Measuring Salt Content in Chili Sauce with LAQUAtwin Salt-11 Pocket Meter

Chili sauces may contain high amount of salts that increase chances of kidney and heart diseases. To measure the salt content in chili sauce, simply dilute a weighed sample with distilled or deionized water and then place some drops onto the sensor of LAQUAtwin Salt-11 pocket meter. The meter measures the salt content accurately and displays the result in either percentage (%) or parts per thousand (ppt) in just a few seconds.

04-2017

Introduction

Chili sauce is a popular condiment that adds spice and flavour to food. It may be hot, sweet, or a combination thereof, and may have a thicker texture and viscosity compared to that of hot sauces. The ingredients of chili sauces vary, but typically include cooked chili peppers, vinegar, sugar, salt and sometimes red tomato. Some chili sauces available commercially are loaded with salt and other preservatives that can be damaging to your health.

Salt, chemically known as sodium chloride (NaCl), is a commonly used seasoning ingredient that serves as flavour enhancer and preservative in packaged or processed foods. It aids in balancing sweetness and suppressing bitterness. It also keeps the growth of pathogenic organisms at bay. Most bacteria, fungi, and other potentially pathogenic organisms cannot survive in a highly salty environment. Such environment is hypertonic, which will dehydrate any living cell causing it to die or temporarily inactivated.

The LAQUAtwin Salt-11 pocket meter offers fast, simple, and easy way of measuring salt content in packaged or processed foods such as chili sauces. This waterproof pocket meter measures the conductivity value of a sample and converts it to salinity value with selected seawater or sodium chloride (NaCl) calibration curve in the meter. The reading on the backlit LCD can be expressed as percentage (%) or parts per thousand (ppt). The replaceable sensor is designed with small sample well, which is embedded with two titanium metal electrodes coated with platinum black. This unique sensor can hold and measure micro-volume sample as little as 0.12ml.

Method

Meter set-up and calibration

Select the desired measurement unit and calibration curve combination in the meter settings - either % NaCl or ppt NaCl. Calibrate the meter according to manufacturer's instructions using 0.5% (5ppt) and 5% (50ppt) NaCl standards that come with the kit.

Sample preparation and measurement

1. Weigh a portion of the chili sauce and add distilled or deionized water.

   Example: 5 to 20 grams of chili sauce diluted to 100 ml or grams with DI water in a volumetric flask.

2. Mix the diluted sample thoroughly.

3. Using a dropper, place some drops of diluted sample onto the sensor.

4. Record the stable reading.

Chili sauce should be diluted with distilled or deionized water to liberate the salt. The reading of the diluted sample should fall within the calibrated measurement range of the meter. To obtain accurate results, a uniform temperature should be maintained for the standards and samples.

After measurement, clean the sensor with detergent and warm water. If there are still sample residues or stains after cleaning, place some drops of household bleach (≤5% sodium hypochlorite) onto the sensor and leave it for 5 to 30 minutes. Rinse the sensor with clean water and blot dry with soft tissue. For more information on maintenance, refer to Technical Tip 3: LAQUAtwin Conductivity Sensor Maintenance Procedures.

Results and benefits

Chili sauces may contain varying amounts of salt. Salt is soluble in water. It contains 40% sodium (Na), which is a mineral required by the body in small amount for maintaining blood pressure and fluid balance as well as transmitting nerve impulses. Besides salt,

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sodium is also found in monosodium glutamate (MSG), baking soda, and baking powder. Too much sodium can increase blood pressure and damage kidneys.

For packaged or processed foods, sodium is listed as milligrams (mg) per serving as well as per 100g on the nutrition information panel of the label, rather than salt. Table 1 shows the measurement results of chili sauce with LAQUAtwin Salt-11 pocket meter.

Table 1: Measurement Results of Chili Sauce with LAQUAtwin Salt-11 Pocket Meter

A	Sodium (mg / 100g) on Bottle Label	4520		
B	Chili Sauce Weight (g)	15.0581		
C	Volume (ml) or weight (g) After Dilution	100		
D	LAQUAtwin Salt-11 Pocket Meter Reading (% NaCl)	1.66	1.71	1.71
E	Calculated NaCl Salt (g / 100g)	11.02	11.36	11.36
F	Calculated Na (mg / 100g)	4335	4469	4469
G	Recovery (%)	96	99	99

To calculate the amount of sodium from salt (NaCl) reading obtained with LAQUAtwin Salt-11 pocket meter, use the equations in Table 2. Refer to the values in Table 1 to follow the sample calculations. Note that the ppt NaCl reading is not indicated in Table 1.

Table 2: Sodium Chloride (NaCl) and Sodium Calculations

Meter Reading	1.66% NaCl =1.66g NaCl / 100 ml or g dil. chili sauce	16.4ppt NaCl =16.4g NaCl / L or Kg dil. chili sauce
NaCl Salt (g / 100g)	**Meter reading (D) x Dilution Factor (C/B) x 100**	
	$\frac{1.66g\ NaCl}{100ml\ (g)} \times \frac{100ml\ (g)}{15.0581g} \times 100g$	$\frac{16.4g}{L\ (Kg)} \times \frac{0.1L\ (Kg)}{15.0581g} \times 100g$
Na (mg / 100g)	**NaCl salt per 100g (E) x $\frac{\text{Na molar mass}}{\text{NaCl molar mass}}$ x 1000**	
	$11.02g\ NaCl \times \frac{22.99\ Na}{58.44\ NaCl} \times \frac{1000mg}{g}$	$10.89g\ NaCl \times \frac{22.99\ Na}{58.44\ NaCl} \times \frac{1000mg}{g}$
Recovery (%)	**$\frac{\text{Calculated Sodium mg / 100g (F)}}{\text{Listed Sodium mg / 100g on Label (A)}}$ x 100**	
	$\frac{4335}{4520} \times 100$	$\frac{4284}{4520} \times 100$

According to the National Health Group Pharmacy in Singapore, adults should limit the amount of salt to one teaspoon per day, which is about 5g of salt or 2g of sodium. To ensure that you are not taking more than that amount, always check the amount of sodium per serving on the nutrition information panel of your chili sauce and other packaged or processed food. If that information is not available, simply perform a quick salt test with LAQUAtwin Salt-11 pocket meter.

References And Suggested Readings
1. Chili Sauce. Wikipedia. https://en.wikipedia.org/wiki/Chili_sauce
2. National Healthcare Group Pharmacy. All About Salt. https://www.pharmacy.nhg.com.sg/All_About_Salt/

REV 0, 17 July 2017

Measuring Salt Content in Chili Sauce with LAQUAtwin Salt-22 Pocket Meter

Chili sauces may contain high amount of salts that increase chances of kidney and heart diseases. To measure the salt content in chili sauce, simply dilute a weighed sample with distilled or deionized water and then place some drops onto the sensor of LAQUAtwin Salt-22 pocket meter. The meter measures the salt content accurately and displays the result in percentage (%) unit in just a few seconds.

Introduction

Chili sauce is a popular condiment that adds spice and flavour to food. It may be hot, sweet, or a combination thereof, and may have a thicker texture and viscosity compared to that of hot sauces. The ingredients of chili sauces vary, but typically include cooked chili peppers, vinegar, sugar, salt and sometimes red tomato. Some chili sauces available commercially are loaded with salt and other preservatives that can be damaging to your health.

Salt, chemically known as sodium chloride (NaCl), is a commonly used seasoning ingredient that serves as flavour enhancer and preservative in packaged or processed foods. It aids in balancing sweetness and suppressing bitterness. It also keeps the growth of pathogenic organisms at bay. Most bacteria, fungi, and other potentially pathogenic organisms cannot survive in a highly salty environment. Such environment is hypertonic, which will dehydrate any living cell causing it to die or temporarily inactivated.

The LAQUAtwin Salt-22 pocket meter offers fast, simple, and easy way of measuring salt content in packaged or processed foods such as chili sauces. This waterproof pocket meter with backlit LCD measures the sodium concentration of a microvolume sample and converts it to salt or sodium chloride concentration in percentage (%) unit. The replaceable sensor has a sample well embedded with flat sodium ion selective sensor. This unique sensor can hold sample as little as 0.3ml or 0.05ml when used with sampling sheet.

Method

Meter Set-up and Calibration

Calibrate the meter according to manufacturer's instructions using 0.5% and 5.0% NaCl standards that come with the kit.

Sample Preparation and Measurement

1. Weigh a portion of the chili sauce and add distilled or deionized water.

   Example: 5 to 20 grams of chili sauce diluted to 100 ml or grams with DI water in a volumetric flask.
2. Mix the diluted sample thoroughly.
3. Using a dropper, place some drops of diluted sample onto the sensor.
4. Record the stable reading.

Chili sauce should be diluted with distilled or deionized water to liberate the salt. The reading of the diluted sample should fall within the calibrated measurement range of the meter. To obtain accurate results, a uniform temperature should be maintained for the standards and samples.

After measurement, clean the sensor with detergent and warm water. If there are still sample residues or stains after cleaning, place some drops of household bleach (≤5% sodium hypochlorite) onto the sensor and leave it for 5 to 30 minutes. Rinse the sensor with clean water and blot dry with soft tissue. For more information on maintenance, refer to Technical Tip 2: LAQUAtwin Ion Sensor Maintenance Procedures.

Results and Benefits

Chili sauces may contain varying amounts of salt. Salt is soluble in water. It contains 40% sodium (Na), which is a mineral required by the body in small amount for maintaining blood pressure and fluid balance as well as transmitting nerve impulses. Besides salt, sodium is also found in monosodium glutamate (MSG), baking soda, and baking powder. Too much sodium can increase blood pressure and damage kidneys.

For packaged or processed foods, sodium is listed as milligrams (mg) per serving as

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well as per 100g on the nutrition information panel of the label, rather than salt. Table 1 shows the measurement results of chili sauce with LAQUAtwin Salt-22 pocket meter.

Table 1: Measurement Results of Chili Sauce with LAQUAtwin Salt-22 Pocket Meter

A	Sodium (mg / 100g) on Bottle Label	4520
B	Chili Sauce Weight (g)	10.0618
C	Volume (ml) or weight (g) After Dilution	100
D	LAQUAtwin Salt-22 Pocket Meter Reading (% NaCl)	1.1
E	Calculated NaCl Salt (g / 100g)	10.93
F	Calculated Na (mg / 100g)	4300
G	Recovery (%)	95

To calculate the amount of sodium from salt (NaCl) reading obtained with LAQUAtwin Salt-22 pocket meter, use the equations in Table 2. Refer to the values in Table 1 to follow the sample calculations.

Table 2: Sodium Chloride (NaCl) and Sodium Calculations

Meter Reading	1.1% NaCl =1.1g NaCl / 100 ml or g dil. chili sauce
NaCl Salt (g / 100g)	Meter reading (D) x Dilution Factor (C/B) x 100
	$\frac{1.1\text{g NaCl}}{100\text{ml (g)}} \times \frac{100\text{ml (g)}}{10.0618\text{g}} \times 100\text{g}$
Na (mg / 100g)	NaCl salt per 100g (E) x $\frac{\text{Na molar mass}}{\text{NaCl molar mass}}$ x 1000
	$10.93\text{g NaCl} \times \frac{22.99\text{ Na}}{58.44\text{ NaCl}} \times \frac{1000\text{mg}}{\text{g}}$
Recovery (%)	$\frac{\text{Calculated Sodium mg / 100g (F)}}{\text{Listed Sodium mg / 100g on Label (A)}} \times 100$
	$\frac{4300}{4520} \times 100$

According to the National Health Group Pharmacy in Singapore, adults should limit the amount of salt to one teaspoon per day, which is about 5g of salt or 2g of sodium. To ensure that you are not taking more than that amount, always check the amount of sodium per serving on the nutrition information panel of your chili sauce and other packaged or processed food. If that information is not available, simply perform a quick salt test with LAQUAtwin Salt-22 pocket meter.

References and Suggested Readings

1. Chili Sauce. Wikipedia. https://en.wikipedia.org/wiki/Chili_sauce
2. National Healthcare Group Pharmacy. All About Salt. https://www.pharmacy.nhg.com.sg/All_About_Salt/

REV 0, 19 July 2017

Measuring Sodium Content in Chili Sauce with LAQUAtwin Na-11 Pocket Meter

Chili sauces may contain high amount of sodium from dissolved salts. To measure the sodium content in chili sauce, simply dilute a weighed sample with distilled or deionized water and then place some drops onto the sensor of LAQUAtwin Na-11 pocket meter. The meter measures the sodium content accurately and displays the result in either parts per million (ppm) or mg/L in just a few seconds.

Introduction

Salt, chemically known as sodium chloride (NaCl), is a commonly used seasoning ingredient that serves as flavour enhancer and preservative in packaged or processed foods. It aids in balancing sweetness and suppressing bitterness. It also keeps the growth of pathogenic organisms at bay. Most bacteria, fungi, and other potentially pathogenic organisms cannot survive in a highly salty environment. Such environment is hypertonic, which will dehydrate any living cell causing it to die or temporarily inactivated.

Chili sauce is a popular condiment that adds spice and flavour to food. It may be hot, sweet, or a combination thereof, and may have a thicker texture and viscosity compared to that of hot sauces. The ingredients of chili sauces vary, but typically include cooked chili peppers, vinegar, sugar, salt and sometimes red tomato.

Chili sauces may contain varying amounts of salt. Salt is soluble in water. It contains 40% sodium (Na), which is a mineral required by the body in small amount for maintaining blood pressure and fluid balance as well as transmitting nerve impulses. Besides salt, sodium is also found in monosodium glutamate (MSG), baking soda, and baking powder. Too much sodium can increase blood pressure and damage kidneys.

The LAQUAtwin Na-11 pocket meter offers fast, simple, and easy way of measuring sodium content in packaged or processed foods such as chili sauces. This waterproof pocket meter measures the sodium concentration in micro volume sample ~ 0.3ml when directly placed onto the sensor or 0.05ml with sampling sheet. The replaceable sensor is designed with small sample well, which is embedded with flat sodium ion selective sensor. The reading on the backlit LCD can be expressed as mg/L or parts per million (ppm).

Method

Meter Set-up and Calibration

Calibrate the meter according to manufacturer's instructions using 150ppm and 2000ppm sodium standards that come with the kit.

Sample Preparation and Measurement

1. Weigh a portion of the chili sauce and add distilled or deionized water.

   Example: 2 to 10 grams of chili sauce diluted to 100 ml or grams with DI water in a volumetric flask.

2. Mix the diluted sample thoroughly.
3. Using a dropper, place some drops of diluted sample onto the sensor.
4. Record the stable reading.

Chili sauce should be diluted with distilled or deionized water to liberate the salt. The reading of the diluted sample should fall within the calibrated measurement range of the meter. To obtain accurate results, a uniform temperature should be maintained for the standards and samples.

After measurement, clean the sensor with detergent and warm water. If there are still sample residues or stains after cleaning, place some drops of household bleach (≤5% sodium hypochlorite) onto the sensor and leave it for 5 to 30 minutes. Rinse the sensor with clean water and blot dry with soft tissue. For more information on maintenance, refer to Technical Tip 2: LAQUAtwin Ion Sensor Maintenance Procedures.

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Results and Benefits

For packaged or processed foods, sodium is listed as milligrams (mg) per serving as well as per 100g on the nutrition information panel of the label, rather than salt. Table 1 shows the measurement results of chili sauce with LAQUAtwin Na-11 pocket meter.

Table 1: Measurement Results of Chili Sauce with LAQUAtwin Na-11 Pocket Meter

A	Sodium (mg / 100g) on Bottle Label	4520
B	Chili Sauce Weight (g)	2.3185
C	Volume (ml) or weight (g) After Dilution	100
D	LAQUAtwin Na-11 Pocket Meter Reading (ppm)	1000
E	Calculated Na (mg / 100g)	4313
F	Calculated NaCl Salt (g / 100g)	10.96
G	Recovery (%)	95

To calculate the amount of salt from sodium reading obtained with LAQUAtwin Na-11 pocket meter, use the equations in Table 2. Refer to the values in Table 1 to follow the sample calculations.

Table 2: Sodium and Sodium Chloride Conversions

Meter Reading	1000ppm Na =1000 mg Na / L or Kg dil. chili sauce
Na (mg / 100g)	Meter reading (D) x Dilution Factor (C/B) x 100
	$\frac{1000\text{ mg Na}}{\text{L (Kg)}} \times \frac{0.1\text{L (Kg)}}{2.3185\text{g}} \times 100\text{g}$
NaCl Salt (g / 100g)	Na per 100g (E) x $\frac{\text{NaCl molar mass}}{\text{Na molar mass}} \times \frac{1}{1000}$
	4313mg Na x $\frac{58.44\text{ NaCl}}{22.99\text{ Na}} \times \frac{\text{g}}{1000\text{mg}}$
Recovery (%)	$\frac{\text{Calculated Sodium mg / 100g (E)}}{\text{Listed Sodium mg / 100g on Label (A)}} \times 100$
	$\frac{4313}{4520} \times 100$

According to the National Health Group Pharmacy in Singapore, adults should limit the amount of salt to one teaspoon per day, which is about 5g of salt or 2g of sodium. To ensure that you are not taking more than that amount, always check the amount of sodium per serving on the nutrition information panel of your chili sauce and other packaged or processed food. If that information is not available, simply perform a quick sodium test with LAQUAtwin Na-11 pocket meter.

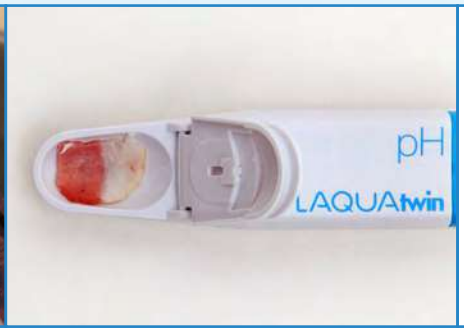
References and Suggested Readings

1. Chili Sauce. Wikipedia. https://en.wikipedia.org/wiki/Chili_sauce
2. National Healthcare Group Pharmacy. All About Salt. https://www.pharmacy.nhg.com.sg/All_About_Salt/

REV 0, 18 July 2017

pH Measurement in the Acidification of Fermented Sausages

Lowering pH or increasing acidity of meat has become main hurdle against pathogenic bacteria in sausage making. pH is used in the course of fermentation process in order to produce microbiologically stable product that has a pH value of 5.3 or less.



03-2015

Introduction

The process of fermenting and drying is believed to be one of the oldest techniques for preserving meat. This results in a characteristic flavoured sausage with a lowered pH and a reduced water activity that makes the final sausage stable with long shelf life, even if not being subjected to heat treatment.

Fermented sausages are a class of chopped or ground meat products that, as a result of microbial fermentation of a sugar have reached a pH of 5.3 or lower and have undergone a drying/aging process to remove 15-25% moisture. They are classified according to moisture content—dry (e.g., Pepperoni, Salami) or semi-dry (e.g., Summer sausage, Thuringer, Cervelat, Landjaegar).

After mixing the ingredients and stuffing into casings, sausages are placed in an environment with controlled temperature and humidity. At this fermentation stage, the pH of the sausages decreases due to lactic acid bacteria that produce lactic acid from metabolizing sugar. Lactic acid bacteria such as *Lactobacillus* or *Pediococcus* are either naturally present or added as starter cultures. Aside from bacteria, chemical acidulants such as glucono-delta-lactone and citric acid can also be added to rapidly increase acidity and create an extra margin for safety. The pH drop causes the proteins to give up water, resulting in a drying effect that creates an environment unfavorable to spoilage organisms. Drying continues after the fermentation stage and more moisture is removed from the sausage.

Fermented sausages should attain a pH of 5.3 or lower within the proper time frame in order to control the growth of pathogenic bacteria such as *E. coli 0157:H* and *Staphylococcus aureus*. During the fermentation of sausages to a pH 5.3, it is necessary to limit the time during which the sausage is exposed to temperatures exceeding 15.6°C, otherwise the product will spoil, even though the recommended pH was attained. This time frame is temperature dependent and these are the criteria (tables shown are guidelines in developing fermentation process):

Time in C degree-hours above 15.6°C	Maximum Chamber Temperature
Less than 665	Less than 33°C
<555	33-37°C
<500	Greater than 37°C

Degrees are measured as the excess over 15.6° C, the critical temperature at which staphylococcal growth effectively begins. Degree-hours = temperature in excess of 15.6°C (deg) x time (hours)

The pH of every batch of sausages should be periodically checked and recorded during fermentation to ensure that the pH reaches 5.3 or lower within the required period. The LAQUAtwin pH meter can be used by home sausage-makers or meat processing plants for monitoring the pH of their sausages.

Constant Temperature Fermentation

Degree (C)-hours limit for the corresponding temperature	Chamber Temperature °C	Maximum hours to pH 5.3
665	24	78.9
665	26	63.8
665	28	53.6
665	30	46.2
665	32	40.5
555	33	31.8
555	34	30.1
555	35	28.6

This table provides maximum hours that a product may be fermented at a given constant fermentation temperature to obtain pH 5.3. Example: At 26°C constant temperature, a sausage must reach pH 5.3 within 63.8 hours or less. Those hours can also be calculated for any temperature.

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Method

Test the meter's accuracy regularly and if necessary, calibrate the LAQUAtwin pH meter using 4.01 and 7.00 pH buffers according to manufacturer's instructions.

Sample Measurement

This method is based on the Australia New Zealand Food Standards Code - Standard 1.6.2.

1. Mince a representative portion of the sausage and place that portion in a stoppered bottle with twice its weight of water then shake.
2. Place a portion of the liquid into the sensor. Record the pH and temperature once stabilized.
3. Clean the sensor with soap and warm water to remove oily residues and/or protein cleaning solution to remove proteins. Rinse the sensor with water and blot dry with soft tissue.

To obtain accurate results, a uniform temperature should be maintained for the standard buffer solutions and samples. The test should be made at a temperature between 20-30°C, the optimum is 25°C.

Results and Benefits

Fermented sausages such as salamis have been associated with food-poisoning outbreaks globally due to pathogenic microorganisms. In light of this, it is of utmost importance to be in strict compliance with the regulatory guidelines for fermented sausages. In the USA, the Food Safety and Inspection Service requires that the shelf-stable dry sausages be nitrite cured, fermented, smoked, reached a final pH of 5 or less and have a moisture/protein ratio of 1.9:1 or less. The two main factors contributing to the safety and stability of these products are low pH and reduced water activity. The product must reach pH 5.3 or below (or other validated pH) within a specified period to control the growth of pathogenic microorganisms including Staphylococcus aureus and pathogenic E. coli.

Average Characteristics of Australian UCFM processes and products*

Characteristic	Salami (range of variation)	Mettwurst (range of variation)
Composition (lean % : fat %)	80.4 : 19.6 (70:30 - 90:10)	83.25 : 16.75 (70:30 - 96:4)
NaCl (%)	2.45 (2.0 - 3.3)	2.02 (1.3 - 2.8)
Nitrite (ppm)	284 (145- 490)	211 (35 - 490)
Final pH	4.72 (5.0 - 4.4)	4.66 (4.8 - 4.4)
Fermentation time (hrs)	49 (24 - 72)	42 (18 - 72)
Fermentation temp. (°C)	23.3 (18 - 28)	28.6 (17 - 40)
Ripening time (days)	14.8 (1-30)	5.3 (0 – 28)
Ripening temp. (°C)	14.1 (4 - 32)	18 (0 - 40)

*Derived from data supplied by ANZFA reflecting current Australian uncooked comminuted fermented meat product formulations
(Source: Ross, T., and Shadbolt, C.T., Predicting Escherichia coli inactivation in uncooked comminuted fermented meat products. University of Tasmania. Meat and Livestock Australia.)

References and Suggested Reading

1. Marianski, Adam and Marianski, Stanley. The Art of Making Fermented Sausages. 2nd ed. USA: Book Magic, 2009.
2. New Zealand Food Safety Authority.Guidelines for the Production of Uncooked Comminuted Fermented Meat (UCFM) Products. July 2009
3. Good Manufacturing Processes for Fermented Dry & Semi-Dry Sausage Products. The American Institute Foundation. October 1997

REV 0, 30 JULY 2015

pH Pocket Meters Lineup

pH 11

pH mV

WATER PROOF | MICRO VOLUME | 2 PT CAL | 0.1 pH

pH 22

pH mV

WATER PROOF | MICRO VOLUME | 3 PT CAL | 0.01 pH

pH 33

pH mV Temp

WATER PROOF | MICRO VOLUME | 5 PT CAL | 0.01 pH

Features

Flat pH sensor with automatic temperature compensation offers quick and direct measurement of fresh meat and meat products

Applications include

Fresh Meat Selection, Processed/ Fermented Meats, Meat Processing Quality Control, Food Safety, etc

LAQUAtwin Pocket Ion Meters Lineup

pH	COND	Na+	K+	NO3–	Ca2+	Salt EC
Acidity and alkalinity	Conductivity and TDS	Sodium Ion	Potassium Ion	Nitrate Ion	Calcium Ion	Salt (NaCl)

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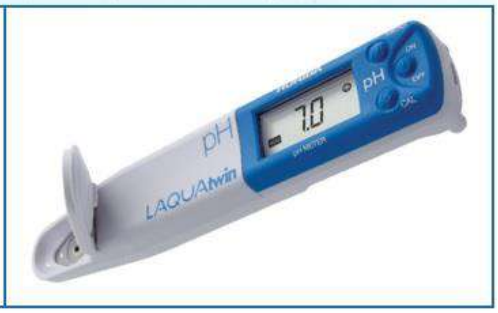
IMS
HORIBA Group is operating Integrated Management System (IMS)
ISO9001 JOA-0298 / ISO14001 JOA-E-90039 / ISO13485 JOA-MD0010 / OHSAS18001 JOA-OH0068

CE RoHS COMPLIANT

Nota de aplicación

pH de salmuera para comida enlatada

Para la salmuera de alimentos ácidos en lata, el valor de pH debe ser de 4.6 o menos para inhibir el crecimiento de *Clostridium Botulinum*, el microorganismo patógeno alimentario más resistente al calor.



Introducción

La bacteria anaerobia Clostridium botulinum producida en alimentos inapropiadamente enlatados ha causado enfermedad y muerte. El sello de vacío en las latas permite un ambiente sin oxígeno pero si el proceso de enlatado no se lleva a cabo correctamente el oxígeno entra, eso permite que las esporas de C. botulinum crezcan y produzcan toxinas mortales. Afortunadamente, las esporas de C. botulinum no crecen en alimentos de alto contenido de ácido (pH ≤ 4,6). Para los alimentos menos ácidos (pH> 4.6), estas esporas, que son resistentes a las temperaturas altas del proceso de esterilización, deben ser eliminadas durante el proceso de enlatado.

El pH apropiado en las latas se obtiene por el uso de salmueras con concentraciones de ácido conocidas o tabletas conteniendo de ácido conocidos que se añaden a las latas por volumen especificado. El contenido de las latas se debe ser agitado para asegurar que el pH se queda abajo de 4.6 en el centro de todas las partículas de alimento. Los ácidos utilizados para bajar el pH a 4.6 son usualmente cítricos, lácticos y málicos, pero también glucono-delta-lactone.

El medidor de pH LAQUAtwin puede ser usado por procesadores de alimentos o fábricas artesanales de latas para medir el pH de la salmuera en los alimentos enlatados. Existen tres modelos de medidores de pH LAQUAtwin disponibles, el pH 11, pH22 y pH33. Estos medidores de bolsillo de tamaño compacto permiten de tener de dos hasta cinco puntos de calibración utilizando soluciones de calibración de pH NIST o USA. El medidor de pH 33 incorpora un sensor de temperatura que mide la temperatura y ofrece la función automática de compensación de temperatura (ATC) que permite la calibración y medición del pH exacto a la temperatura medida. Referirse a las especificaciones de cada modelo de medidor para obtener más información.

Método

Calibre el medidor de pH LAQUAtwin usando las soluciones de calibración de pH 4.01 y 7.00 de siguiendo las instrucciones del fabricante.

Medición de muestras

Calibra el medidor de pH LAQUAtwin siguiendo las instrucciones del fabricante usando por lo menos dos soluciones de calibración para encerrar el pH esperado.

Usando la pipeta que viene con el medidor, tomar una parte alícuota de muestra de salmuera y colocar algunas gotas en el sensor. Nota el valor de pH y la temperatura cuando el resultado se estabiliza. Después de medir cada muestra de salmuera, enjuagar el sensor con agua y secarlo con un pañuelito.

Para obtener resultados precisos, se debe calibrar con soluciones de calibración a la misma temperatura que la muestra de salmuera. La prueba debe realizarse a una temperatura entre 20-30°C, el óptimo es de 25°C.

Food	pH
Vinegar	2.5
Lemon Juice	2.6
Jelly	3.1
Ketchup	3.6
Mayonnaise	3.7
Canned peaches	3.9
Canned Tomatoes	4.0
Canned Green Beans	5.0
Canned Hominy	6.8

(Source: John E. Rushing, Ph.D., Formulating Dressings, Sauces, and Marinades. Food Safety)

La acidez de los alimentos es importante para prevenir el botulismo, una enfermedad transmitida por los alimentos que se contrae por el hecho de comer alimentos contaminados con toxinas producidas por C. botulinum. Es importante de asegurarse de buena preparación de las recetas probadas y de tener los métodos adecuados de enlatado para tener certeza que C. botulinum muera y no crezca en alimentos enlatados. Pero también es necesario realizar una medición precisa de pH utilizando un equipo fiable para verificar que el valor de pH es correcto (4.6 o menos) y alcanzar de cumplir con las normas de Seguridad alimentaria. El pH de equilibrio final (el pH de un producto alimenticio después de que el ácido alimenticio se distribuye por igual en todo el producto) debe ser controlado y documentado después de la etapa de tratamiento térmico del producto.

Table 2: Acidity and Canning Requirements

Acid (pH)	Type	Botulism Potential	Canning Method
≤ 4.6	Acid Food	No	Hot fill* (~190°F) or Boiling Water Canner (~212°F)
> 4.6	Low Acid Food	Yes	Pressure required (~250°F)

*Hot fill processing is only recommended for licensed food processors. Home canners should use the boiling water canning process. (Source: Numer, Brian. Food Acidity and Safety, FN/Food Safety/2008-01)

Medidores de bolsillo de pH HORIBA LAQUAtwin

Características

Sensor de pH plano con compensación de temperatura ofrece mediciones rápidas y confiables directamente a partir micromuestras de 100 µl.

Aplicaciones

Análisis de aguas dulces (lluvia, ríos, lagos, manantiales), acuarios, aguas residuales, análisis del suelo para una agricultura mejorada, análisis de la frescura de los alimentos. Fermentación y elaboración de la cerveza, laboratorios de investigación, controles de calidad de productos médicos y cosméticos, odontología preventiva, educación escolar, etc.

Modelo	pH11	pH22	pH33
Principio de medición	Método de electrodo de vidrio		
Volumen mínimo de la muestra	0.1 ml o más (50 µl con hoja de muestra B)		
Rango de medición pH /mV	de 0 a 14 pH / ± 650 mV		
Resolución	0.1 pH	0.01 pH	
Calibración	Dos puntos	Tres puntos	Cinco puntos
Precisión	± 0.1 pH	± 0.01 pH	
Curva de calibración	USA / NIST		
Funciones	Compensación de temperatura, A prueba de agua (IP67), Detección de la estabilidad del resultado, Apagado automático (30 minutos)		
Pantalla	LCD digital personalizable (monocromática)		
Temperatura/humedad de funcionamiento	De 5 a 40°C, 85 % o menos de humedad relativa (sin condensación)		
Duración de las pilas	Aprox. 400 horas en uso continuado		
Material principal	Epoxi ABS		
Dimensiones/Peso	164 mm × 29 mm × 20 mm (sin incluir salientes) / Aprox. 45 g (solo medidor, sin pilas)		
Accesorios incluidos	2 pilas CR2032, 1 pipeta, instrucciones y Guía rápida, Estuche de almacenamiento, solución de calibración pH 4 & 7 (14 ml)		
Referencia	3999960122	3999960123	3999960124

Rango de medidores de bolsillo HORIBA LAQUAtwin

pH
Acidity and alkalinity

COND
Conductivity and TDS

Na^+
Sodium Ion

K^+
Potassium Ion

NO^{3-}
Nitrate Ion

Ca^{2+}
Calcium Ion

Salt EC
Salt (NaCl)

IMS

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ISO9001 JOA-0298 / ISO14001 JOA-E-90039 / ISO13485
JOA-MD0010 / OHSAS18001 JOA-OH0068

Nota de aplicación

Medición de pH en carne

LAQUAtwin es un rango de medidores de bolsillo de electroquímica. Los medidores de iones usan un electrodo selectivo, para medir el potasio, el calcio, los nitratos y el sodio este rango también incluye medidores de pH y de conductividad. Con tan solo una gota de muestra, el sensor plano LAQUAtwin mide rápidamente y con precisión las concentraciones de parámetros químicos en el campo o en laboratorio.

Introducción

La carne fresca debe tener un valor de pH comprendido entre 5.5 y 6.2[(1)]. Durante el almacenamiento, especialmente cuando no se conserva adecuadamente, la carne fresca se vuelve rancia y tiene un valor de pH inferior a 5,3. El medidor de pH de bolsillo LAQUAtwin se utiliza por control de calidad para asegurarse de la frescura de la carne antes de venderla a los consumidores. Este método de verificación fácil y rápida se utiliza para cumplir con los estándares vietnamitas para garantizar que los clientes están comprando carne fresca que se puede consumir con seguridad.

Método

Una pequeña muestra de carne es cortada y picada. Esto es para asegurar un muestreo total de la parte interna y externa de la carne. Coloque la carne picada en el sensor plano del medidor de bolsillo de pH LAQUAtwin y mide el valor. Para repetir el muestreo, lavar con agua jabonosa diluida y secar con un pañuelo de papel. Coloque una nueva muestra de carne en el sensor y repita el proceso de prueba.

Resultado y Beneficios

Como se menciona en el artículo de VNExpress del 1 de marzo de 2014, el medidor de pH LAQUAtwin ofrece una manera simple y económica de comprobar la frescura de la carne en los mercados locales.

Este procedimiento de medición es implementado por los Departamentos de Salud, Agricultura, Industrias y Comercio de Hanoi para establecer el control de calidad de la seguridad alimentaria usando una herramienta de inspección rápida en los mercados de mayoristas en Vietnam.

El medidor de pH LAQUAtwin es pequeño y compacto; conveniente para llevar en cualquier lugar como en un mercado para la prueba en sitio fácil. Su interfaz fácil de usar es accesible para cualquiera que use el medidor de pH LAQUAtwin. Los resultados preliminares muestran que las lecturas estables y precisas se obtuvieron durante una campana de medición usando el pH LAQUATwin en el mercado de carne de Hanoi.

Valores de pH típica por carnes y productos derivados

Producto	Valor de pH
Mescal de carne en gelatina con vinagre	de 4.5 a 5.2
Salchicha cruda fermentada	de 4.8 a 6.0
Carne de res	de 5.4 a 6.0
Carne de cerdo	de 5.5 a 6.2
Carne enlatada	de 5.8 a 6.2
Salmuera de curación	de 6.2 a 6.4
Salchicha de sangre	de 6.5 a 6.8
Tejido musculoso después matanza	de 7.0 a 7.2
Sangre	de 7.3 a 7.6

[1] Vietnam's National Standard TCVN 7046 2002
[2] Meat Processing Technology For Small- To Medium-Scale Producers, FAO Document Repository

Medidor de bolsillo

LAQUAtwin

Características únicas

Realice calibraciones y mediciones con tan solo pulsar un botón; le indicará que ya puede leer el resultado.

La sencilla calibración automática con tan solo unas gotas de solución de calibración, le garantiza la exactitud de la medición. También se puede realizar la calibración en dos puntos y hasta 3 y 5 puntos con los modelos pH33 y EC33.

LAQUAtwin es totalmente a prueba de agua y polvo.

El medidor y el sensor son totalmente resistentes al agua y al polvo, por lo que puede llevarlo donde quiera.

1 IP67: no da errores al sumergirse en agua a una profundidad de un metro durante treinta minutos. Sin embargo, el producto no puede usarse bajo el agua

LAQUAtwin: Tecnología única de sensor plano ISE y pH

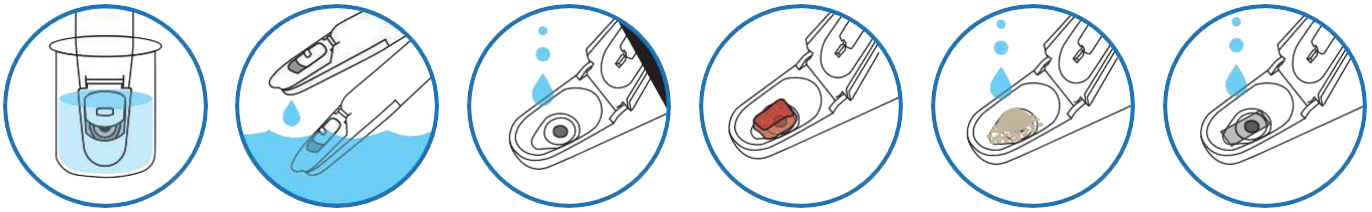
La tecnología HORIBA de sensor plano de alta sensibilidad abre nuevas posibilidades para medir diferente tipos de muestras. Puede hacer una medición a partir de un volumen de 0.1 ml y no necesita vaso para calibrar o medir, solo punga unas gotas directamente en el sensor.

Incluye un estuche para transportarlo de forma práctica.

El estuche compacto contiene todo lo que necesita para las mediciones, incluyendo las soluciones de calibración y una pipeta de plástico.

1 X 6 Un medidor, seis métodos de medición

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



1 Inmersión

Cuando se encuentre en un laboratorio, puede analizar la muestra en un vaso de precipitados. Asegúrese que la tapa deslizante que protege el sensor esté abierta.

2 Muestreo

Utilícelo como una pala para analizar el agua, por ejemplo, de un río.

3 Gotas

Los medidores LAQUAtwin pueden medir volúmenes de muestra de tan solo 0.1ml. Coloque una gota de la muestra en el sensor con una pipeta.

4 Muestras sólidas

Los alimentos que contengan cierta humedad pueden analizarse si coloca un trozo pequeño directamente en el sensor.

5 Polvos

Los medidores LAQUAtwin también pueden analizar polvos secos. Simplemente, coloque la muestra de polvo en el sensor y versa encima el volumen definido de agua desionizada.

6 Papel y tejidos

Si desea analizar hojas de papel y tejidos, corte la muestra en trozos pequeños y colóquelo directamente en el sensor. Versa encima un volumen definido de agua desionizada.

Rango

pH

Medición precisa de pH directamente a partir de una sola gota. El pH del agua varía en función al ambiente y un ligero cambio a menudo puede tener un gran impacto. Tanto si debe mantener el pH de un acuario dentro de niveles estrictos, comprobar la acidez del agua de lluvia o la calidad de producto alimenticio (carnes, pescados…), los medidores de pH de bolsillo LAQUAtwin son la solución perfecta. No importa dónde o cuándo debe realizar un análisis.

COND

Determine la conductividad con tan solo una muestra de 0.12 ml. La conductividad del agua de lluvia es una referencia fiable para determinar la pureza atmosférica. En agricultura, la medición de la conductividad del suelo permite a los agricultores establecer el uso óptimo de fertilizantes y comprobar la «salud» del suelo tras el daño provocado por el agua salada. Los medidores de conductividad LAQUAtwin hace que el análisis de la conductividad sea una tarea sencilla que se puede realizar en

Na+

Único medidor de bolsillo para medir rápidamente y con precisión el sodio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 23 a 2300 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

K+

Único medidor de bolsillo para medir rápidamente y con precisión el potasio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 39 a 3900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

NO3–

Único medidor de bolsillo para medir rápidamente y con precisión el nitrato con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 30 a 9900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

Ca2+

Único medidor de bolsillo para medir rápidamente y con precisión el calcio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 40 a 4000 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

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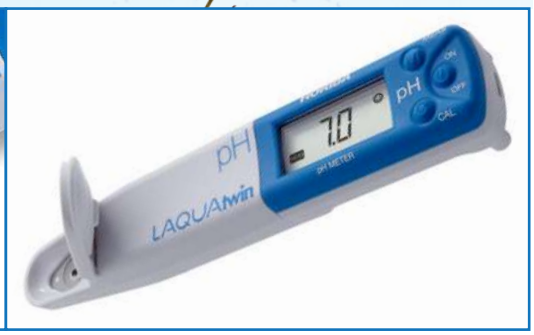
HORIBA

LAQUAtwin pH

Application Note

pH Measurement To Determine Acidification of Sushi Rice

LAQUAtwin is a series of pocket ION meters. Using Ion Selective Electrode (ISE) technology, they are available for measuring Conductivity, Calcium, Nitrate, Potassium, Sodium, Salt concentration and pH measurement. Using just a tiny amount of sample, the LAQUAtwin proprietary flat sensors can quickly and accurately measure the values of the chemical parameters in the field.



Introduction

Rice used for sushi must have a pH of less than 4.6. At pH levels below 4.6, most pathogenic bacteria do not grow or produce toxins[1]. Thus, the rice must be acidified using acetic acid (vinegar) to be classified as non-hazardous. The LAQUAtwin pocket pH Meter is used as quality control check to ensure that the rice is adequately acidified, before selling to consumers. This is an easy, quick check method used to abide to the ANZ Standards[2] in ensuring that customers are safely consuming sushi.

Method

Acetic acid (vinegar) should be mixed into the rice according to the following table.

Ingredients	Recipe 1	Recipe 2	Recipe 3
Short Grain Rice	900 g	900 g	900 g
Water	1100 ml	1320 ml	1250 ml
Rice Vinegar	135 ml	99 ml	128 ml
Sugar	57 g	94 g	44 g
Salt	9 g	25 g	8 g

A small sample of the rice mixture is placed on the flat sensor of the LAQUAtwin pocket pH Meter and measured. If the measured value is above pH 4.6, add more acetic acid to the rice mixture and stir well. Place new rice sample on the senor and repeat testing process. After tests, wash the sensor with diluted soap water and pat dry with a paper tissue.

Results and Benefits

The use of accurate pH testing in controlling the quality of sushi rice prevents the growth of pathogenic bacteria and toxins.

The LAQUAtwin pocket pH meter is small and compact; convenient to carry around in your pocket and is ideal for on-site testing. Its easy-to-use interface makes the LAQUATwin pocket pH Meter an indispensable tool for food testing.

[1] Hocking, A.D; 2003. Foodborne Microorganisms of Public Health Significance, AIFST, Waterloo
[2] Food Safety Guideline for Preparation and Display of Sushi, June 2007, NSW/FA/F1005/0706

Pocket ION Meter

LAQUAtwin

Unique Features

Calibrate and measure at the touch of a button—the smiley face will tell you when the result can be read.

Hassle-free automatic calibration with a few drops of standard solution reassures you of your measurement accuracy. Two-point calibration is also possible.*1

*1 Except for B-711

LAQUAtwin is fully waterproof and dustproof.

The meter and sensor are fully waterproof*3 and dustproof, so you can take it anywhere.

*3 IP67 rated. Will withstand immersion for 30 minutes at 1 m. Not suitable for underwater use.

LAQUAtwin: the only meters with flat sensor technology.

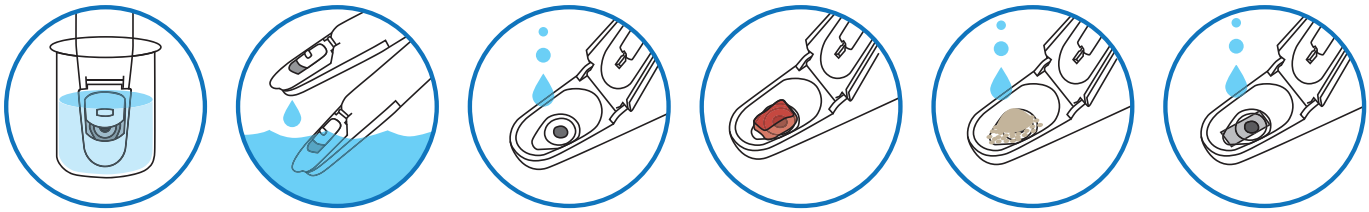
HORIBA's highly-sensitive, flat sensor technology opens up new possibilities for sampling and sample types. Only a small amount of sample is required, so you can easily sample in situ without the need for beakers or other labware. Sensors are easily replaced as required.

Carry case comes as standard for handy portability.

The compact carry case contains everything you need for your measurements, including the standard solution and sampling sheets.

1 X 6 One meter, six methods.

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



01 Immersion

When you're in the lab, you can test the sample in a breaker. Ensure the sensor guard sliding cap is open.

02 Scoop

Use as a scoop to test water eg from a river. A vertical scoop for an aquarium is also available with a unique sensor guard.

03 Drops

Place a drop of the sample onto the sensor with a pipette. Laquatwin meters can measure sample volume as low as 0.1mL

04 Solid Samples

Foods containing some moisture can be tested by placing a small piece directly onto the sensor.

05 Powders

Laquatwin meters can also test dry powders. Simply place the powder sample onto the sensor and drop on your defined volume of pure water.

06 Paper and textiles

To test sheets of paper and textiles, cut up the sample into small pieces and place directly onto the sensor. Drop on your defined volume of pure water.

Lineup

pH

Accurate pH measurements in a few seconds, from a single drop.

Water pH varies in different environments, and a slight change can often have a major effect.

Whether you need to keep the pH of an aquarium within tight limits, are checking for the acidity of rain water or for the quality of meat and fish products, LAQUAtwin compact pH meters are ideal for you. No matter where and when you need to test.

COND

Determine water conductivity with as little as 0.12 mL of sample.

The conductivity of rain water is a trusted guide to determining atmospheric purity. In agriculture, measuring the conductivity of soil allows farmers and agronomists to determine optimum fertilizer usage and check the 'health' of soil after salt water damage. The LAQUAtwin meter makes conductivity testing simple, anywhere.

Na+

Only compact meter for a quick and reliable measurement of sodium ion at the scene using ion selective membrane.

K+

Only compact meter for a quick and reliable measurement of potassium ion at the scene using ion selective membrane.

NO3–

Only compact meter for a quick and reliable measurement of nitrate ion at the scene. Special application packages for crop (B-741) and soil (B-742) are also available.

Ca2+

Only compact meter for a quick and reliable measurement of ionized calcium at the scene using ion selective membrane.

http://www.horiba.com/laquatwin

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CE RoHS COMPLIANT

Application Note

pH Measurement of Pickled Fruits and Vegetables

Pickling is a process of preserving fruits and vegetables in brine, oil, water or vinegar. The Australia New Zealand Food Standard Code 2.3.1 requires the preserved fruits and vegetables to have a pH not greater than 4.6 to prevent botulism.

Introduction

Vegetables in oil have caused botulism outbreaks in United States. Botulism is caused by the anaerobic, spore-forming bacterium *Clostridium botulinum*. This resulted to the development of Title 21 of the Code of Federal Regulation (21 CFR 114), a regulation for acidified foods. Australian authorities adopted similar precautions to 21 CFR 114 and included a requirement in the Australia New Zealand Food Standard Code 2.3.1. This code states that "fruits and vegetables in brine, oil, vinegar or water, other than commercially canned fruit and vegetables, must have a pH not greater than 4.6".

The LAQUAtwin pH meter have three (3) models, namely pH 11, 22 and 33, which can be used to measure pH of pickled fruits and vegetables. These pocket-sized meters allow two to five calibration points using either NIST or USA pH buffers. The pH 33 meter has built-in temperature sensor that measures and displays temperature and automatic temperature compensation feature (ATC) that performs automatic calibration to the exact pH of the buffer at the measured temperature. Refer to the specifications of the meters for more information.

Method

Calibrate the LAQUAtwin pH meter using pH 4.01 and 7.00 (or 6.86) buffers according to manufacturer's instructions.

Sample Preparation And Measurement

1. Drain the liquid of pickled fruits and vegetables.
2. Blend the fruits and vegetables in a blender to a paste consistency. For some samples, it may be necessary to add a small amount of distilled water (less than 20mL DI in 100g sample) to facilitate blending. This will not alter the pH of most products as distilled water contains no hydrogen ions.
3. Place a portion of the paste into the sensor.
4. Record the pH and temperature once stabilized.
5. After each sample, rinse the sensor with water and blot dry with soft tissue.
6. Determine two pH values on the blended sample. These readings should agree with one another to indicate that the sample is homogeneous.

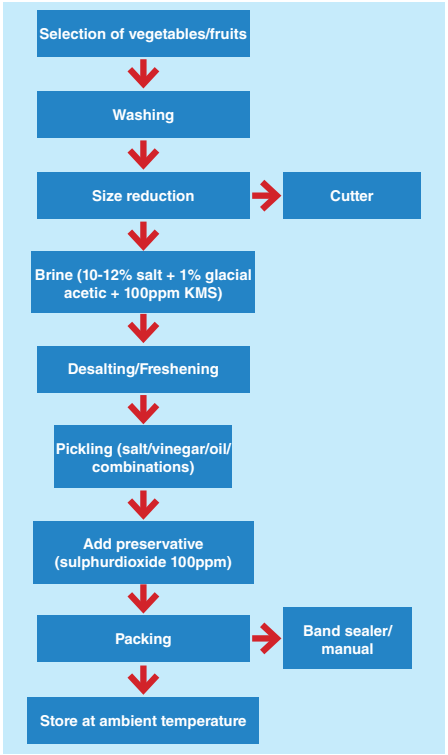

Figure 1: Flowchart of Pickling Process
(Source: Lesson 9. Processed Products from Fruits and Vegetables, Crop Process Engineering)

Continued at the back

Continued from the front

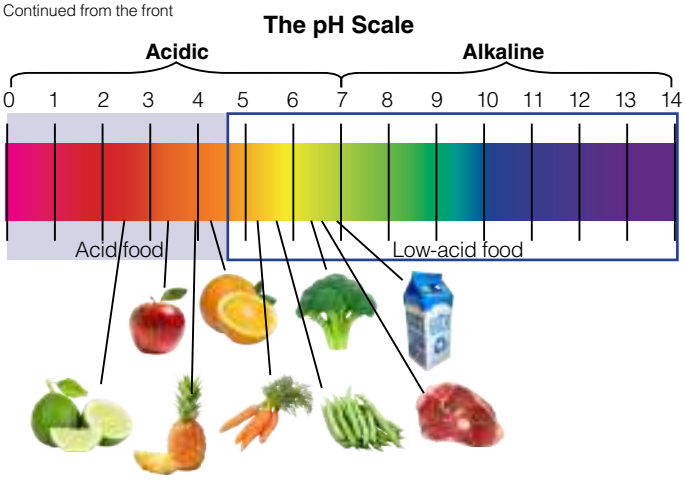

Figure 2: The pH Scale
(Source: Science Basics for Food and Safety and Quality, Virginia Cooperative Extension)

Results and Benefits

Food acidity is important in preventing botulism, a foodborne illness that comes from eating contaminated food with toxins produced by *C. botulinum*. This fact is used in preparing pickled fruits and vegetables. Aside from following tested recipes in acidification and proper packaging of products, performing accurate pH measurement using a reliable instrument is also necessary to check if pH 4.6 or below is attained for food safety and regulatory compliance.

References
1. NSW Food Authority. Shelf stable acid preserved foods. NSW/FA/FI035/0811
2. Title 21 of the Code of Federal Regulation (21 CFR 114)

REV 0, 13 AUGUST 2015

pH Meters Lineup

pH 11 Meter: pH, mV | WATER PROOF, MICRO VOLUME, 2 PT CAL, 0.1 pH

pH 22 Meter: pH, mV | WATER PROOF, MICRO VOLUME, 3 PT CAL, 0.01 pH

pH 33 Meter: pH, mV, Temp | WATER PROOF, MICRO VOLUME, 5 PT CAL, 0.01 pH

Features

Flat pH sensor with temperature compensation offers a reliable and quick direct measurement of micro-samples from 100 µL.

Applications include

Fresh water testing; aquarium; affluent treatment; soil & food testing; research laboratories; QC education, etc.

Model	pH 11	pH 22	pH 33
Measurement principle	Glass electrode method		
Minimum sample volume	0.1 mL (0.05 mL with sampling sheet B)		
Measurement range pH / mV	0 to 14 pH / ± 650 mV		
Resolution	0.1 pH	0.01 pH	
Calibration	Two-point	Three-point	Five-point
Accuracy	± 0.1 pH	± 0.01 pH	
Calibration curves	USA / NIST		
Functions	Temperature compensation • IP67 Water/Dust Proof • Auto Hold • Auto Stable • Automatic power off (30 minutes)		
Display	Custom (monochrome) digital LCD		
Operating temperature/humidity	5 to 40°C, 85% or less in relative humidity (no condensation)		
Battery life	Approx. 400 hours in continuous use with x2 CR 2032 batteries		
Main Material	ABS epoxy		
Dimensions/Mass	164 mm x 29 mm x 20 mm (excluding projections) /Approx. 50 g (meter only, without batteries, approx. 45 g)		
Accessories included	2 CR2032 batteries • 1 Pipette • Instruction manual • Quick manual • Storage case • 14 mL Standard solutions (pH 4 & pH 7)		
Ordering Code	3999960122	3999960123	3999960124

LAQUAtwin Pocket Ion Meters Lineup

pH COND Na+ K+ NO3– Ca2+ Salt EC

Horiba Instruments (Singapore) Pte Ltd
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Tel. +65 6908 9660
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http://www.horiba-laqua.com

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Nota de aplicación

Determinación de la concentración de sodio en alimentos

Los alimentos contienen concentraciones variables de sal (NaCl), que contiene 40% de sodio (Na+). La determinación precisa de la concentración de sodio en los alimentos reduce los riesgos para la salud asociados a la consumación excesiva de sal. La Asociación Estadounidense del Corazón[1] recomienda un consumo de sodio inferior a 1500 mg / día para la mayoría de los adultos estadounidenses, que es el elemento con el mayor efecto sobre la presión arterial.

Introducción

La mayoría de los alimentos contienen de sodio, este elemento químico puede ser presente naturalmente o añadido en el proceso de fabricación. La sal de mesa conocido el cloruro de sodio (NaCl) es la fuente más común de sodio. Se compone de 40% de sodio y cloruro de 60% y a menudo utilizado en alimentos procesados y envasados, el sodio actúa como un de potenciador de sabor o un conservantes. Otras fuentes de sodio añado en los alimentos es el glutamato monosódico (MSG), nitrito de sodio, sacarina de sodio, bicarbonato de sodio y benzoato de sodio.

Rango de sodio en diferente tipo de comida

Tipo de comida	Cuantidad	Rango (mg)
Pan	1 Oz	95-210
Pizza congelada, queso	4 Oz	450 - 1200
Vinagreta	30 ml	110 -505
Salsa	30 ml	150 -240
Sopa	8 Oz	700 -1260
Patatas fritas	8 Oz	120 - 180
Jugo de tomate	1 Oz	341 - 1040
Tortilla	1 Oz	105 -160
Pretzels	1 Oz	290 -560
1 oz = 28.4 g		

(Fuente: Dietary Guidelines for Americans- http://health.gov/dietaryguidelines/dga2005/document/html/chapter8.htm)

El contenido de sodio de los alimentos tiene consecuencias en nuestra salud. El sodio es un mineral esencial requerido por el cuerpo en pequeñas cantidades para controlar la presión arterial y ayuda a los nervios y músculos a funcionar correctamente. Sin embargo, la ingesta elevada de sodio puede causar problemas de salud como la hipertensión arterial y las enfermedades cardiovasculares, que incluyen ataque al corazón, accidente cerebrovascular y enfermedad de los vasos sanguíneos. Por lo tanto, el conociendo de la concentración de sodio en los alimentos y el control de la ingesta son importante para mantener a raya las enfermedades.

Para determinar el contenido de sodio en muestras de alimentos, el medidor de ion Sodio LAQUAtwin B-722 ofrece una medición rápida, simple y fácil. Este medidor de bolsillo tiene un sensor plano de sodio, que permite de medir la concentración de sodio en las muestras sólidas y ajuste de compensación de resultado (factor de dilución), que puede ser utilizado para tener en cuenta la preparación de muestras en los resultados. Los resultados se pueden exprimido en partes por millón (ppm) o mg/l.

Método

Configuración del medidor y calibración

Asegúrese de que el medidor está configurado en dos (2) puntos de calibración antes de calibrar. Calibra el medidor siguiendo las recomendaciones del fabricante, utilizando los estándares de 150 ppm y 2000 ppm de iones de sodio.

Preparación de muestras y medición

Las muestras líquidas tales como sopas, salsas, salmueras, bebidas, etc., se pueden colocar directamente sobre el sensor. Diluye la muestra con agua destilada o desionizada, si los resultados están arriba del valor de calibración o del rango de medición especificado del medidor (por ejemplo, 5 ml de muestra diluida a 20 ml utilizando agua DI).

Las muestras sólidas, tales como papas fritas, queso, jamón, etc., deben estar preparadas para liberar el sodio. Picar o moler la muestra en una licuadora. Pesar la muestra triturada con precisión, y luego añadir agua destilada o desionizada (por ejemplo, 5 gramos de muestra con 20 ml de agua). Mezclar la muestra y coloque unas gotas de muestra preparada en el sensor y registrar el valor. Para obtener resultados precisos, asegurase que la temperatura de la muestra es la misma que la temperatura de la soluciones de

Después de la medición, limpie el sensor con detergente y agua (caliente, si la muestra medida es grasosa). Si el sensor está manchado con restos de muestra, coloque unas gotas de lejía en el sensor y dejar actuar durante 5 a 30 minutos. Enjuague el sensor con agua y secarlo con un tejido de papel. Dejar el sensor en contacto con la solución de calibración de 2000 ppm de sodio durante 10 minutos a 1 hora antes del siguiente uso.

Para la medición de alta precisión, preparar la solución de fuerza iónica de ajuste (ISA) que contiene 4 M NH4Cl y 4M NH4OH. Añadir un volumen igual de ISA para todas las muestras y estándares (por ejemplo, 2 ml de ISA en muestras o estándares 100ml)[2]

Cuantidad por porción	Líquidos	Solidos
Sodio (mg)	Sodio (mg/L o ppm) x volumen de muestra (L)	Sodio (mg/L o ppm) x volumen de agua (L) x peso de muestra (g) / peso total de la muestra (g)
NaCl (mg)	Sodio (mg) x 2.54	Sodio (mg) x 2.54
Ejemplo	Muestra: 150mL de jugo de tomate 1) Muestra medida = 1500 ppm 2) 5ml de jugo diluido en 20 ppm (dilución 1/5) = 300 ppm Para 1 y 2, la cantidad de sodio 225 mg y la concentración en NaCl es de 571.5 mg.	Ejemplo: 28.4g patata frita Molar la patata frita y pesar 5g y añadir 100ml de agua y mesclar. Resultado 250 ppm, cantidad de sodio es 142 mg y 360.68 mg de NaCl.

Resultado y Beneficios

Los alimentos contienen concentraciones variables de sal. Para los alimentos procesados o envasados, sodio está listado en miligramos (mg) por porción en el panel de información nutricional. Para calcular el contenido de sal (NaCl) de sodio y en muestras de alimentos a partir de los resultados, utilizar las fórmulas en la tabla anterior.

La Asociación Estadounidense del Corazón[1] recomienda el consumo de menos de 1500 mg de sodio por día para la mayoría de los adultos estadounidenses, que es el nivel con el mayor efecto sobre la presión arterial. Este nivel no se aplica a las personas que pierden grandes cantidades de sodio en el sudor, como los deportistas de competición, los trabajadores expuestos a estrés por calor extremo, o a los que se lo indique su médico.

Para lograr el nivel recomendado, consulte el panel de información nutricional en los envases de alimentos cuando se compra los productos y escoge los alimentos que tiene la concentración la más baja de sodio después de comparar diferentes marcas. Como alternativa, probar sus muestras de alimentos para determinar el contenido de sodio.

Referencia y lecturas sugeridas

[1] American Heart Association. Frequently Asked Questions about Sodium. www.heart.org

[2] Nielsen, Suzanne. Sodium Determination Using Ion Selective Electrodes, Mohr Titration, and Test Strips. Chapter 10. Food Analysis Laboratory Manual. 2nd Edition. USA: Springer. 2015

Medidores de bolsillo de sodio HORIBA LAQUAtwin

Medidor de sodio B-722

WATER PROOF | MICRO VOLUME | 2 PT CAL

Características

Sensor de pH plano con compensación de temperatura ofrece mediciones rápidas y confiables directamente a partir micromuestras de 100 µl.

Aplicaciones

Análisis de aguas dulces (lluvia, ríos, lagos, manantiales), acuarios, aguas residuales, análisis del suelo para una agricultura mejorada, análisis de la frescura de los alimentos. Fermentación y elaboración de la cerveza, laboratorios de investigación, controles de calidad de productos médicos y cosméticos, odontología preventiva, educación escolar, etc.

Rango de medidores de bolsillo HORIBA LAQUAtwin

pH	COND	Na^+	K^+	NO^{3-}	Ca^{2+}	Salt EC
Acidity and alkalinity	Conductivity and TDS	Sodium Ion	Potassium Ion	Nitrate Ion	Calcium Ion	Salt (NaCl)

IMS

HORIBA Group is operating Integrated Management System (IMS)
ISO9001 JOA-0298 / ISO14001 JOA-E-90039 / ISO13485
JOA-MD0010 / OHSAS18001 JOA-OH0068

Nota de aplicación

Medición del valor de Sodio en comida enlatada

LAQUAtwin es un rango de medidores de bolsillo de electroquímica. Los medidores de iones usan un electrodo selectivo, para medir el potasio, el calcio, los nitratos y el sodio este rango también incluye medidores de pH y de conductividad. Con tan solo una gota de muestra, el sensor plano LAQUAtwin mide rápidamente y con precisión las concentraciones de parámetros químicos para la calidad de los alimentos en línea de producción.

Introducción

El sodio es un mineral necesario para un buen funcionamiento del cuerpo pero su consumo excesivo puede ocasionar alta presión arterial y hipertensión. En 2010, las guías dietéticas estadounidenses recomiendan consumir menos de 2300 mg de sodio por día.

La alta concentración de sodio en comida enlatada es una preocupación creciente. Varios alimentos engaño con respecto a su concentración de sodio y es importante que las personas pueden saber la concentración real.

El medidor LAQUAtwin Na+ es el equipo perfecto para una determinación fácil y rápida de esta concentración de sodio en alimentos en lata.

Método

1. **La comida tiene que ser liquida, usa una liquidadora si se trata de alimentos solidos**
2. **Toma 1g de comida y 4 ml de agua deionizada**
3. **Mescla los dos un minuto para tener una buena homogeneización**
4. **Usa una pipeta para colocar en la muestra en el sensor**
5. Repita la medición de la muestra, limpia el sensor con agua de la llave y seca el sensor.

Resultado y Beneficios

El uso del medidor HORIBA LAQUAtwin Na+ para medir la concentración de sodio en comida enlatada va mejorar el conocimiento del consumidor de su consumo de sodio. Eso va ayudar a mantener una alimentación sana y evitar enfermedad cardiovascular.

Este medidor es práctico para llevar en todos lados y fácilmente realizar medición en el campo o en línea de producción. Gracias a su

Muestra	Concentración de sodio en la etiqueta	Concentración de sodio (después 1/5 dilución)	Resultados del LAQUAtwin	Etiqueta vs resultado LAQUAtwin
Sopa minestrone	5390 mg/l	1078 mg/l	1000 mg/l	+/-10%
Sopa de almejas	6530 mg/l	1306 mg/l	1300 mg/l	+/-10%
Sopa de maiz	6330 mg/l	1266 mg/l	1200 mg/l	+/-10%

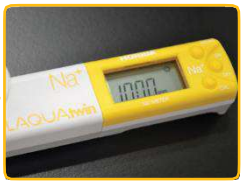
Como medir el sodio en sopa enlatada con LAQUAtwin (con factor de 1/5)

1. **Pesar 1g de muestra**

2. **Añadir 4g de agua, para llegar a 5g**

3. **Mesclar la muestra por 1 minuto.**

4. **Cubrir el electrodo con la muestra**



5. **Leer el resultado después de un minuto**

Medidor de bolsillo

LAQUAtwin

Características únicas

Realice calibraciones y mediciones con tan solo pulsar un botón; le indicará que ya puede leer el resultado.

La sencilla calibración automática con tan solo unas gotas de solución de calibración, le garantiza la exactitud de la medición. También se puede realizar la calibración en dos puntos y hasta 3 y 5 puntos con los modelos pH33 y EC33.

LAQUAtwin es totalmente a prueba de agua y polvo.

El medidor y el sensor son totalmente resistentes al agua y al polvo, por lo que puede llevarlo donde quiera.

1 IP67: no da errores al sumergirse en agua a una profundidad de un metro durante treinta minutos. Sin embargo, el producto no puede usarse bajo el agua

LAQUAtwin: Tecnología única de sensor plano ISE y pH

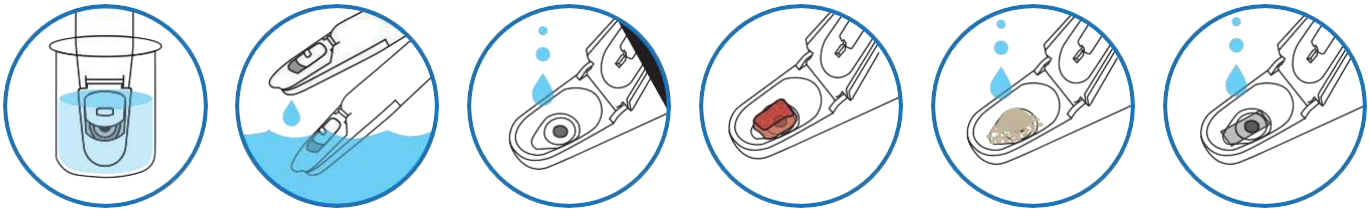
La tecnología HORIBA de sensor plano de alta sensibilidad abre nuevas posibilidades para medir diferente tipos de muestras. Puede hacer una medición a partir de un volumen de 0.1 ml y no necesita vaso para calibrar o medir, solo punga unas gotas directamente en el sensor.

Incluye un estuche para transportarlo de forma práctica.

El estuche compacto contiene todo lo que necesita para las mediciones, incluyendo las soluciones de calibración y una pipeta de plástico.

1 X 6 Un medidor, seis métodos de medición

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



1 Inmersión

Cuando se encuentre en un laboratorio, puede analizar la muestra en un vaso de precipitados. Asegúrese que la tapa deslizante que protege el sensor esté abierta.

2 Muestreo

Utilícelo como una pala para analizar el agua, por ejemplo, de un río.

3 Gotas

Los medidores LAQUAtwin pueden medir volúmenes de muestra de tan solo 0.1ml. Coloque una gota de la muestra en el sensor con una pipeta.

4 Muestras sólidas

Los alimentos que contengan cierta humedad pueden analizarse si coloca un trozo pequeño directamente en el sensor.

5 Polvos

Los medidores LAQUAtwin también pueden analizar polvos secos. Simplemente, coloque la muestra de polvo en el sensor y versa encima el volumen definido de agua desionizada.

6 Papel y tejidos

Si desea analizar hojas de papel y tejidos, corte la muestra en trozos pequeños y colóquelo directamente en el sensor. Versa encima un volumen definido de agua desionizada.

Rango

pH

Medición precisa de pH directamente a partir de una sola gota. El pH del agua varía en función al ambiente y un ligero cambio a menudo puede tener un gran impacto. Tanto si debe mantener el pH de un acuario dentro de niveles estrictos, comprobar la acidez del agua de lluvia o la calidad de producto alimenticio (carnes, pescados…), los medidores de pH de bolsillo LAQUAtwin son la solución perfecta. No importa dónde o cuándo debe realizar un análisis.

COND

Determine la conductividad con tan solo una muestra de 0.12 ml. La conductividad del agua de lluvia es una referencia fiable para determinar la pureza atmosférica. En agricultura, la medición de la conductividad del suelo permite a los agricultores establecer el uso óptimo de fertilizantes y comprobar la «salud» del suelo tras el daño provocado por el agua salada. Los medidores de conductividad LAQUAtwin hace que el análisis de la conductividad sea una tarea sencilla que se puede realizar en

Na+

Único medidor de bolsillo para medir rápidamente y con precisión el sodio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 23 a 2300 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

K+

Único medidor de bolsillo para medir rápidamente y con precisión el potasio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 39 a 3900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

NO3–

Único medidor de bolsillo para medir rápidamente y con precisión el nitrato con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 30 a 9900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

Ca2+

Único medidor de bolsillo para medir rápidamente y con precisión el calcio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 40 a 4000 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

CE RoHS

IMS

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HORIBA

LAQUAtwin Ca^{2+}

Application Note

Measurement Of Calcium In Milk And Milk Beverages

LAQUAtwin is a series of pocket ION meters. Using Ion Selective Electrode (ISE) technology, they are available for measuring Conductivity, Calcium, Nitrate, Potassium, Sodium, Salt concentration and pH measurement. Using just a tiny amount of sample, the LAQUAtwin proprietary flat sensors can quickly and accurately measure the values of the chemical parameters in the field.

Introduction

It is often necessary to determine the calcium content of milk and milk beverages. This may be done by atomic absorption spectroscopy (AA) or inductively coupled plasma atomic emission spectroscopy (ICP). Alternatively, by ionizing protein-bound calcium using an acidizing pretreatment, the LAQUAtwin Ca2+ can be used to measure the total amount of calcium easily.

The LAQUAtwin Ca2+ meter is used as check to determine the Calcium content of milk products before selling to consumers. This is an easy, quick method to check the amount of calcium in lactic products.

Method

Pretreatment procedure (for milk)

Acidify the milk with hydrochloric acid (HCl) to a pH of between 4.3 and 4.6 (which can be determined by use of the LAQUAtwin pocket pH meter). Wait for the solution to precipitate and use the liquid part of the sample for the test. A small sample of the solution is placed on the sensor of the LAQUAtwin Ca2+ and measured. To repeat sampling, wash with diluted soap water and pat dry with a paper tissue.

Pretreatment procedure (for milk beverages such as lactic drinks)

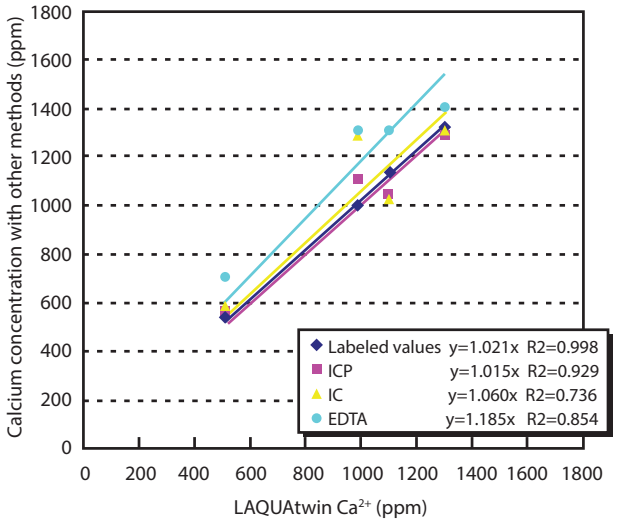
Acidify the lactic drink with hydrochloric acid (HCl) and use the LAQUAtwin pH meter to confirm it has a pH of about 2. Then, dilute this sample and add tris-hydroxy-aminomethane so that the solution has a pH value between 4.3 and 4.6. Wait for the solution to precipitate and use the liquid to sample. A small sample of the solution is placed on the sensor of the LAQUAtwin Ca2+ and measured. To repeat sampling, wash with diluted soap water and pat dry with a paper tissue.

Results and Benefits

The use of accurate Calcium ion testing in controlling the quality and calcium content of lactic products ensures that consumers are accurately able to gauge their calcium intake. This is especially beneficial for those who are lactose intolerant.

The LAQUAtwin Ca2+ pocket meter is small and compact; convenient to carry around the marketplace for easy on-site testing. Its easy-to-use interface is simple for anyone to use the LAQUATwin Ca2+ pocket meter.

[1] Correlation of Calcium concentration between LAQUAtwin Ca^{2+} and other methods



[1] Internal study by HORIBA labs, 2013

Pocket ION Meter

LAQUAtwin

Unique Features

Calibrate and measure at the touch of a button—the smiley face will tell you when the result can be read.

Hassle-free automatic calibration with a few drops of standard solution reassures you of your measurement accuracy. Two-point calibration is also possible.*1

*1 Except for B-711

LAQUAtwin: the only meters with flat sensor technology.

HORIBA's highly-sensitive, flat sensor technology opens up new possibilities for sampling and sample types. Only a small amount of sample is required, so you can easily sample in situ without the need for beakers or other labware. Sensors are easily replaced as required.

LAQUAtwin is fully waterproof and dustproof.

The meter and sensor are fully waterproof*3 and dustproof, so you can take it anywhere.

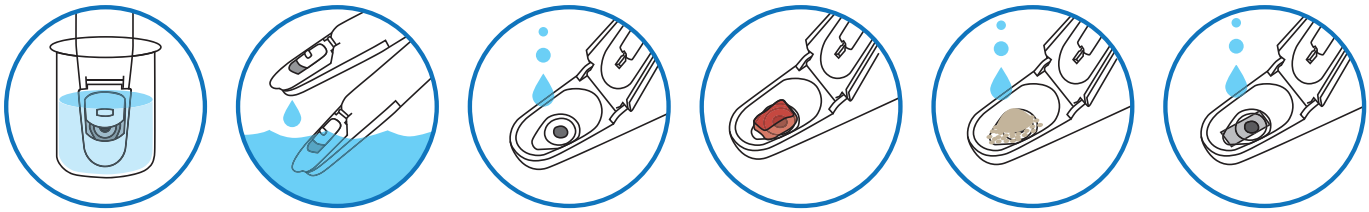
*3 IP67 rated. Will withstand immersion for 30 minutes at 1 m. Not suitable for underwater use.

Carry case comes as standard for handy portability.

The compact carry case contains everything you need for your measurements, including the standard solution and sampling sheets.

1 X 6 One meter, six methods.

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



01 Immersion
When you're in the lab, you can test the sample in a breaker. Ensure the sensor guard sliding cap is open.

02 Scoop
Use as a scoop to test water eg from a river. A vertical scoop for an aquarium is also available with a unique sensor guard.

03 Drops
Place a drop of the sample onto the sensor with a pipette. Laquatwin meters can measure sample volume as low as 0.1mL

04 Solid Samples
Foods containing some moisture can be tested by placing a small piece directly onto the sensor.

05 Powders
Laquatwin meters can also test dry powders. Simply place the powder sample onto the sensor and drop on your defined volume of pure water.

06 Paper and textiles
To test sheets of paper and textiles, cut up the sample into small pieces and place directly onto the sensor. Drop on your defined volume of pure water.

Lineup

pH

Accurate pH measurements in a few seconds, from a single drop.

Water pH varies in different environments, and a slight change can often have a major effect.

Whether you need to keep the pH of an aquarium within tight limits, are checking for the acidity of rain water or for the quality of meat and fish products, LAQUAtwin compact pH meters are ideal for you. No matter where and when you need to test.

COND

Determine water conductivity with as little as 0.12 mL of sample.

The conductivity of rain water is a trusted guide to determining atmospheric purity. In agriculture, measuring the conductivity of soil allows farmers and agronomists to determine optimum fertilizer usage and check the 'health' of soil after salt water damage. The LAQUAtwin meter makes conductivity testing simple, anywhere.

Na+

Only compact meter for a quick and reliable measurement of sodium ion at the scene using ion selective membrane.

K+

Only compact meter for a quick and reliable measurement of potassium ion at the scene using ion selective membrane.

NO3–

Only compact meter for a quick and reliable measurement of nitrate ion at the scene. Special application packages for crop (B-741) and soil (B-742) are also available.

Ca2+

Only compact meter for a quick and reliable measurement of ionized calcium at the scene using ion selective membrane.

http://www.horiba.com/laquatwin

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CE RoHS COMPLIANT

Water Quality Check in Beer Brewing

The quality of brewing water affects the enzyme activity in mash, solubility of minerals, taste and quality of beer, and the condition of brewing equipment. To achieve the great taste of beer and ascertain the cleanliness of equipment after cleaning process, water quality check must be carried out in the various stages of brewing process with reliable and accurate instruments. Having the advantages of less maintenance design, low-volume sample requirement, and hassle-free operation, the HORIBA LAQUAtwin pocket meters and LAQUA dissolved oxygen (DO) handheld meters and electrodes are recommended for home and commercial beer brewers.

Introduction

Beer is one of the most widely consumed alcoholic drinks and the third most popular drink overall (after water and tea) in the world. It has become a part of the culture of many nations and often associated with social traditions such as festivals and games.[1]

Brewing is the process of making beer. The four main ingredients of beer are cereal grains (e.g., malted barley, wheat, maize, rice) as starch source, water, flavoring agents (e.g., hops, gruit, herbs, fruits), and yeast. Malted barley and hops are the most commonly used cereal grain and flavoring agent, respectively. In beer brewing, the starch source is mixed with water and converted into a sugary liquid called wort. The wort is subsequently converted into the alcoholic drink by fermentation using yeast.

As beer is mostly water, the composition of brewing water can affect the quality of beer. Brewing water should be clean and odorless. Water can come from two sources—surface water and groundwater. The former is low in dissolved minerals but higher in organic matter while the latter is generally higher in dissolved minerals and low in organic matter.[2] To determine the mineral composition of water, beer brewers can ask reports from local water companies, send sample water to laboratories, or perform the tests by themselves using proper equipment. The common test parameters are explained below. Based on the results, brewers can make necessary water adjustments to make a great beer.

As water quality check in beer brewing process is a crucial step to achieve exceptional taste and quality of beer, the HORIBA LAQUAtwin pocket meters and LAQUA dissolved oxygen (DO) handheld meters and dissolved oxygen (DO) electrodes are recommended for beer brewers. Aside from their simple and easy operation, the LAQUAtwin pocket meters have unique flat sensors that can measure sample as low as 0.05 ml in just few seconds. The LAQUA DO handheld meters are packaged with DO electrodes, which have innovative replaceable DO tips and built-in temperature sensor, in carrying cases for routine measurements in the field.

Water Hardness

Water hardness is defined as the amount of dissolved calcium and magnesium in the water. Calcium is the principal ion that determines water hardness. It can overcome the buffering capacity of malt phosphates, lower the mash pH to acceptable range[3] and promote clarity, flavor, and stability in the finished beer.[2] The ideal calcium concentration in the brewing water is between 50 and 150 ppm.[3] Calcium sulfate ($CaSO_4$), also known as gypsum, or calcium chloride ($CaCl_2$) can be added to increase the amount of calcium ions in water. Magnesium also contributes to water hardness and therefore affects the mash pH, but to a lesser extent than the calcium.[2]

Alkalinity

Alkalinity is the capacity of water to resist changes in pH that would make the water more acidic. It is a measurement of the concentration of all alkaline substances dissolved in the water such as carbonates and bicarbonates which buffer pH in the

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Total Dissolved Solids (TDS)

Brewing water from municipal water sources may contain total dissolved solids (TDS) such as minerals, salts, and organic matter. TDS is an indicator of water quality and, as discussed above, mineral composition of water affects mash pH in brewing process. The recommended TDS level in water is 500ppm.[6] The amount of TDS in water can be estimated using a TDS meter, which measures the conductivity of solution and converts it to TDS using a factor. Although TDS does not specify the exact mineral composition of water, it can be used in monitoring any changes in the water.

Electrical Conductivity (EC)

Electrical conductivity (EC), often simply referred to as conductivity, is a measure of the ability of an aqueous solution to carry an electric current. Pure water has no conductivity (reading is not zero but very low) because there are no dissolved ions in it. The more ions in solution, the higher the conductivity value. Conductivity measurement of water source in beer brewing gives an indication of the water purity and the baseline measurement before brewer can make any adjustments, like addition of minerals.

Dissolved Oxygen (DO)

After boiling in the kettle, the hopped wort is devoid of oxygen. It is cooled down rapidly to below 80 °F (27 °C) before oxygenation for better oxygen uptake. The amount of dissolved oxygen required depends on the yeast strain and the original gravity of the wort. Traditional ale and lager worts were usually not collected higher than 1045 (12°P) and required 6 to 8 ppm dissolved oxygen. With high gravity brewing original gravities have increased up to 1080 (20°P) and require dissolved wort oxygen levels of 16 ppm or higher.[7] Modern strains of yeast can require as high as 20ppm DO. After oxygenation, yeast is pitched into the wort. Yeast utilizes oxygen to become healthy and to reproduce before fermenting the wort to beer. Oxygen is necessary to produce unsaturated fatty acids and sterols for yeast's cell walls. A strong cell wall enhances the yeast' alcohol tolerance. Healthy yeast metabolizes wort into alcohol and carbon dioxide without giving off-flavors or off-odors.[8] Once fermentation is complete, the beer is free from oxygen and must be protected from oxygen exposure to prevent oxidation and staling. It is almost impossible not to introduce oxygen during transfers and packaging (bottling and canning), but the amount should be insufficient for healthy yeast to grow.[7] Brewers should be capable of achieving less than 50 ppb (0.05ppm) total in package oxygen.

Potassium

Malt contains between 4-6 g/kg of potassium, the major part of which is solubilized during mashing; in beer the concentration of potassium lies between 300 – 500 ppm (mg/L). Above 500 ppm, beer can be salty. Potassium has a purely saline effect. The potassium/calcium ratio affects yeasts flocculation.[9]

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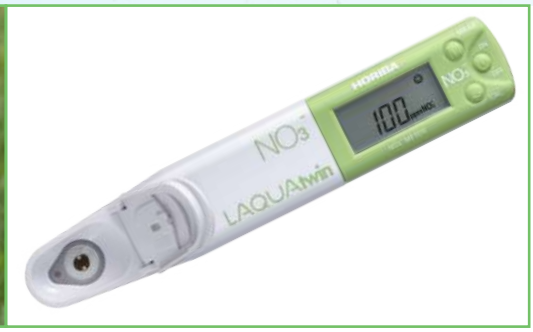
AGRICULTURA

Nitrate Measurement in Turf Grass

Nitrate concentration in grasses can be used as an indicator of soil nitrogen (N) availability for their growth. Research at the University of Connecticut suggests verdure sap nitrate-N concentrations at 200-300 ppm as the optimum level.



Introduction

Grasses store nitrogen (N) as nitrate in the bases of stems and shoots. Research conducted by Guillard and Morris (2013) at the University of Connecticut suggests that nitrate accumulate in the shoot bases of perennial turf grasses during the fall (when new leaf blade formation declines), which could be a significant source of N for the turf plant at the onset of new growth in the following spring after winter dormancy. At the optimum critical level of nitrate-N concentration and beyond, the turf response will plateau or flatten out – increasing the fall verdure nitrate-N concentrations with more fertilizer beyond the optimum critical level will not increase the grass quality in the fall or the following spring; the maximum quality response has been reached.

Pocket-sized LAQUA twin Nitrate Ion meter was used to measure nitrate-N concentrations in verdure sap. It eliminates the need to transport samples to a laboratory for expensive analysis performed using either colorimetry or chromatography by trained analyst.

Method

Calibrate the LAQUAtwin Nitrate Ion meter according to manufacturer's instructions.

Sample Collection And Preparation

1. Mow the turf to desired height and remove mowed clippings.
2. Collect verdure samples—aboveground parts of the turf plant remaining after clippings removed. A golf-ball sized, compressed verdure sample is usually sufficient to produce adequate sap for the test.
3. Squeeze the sap from the verdure sample using a hydraulic or garlic-type press.

Sample Measurement

1. Place some drops of the extracted sap directly into the sensor.
2. Record the reading once stabilized—☺ appears.
3. After each sample, rinse the sensor with water and blot it dry with tissue.

Collect verdure samples—aboveground parts of the turf plant remaining after clippings removed. A golf-ball sized, compressed verdure sample is usually sufficient to produce adequate sap for the test.

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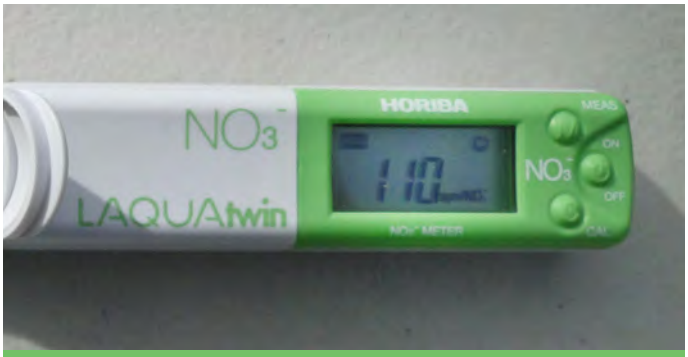
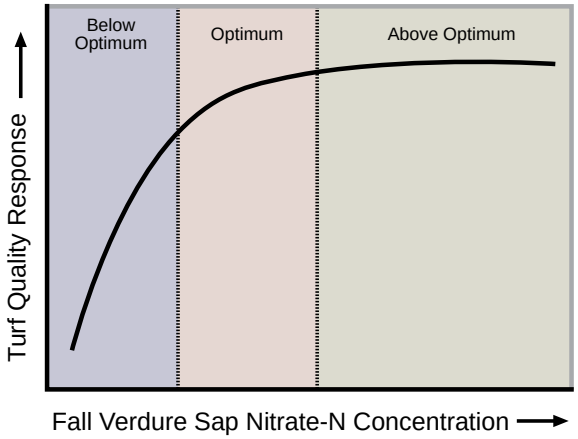
Continued from the front

Place some drops of the extracted sap directly into the sensor.



Record the reading once stabilized—☺ appears.



Results and Benefits

Research at the University of Connecticut suggests that no fertilizer is required in the fall if the verdure sap nitrate-N concentrations are 200-300 ppm or above during October through November in their climate (critical values were based on turf mowed to a height of 2¼ inches and test was conducted using Horiba's LAQUA twin Nitrate ion meter). If less than 200, it suggests that some nitrogen be applied to obtain optimum turf responses. When readings are between 100 to 200 ppm, 0.25 to 0.33 lbs N/1000ft2 can be considered. If readings are less than 100 ppm, then 0.33 to 0.50 lbs N/1000ft2 can be considered, provided that N is applied before the onset of winter.

REFERENCE
Guillard, Karl and Morris, Thomas. The Verdure Sap Nitrate Test To Guide Fall N Fertilization of Turf Sod. Sod Nutrient Management Technical Guide TG-0265-R1, June 2013
REV 0, 6 JULY 2015

Nitrate Ion Meter for crop B-741

Measurement range: 100~9,900 ppm (NO_3^-), 23~2,200 ppm (NO_3^--N)

[Accessories included]
- Standard solution for crops (300 ppm & 5000 ppm) (14 mL)
- 2 CR2032 batteries
- Instruction manual
- 5 Pipettes
- Cleaning solution bottle (250 mL)
- Crop sample press
- 3 Medical cups
- Quick manual
- Carrying case

LAQUAtwin Pocket Ion Meters Lineup

pH COND Na+ K+ NO3– Ca2+ Salt EC

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IMS
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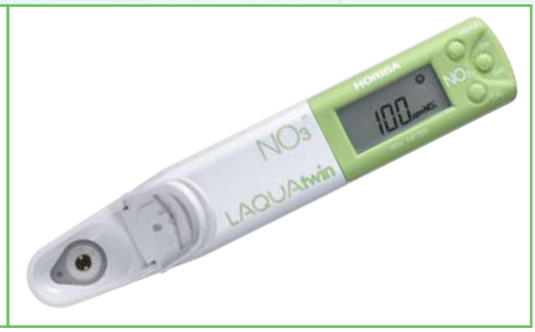
Rapid In-Field Determination of Nitrogen in Onions

Fresh root sap analysis with LAQUAtwin nitrate ion meter offers cost-effective, rapid and easy solution to determine nitrogen status in onion plants. The nitrate-nitrogen (NO_3-N) concentrations in onion vary at different growth stages. The acceptable root sap NO_3-N concentration range for 0.5 to 1.5-inch onion bulbs is 350 to 500 ppm.



02-2016

Introduction

Nitrogen is a nutrient taken up by plants in the form of ammonium and nitrate ions for their green leafy growth. When ammonium fertilizers are applied to plants, the ammonium is converted to nitrate by nitrification process. Also, organic matter broken down in soil is transformed into ammonium first and then eventually into nitrate. These circumstances result in more nitrate in soils. Thus nitrogen tests measure nitrate rather than ammonium.

Plant tissue such as leaf and petiole contain high levels of nitrate, which has been shown over many years to be a good indication of the nitrogen status of the plant. Testing laboratories analysing for nitrogen content of dry plant tissue usually require ample time for collecting, transporting, drying, grinding and analysis. They deliver results after several days. With modern technology, quick tests for determining the nitrogen content in plant tissue like handheld nitrate meters with ion selective electrode, chlorophyll meter, and nitrate test strips have been developed.

As a general rule for nitrate testing, twenty petioles of most recently fully expanded mature leaves from different plants in a field are required for a representative sample. However, with onions, roots are used to determine nitrate levels.[1]

The LAQUAtwin nitrate ion meter provides the easiest way to measure nitrate concentration in fresh plant sap. The sensor requires only few drops of sap, which can be quickly extracted using a garlic press. The meter analyses the sap in just few seconds and displays reading expressed as either nitrate (NO_3) or nitrate-nitrogen (NO_3-N) ppm units. Results can be obtained immediately in the field with much less effort and relatively low cost. These advantages over conventional laboratory testing are useful for onion growers in determining fertilization applications.

Method

Select mg/L or ppm NO_3-N in the LAQUAtwin nitrate ion meter set-up. Calibrate the meter according to manufacturer's instructions using the 150ppm and 2000ppm nitrate standards included in the kit. The readings of 150ppm and 2000ppm nitrate standards will be calibrated as 34 ppm and 450 ppm NO_3-N, respectively.

Sample Collection And Preparation

1. Collect root samples from 20-30 representative onion plants in the field. Use a small spade or other lifting tool to remove the plants.
2. Cut the roots from the bulbs and wash with distilled or deionized water to remove soil.
3. Blot the roots dry with a paper towel and mix them thoroughly.
4. Load a random sample of roots in a garlic press and squeeze the sap.
5. Place drops of sap onto the flat sensor until it is fully covered. Record the reading once it is stable.
6. After each use, rinse the sensor with distilled or deionized water and blot dry with soft tissue.

Continued at the back

Continued from the front

7. Repeat the procedure two or three times with the remaining sample if possible. Calculate the average of the readings of the samples.

It is best not to take readings in areas of direct sunlight or high temperatures. Collect samples and bring them indoor for analysis. Allow the samples and standards to reach same temperature before proceeding with the analysis.

Refer to Technical Tip 2: LAQUAtwin Ion Sensor Maintenance Procedures for detailed information on conditioning, cleaning, and storing the nitrate ion sensor. The technical tip can be downloaded from the support section of our website www.horiba-laqua.com.

Results and Benefits

Onion roots display the greatest response to available nitrogen supply of any plant part.[2] They are used in analysis because of the stable nitrate concentrations in the root xylem. The LAQUAtwin nitrate ion meter has been successfully used in determining nitrate-nitrogen (NO_3-N) in onions and readings have been found correlated with lab results.[3]

When sampling, it is important to note the onion growth stage so you can determine the correct sufficiency guideline to apply with your analysis results. Sufficiency guidelines are generally expressed as nitrate-nitrogen (NO_3-N) values. The NO_3-N refers to the nitrogen portion of the nitrate molecule. The table below provides the general guidelines for acceptable root sap nitrate concentrations at various stages of onion plant growth.[4] Notice that the nitrate concentrations decline as the plant matures. For 0.5 to 1.5-inch onion bulbs, the acceptable root sap NO_3-N concentration range is 350 to 500 ppm.[1] You may use the table in interpreting the LAQUAtwin nitrate ion meter results. Record the initial analysis results and use them to compare future results.

Table 1: General Sufficiency Guidelines for Onion Root Sap

Onion Stage of Growth	Acceptable Onion Root Sap Concentration	
	NO_3^- (ppm)	NO_3-N (ppm)
Up to 5 leaves	3400-4300	768-972
5 to 7 leaves	2600-3400	588-768
Bulb Initiation	1300-2150	294-486
Bulb Bulking	850-1700	192-384

ppm is parts per million, equivalent to mg/L

References and Suggested Readings

1. Hartz, T., Jackson L., Schulbach, K., and Smith, R. Guide to Nitrogen Quick-Tests for Vegetables with the Cardy Nitrate Meter. Retrieved from https://www.cdfa.ca.gov/is/docs/Schulbach95.pdf
2. Sullivan, D.M., Shock, C.C., Horneck, D.A., Stevens, R.G., Pelter, G.Q. and Feibert, E.B.G. (2001). Nutrient Management for Onions in the Pacific Northwest. PNW 546. Retrieved from https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw546.pdf
3. McDonald, M.R., McKeown, A.W., Scott-Dupree, C.D., and Westerveld, S.M. Assessment of Chlorophyll and Nitrate Meters as Nitrogen Tests for Cabbage, Onions, and Carrots. HorTechnology, April-June 2004, pp 179-188. Retrieved from http://horttech.ashspublications.org/content/14/2/179.full.pdf+html
4. Petiole Sap Nitrate Guidelines. Michigan State University Extension. Retrieved from http://msue.anr.msu.edu/news/petiole_sap_nitrate_guidelines
5. Bevacqua, R. and Cardenas, T. (2002). Nitrogen Monitoring Techniques for Vegetable Crops. Circular 579. College of Agriculture and Home Economics New Mexico State University. Retrieved from http://aces.nmsu.edu/pubs/_circulars/CR579.pdf

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HORIBA

LAQUAtwin K+

Application Note

Measurement of Potassium in Rice

LAQUAtwin is a series of pocket ION meters. Using Ion Selective Electrode (ISE) technology, they are available for measuring Conductivity, Calcium, Nitrate, Potassium, Sodium, Salt concentration and pH measurement. Using just a tiny amount of sample, the LAQUAtwin proprietary flat sensors can quickly and accurately measure the values of the chemical parameters in the field.

Introduction

Potassium is a necessary nutrient for soil in which rice grain is grown, as it is critical in maximising yield.

In order to profitably produce rice, reliable information regarding the potassium content of the soil must be available to farmers. Thus, we can analyse the potassium content of the plant tissue in the roots of the rice grain.

To determine the potassium content, the Horiba LAQUAtwin K+ ion meter can be used. This is an easy and quick method used to determine the potassium content of soil for the growth of rice crops.

Method

1. The above ground portion of the crop is separated from the root using shears.
2. The lower stem is washed of soil.
3. The stem is cut into 1 cm pieces.
4. The pieces of stem are frozen overnight
5. A frozen piece of stem is placed in a sap press to obtain the sap
6. A small sample of the sap is placed on the sensor of the LAQUAtwin K+ ion meter and the potassium content is measured after one minute.
7. To repeat sampling, wash the sensor with tap water and pat dry with a paper tissue.

Results and Benefits

The use of the Horiba LAQUAtwin K+ ion meter to measure the potassium content of soil around rice crops will improve farmers' knowledge of the potassium accumulation. Accordingly, farmers can fertilise their crops with optimal amounts of potassium.

The LAQUAtwin K+ ion meter is small and compact, and convenient to carry for easy on-site testing. Its easy-to-use interface is simple for anyone to use the LAQUAtwin K+ ion meter.

Average tissue K levels for rice plant parts at growth stages for K treatments, 2004.

Growth Stage	Plant Part	Tissue K %		
		0 lbs K/a	50 lbs K/a	200 lbs K/a
First tiller	Whole	2.53	2.99	2.62
Internode elongation	Whole	2.19	2.27	2.82
Internode elongation	Flag leaf	1.85	2.34	2.37
Internode elongation	Lowest leaf	1.62	1.99	2.24
Internode elongation	Stem	2.77	2.88	3.20
10% Heading	Whole	1.50	1.71	1.74
10% Heading	Flag leaf	1.60	1.56	1.73
10% Heading	Lowest leaf	1.45	1.39	1.37
10% Heading	Stem	1.47	1.28	1.49
10% Heading	Head	0.92	0.91	0.86

Dry matter and K uptake for K treatments at three rice growth stages, 2004

Growth stage	Pre-plant K treatment (lbs K/a)			Pre-plant K treatment (lbs K/a)		
	0	50	200	0	50	200
	…Dry matter (lbs/a)…			…K uptake (lbs K/a)…		
First tiller	131	154	220	3.5	4.5	5.7
Inter-node elongation	1770	2070	1853	33.1	44.7	52.8
100% heading	6734	7055	7660	101	120	131

David Dunn, Gene Stevens "Plant Mapping Potassium in Rice Tissue: What Part to Sample When?: Second Year (2004) Progress report" University of Missouri-Delta Center

Pocket ION Meter

LAQUAtwin

Unique Features

Calibrate and measure at the touch of a button—the smiley face will tell you when the result can be read.

Hassle-free automatic calibration with a few drops of standard solution reassures you of your measurement accuracy. Two-point calibration is also possible.*1

*1 Except for B-711

LAQUAtwin is fully waterproof and dustproof.

The meter and sensor are fully waterproof*3 and dustproof, so you can take it anywhere.

*3 IP67 rated. Will withstand immersion for 30 minutes at 1 m. Not suitable for underwater use.

LAQUAtwin: the only meters with flat sensor technology.

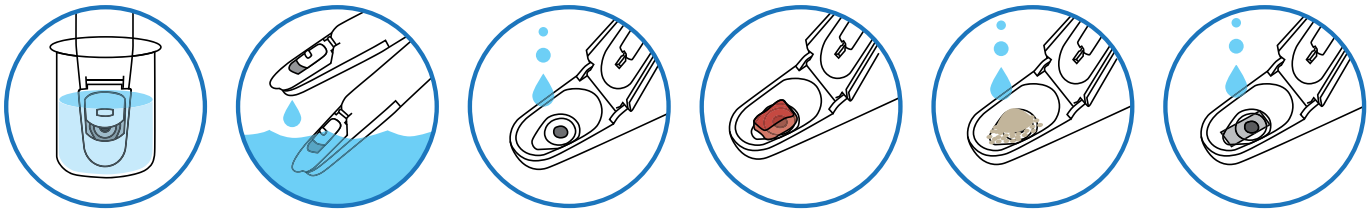
HORIBA's highly-sensitive, flat sensor technology opens up new possibilities for sampling and sample types. Only a small amount of sample is required, so you can easily sample in situ without the need for beakers or other labware. Sensors are easily replaced as required.

Carry case comes as standard for handy portability.

The compact carry case contains everything you need for your measurements, including the standard solution and sampling sheets.

1 X 6 One meter, six methods.

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



01 Immersion

When you're in the lab, you can test the sample in a breaker. Ensure the sensor guard sliding cap is open.

02 Scoop

Use as a scoop to test water eg from a river. A vertical scoop for an aquarium is also available with a unique sensor guard.

03 Drops

Place a drop of the sample onto the sensor with a pipette. Laquatwin meters can measure sample volume as low as 0.1mL

04 Solid Samples

Foods containing some moisture can be tested by placing a small piece directly onto the sensor.

05 Powders

Laquatwin meters can also test dry powders. Simply place the powder sample onto the sensor and drop on your defined volume of pure water.

06 Paper and textiles

To test sheets of paper and textiles, cut up the sample into small pieces and place directly onto the sensor. Drop on your defined volume of pure water.

Lineup

pH

Accurate pH measurements in a few seconds, from a single drop.

Water pH varies in different environments, and a slight change can often have a major effect.

Whether you need to keep the pH of an aquarium within tight limits, are checking for the acidity of rain water or for the quality of meat and fish products, LAQUAtwin compact pH meters are ideal for you. No matter where and when you need to test.

COND

Determine water conductivity with as little as 0.12 mL of sample.

The conductivity of rain water is a trusted guide to determining atmospheric purity. In agriculture, measuring the conductivity of soil allows farmers and agronomists to determine optimum fertilizer usage and check the 'health' of soil after salt water damage. The LAQUAtwin meter makes conductivity testing simple, anywhere.

Na+

Only compact meter for a quick and reliable measurement of sodium ion at the scene using ion selective membrane.

K+

Only compact meter for a quick and reliable measurement of potassium ion at the scene using ion selective membrane.

NO3–

Only compact meter for a quick and reliable measurement of nitrate ion at the scene. Special application packages for crop (B-741) and soil (B-742) are also available.

Ca2+

Only compact meter for a quick and reliable measurement of ionized calcium at the scene using ion selective membrane.

http://www.horiba.com/laquatwin

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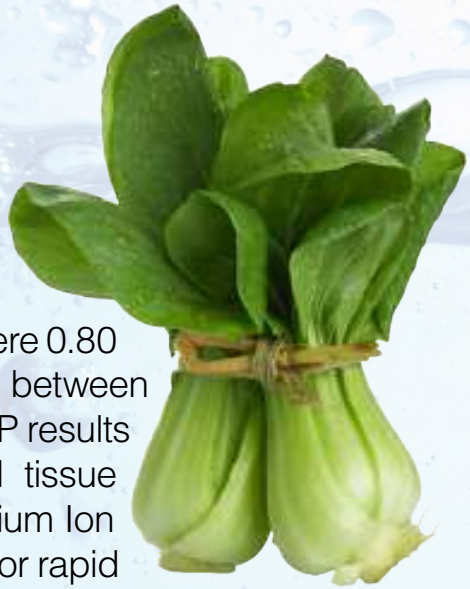
Potassium Determination In Plant Tissue



Comparison of LAQUAtwin Potassium Ion Meter and ICP Spectrometry

Trials revealed close significant correlation (r values were 0.80 and 0.93 for first trial and second trial respectively) between the LAQUAtwin Potassium Ion meter readings and ICP results obtained from plant's fresh petiole sap and dried tissue respectively. This suggested that LAQUAtwin Potassium Ion meter could be an appealing field method substitute for rapid determination of potassium concentration in plant.

04-2015

Introduction

Plant tissue analysis has been used for evaluating the nutritional status of vegetable crops. The conventional laboratory method for plant tissue analysis is Inductively Coupled Plasma (ICP) spectrometry, which requires a dried plant tissue to be subjected to either wet digestion or dry ashing prior to analysis. Among the recent techniques for nitrate-nitrogen (NO_3-N) and potassium (K) management in vegetable crops has been the use of petiole sap analysis to determine supplemental fertilizer needs.

The LAQUAtwin Potassium Ion meter was used to measure K concentration in fresh petiole sap of pak choi (Brassica rapa, Chinensis group) plants, which were grown, applied with K and other nutrients, and harvested at University of Hawaii's Magoon Research facility. The results were compared to K concentration in dried tissue of the same plant analysed by wet digestion and ICP.

The pocket-sized LAQUAtwin Potassium Ion meter is ideal for on-site testing as it provides quick result with just a few drops of sample that doesn't require tedious preparation. It eliminates the need to transport samples to a laboratory for costly and time-consuming ICP spectrometry analysis.

Method

Sample Collection And Preparation

For LAQUAtwin Potassium Ion meter analysis, plant's petioles were collected immediately after harvest at 5 weeks after emergence and fresh weights were recorded. Petioles were pressed in a garlic press to extract sap. One (1) ml of sap was diluted with deionized water to a volume of 5ml. After calibrating the LAQUAtwin Potassium Ion meter according to manufacturer's instructions, few drops of the diluted sap were placed into the sensor of LAQUAtwin Potassium Ion meter to determine the potassium concentration.

For ICP spectrometry analysis, plants were placed in a conventional oven at 70°C and were dried for 72hrs. The dried weights were recorded. The dried samples were submitted to a laboratory for ICP spectrometry analysis to determine the potassium concentration.

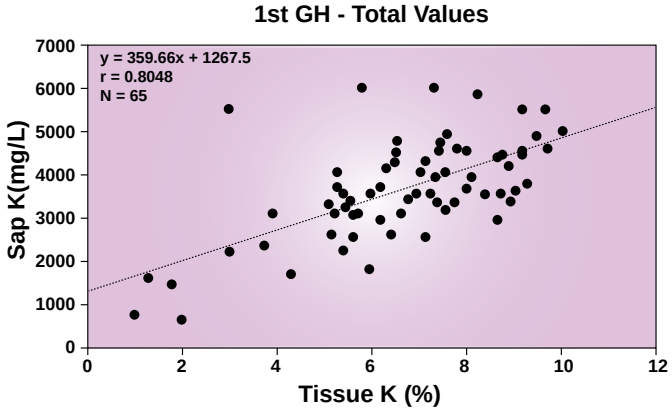


Figure 1: Relationship between K concentrations in fresh petiole sap and dried tissue of pak choi plant measured by LAQUAtwin Potassium Ion meter and ICP Spectrometry respectively for 1st greenhouse trial (n= 65)

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Continued from the front

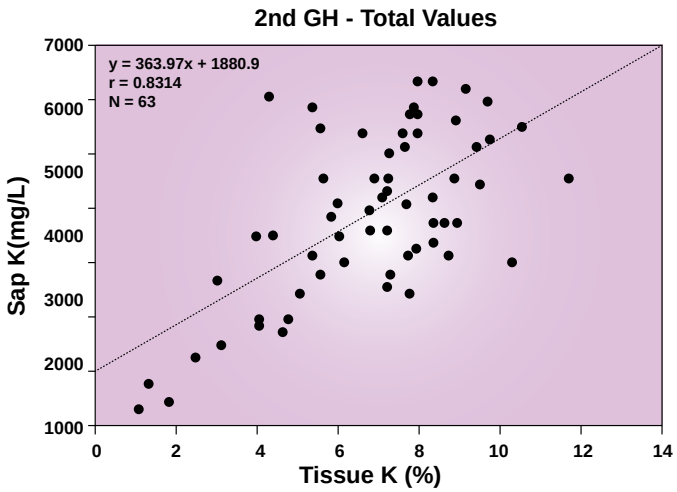

Figure 2: Relationship between K concentrations in fresh petiole sap and dried tissue of pak choi plant measured by LAQUAtwin Potassium Ion meter and ICP Spectrometry respectively for 2nd greenhouse trial (n= 63)

Results and Benefits

The K concentrations increased linearly in both the sap and dried tissue with increased amount of K applied (see figures 1 & 2) and the relationships were highly significant (P<0.0001). The correlation coefficient (r) was stronger between the LAQUAtwin Potassium Ion meter and ICP spectrometry results when totals of the replicates were used for correlation analysis – r values were 0.80 and 0.93 for first trial and second trial respectively. With these results, it was concluded that the LAQUAtwin Potassium Ion meter, which is easy to use and less expensive than standard laboratory analysis, is a valuable tool for onsite monitoring of plant's K status. It was also concluded that 4500-5000 mg K/L for fresh petiole sap and 7.5% tissue are critical levels for K concentration in pak choi plant.

Petiole Potassium Sufficiency Levels

(Source: University of Florida)

Crop	Growth Stage	K (ppm)
Tomato (field)	First Buds	3500-4000
	First Open Flowers	3500-4000
	First 1-inch Diameter	3000-3500
	First 2-inch Diameter	3000-3500
	First Harvest	2500-3000
	Second Harvest	2000-2500
Tomato (Greenhouse)	Transplant to second fruit cluster	4500-5000
	Second cluster to fifth fruit cluster	4000-5000
	Harvest Season (Dec.-June)	3500-4000
Bell Pepper	First Flower Buds	3200-3500
	First Open Flowers	3000-3200
	Fruits Half-Growth	3000-3200
	First Harvest	2400-3000
	Second Harvest	2000-2400
Eggplant	First Fruit (2-inches long)	4500-5000
	First Harvest	4000-4500
	Mid Harvest	3500-4000
Potatoes	Plants 8-inches Tall	4500-5000
	First Open Flowers	4000-5000
	50% of Flowers Open	4000-4500
	100% of Flowers Open	3500-4000
	Tops Falling Over	2500-3000

SUPPLEMENTARY INFORMATION

- Dilution – Undiluted sap can be analysed directly. However, sap for some crops has to be diluted to keep the determinations within the range of the calibrated standard curve. In another study conducted with LAQUAtwin Potassium Ion meter, it was found that sap diluted with water or 0.075M aluminum sulfate solution resulted in higher K recovery than undiluted one (Rosen et al). For testing sap diluted with 0.075M aluminum sulfate, 150ppm and 2000ppm K standard solutions with aluminum sulfate were prepared for calibration.
- Sap K Concentration - To determine K concentration of the undiluted sap, the meter reading obtained for the diluted sap should be multiplied by the dilution factor (final volume divided by original volume), which is '5' in the method described above. Alternatively, set the meter coefficient to 5.00 (default value=1.00). This meter feature eliminates manual computation for diluted or even concentrated sample by using a coefficient that can be set from 0.01-9.90. Refer to the Multiplying Compensation Setting of the meter's instruction manual.

References and suggested readings

1. Chandrappa Gangaiah, Amjad A. Ahmad, Nguyen V. Hue, and Theodore J.K. Radovich. Comparison of potassium (K+) status in pak choi (Brassica rapa Chinensis group) using rapid cardy meter sap test and ICP spectrometry. The Food Provider. May 2015
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REV 0, 18 AUGUST 2015

HORIBA

LAQUAtwin K+

Application Note

Measurement of potassium in soil

LAQUAtwin is a series of compact water quality testers. Using Ion Specific Electrode (ISE) technology, they are available for Conductivity, Calcium ion, Nitrate ion, Potassium ion, Sodium ion and pH measurement. Using just a single drop of sample, the LAQUAtwin proprietary flat sensors can quickly and accurately measure the values of the chemical parameters for quality check of food in production lines.

Introduction

Typically, Atomic Absorption (AA) or Inductivity Coupled Plasma-Optical Emission Spectrometry (ICP-OES) is used to measure potassium ion, by first extracting the potassium ion from sample soils by 1 mol/L ammonium acetate (CH3COONH4). These are the methods performed in laboratories.

A simpler method for a rapid measurement of potassium ion in soil uses the LAQUAtwin potassium ion meter B-731. The extraction method is the same as the lab method. The following procedure explains how you can measure K^+ with good correlation to analytical lab tests.

Method

1. Put 1g each of air-dried soils (four samples) in 100mL glass beakers, two beakers per soil sample.
2. Prepare two kinds of extraction per soil sample, one by adding 20 ml of 1mol/L CH_3COONH_4 to one beaker, and 20ml of 0.01mol/L CH_3COONH_4 to another beaker.
3. Shake the beakers around 1 hour to extract K^+ from the soil using a bench top shaker.
4. Calibrate LAQUAtwin B-731 with 150mg/L and 2000mg/L K^+ standard solutions included in the product.
5. Measure potassium ion concentration of the filtrated solution with calibrated B-731 and with ICP-OES (e.g. HORIBA Jobin Yvon. Model ULTIMA2).
6. Perform this measurement with 4 different samples.

Results and Benefits

The Laqua Twin B-731 allows for a simple on site determination of potassium which provides accuracy close to laboratory techniques.

[1]Table 1 shows the results from ICP-OES and LAQUAtwin K^+ extracted with 1 mol/L and 0.01 mol/L CH_3COONH_4.

[1] Internal study by HORIBA labs, 2013

*Extraction efficiencies will vary amongst soil samples.

Table [1]: K^+ concentrations measured by ICP-OES and LAQUAtwin exctracted with 1 mol/L CH_3COONH_4 and 0.01 mol/L CH_3COONH_4.

(Unit : mg/L)

Kind of soil	Extracted by the use of 1 mol/L CH_3COONH_4		Extracted by the use of 0.01 mol/L CH_3COONH_4	
	ICP-OES	LAQUAtwin K^+	ICP-OES	LAQUAtwin K^+
For vegetables (in house)	35	120	27	25
For Chinese cabbage (field)	16	76	14	14
For turnip leaf (Komatsuna)(field)	25	130	18	19
For potherb mustard (field)	21	93	17	16

Based on table 1, higher value against ICP-OES is detected by LAQUAtwin K^+ with 1 mol/L CH_3COONH_4 extraction, due to strong interference by NH+ of CH_3COONH_4. However, with 0.01 mol/L CH_3COONH_4 extraction, although the extraction efficiency is reduced by approximately 80%* (Figure 1), very good correlation (R=0.981, R2=0.962) is obtained between ICP-OES and LAQUAtwin (Figure 2).

Figure 1 shows the potassium extraction efficiency measured with ICP-OES. Setting 1 mol/L CH_3COONH_4 extraction as 100%, efficiency trend is plotted depending on different CH_3COONH_4 concentration.

Figure 2 shows the correlation between ICP-OES and LAQUAtwin K^+ measurements with 0.01 mol/L CH_3COONH_4 extraction.

Fig. 1 : Variation of extraction efficiency with CH_3COONH_4 concentration.

*Extraction efficiencies will vary amongst soil samples.

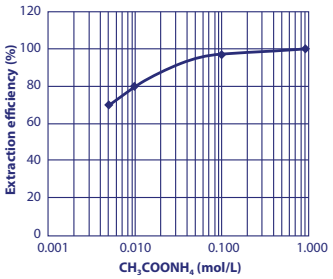
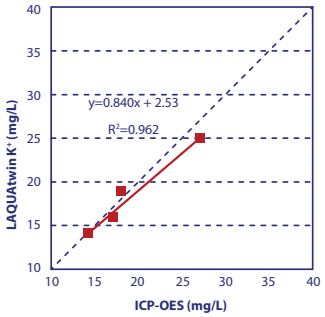


Fig. 2 : Relation between measured values of K^+ (mol/L) by ICP-OES and by LAQUAtwin.



Pocket ION Meter

LAQUAtwin

Unique Features

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Hassle-free automatic calibration with a few drops of standard solution reassures you of your measurement accuracy. Two-point calibration is also possible.*1

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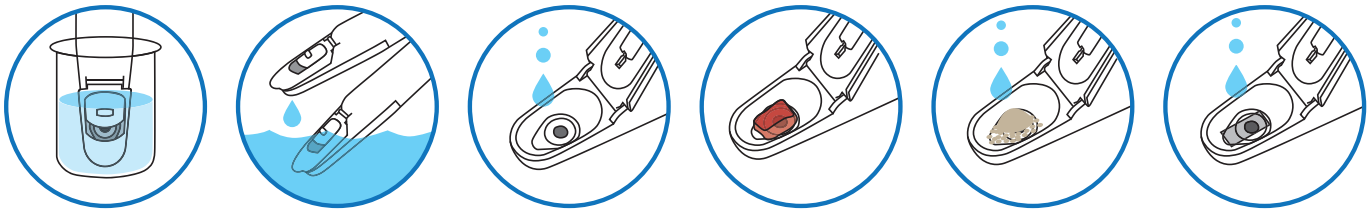

01 Immersion

When you're in the lab, you can test the sample in a breaker. Ensure the sensor guard sliding cap is open.

02 Scoop

Use as a scoop to test water eg from a river. A vertical scoop for an aquarium is also available with a unique sensor guard.

03 Drops

Place a drop of the sample onto the sensor with a pipette. Laquatwin meters can measure sample volume as low as 0.1mL

04 Solid Samples

Foods containing some moisture can be tested by placing a small piece directly onto the sensor.

05 Powders

Laquatwin meters can also test dry powders. Simply place the powder sample onto the sensor and drop on your defined volume of pure water.

06 Paper and textiles

To test sheets of paper and textiles, cut up the sample into small pieces and place directly onto the sensor. Drop on your defined volume of pure water.

Lineup

pH

Accurate pH measurements in a few seconds, from a single drop.

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Whether you need to keep the pH of an aquarium within tight limits, are checking for the acidity of rain water or for the quality of meat and fish products, LAQUAtwin compact pH meters are ideal for you. No matter where and when you need to test.

COND

Determine water conductivity with as little as 0.12 mL of sample.

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K+

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NO3–

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Only compact meter for a quick and reliable measurement of ionized calcium at the scene using ion selective membrane.

http://www.horiba.com/laquatwin

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CE RoHS COMPLIANT

HORIBA

LAQUAtwin Ca^{2+}

Application Note

Measurement Of Calcium In Soil

LAQUAtwin is a series of pocket ION meters. Using Ion Selective Electrode (ISE) technology, they are available for measuring Conductivity, Calcium, Nitrate, Potassium, Sodium, Salt concentration and pH measurement. Using just a tiny amount of sample, the LAQUAtwin proprietary flat sensors can quickly and accurately measure the values of the chemical parameters in the field.

Introduction

All plants need calcium rich soil to grow. The calcium is used by the plant in developing the plant cell walls and membranes. Furthermore, it is a non-leaching mineral (it will stay in the soil) and will improve water penetrability and reduce soil salinity. It is thus helpful to determine the amount of calcium contained in soil. Generally, Atomic Absorption Instruments (AA) or Inductivity Coupled Plasma-Optical Emission Spectrometry Instruments (ICP-OES) are used to measure the amount of calcium ions present in soil. An easier method involves extracting the calcium ion from sample soils with 1 mol/L ammonium acetate (CH_3COONH_4), and then by using the handy and affordable LAQUAtwin calcium ion meter B-751.
The LAQUAtwin Ca2+ meter is used as a quick check to determine the Calcium content of soil.

Method

1. Dry the soil for about a week, and sift it using a 2mm diameter net sieve.
2. Place 1g of test soil in 100mL glass beaker and add the 20 mL of 1mol/L CH_3COONH_4 to the beakers.
3. Shake the beakers (amplitude 40m/min, speed 250 rpm) for 1 hour to extract Ca2+ from the soil using a laboratory shaker (Recipro Shaker SR-IIW made by Taiyo Kagaku Kogyo Company of Japan).
4. Filter the liquid through JIS No.6 filter paper.
5. Calibrate LAQUAtwin B-751 with 150mg/L and 2000mg/L Ca2+ standard solutions which contain the same concentration of CH_3COONH_4 as in the filtered samples. (Do not use the standard solutions packed with the instrument)
6. A small sample of the filtered solution is placed on the sensor of the LAQUAtwin Ca2+ and measured. To repeat sampling, wash with tap water and pat dry with a paper tissue.

Results and Benefits

The use of accurate Calcium ion testing in controlling the calcium content of soil ensures that the plants which are grown in the soil are given the necessary minerals and can easily absorb water. The table below shows that the results given by the LAQUAtwin Ca2+ pocket meter are comparable to those from Inductivity Coupled Plasma-Optical Emission Spectrometry Instruments (ICP-OES).

Soil types	Measured Ca2+ concentration (mg/L)		CaO converted values (mg/100g of air-dried soil)	
	ICP-OES	LAQUAtwin B-751	ICP-OES	LAQUAtwin B-751
For bell pepper	130	140	360	390
For tomato	110	120	310	340
For spinach	82	88	230	240
For lettuce	88	97	240	270
For kale	59	68	160	190

The LAQUAtwin Ca2+ pocket meter is small and compact; convenient to carry around in your pocket for quick on-site testing. Its easy-to-use interface is simple for anyone to use the LAQUATwin Ca2+ pocket meter.

Pocket ION Meter

LAQUAtwin

Unique Features

Calibrate and measure at the touch of a button—the smiley face will tell you when the result can be read.

Hassle-free automatic calibration with a few drops of standard solution reassures you of your measurement accuracy. Two-point calibration is also possible.*1

*1 Except for B-711

LAQUAtwin is fully waterproof and dustproof.

The meter and sensor are fully waterproof*3 and dustproof, so you can take it anywhere.

*3 IP67 rated. Will withstand immersion for 30 minutes at 1 m. Not suitable for underwater use.

LAQUAtwin: the only meters with flat sensor technology.

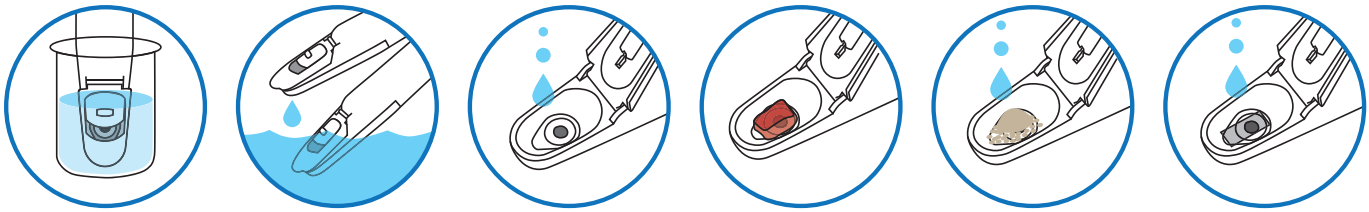
HORIBA's highly-sensitive, flat sensor technology opens up new possibilities for sampling and sample types. Only a small amount of sample is required, so you can easily sample in situ without the need for beakers or other labware. Sensors are easily replaced as required.

Carry case comes as standard for handy portability.

The compact carry case contains everything you need for your measurements, including the standard solution and sampling sheets.

1 X 6 One meter, six methods.

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



01 Immersion

When you're in the lab, you can test the sample in a breaker. Ensure the sensor guard sliding cap is open.

02 Scoop

Use as a scoop to test water eg from a river. A vertical scoop for an aquarium is also available with a unique sensor guard.

03 Drops

Place a drop of the sample onto the sensor with a pipette. Laquatwin meters can measure sample volume as low as 0.1mL

04 Solid Samples

Foods containing some moisture can be tested by placing a small piece directly onto the sensor.

05 Powders

Laquatwin meters can also test dry powders. Simply place the powder sample onto the sensor and drop on your defined volume of pure water.

06 Paper and textiles

To test sheets of paper and textiles, cut up the sample into small pieces and place directly onto the sensor. Drop on your defined volume of pure water.

Lineup

pH

Accurate pH measurements in a few seconds, from a single drop.

Water pH varies in different environments, and a slight change can often have a major effect.

Whether you need to keep the pH of an aquarium within tight limits, are checking for the acidity of rain water or for the quality of meat and fish products, LAQUAtwin compact pH meters are ideal for you. No matter where and when you need to test.

COND

Determine water conductivity with as little as 0.12 mL of sample.

The conductivity of rain water is a trusted guide to determining atmospheric purity. In agriculture, measuring the conductivity of soil allows farmers and agronomists to determine optimum fertilizer usage and check the 'health' of soil after salt water damage. The LAQUAtwin meter makes conductivity testing simple, anywhere.

Na+

Only compact meter for a quick and reliable measurement of sodium ion at the scene using ion selective membrane.

K+

Only compact meter for a quick and reliable measurement of potassium ion at the scene using ion selective membrane.

NO3–

Only compact meter for a quick and reliable measurement of nitrate ion at the scene. Special application packages for crop (B-741) and soil (B-742) are also available.

Ca2+

Only compact meter for a quick and reliable measurement of ionized calcium at the scene using ion selective membrane.

http://www.horiba.com/laquatwin

IMS

HORIBA Group is operating Integrated Management System (IMS)
ISO9001 JOA-0298 / ISO14001 JOA-E-90039 / ISO13485 JOA-MD0010 / OHSAS18001 JOA-OH0068

CE RoHS COMPLIANT

HORIBA

LAQUAtwin Na+

Nota de aplicación

Salinidad del suelo y impacto sobre la producción de caña de azúcar

LAQUAtwin es un rango de medidores de bolsillo de electroquímica. Los medidores de iones usan un electrodo selectivo, para medir el potasio, el calcio, los nitratos y el sodio este rango también incluye medidores de pH y de conductividad. Con tan solo una gota de muestra, el sensor plano LAQUAtwin mide rápidamente y con precisión las concentraciones de parámetros químicos en el campo o en laboratorio.

Introducción

La caña de azúcar es una fuente importante de azúcar utilizada en la industria alimentaria. El crecimiento de los cultivos de caña de azúcar está afectado negativamente por la salinidad del suelo. Por lo tanto, es necesario determinar la concentración de sodio de los suelos en zonas donde se están cultivando las plantas de caña de azúcar.

El sodio es un mineral generalmente presente en el suelo, pero un exceso su concentración puede actúa como un factor limitante por el rendimiento del crecimiento de la caña de azúcar. Por esta razón, es útil de medir la salinidad del suelo sobre el que se cultivan cultivos de caña de azúcar.

Se puede utilizar el medidor HORIBA LAQUAtwin Na+ para determinar el contenido de sodio en el suelo. Este medidor representa un método fácil y rápido para controlar la concentración de sodio en suelo.

Método

El sodio es soluble en agua, toma una muestra 1g de suelo y mezclarla con 4g de agua tibia y mesclar la solución de suelo.

Después de 5 minutos, las partículas en suspensión se sedimentan para producir la muestra de agua salada del suelo.

Una pequeña muestra se puede extraer con una pipeta.

Pone la muestra de solución de suelo el sensor del medidor LAQUAtwin Na+ y asegurarse de cubrir todo el sensor para medir la concentración de sodio después de un minuto el

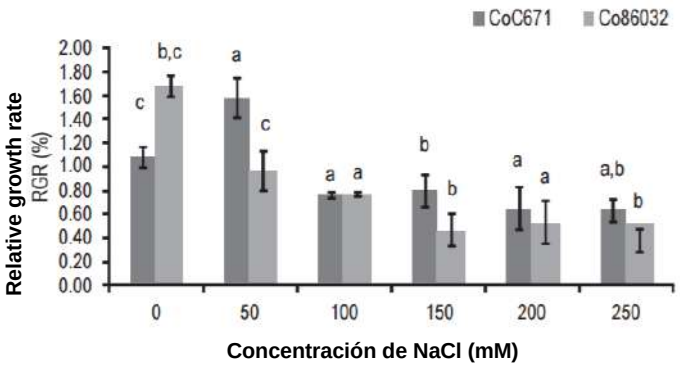
Para repetir la medición, lava el sensor con agua del grifo y secar con un pañuelo de papel.

Resultado y Beneficios

El uso del medidor de HORIBA LAQUAtwin Na+ para medir la concentración de sodio del suelo mejorará el conocimiento de los productores para escoger la mejor tierra para el cultivo de caña de azúcar y por lo tanto permitir un rendimiento optimizado de los agricultores.

El medidor LAQUAtwin Na+ es pequeño y compacto; cómodo para llevar en el bolsillo para facilitar las pruebas en cualquier lugar. Su interfaz sencilla a usar hace de este equipo una herramienta accesible a cualquier persona.

Impacto del NaCl sobre la repuesta fisiológica y bioquímica de la caña de azúcar



Medidor de bolsillo

LAQUAtwin

Características únicas

Realice calibraciones y mediciones con tan solo pulsar un botón; le indicará que ya puede leer el resultado.

La sencilla calibración automática con tan solo unas gotas de solución de calibración, le garantiza la exactitud de la medición. También se puede realizar la calibración en dos puntos y hasta 3 y 5 puntos con los modelos pH33 y EC33.

LAQUAtwin es totalmente a prueba de agua y polvo.

El medidor y el sensor son totalmente resistentes al agua y al polvo, por lo que puede llevarlo donde quiera.

1 IP67: no da errores al sumergirse en agua a una profundidad de un metro durante treinta minutos. Sin embargo, el producto no puede usarse bajo el agua

LAQUAtwin: Tecnología única de sensor plano ISE y pH

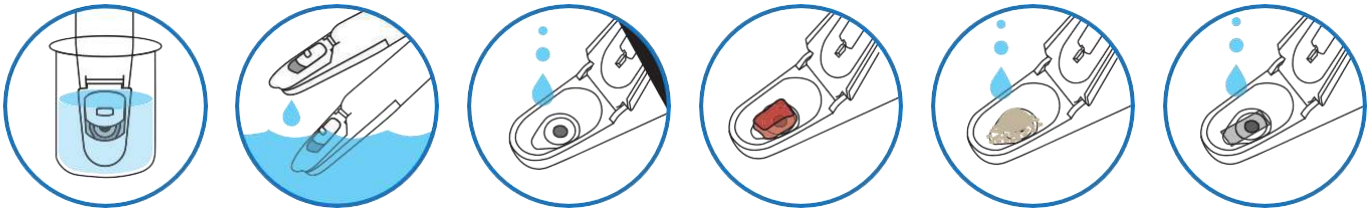
La tecnología HORIBA de sensor plano de alta sensibilidad abre nuevas posibilidades para medir diferente tipos de muestras. Puede hacer una medición a partir de un volumen de 0.1 ml y no necesita vaso para calibrar o medir, solo punga unas gotas directamente en el sensor.

Incluye un estuche para transportarlo de forma práctica.

El estuche compacto contiene todo lo que necesita para las mediciones, incluyendo las soluciones de calibración y una pipeta de plástico.

1 X 6 Un medidor, seis métodos de medición

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



1 Inmersión

Cuando se encuentre en un laboratorio, puede analizar la muestra en un vaso de precipitados. Asegúrese que la tapa deslizante que protege el sensor esté abierta.

2 Muestreo

Utilícelo como una pala para analizar el agua, por ejemplo, de un río.

3 Gotas

Los medidores LAQUAtwin pueden medir volúmenes de muestra de tan solo 0.1ml. Coloque una gota de la muestra en el sensor con una pipeta.

4 Muestras sólidas

Los alimentos que contengan cierta humedad pueden analizarse si coloca un trozo pequeño directamente en el sensor.

5 Polvos

Los medidores LAQUAtwin también pueden analizar polvos secos. Simplemente, coloque la muestra de polvo en el sensor y versa encima el volumen definido de agua desionizada.

6 Papel y tejidos

Si desea analizar hojas de papel y tejidos, corte la muestra en trozos pequeños y colóquelo directamente en el sensor. Versa encima un volumen definido de agua desionizada.

Rango

pH

Medición precisa de pH directamente a partir de una sola gota. El pH del agua varía en función al ambiente y un ligero cambio a menudo puede tener un gran impacto. Tanto si debe mantener el pH de un acuario dentro de niveles estrictos, comprobar la acidez del agua de lluvia o la calidad de producto alimenticio (carnes, pescados…), los medidores de pH de bolsillo LAQUAtwin son la solución perfecta. No importa dónde o cuándo debe realizar un análisis.

COND

Determine la conductividad con tan solo una muestra de 0.12 ml. La conductividad del agua de lluvia es una referencia fiable para determinar la pureza atmosférica. En agricultura, la medición de la conductividad del suelo permite a los agricultores establecer el uso óptimo de fertilizantes y comprobar la «salud» del suelo tras el daño provocado por el agua salada. Los medidores de conductividad LAQUAtwin hace que el análisis de la conductividad sea una tarea sencilla que se puede realizar en

Na+

Único medidor de bolsillo para medir rápidamente y con precisión el sodio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 23 a 2300 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

K+

Único medidor de bolsillo para medir rápidamente y con precisión el potasio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 39 a 3900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

NO3–

Único medidor de bolsillo para medir rápidamente y con precisión el nitrato con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 30 a 9900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

Ca2+

Único medidor de bolsillo para medir rápidamente y con precisión el calcio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 40 a 4000 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

CE RoHS

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JOA-MD0010 / OHSAS18001 JOA-OH0068

Soil Salinity Measurement in Almond Orchard

Crops have different levels of tolerance to salinity. Testing soil salinity is the best way to check soil condition in the orchard before salt damage occurs. The $EC_{1:5}$ test is used to estimate soil salinity (EC_e). The soil salinity threshold value for almond is 1.5 mS/cm.

Introduction

Soils with high concentration of salts can induce salinity stress and restrict the growth of salt-sensitive plants. Among the factors that can cause salinity stress (See Figure 1), toxicity of ions, usually sodium (Na), chloride (Cl), and boron (B), is the most common that result in leaf tissue damage. In the orchard, the most typical salt damage observed is "leaf-tip burn" (See Figure 2) and the best way to prevent it is by monitoring the soil salinity. The advantage of soil salinity monitoring is remedial action can be performed on soil before symptoms on leaf tissue appear. Annual testing of soil samples from selected locations in the orchard should be part of every growers' management program.

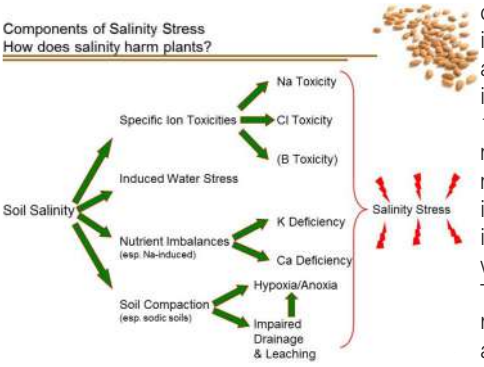

Figure 1: Components of Salinity Stress
Source: Rosenzweig, B. (2016). Soil Salinity Management.

Figure 2: Leaf-tip Burn in Almond Orchard
Source: Rosenzweig, B. (2016). Soil Salinity Management.

Electrical conductivity (EC) is the method used to measure soil salinity, which is influenced by the concentration and composition of dissolved salts. Salts increase the ability of a solution to conduct an electrical current, so a high EC value indicates high salinity. The LAQUAtwin EC 11, 22 and 33 conductivity pocket meters measure electrical conductivity in drops or micro-volume samples and display reading in just few seconds. The replaceable sensor is made of two flat titanium metals coated with platinum black that resist corrosion. The meters are programmed with standard recognition function for automatic calibration and automatic temperature compensation (ATC) function for accurate measurement.

Based on the Australian Soil Fertility Manual published by Commonwealth Scientific and Industrial Research Organization (CSIRO), sodium chloride (NaCl) is the major offender in the development of saline soils in Australia. The LAQUAtwin Salt 11 pocket meter can be used to measure NaCl concentration in soils. The meter measures the conductivity of the sample and converts it to salinity reading in either parts per thousand (g/L) or percentage (%) unit.

Method

A. Soil Sample Collection

Select representative sites in the orchard for routine sampling.

Drip Irrigated Orchards

Collect double handful of soil from two locations—20cm from the dripper and on the edge of the wetted area ~ approx. 60cm from the dripper. Soil should be drawn from two or three depths in the root zone—every 30cm down to 1m. Place soil sample from each depth/ location in a bag for analysis.

Continued at the back

Continued from the front

Sprinkler Irrigated Orchards

The sampling is similar to that of drip irrigated orchards, except three locations are sampled—2meters of a sprinkler, 1/3 distance between sprinklers on a diagonal, and middle of the sprinkler pattern. If the irrigation system has a designed and measured distribution uniformity of ≥ 80% or salinity results from 2 or more years indicate there is no variation by location, then the number of locations could be decreased.

B. Soil Salinity Measurement

1. Allow the soil sample to dry by leaving the sample bag or container open for at least a day. It can be oven-dried on a tray in a cool oven.
2. Crush dried sample with a mortar and pestle, rolling pin or hammer so there are no large aggregates (clods of soil 2mm or larger). Remove any foreign matter, plant matter, and stones from the sample.
3. Add 1 part soil for every 5 parts distilled or deionized (DI) water. For example, mix 50g soil and 250ml DI water in a container.
4. Shake the container for 3 minutes to dissolve the salts. For clay loams and clay soils, more shaking (for 1 minute every 3 minutes, repeat 3 times) will dissolve more salts and increase the accuracy of the test.
5. While allowing the solution to settle for a minute before testing, calibrate the LAQUAtwin EC 11, 22 or 33 pocket meter with 1413µS/cm and 12.88mS/cm conductivity standards included in the kit. Rinse the conductivity sensor with DI water and blot dry with soft tissue between standards and after calibration.
6. Immerse the conductivity sensor in the solution (without touching the soil in the bottom of the container) and record the $EC_{1:5}$ reading once it has stabilized. Alternatively, place drops of solution onto the sensor using the pipette included in the kit.
7. Rinse the conductivity sensor with DI water and blot dry with soft tissue.
8. Convert the $EC_{1:5}$ reading to actual soil salinity (EC_e) by multiplying the value by the conversion factor based on the texture of the soil sample (Refer to Table 1 below).

Table 1: $EC_{1:5}$ to EC_e Conversion Factors

Soil Texture	Multiplication Factor
Sands	17
Sandy Loams	13.8
Loams	9.5
Clay Loams & Light Clays	8.6
Medium & Heavy Clays	7

Note: These factors are calibrated for southern NSW (AU) soils
Source: Gibbs, S. (2000).Salinity Notes: How to Texture Soils & Test for Salinity.

Results and Benefits

Monitoring soil salinity can help identify the current soil conditions, predict problems, and establish baseline for management decisions. Crops have different levels of tolerance to salinity. The soil salinity threshold value for almond is 1.5 mS/cm. Table 2 below shows the salt tolerance data for selected crops.

Soil salinity derived from electrical conductivity (EC) measurements in the field or laboratory are often reported with subscript abbreviations to indicate the origin of the sample tested and the method used to determine the salinity. Common abbreviations and their descriptions are explained below.

- $EC_{1:5}$ – test used to estimate soil salinity (EC_e). It is determined by mixing 1 part soil with 5 parts DI water. After mixing the sample and allowing the sediments to settle, the electrical conductivity of the solution is tested.
- EC_e – the estimated amount of salt in the soil. EC_e = $EC_{1:5}$ x conversion factor (based on soil texture)
- EC_{se} – the electrical conductivity of a saturated soil extract, which should be conducted by a National Association of Testing Authorities, Australia (NATA) accredited laboratory. $EC_{se} = EC_e$

A soil salinity test gives an indication on the soil conditions around the plant roots, taking into account the influence of soil texture. Texture is an estimate of the relative amounts of sand, silt, and clay particles in a soil. It affects fertility, water holding capacity, internal drainage, irrigation scheduling, and soil workability for tillage. Soil texture usually changes with depth. To guide you identify soil texture, refer to *Salinity Notes: How to Texture Soils & Test for Salinity by Simon Gibbs*.

Table 2: Salt Tolerance Data for Selected Crops

Crop	Soil Salinity EC_{se} (mS/cm)*			
	0% Yield Loss	10% Yield Loss	25% Yield Loss	50% Yield Loss
Almond	1.5	2.0	2.8	4.1
Avocado	1.3	1.8	2.5	3.7
Citrus	1.7	2.3	3.3	4.8
Date Palm	4.0	6.8	11.0	18.0
Lucerne	2.0	3.4	5.4	8.8
Olive	2.7	3.8	5.5	8.4
Onion	1.2	1.8	2.8	4.3
Pistachio	4.0	4.5	5.0	6.0
Pomefruit	1.7	2.3	3.3	4.8
Potato	1.7	2.5	3.8	5.9
Stonefruit	1.7	2.2	2.9	4.1
Tomato	2.5	3.5	5.0	7.6
Vine	1.5	2.5	4.1	6.7
Beans	1.0	1.5	2.3	3.6
Eggplant	1.1	2.5	4.7	8.3
Cucumber	2.5	3.3	4.4	6.3
Capsicum	1.5	2.2	3.3	5.0

*Equivalent to dS/m
Source: Irrigation Management Training. Measuring Soil Salinity.

References and Suggested Readings

1. Rosenzweig, B. (2016). Soil Salinity Management. Available at https://growing.australianalmonds.com.au/2016/02/28soil-salinity-management/ (Accessed 30 December 2016).
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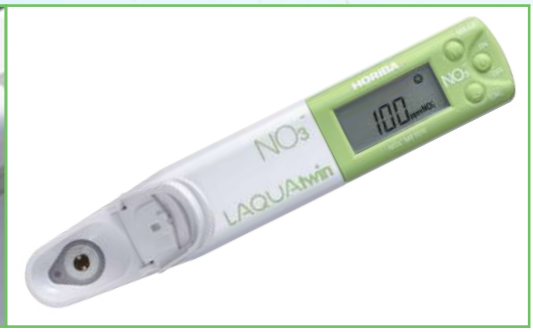
Revision 1.0, 23 January 2017

Medición de nitrato en suelo para determinar el Nitrógeno disponible para la planta.

La concentración de nitrato en suelo es un buen indicador de la cuantidad de nitrógeno disponible para el cultivo. Los requerimientos en Nitrógeno (NO3-N) cambia por cada tipo de cultivo, pero en general una concentración entre 10 y50 mg/kg considerada como óptima.



Introducción

Los análisis de suelo han hecho usado por mucho tiempo para determinar las concentraciones de nutrientes disponibles para las plantas. Nitrógeno es uno de los nutrientes esencial, que se convierte aminoácidos y luego permite la producción de enzimas y parte estructural de la planta.

El medidor de Nitrato LAQUAtwin NO3-11 puede ser usado para determinar la concentración de Nitrógeno (NO3-N) en muestra de suelo. Es un equipo de bolsillo fácil a usar que entrega resultados inmediatos en campo, lo que permiten eliminar el envió de la muestra a laboratorios y también el tiempo de entrega de los resultados que es de dos semanas en promedio.

Método

Colección y preparación de las muestras

1. Tome una muestra de suelo seco y pásala en un tamiz de 2 mm
2. Prepare la solución de suelo mezclando el suelo con agua en ratio 1:5 (ejemplo: 5 g de suelo y 25 ml de agua). Mezclar por un minuto y deje la muestra reposarse por 5 minutos o realizar una filtración directamente después de la mezcla.

Calibración

Calibrar el medidor de nitrato LAQUAtwin usando las dos soluciones de calibración. Asegúrese de configurar el equipo por que entrega los resultados en mg/l o ppm Nitrógeno (NO3-N).

Medición de las muestras

1. Mide el agua usada por la dilución
2. Nota el valor y tómelo como el valor blanco.
3. Enjuagar el sensor con agua destilada y secarlo con un papel absorbente
4. Usa unas gotas de la parte superior de la solución de suelo y del líquido filtrado
5. Nota el valor cuando está estable
6. Enjuagar y luego secar el sensor con agua entre cada medición

Tome una muestra de suelo seco y pásala en un tamiz de 2 mm

Resultados y beneficios

Para obtener resultados en NO3-N en mg/kg en suelo, usa la formula siguiente: NO3-N mg/kg = resultado de la medición de la solución de suelo de NO3-N en ppm (o mg/L) x 5. Si se usa una diferente ratio de dilución tendría que cambiar el “5”.

El Nitrato exprimido en Nitrógeno (NO3-N) representa la cuantidad de Nitrógeno disponible en el suelo que puede ser absorbido inmediatamente por el cultivo. El valor optimo depende de cada tipo de cultivo, pero en general en valor no tiene que ser más bajo que 10 mg/kg y no debe pasar más de 50 mg/kg. Sin embargo, el nitrato puede cambiar con el agua del suelo de esta manara las concentraciones pueden fluctuar en función del movimiento del agua en el suelo.

Nitrógeno NO3-N (mg/kg)

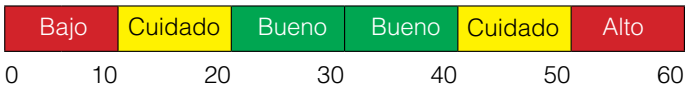


Figure 1: Guide to the interpretation of nitrate-nitrogen values for soils (Source: Soil health for vegetable production in Australia—Part 4)

Para determinar la cuantidad de nitrógeno en fertilizante para llegar a los requisitos nutricional del cultivo, la concentración de NO3-N medida en cultivo se sustrae de la concentración óptima para el cultivo.

Información adiciónale

- **Suelo** – Muestra humedad necesita que ser secada con secador de cabello o por el sol si el suelo se deja en el sol. Eso permite de eliminar el efecto de la humedad del suelo que puede diluir la concentración de nitrógeno. Muestra con mucho barro tiene que ser machucada.
- **Agua** - Agua o soluciones de sales diluidos puede ser usadas para extraer el nitrato la la mayoría de los suelos porque básicamente todos los nitratos del suelo con baja capacidad de intercambio de anión son solubles en agua. El principal límite del agua es su bajo fuerza iónica que puede causar resultado irregular en filtrado con suspensión. También usar extractante que contiene cloruro puede generar interferencia por las muestras medidas por cromatografía iónica y electrodo selectivo de ion (ISE). Sulfato de amonio (NH4)2SO4 es el extractante recomendado por las mediciones de nitrato con electrodo ISE (Griffin et al., 1995).
- **Soluciones de calibración** – Para verificar las concentraciones de NO_3-N. Las dos soluciones incluidas con el medidor permiten calibrar el medidor por concentraciones de NO3-N a 34 y 450 ppm.
- **Unidad de medición** – El medidor de nitrato puede ser configurado para medir en mg/L o ppm de Nitrato (NO3-) o Nitrato exprimido en Nitrógeno (NO3-N). Refiere se al manual para realizar la configuración. Si el medidor medir en NO3 los puntos de calibración serán de 150 y 2000 ppm o 34 y 450 ppm si el medidor mide NO3-N.

Referencias

1. Bagshaw, J., Moody, P., and Pattison T., (2010) Soil health for vegetable production in Australia—Part 4: Measuring soil health. The State of Queensland, Department of Employment, Economic Development and Innovation
2. Geisseler, Daniel and Horwath, William. Sampling for Soil Nitrate Determination. Fertilizer Research and Education Program.
3. Griffin, G., Jokela, W., Ross, D., Pettinelli, D., Morris, T., and Wolf, A. (2009). Chapter 4 Recommended Soil Nitrate Tests. Recommended Soil Testing Procedures for the Northeastern United States. Cooperative Bulletin No. 493.
4. Thomas, J. (1986). Ion Selective Electrode Reviews, Volume 7. UK: Pergamon Press

REV 0, 4 AUGUST 2015

edido it pa a an lisis de suelo

Rango de medición: 30~600 ppm (NO3-),
6.8~140 ppm (NO3--N),
3.4~68 kg/10a (NO3--N)

Accesorios incluidos:

- Medidor de Nitrato NO3-11
- Soluciones de calibración (30 ppm, 300 ppm) (14 mL)
- 2 pilas CR2032
- Manual de instrucción
- 5 pipetas
- Botella de solución de limpieza (250 ml)
- 3 botellas de extracción (100 ml)
- 2 spatulas para muestreo de suelo
- Pincitas,
- Papel de muestreo B
- 2 soportes para papel de muestreo
- Guía rápida
- Maletín de transporte.

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HORIBA

LAQUAtwin pH

pH del suelo y disponibilidad de nutrientes

El rango de pH deseable por un crecimiento óptimo para varios tipos de planta es entre pH 6 y 7.5 además a estos valores de pH, los nutrientes se conviertan lo más disponibles para las plantas. Se puede determinar el pH del suelo mesclando una muestra de suelo con agua y mediando esta solución de suelo acuosas con los medidores LAQUAtwin.

Introducción

El pH del suelo es la medición de la acidez o alcalinidad en el suelo. En la escala de pH, pH 7 es neutral. Debajo de 7.0 es ácido y abajo es alcalino. El pH del suelo afecta los nutrientes disponibles para el crecimiento de las plantas. En suelo muy acido, el aluminio y manganeso se conviertan más disponibles and también más toxico mientras tanto el calcio, fosforo and magnesio están menos disponible para la planta.

pH del suelo	Crecimiento de la planta
> 8.3	Demasiado alcalino para la mayoría de las plantas
7.5 pH del suelo	Disponibilidad del hierro es un problema en suelo alcalino
7.2	de 6.8 a 7.2 casi neutral de 6.0 a 7.5 aceptable para la mayoría de las plantas
7.0	
6.8	
6.0	
5.5	Reduce la actividad microbiológica del suelo
< 4.6	Demasiado acido para la mayoría de las plantas

En suelo muy alcalino, el fosforo y la mayoría de los micronutrientes están menos disponibles.

Antes de diseñar o plantar un nuevo jardín o cultivo, es importante de entender los requisitos de pH de cada variedad de planta. La determinación del pH puede dar informaciones útiles tal como si el suelo es apropiado para la planta que queremos cultivar o si necesitamos ajustar el pH para un crecimiento óptimo. El pH del suelo puede ser medido fácilmente y directamente en el campo con los medidores de pH HORIBA LAQUAtwin pH11, pH22 y pH33. Estos medidores de bolsillo pueden ser calibrados hasta 5 puntos usando solución de calibración tipo USA. El modelo pH 33 tiene un sensor de temperatura incorporado y una función de compensación de temperatura para calibrar y medir el pH exacto a la temperatura medida. Referirse a las especificaciones técnicas de cada modelo.

Método

Calibra el medidor de pH LAQUAtwin siguiendo las instrucciones del fabricante usando por lo menos dos soluciones de calibración para encerrar el pH esperado.

Preparación de la muestra y medición

El método descrito abajo es basado sobre el método US EPA 9045D. Es también aplicable para la medición de pH en agua sucia, barros activados y líquidos no acuosos. Si la muestra contiene agua, el volumen de agua debe ser menos que 20% del volumen total.

1. Añadir 20ml de agua a 20g de muestra de suelo en un vaso. Mesclar 5 minutos y cubrir.

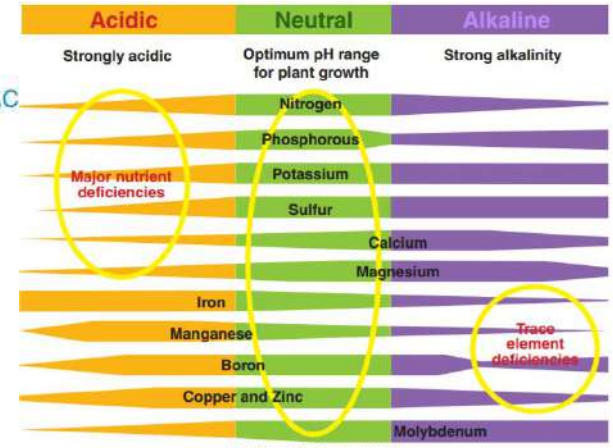
2. dejar la solución de suelo por descansar 1 hora.

3. Medir la solución y notar el valor de pH y temperatura.

Para obtener resultado preciso, la solución de calibración y la muestra deben tener la misma temperatura. Si el electrodo está cubierto de una película de aceite o grasa, limpiarlo y enjuagarlo con detergente y agua.

pH 4.0-6.0	pH 5.0-6.5	pH 6.0-7.5	pH 5.0-7.5	pH 6.0-8.0
Potato	Apple	Apricot	Banana	Avocado
	Blackberry	Cherry	Rhubarb	Asparagus
	Cranberry	Grapevine	Strawberry	Ginger
	Gooseberryy	Grapefruit	Rasberry	Leek
	Mango	Hazelnut	Carrot	Mint
	Melon	Hop	Cauliflower	Paprika
	Pineapple	Lemon	Sweet corn	Watercress
	Pomegranate	Lychee	Cucumber	
	Watermelon	Mulberry	Garlic	
	Basil	Nectarine	Lentil	
	Chicory	Peach	Parsley	
	Fennel	Plum	Pepper	
	Olive	Quince	Pumpkin	
	Peanut	Artichoke	Shallot	
	Sweet potato	Bean	Spearmint	
	Rice	Beetroot	Thyme	
	Rosemary	Broccoli	Tomato	
	Sage	Brussels sprouts	Turnip	
	Soybean	Cabbage		
		Calabrese		
		Celery		
		Chinese cabbage		
		Chives		
		Lettuce		
		Millet		
		Mushroom		
		Mustard		
		Onion		
		Pea		
		Peppermint		
		Radish		
		Spinach		

(Source: Gurumaganize.org)



Soil pH and Nutrient Availability
(Source: Bluedale - http://www.bluedale.com.au)

Resultado y Beneficios

El rango de pH deseable en el suelo para un crecimiento optima de la plantas es de 6.0 a 7.5. Generalmente, estos valores de pH son aceptable por la mayoría de la plantas y los nutrientes se convierten más disponibles. El pH del suelo es importante porque afecta directamente la disponibilidad de los nutrientes, nitrógeno, fosforo y potasio son los nutriente básico necesaria en grande cantidad. Calcio, magnesio y sulfuro son nutrientes secundarios necesarios en cuantidad más pequeña. Zinc y magnesio son los micronutrientes necesarios en muy baja cuantidad. Las deficiencias de nutrientes secundarios y de micronutrientes pueden ser fácilmente arregladas guardando el pH del suelo a un valor óptimo.

El pH del suelo afecta también la actividad de los microorganismos, la población de bacterias que descomponen la materia orgánica declina y su actividad reduce cuando el suelo tiene un pH muy acido, en esta caso se observa una acumulación de materias orgánicas amarradas con nutriente en particular el nitrógeno.

Aumentar el pH del suelo

Aplicar una sustancia que contiene un tipo de cal (carbonato de calcio) como caliza o fresno de madera puede aumentar el pH del suelo. Lo más fina es la caliza lo más rápido y efectivo será. La cantidad de caliza depende del tipo de suelo. El fresno de madera contiene alta concentración de potasio y calcio una pequeña cuantidad de fosfato, boro y otros nutrientes aunque no esta tan eficiente como la caliza puede aumentar el pH del suelo si la operación es repetida varias veces.

Bajar el pH del suelo

Aparte de los fertilizantes basados con amonio y material orgánica, el sulfato de aluminio y sulfato y azufre son sustancia común para bajar el pH del suelo. El sulfato de aluminio es preferido pero el cambia el pH del suelo desde el momento que se disuelve en el suelo. Azufre toma más tiempo para tener efecto porque tiene que ser convertido en ácido sulfúrico

Referencia y lecturas sugeridas

1. US Environmental Protection Agency Method 9045D Soil and Waste pH, Revision 4, November 2004
2. Changing the pH of your Soil. Clemson University Cooperative Extension. www.clemenson.edu

Medidores de bolsillo de pH HORIBA LAQUAtwin

Características

Sensor de pH plano con compensación de temperatura ofrece mediciones rápidas y confiables directamente a partir micromuestras de 100 µl.

Aplicaciones

Análisis de aguas dulces (lluvia, ríos, lagos, manantiales), acuarios, aguas residuales, análisis del suelo para una agricultura mejorada, análisis de la frescura de los alimentos. Fermentación y elaboración de la cerveza, laboratorios de investigación, controles de calidad de productos médicos y cosméticos, odontología preventiva, educación escolar, etc.

Rango de medidores de bolsillo HORIBA LAQUAtwin

pH	COND	Na+	K+	NO3–	Ca2+	Salt EC
Acidity and alkalinity	Conductivity and TDS	Sodium Ion	Potassium Ion	Nitrate Ion	Calcium Ion	Salt (NaCl)

IMS

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ISO9001 JOA-0298 / ISO14001 JOA-E-90039 / ISO13485
JOA-MD0010 / OHSAS18001 JOA-OH0068

Application Note

Conductivity and Elephant's Foot Testing

LAQUAtwin is a series of pocket ION meters. Using Ion Selective Electrode (ISE) technology, they are available for measuring Conductivity, Calcium, Nitrate, Potassium, Sodium, Salt concentration and pH measurement. Using just a tiny amount of sample, the LAQUAtwin proprietary flat sensors can quickly and accurately measure the values of the chemical parameters in the field.

Photo Credit: Elio Jovicich, University of Florida.

Introduction

A physiological disorder in greenhouse hydroponic sweet pepper (Capsicum annuum L.), where the base of the plant's stem becomes swollen below the cotyledon level and wounds develop at the base of the stem's epidermis has been named "Elephant's Foot".

Sodium is a mineral constantly present in soil, but an excess of it concentrated at the base of the plant stem has been shown to have a correlation with Elephant's Foot in plants. It is necessary to analyse the conductivity of soil in which hydroponic sweet pepper is grown to consider the extent to which the stem of the plant has accumulated salt.

To determine the conductivity of the soil, the Horiba LAQUAtwin Conductivity meter can be used. This is an easy and quick method used to measure the conductivity of soil.

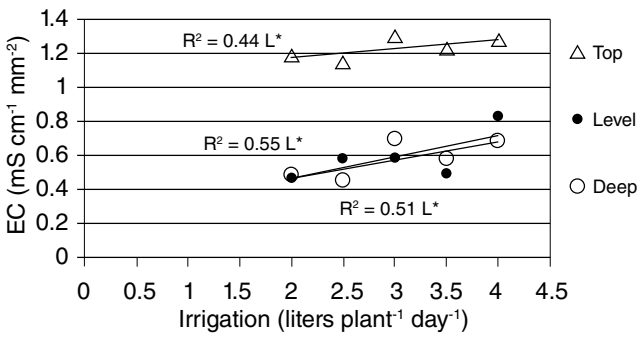
Method

1. A small 5g soil sample is watered down with 20 ml of water.
2. The water and soil mixture is shaken, thus 'washing' the soil.
3. A small sample can be extracted via pipette
4. This is placed on the sensor of the LAQUAtwin Conductivity meter and the conductivity is measured after one minute.
5. To repeat sampling, wash the sensor with tap water and pat dry with a paper tissue.

Results and Benefits

The use of the Horiba LAQUAtwin Conductivity meter to measure the conductivity of soil will improve farmers' knowledge of the sodium accumulation and hence choose the best land to grow sweet pepper crops and avoid Elephant's Foot disorder.

The LAQUAtwin Conductivity meter is small and compact, and convenient to carry for easy on-site testing. Its easy-to-use interface is simple for anyone to use the LAQUAtwin hand held Conductivity meter.



Salt accumulation on the stem base (measured by EC) and volumes of nutrient solution per plant per day at the three transplant depths: "Top": plants transplanted to half of the container height, "Level": plants transplanted to the cotyledons level, and "Deep": plants transplanted to the 2nd node. Electrical conductivity values for each transplant depth and irrigation volume average four soilless media type (coconut coir, peat mix, perlite, and pine bark). L*, linear polynomial effect at 5% level of significance.

Jovicich, E. and Cantliffe, D.J. 2001. "Transplant Depth, Irrigation, And Soilless Media Effect On 'Elephant's Foot' Plant Disorder In A Hydroponic Greenhouse Sweet Pepper Crop". Acta Hort. (ISHS) 559:515-520

Pocket ION Meter

LAQUAtwin

Unique Features

Calibrate and measure at the touch of a button—the smiley face will tell you when the result can be read.

Hassle-free automatic calibration with a few drops of standard solution reassures you of your measurement accuracy. Two-point calibration is also possible.*1

*1 Except for B-711

LAQUAtwin is fully waterproof and dustproof.

The meter and sensor are fully waterproof*3 and dustproof, so you can take it anywhere.

*3 IP67 rated. Will withstand immersion for 30 minutes at 1 m. Not suitable for underwater use.

LAQUAtwin: the only meters with flat sensor technology.

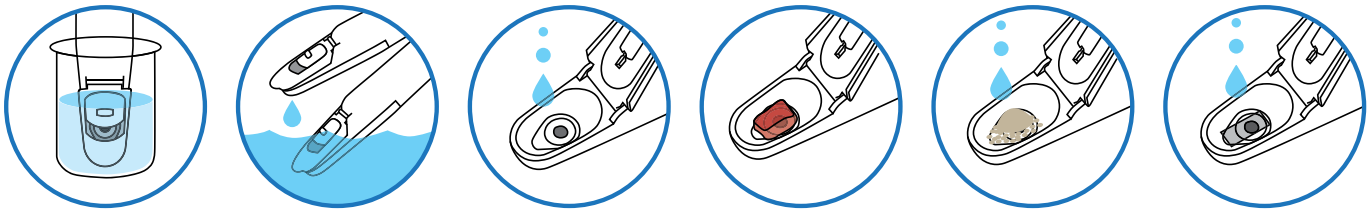
HORIBA's highly-sensitive, flat sensor technology opens up new possibilities for sampling and sample types. Only a small amount of sample is required, so you can easily sample in situ without the need for beakers or other labware. Sensors are easily replaced as required.

Carry case comes as standard for handy portability.

The compact carry case contains everything you need for your measurements, including the standard solution and sampling sheets.

1 X 6 One meter, six methods.

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



01 Immersion
When you're in the lab, you can test the sample in a breaker. Ensure the sensor guard sliding cap is open.

02 Scoop
Use as a scoop to test water eg from a river. A vertical scoop for an aquarium is also available with a unique sensor guard.

03 Drops
Place a drop of the sample onto the sensor with a pipette. Laquatwin meters can measure sample volume as low as 0.1mL

04 Solid Samples
Foods containing some moisture can be tested by placing a small piece directly onto the sensor.

05 Powders
Laquatwin meters can also test dry powders. Simply place the powder sample onto the sensor and drop on your defined volume of pure water.

06 Paper and textiles
To test sheets of paper and textiles, cut up the sample into small pieces and place directly onto the sensor. Drop on your defined volume of pure water.

Lineup

pH

Accurate pH measurements in a few seconds, from a single drop.

Water pH varies in different environments, and a slight change can often have a major effect.

Whether you need to keep the pH of an aquarium within tight limits, are checking for the acidity of rain water or for the quality of meat and fish products, LAQUAtwin compact pH meters are ideal for you. No matter where and when you need to test.

COND

Determine water conductivity with as little as 0.12 mL of sample.

The conductivity of rain water is a trusted guide to determining atmospheric purity. In agriculture, measuring the conductivity of soil allows farmers and agronomists to determine optimum fertilizer usage and check the 'health' of soil after salt water damage. The LAQUAtwin meter makes conductivity testing simple, anywhere.

Na+

Only compact meter for a quick and reliable measurement of sodium ion at the scene using ion selective membrane.

K+

Only compact meter for a quick and reliable measurement of potassium ion at the scene using ion selective membrane.

NO3–

Only compact meter for a quick and reliable measurement of nitrate ion at the scene. Special application packages for crop (B-741) and soil (B-742) are also available.

Ca2+

Only compact meter for a quick and reliable measurement of ionized calcium at the scene using ion selective membrane.

http://www.horiba.com/laquatwin

IMS

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CE RoHS COMPLIANT

Nota de aplicación

Medición de pH en savia de planta

LAQUAtwin es un rango de medidores de bolsillo de electroquímica. Los medidores de iones usan un electrodo selectivo, para medir el potasio, el calcio, los nitratos y el sodio este rango también incluye medidores de pH y de conductividad. Con tan solo una gota de muestra, el sensor plano LAQUAtwin mide rápidamente y con precisión las concentraciones de parámetros químicos en el campo o en laboratorio.

Introducción

En varios casos es necesario medir el valor de pH en la savia de planta para determinar el estado de salud de la planta. Si el valor de pH está arriba de 6.4, la planta es más propensa a ser atacada por los insectos del otro lado un pH debajo de 6.4 puede conducir a algunas enfermedad. Por eso el pH optimo deseo un la savia es de pH 6.4. Los análisis de suelo y de savia en laboratorio son informaciones importantes pero los resultados solo son disponibles días a veces semanas después de la colecta de muestra. Eso puede ser problemática porque en muchos casos el productor tiene que reaccionar rápidamente si hay un problema. En este caso los medidores de pH HORIBA son equipos muy útiles para diagnosticar la salud de la planta en tiempo real. Es equipo es fácil de usar y entrega un resultado preciso en tan solo segundos.

Método

Para hacer la medición, colecta unas hojas y póngalas en el picador a ajos y exprima para obtener unas gotas de muestra de savia. Generalmente, las hojas maduras aportan una indicación más precisa del estado de salud de la planta. La muestra de savia puede ser medida directamente con los medidores de pH LAQUAtwin pH11, pH22 o pH 33. Después de calibrar el equipo, coloca la muestra sobre el sensor y asegurase de cubrir completamente el electrodo. Espera 30 segundos antes de tomar el valor en la pantalla.

Si el valor de pH medido es diferente de más de 0.5 pH del valor óptimo 6.4, puede ajustar de la manera siguiente:

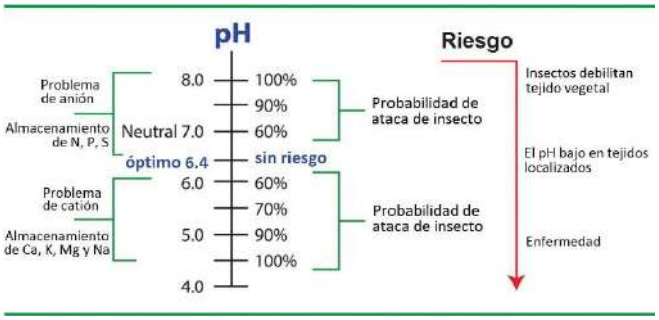
- Si el pH está más que 0.5 pH arriba del valor pH 6.4: añadir una pequeña cuantidad de fertilizante de fosfato
- Si el pH está más que 0.5 pH debajo del valor pH 6.4: añadir una pequeña cuantidad de fertilizante de calcio/potasio

Después de una semana, repite el análisis para asegurarse que el pH está más cercano del valor óptimo pH 6.4

Resultado y Beneficios

El uso del medidor de PH HORIBA LAQUAtwin permite de diagnosticar el pH interno de la planta y de asegurarse que está cerca del valor óptimo para mantener una buena salud de la planta y evitar problema sobre su cosecha.

Este medidor es práctico para llevar en todos lados y fácilmente realizar medición en el campo o en laboratorio. Gracias a su simplicidad de uso el LAQUAtwin es accesible para todos usuarios.



Medidor de bolsillo

LAQUAtwin

Características únicas

Realice calibraciones y mediciones con tan solo pulsar un botón; le indicará que ya puede leer el resultado.

La sencilla calibración automática con tan solo unas gotas de solución de calibración, le garantiza la exactitud de la medición. También se puede realizar la calibración en dos puntos y hasta 3 y 5 puntos con los modelos pH33 y EC33.

LAQUAtwin es totalmente a prueba de agua y polvo.

El medidor y el sensor son totalmente resistentes al agua y al polvo, por lo que puede llevarlo donde quiera.

1 IP67: no da errores al sumergirse en agua a una profundidad de un metro durante treinta minutos. Sin embargo, el producto no puede usarse bajo el agua

LAQUAtwin: Tecnología única de sensor plano ISE y pH

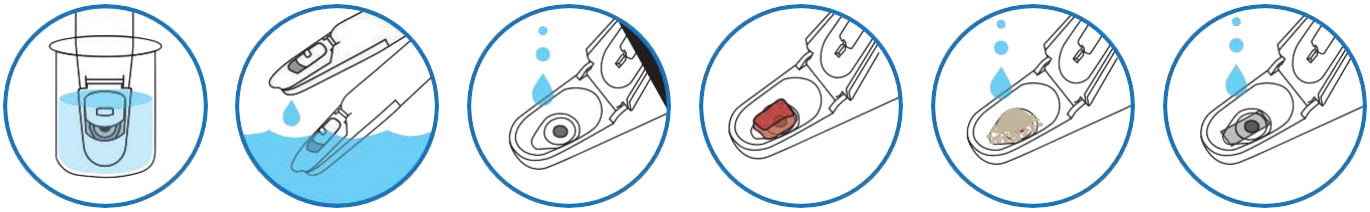
La tecnología HORIBA de sensor plano de alta sensibilidad abre nuevas posibilidades para medir diferente tipos de muestras. Puede hacer una medición a partir de un volumen de 0.1 ml y no necesita vaso para calibrar o medir, solo punga unas gotas directamente en el sensor.

Incluye un estuche para transportarlo de forma práctica.

El estuche compacto contiene todo lo que necesita para las mediciones, incluyendo las soluciones de calibración y una pipeta de plástico.

1 X 6 Un medidor, seis métodos de medición

Only LAQUAtwin allows you to be this flexible!
Choose the best method according to your sample, your situation, and your needs.



1 Inmersión

Cuando se encuentre en un laboratorio, puede analizar la muestra en un vaso de precipitados. Asegúrese que la tapa deslizante que protege el sensor esté abierta.

2 Muestreo

Utilícelo como una pala para analizar el agua, por ejemplo, de un río.

3 Gotas

Los medidores LAQUAtwin pueden medir volúmenes de muestra de tan solo 0.1ml. Coloque una gota de la muestra en el sensor con una pipeta.

4 Muestras sólidas

Los alimentos que contengan cierta humedad pueden analizarse si coloca un trozo pequeño directamente en el sensor.

5 Polvos

Los medidores LAQUAtwin también pueden analizar polvos secos. Simplemente, coloque la muestra de polvo en el sensor y versa encima el volumen definido de agua desionizada.

6 Papel y tejidos

Si desea analizar hojas de papel y tejidos, corte la muestra en trozos pequeños y colóquelo directamente en el sensor. Versa encima un volumen definido de agua desionizada.

Rango

pH

Medición precisa de pH directamente a partir de una sola gota. El pH del agua varía en función al ambiente y un ligero cambio a menudo puede tener un gran impacto. Tanto si debe mantener el pH de un acuario dentro de niveles estrictos, comprobar la acidez del agua de lluvia o la calidad de producto alimenticio (carnes, pescados…), los medidores de pH de bolsillo LAQUAtwin son la solución perfecta. No importa dónde o cuándo debe realizar un análisis.

COND

Determine la conductividad con tan solo una muestra de 0.12 ml. La conductividad del agua de lluvia es una referencia fiable para determinar la pureza atmosférica. En agricultura, la medición de la conductividad del suelo permite a los agricultores establecer el uso óptimo de fertilizantes y comprobar la «salud» del suelo tras el daño provocado por el agua salada. Los medidores de conductividad LAQUAtwin hace que el análisis de la conductividad sea una tarea sencilla que se puede realizar en

Na+

Único medidor de bolsillo para medir rápidamente y con precisión el sodio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 23 a 2300 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

K+

Único medidor de bolsillo para medir rápidamente y con precisión el potasio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 39 a 3900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

NO3–

Único medidor de bolsillo para medir rápidamente y con precisión el nitrato con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 30 a 9900 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

Ca2+

Único medidor de bolsillo para medir rápidamente y con precisión el calcio con un electrodo con membrana selectiva. El amplio rango de medición que incorpora (de 40 a 4000 ppm) permite medir concentraciones altas sin necesidad de realizar una dilución.

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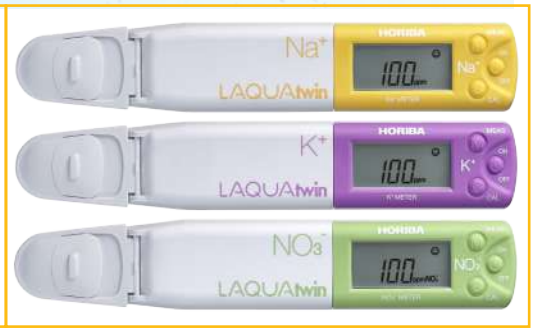
ete minaci n de la concent aci n de nut ientes en soluci n de suelo sa ia de tomate

El manejo de la fertirrigación requiere método rápido y preciso para determinar la concentración de nutrientes en solución de suelo y savia de cultivo. Folegatti et al (2005) descubrieran que las concentraciones de nitrato, potasio y sodio en solución de suela y savia de planta de tomate medidas con los medidores LAQUAtwin muestran alta correlación con los analices realizados en laboratorio certificado. Este estudio valida la precisión de los medidores LAQUAtwin y confirma su utilidad como herramienta para el implementar una buena nutrición de su cultivo.



Introducción

Los cultivos toman los nutrientes del suelo para su crecimiento. Los niveles de nutrientes en suelo y savia dan indicaciones sobre las necesidades nutricionales en tiempo real del cultivo. Folegatti et al (2005) hicieron un estudio para evaluar la precisión de los medidores Cardy/LAQUAtwin para la determinación de Nitrato (NO3-), Potasio (k+) y Sodio (Na +) con muestra de solución de suelo y de savia para el manejo de la fertirrigación. El sodio no es un ion esencial para cultiva de tomate, al contrario, su presencia en alto nivel impacta el cultivo. Por eso su monitoreo en agua de riego es importante.

Los medidores Cardy fueran reemplazados por los modelos LAQUAtwin, que tienen un nuevo sensor, un software mejorado y una interfaz más sencilla. The LAQUAtwin Na-11, K-11 y NO3-11 miden el Sodio, Potasio y Nitrato. Como los medidores cardy, los modelos LAQUAtwin solo requieren unas gotas para realizar una medición y entregan un resultado en tan solo unos segundos. Eso permiten medir muestra de pequeño volumen como savia y realizar varios análisis en campo en poco tiempo, eso permiten también evitar la demora de entrega de resultados de los análisis de laboratorio.

Método

Se usó un cultivo de tomate en invernadero en Piracicaba, Brasil con soluciones de riego de diferentes niveles de nutrientes. Los fertilizantes y sales usados fueran nitrato de amonio (NH4NO3), Cloruro de Potasio (KCl), Cloruro de Calcio (CaCl2), Cloruro de Sodio (NaCl) que fueran aplicado con un sistema de gotero. Las soluciones de suelo fueran colectadas cada 15 días en promedio, 24 horas después de la irrigación usando lisímetro para absorber solución de suelo a una profundidad de 15 cm. Las concentraciones de Nitrato, Potasio y Sodio fueran medidas con los medidores de ion Cardy. Los resultados se compararon con los obtenidos por análisis de laboratorio certificado usando un fotómetro de flama (Na+/K+) y destilación de vapor (NO3-).

50 muestras de las ultimas hojas maduras fueran colectadas por cada sección del cultivo que fueran diferentes tipos de fertilización. Las bases de los peciolos fueran exprimidas usando una prensa de ajo and las muestras de savia obtenidas fueran medidas con los medidores Cardy. En laboratorio las hojas fueran secadas en hornos a 60°C por 48 horas y se determinaran las concentraciones de Nitrógeno, Potasio y Sodio total (estructural e intercelular). Las concentraciones medidas en peciolos fueran comparadas con los análisis de hoja seca en laboratorio.

Los medidores fueran calibrados en dos puntos cada 10 muestras y los sensores fueran limpiado con agua destilada entra cada medición.

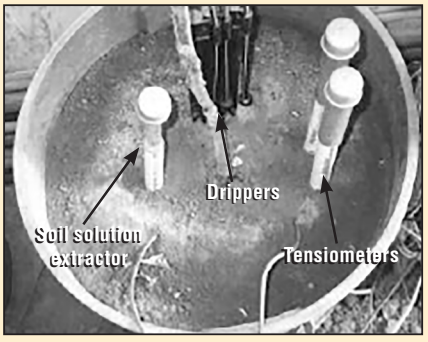


Figure 1A: Greenhouse experimental pot

Continued at the back

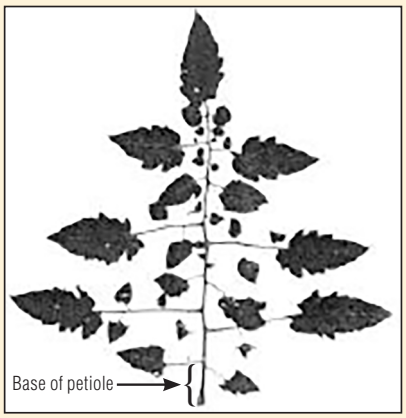


Figure 1B: Base of petiole used for sap nutrient determination

Beneficios y resultados

La figura 2 demuestra una alta correlación entre las concentraciones de NO3-, K+, Na+ medidas con los medidores Cardy y los análisis del laboratorio certificado. Las concentraciones de nitratos estaban 39% más bajas que los análisis de laboratorio, cuando las concentraciones de Potasio y Sodio estaban 21% y 67% más altas que los resultados de laboratorio. El coeficiente de determinación (r2) es alto para cada ion y la relación fue significante 1% (Tabla1).

Las concentraciones de NO3-, K+ y Na+ medidas en peciolos con los medidores Cardy muestran una buena correlación con los análisis en hoja seca de laboratorio and la correlación fue buena por cada ion (tabla 1).

Los valores r2 por las concentraciones de nutrientes en peciolos y hoja seca fueran cerco de los resultados observados en otros estudios.

Las discrepancias observadas entre los resultados de los medidores LAQUAwtin y los resultados del laboratorio certificado fueran probablemente causadas por la presencia de otros nutrientes en las soluciones de suelo y las muestras de savia. Sin embargo, Folegatti et al (2005) concluyeran que los medidores Cardy, ahora llamados LAQUAtwin, ofrecen buena correlación con análisis de laboratorio certificado, por esta razón esto medidores están adecuados para realizar mediciones directo de nutrientes en solución de suelo y sabia en campo.

Table 1 - Values of paired-t test for concentrations of NO_3^-, K^+ and Na^+ determined by CIM and by standard methods, in the soil solution and tomato petiole sap.

Statistic	NO_3^-	K^+	Na^+
	Soil solution		
t	-12.1**	12.3**	26.4**
	Petiole sap		
t	13.4** [ξ]	13.9**	14.0**

**Significant at 0.01.
[ξ] NO_3^- in sap tested against total-N in leaf dry matter.

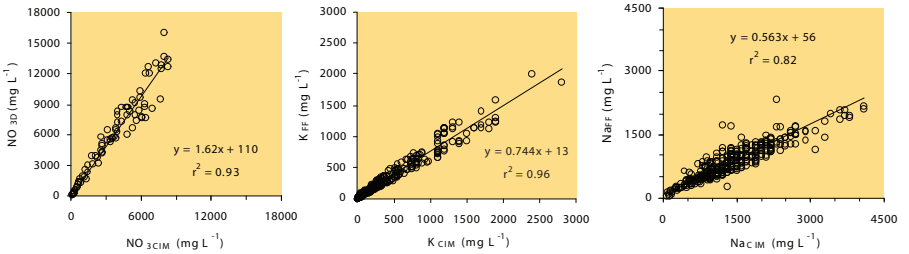


Figure 2 - Relationships between concentrations of nitrate, potassium and sodium in the soil solution measured by cardy-ion meters (CIM) and by standard methods. FF = flame fotometry; D = steam-distillation.

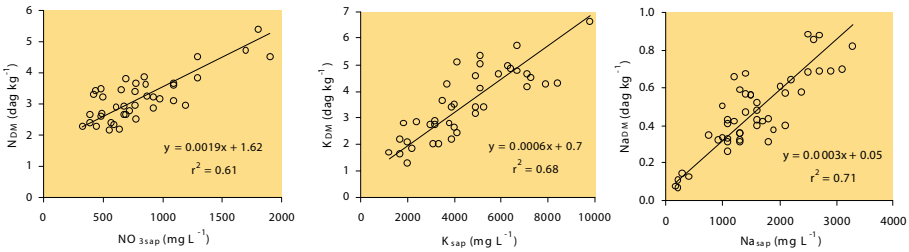


Figure 3 - Relationships between the concentrations of nitrate, potassium and sodium in petiole sap and total-N, potassium and sodium in the dry matter (DM) of tomato leaves, hybrid Facundo.

References and Suggested Readings

1. Folegatti, M.V., Blanco, F.F., Boaretto, R.M. and Boaretto, A.E. (2005) Calibration of cardy-ion meters to measure nutrient concentrations in soil solution and in plant sap. Sci. Agric. (Piracicaba, Braz.), v.62, n.1, pp 8-11.
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Revision 1.0, 30 December 2016

Medición de pH y conductividad en fibra de coco

La medición de fibra de coco supone extractar una solución de muestra con agua deionizada and medir el pH y la conductividad de este extracto y de usar un método por filtración. El valor de conductividad aceptable es con muestra diluida una vez (1:2) es de 0.26 a 0.75 mS/cm por dilución y de 1.0 a 2.6 mS/cm con método por filtración, el rango de pH optimo es de pH 5.4 a 6.2.

Introducción

El material fibroso encontrado entre la cáscara interna dura y la cáscara externa del coco su usa por varias aplicaciones. Los cocos maduros tienen una fibra marrón espesa y fuerte, que se utiliza normalmente en relleno de tapicería, saqueo para la horticultura. Los cocos verdes tienen una fibra fina, blanca o marrón claro, que se utiliza en la producción de productos para el doméstico, tales como esteras, cepillos, cuerdas y redes de pesca. Para cosechar esta fibra tradicionalmente, las cáscaras fibrosas son remojadas con agua dulce o agua de mar para ablandar las fibras antes de la extracción.

La fibra de coco marrón se ha convertido en popular sustrato de crecimiento o medio de cultivo en horticultura en razón de su alto contenido de lignina, que dura mucho tiempo, aguarda bien el agua, y no se encoge cuando está seco permitiendo una rehidratación fácil. La mayoría de la fibra de coco disponible comercialmente se lava para eliminar las concentraciones altas de sodio y potasio Después de lavar, algunos proveedores tratan la fibra con solución de calcio para ajustar su capacidad de intercambio catiónico (se refiere a la capacidad del sustrato a absorber y liberar cationes cargados positivamente, de esta manera proteger el substrato contra cambios bruscos de pH o de concentración de nutrientes).

Tener una fibra de buena calidad es esencial para lograr un crecimiento óptimo para sus cultivos. Para determinar si la fibra de coco que usted compró es adecuada para su cultivo se puede medir el pH y la conductividad antes de usarlo.

Los medidores de pH y de conductividad LAQUAtwin permiten una medición directa de muestras aun micro-volumen en pocos segundos. Estos medidores a prueba de agua son programados con función de calibración automática y compensación de temperatura para asegurar una medición precisa. Ambos medidores se decline en tres modelos diferentes y cada uno viene con dos soluciones de calibración.

Método

Calibra el medidor de pH y de conductividad LAQUAtwin siguiendo las instrucciones del fabricante usando por lo menos dos soluciones de calibración para encerrar el valor esperado.

Preparación de la muestra y medición
Dos métodos descritos abajo

Método con dilución (1:2)

1) Pone 1 parte de fibra de coco con 2 partes de agua deionizada (pH neutral, sin mineral) en un vaso limpio. Por ejemplo, 50 g de fibra con 100 de agua deionizada.
2) Mesclar y dejar la muestra descansar 30 minutos.
3) Poner la muestra en embudo con conteniendo un papel filtrante.
4) Recoger el extracto en un vaso limpio, mesclar otra vez and poner unas gotas de muestra en el sensor de los medidores de pH y conductividad.

Método por filtración

5) Pone una vaso debajo de la muestra de fibra de coco y pone 100ml de agua deionizada.

6) Recoger 50ml del liquidó obtenido, mezclarlo y poner unas gotas sobre el sensor de los medidores de conductividad y pH después de calibrarlos.

Referirse a los consejos técnicos *01 LAQUAtwin pH Sensor Maintenance Procedures and Technical Tip 03 LAQUAtwin Conductivity Sensor Maintenance Procedures for conditioning, cleaning, and storing the sensors*. Estos consejos se pueden descargar en la parte *support* en el sitio www.horiba-

Resultado y Beneficios

Los sustratos y medios de cultivo sirven como un entorno para el sistema de raíces de una planta para crecer y funcionar. Las propiedades químicas del sustrato, tal como el pH y la conductividad, deben ser adecuadas para el cultivo que desea cultivar. Cada cultivo tiene valores de pH y conductividad específicos por el sustrato para lograr un crecimiento óptimo.

El pH afecta la cantidad de nutrientes disponibles para las plantas y todos están fácilmente disponibles a un pH de 5,4 a 6,2. La conductividad indica la cuantidad de nutrientes o de sal (salinidad) que afectan el desarrollo y la salud de la planta. El rango de conductividad del sustrato adecuados para plántulas, plantas de lecho y plantas sensibles a la sal es de 0.26 a 0.75 mS / cm con método por dilución y de 1.0 a 2.6 mS / cm con un método por filtración.
A medida que su cultivo crece, mide los valores de pH y conductividad del sustrato cada 2 a 3 semanas tomando la muestra de manera aleatoria porque su valor puede cambiar con el tiempo. En este caso, el método por dilución requiere tomar la muestra en la parte inferior de la maceta. Esto perturba las raíces y se debe tener cuidado. El método por filtración, permite de medir toda la fibra sin molestarla las raíces, pero los resultados son variables. Elije un método de muestreo y úselo a través de su programa de monitoreo.

Referencia y lecturas sugeridas

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Medidores de bolsillo de conductividad HORIBA LAQUAtwin

Características

Medición de conductividad y Solidos Totales Disueltos (TDS). Adjuste automático de rango y compensación de temperatura para análisis de alta precisión.

Aplicaciones

Agua dulce, acuario, suelo, contaminación del agua con sal, contaminación de superficie antes de la aplicación del revestimiento.

Medidores de bolsillo de pH HORIBA LAQUAtwin

Características

Sensor de pH plano con compensación de temperatura ofrece mediciones rápidas y confiables directamente a partir micromuestras de 100 µl.

Aplicaciones

Análisis de aguas dulces (lluvia, ríos, lagos, manantiales), acuarios, aguas residuales, análisis del suelo para una agricultura mejorada, análisis de la frescura de los alimentos. Fermentación y elaboración de la cerveza, laboratorios de investigación, controles de calidad de productos médicos y cosméticos, odontología preventiva, educación escolar, etc.

Rango de medidores de bolsillo HORIBA LAQUAtwin

IMS

HORIBA Group is operating Integrated Management System (IMS)
ISO9001 JOA-0298 / ISO14001 JOA-E-90039 / ISO13485
JOA-MD0010 / OHSAS18001 JOA-OH0068

Quick Nutrient Analysis in Strawberry Production

Regular monitoring of nutrient levels such as nitrate (NO_3^-), potassium (K^+) and calcium (Ca^{2+}) in plant petioles, soil solution, irrigation water, and drain water produces not only good yield and fruit quality, but also reduces fertilizer cost and mitigates environmental hazards. The LAQUAtwin pocket meters are the perfect tools for testing as they directly measure samples and provide results in just few seconds, allowing growers to identify and correct any nutrient deficiency or excess immediately.

Introduction

Strawberry production requires a root environment with good availability of essential nutrients to achieve optimum plant growth, fruit quality, and yield. Soil pH influences the availability of nutrients such as nitrate (NO_3^-), potassium (K^+) and calcium (Ca^{2+}) ions, which have specific roles in strawberry fruit quality - NO_3^- determines the size, K^+ influences the taste, and Ca^{2+} affects the firmness. The nutrients should be present in a right balance to avoid competition or improper plant uptake. Aside from maintaining the correct soil pH for nutrient availability, the conductivity should also be closely and frequently monitored, as strawberry plants do not tolerate high conductivity value.

Plant sap analysis has been used by growers to manage crop nutrient content and fertilization strategies. A plant sap test gives a view of the nutrients available for the plant, at that time, for growth or development. It directly shows if a crop suffers from a nutrient deficiency or an excess. Soil solution analysis is also important for growers. It gives a view of the nutrient and salinity levels in the soil and nutrient leaching past the root zone. Soil solution is the water held in the soil, which contains a mixture of nutrients taken up by roots.

HORIBA offers LAQUAtwin pocket meters which provide reliable and accurate results for plant sap and soil testing parameters such as pH, conductivity (EC), nitrate (NO_3^-) / nitrate-nitrogen (NO_3-N), potassium (K^+), calcium (Ca^{2+}) and sodium (Na^+). Several research studies have proven that results obtained with LAQUAtwin pocket meters are strongly correlated with those of traditional laboratory analyses. With their unique and compact design, the LAQUAtwin pocket meters allow direct measurement of micro-volume sample (as low as 0.1ml) and deliver results in just a few seconds. These advantages enable growers to make fertilization and irrigation decisions quickly.

Method

Calibrate the LAQUAtwin pocket meters according to manufacturer's instructions.

A. Plant Sap Analysis

For sampling, it is critical to always follow the same protocol and collect the correct tissue in order to get consistent and reliable results. The most recent mature trifoliate leaf is the best indicator of the most essential nutrients for plant growth (e.g., P, K, Ca, etc.) and the petiole from this leaf is the best indicator of NO_3-N. Plant temperature should be within 20 to 25°C.

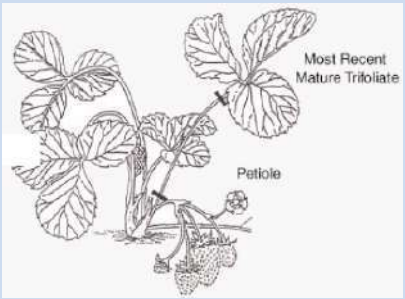

Figure 1: Proper leaf and petiole samples ensure reliable results.

Source: Casteel, S. (2004). Strawberry Fertility and Nutrient Management.

1. Collect 2 most recent mature trifoliate leaves and the associated petioles from 20 different strawberry plants to get a representative sample. The petiole must be detached from the plant near the crown.

2. Separate the petioles from the leaves and cut them into small pieces.

3. Load the small pieces of petioles into a garlic press or hydraulic sap press and squeeze them to extract sap.

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4. Place the sap directly onto the respective sensors of LAQUAtwin nitrate and potassium pocket meters.

5. Compare the results with the reference values in Table 1 to evaluate the current nutritional condition of the plants and implement the best course of action.

6. Rinse the sensors with clean water before testing another sample or storing them.

Table 1: Reference Nutrient Levels for Petiole Sap in Strawberry Cultivation

Days after sowing	NO_3-N	P	K
	ppm		
30	500 – 700	150 – 350	4000 – 5000
60	550 – 750	150 – 350	4000 – 4500
90	400 – 600	150 – 350	4000 – 5000
110	500 – 300	150 – 350	4000 – 5000

Source: Carlos Cadahia, Ediciones Mundi-Prensa. La Savia como índice de fertilización, 2008, page 246

B. Soil Solution Analysis

Soil solution for pH, salinity (usually reported as conductivity), and nutrient analysis can be extracted through lysimeters installed in the field – at 15-20cm depth, where strawberries have the bulk of their roots and at 50-60cm depth below most of the roots. Lysimeters are installed under vacuum pressure and pull water from the soil similar to the root of the plant. To extract suitable samples, the soil must have been recently wetted with rainfall or irrigation water.

1. Place the sample of extracted soil solution directly onto the respective sensors of LAQUAtwin pH, conductivity, sodium, nitrate, potassium, and calcium meters.

2. Record the results and monitor the nutrients on a weekly basis.

3. Rinse the sensors with clean water before testing another sample or storing them.

Results should be interpreted by comparing trends from season-to-season and block-to-block with strawberry performance indicators such as yield and fruit quality. Irrigation and drain water can also be analysed directly with LAQUAtwin pocket meters.

Strawberries have salt tolerance threshold of 1.0 mS/cm and will grow best in soil pH range of 5.5 to 6.5.

Results and Benefits

Plant sap analysis provides information on the current nutritional status of the plant. This information makes it possible to fine-tune N application, to maximize yield and quality, and to extend the fruiting season. The plant sap analysis complements soil solution analysis.

Soil solution analysis can help growers make decisions about their irrigation and nutrient management program. It should be used to enhance nutrient management and not as a measure of overall soil nutrient status. Nitrate and salinity levels are the key focus of soil solution monitoring. As nitrate is a highly mobile nutrient, soil solution can help identify incorrect nitrogen application, which could result in nitrate accumulation within the root zone and nitrate leaching below the root zone. Potassium and calcium are bound to soil and their levels in soil solution do not provide a reliable indication of their supply and availability to the crop. However, potassium, calcium, and sodium levels in soil, irrigation water, and drain water should be checked regularly. Salinity levels measured in soil solution allow growers to perform corrective action (e.g., increase irrigation to maintain salinity levels) before symptoms appear on leaves, yields or crop quality. Overwatering leaches fertilizer out of the root zone and results in environmental hazard (e.g., groundwater contamination). Soil solution analysis can be tested throughout the growing season.

References and Suggested Readings

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Revision 1.0, 6 March 2017

Figure 2: Cutting of petioles into small pieces.

Figure 3: Loading of petioles into the chamber of garlic press for sap extraction.

Figure 4: Placing sap directly onto LAQUAtwin nitrate sensor.

Figure 5: pH and conductivity testing on soil solution.

Figure 6: Irrigation wáter testing with LAQUAtwin pocket meters.

Rapid pH and Nutrient Analysis of Coco Coir and Coco Peat Using LAQUAtwin Pocket Meters

Coco coir and coco peat are commonly used in gardening as growth mediums. Due to slight differences in pH, it is important to measure the pH of the coco coir and coco peat before use, as this could affect the nutrient level present in the soil. This is done by mixing moist coco peat with distilled water and results can be obtained quickly by using the **LAQUAtwin** pH meter. Other information like salinity, electrical conductivity and nutrient levels (sodium, potassium, calcium) can also be obtained by using an appropriate **LAQUAtwin** pocket meter.

Introduction

The coconut industry contributes significantly to the Sri Lankan economy, accounting for approximately 12% of all agricultural produce in Sri Lanka. They are also the world's fourth-largest exporter of coconut and coconut-based products. In 2024, Sri Lanka's coconut industry generated USD 856.79 million[1]. According to existing demand for coconuts in Sri Lanka, around 4.0 billion nuts are required, but current level of production is only between 2.8 to 3.0 billion. As such, there are several strategies recommended by the Coconut Research Institute of Sri Lanka to try and step up the country's coconut crop, such as enhancing soil quality and managing soil water[2].

Aside from their use in food and beverages, coconuts have a wide array of uses in other applications as well. The husk, which is the outer layer of the coconut, can be harvested and processed to obtain coco coir and coco peat, which are commonly used in gardening as growing mediums. Coco coir contains natural rooting hormones that aid with plant development even though it is relatively low in nutritional value. Coco peat on the other hand, possesses more nutrients such as nitrogen, potassium and phosphorous, which are vital for plant growth. Both products have no overlapping features, nor do they cancel each other out, and as such are commonly used together in the market[3]. This makes it very versatile, as it can be mixed with other soil supplements, nutrients and fertilizers, to create customized soil blends for specific plant needs. One thing to note is that there are slight pH differences between coco coir and coco peat. Coco coir has a more neutral pH level of 6 to 6.8, while coco peat tends to be more acidic at a pH level of 5.5 to 6.5. When dealing with sensitive plants, it is thus important to measure the pH level of the soil, as the level of nutrients in the soil varies depending on the pH level, so that the plant receives an adequate amount of nutrients for its growth.

The **LAQUAtwin** series of water quality meters provide quick and accurate on-site readings from small volumes of sample across various parameters like pH, electrical conductivity (EC), salinity and ions such as sodium, potassium and calcium, depending on the meter chosen. They are cost-efficient and easy to use and operate, to ensure you get the most accurate reading, all in a small form factor. Each **LAQUAtwin** meter comes packaged with its own set of calibration standards to be used for calibration, according to manufacturer's instructions.

Method

Calibrate the LAQUAtwin meters being used using standards included with each kit, according to manufacturer's instructions.

Sample Preparation and Measurement

The method described below is to prepare a uniform and representative extract of coco peat that is suitable to measure electrical conductivity (EC), pH, salinity, as well as various ions such as sodium, potassium and calcium.

1. Collect 3-5 portions of coco peat from different locations within the bulk batch to avoid localised variation and mix them thoroughly to homogenise the sample. Add a small volume of distilled water (e.g. 20mL) to moisten the dry coco peat to allow for better mixing.
2. Combine the moist, homogenized coco peat and distilled water in a 1:5 ratio. (e.g. 30mL of moist coco peat with 150mL distilled water)

Note: For calcium measurements, 0.1M of barium chloride is used instead of distilled water, as calcium binds to organic matter in coco peat and may not be fully extracted if distilled water were used.

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3. Shake / stir the mixture vigorously and thoroughly for 3 minutes to ensure soluble ions are extracted into the aqueous phase.

   Example: A magnetic stirrer with stir bar or mechanical shaker can be used for this step.

4. Allow the solid particles to settle for about 30 minutes **OR** pass the solution through a filter paper to obtain a clear extract for measurement.
5. Measure filtrate immediately using the respective calibrated LAQUAtwin meters.

Results And Benefits

pH

pH affects nutrient solubility. Outside of a specific pH range, nutrients may become less soluble/more unavailable, leading to potential deficiencies. Hence, pH monitoring is required to ensure optimal nutrient availability to the plant and to avoid any deficiencies and toxicities which can affect plant growth.

Electrical Conductivity (EC)

Electrical conductivity is the measure of the ability of a substance in conducting electricity. While dissolved salts in solution contribute to conductivity, it can also be impacted by other dissolved substances. It also provides some insight into the salinity of the coco peat and the availability of nutrients present. It should be noted that while the terms electrical conductivity and salinity might be used interchangeably sometimes, electrical conductivity is affected by the concentration of **ALL** dissolved ions in solution, while salinity is only affected by dissolved salts **ONLY**.

Salinity

As mentioned above, while salinity may sometimes be referred to as electrical conductivity, salinity refers to **ONLY** the concentration of dissolved salts present (e.g. sodium chloride, calcium chloride). High salinity levels reduce water availability to the plant, eventually causing drought and plant death.

Sodium Ion

Coco peat naturally possesses moderate to high levels of sodium, especially if it's raw or unwashed. High levels of sodium can be toxic to plants as it competes with other essential nutrients like potassium and calcium. This causes osmotic stress to the plant as it inhibits water and nutrient uptake. This can be corrected by washing with water and buffering with calcium nitrate solution.

Potassium Ion

Potassium is an essential macronutrient for plants as it is responsible for flowering, fruiting and stress tolerance. Raw, unprocessed coco peat contains high levels of potassium and this causes uptake competition with other nutrients like calcium and magnesium. This could result in nutrient imbalances and deficiencies. One way to work around this is to wash the coco peat and buffering the coco peat with calcium nitrate solution.

Calcium Ion

Coco peat naturally contains low levels of calcium due to its cation exchange profile. Cation exchange sites in coco peat are often filled with potassium and sodium ions, and this can block calcium uptake of the plant unless it is corrected. Low calcium intake would result in calcium deficiency in plants, especially in fruiting crops like tomatoes or peppers. One way to correct this is to treat coco peat by buffering with calcium nitrate or calcium chloride solution, as this displaces sodium and potassium from the cation exchange sites.

Summarised below is a table of ideal values of each measurement parameter in coco peat:

Parameter	Coco peat	
	Raw, unwashed	Washed and buffered (ideal)
Electrical Conductivity (EC)	>0.8 mS/cm	<0.5 mS/cm
Salinity*	>2 g/L | >0.2 %	<1 g/L | <0.1 %
pH	5.5-6.5	5.5-6.8[4]
Sodium	200-1000 ppm	30-50 ppm
Potassium	1500-7000 ppm	100-500 ppm
Calcium	10-100 ppm	100-200 ppm

*Values are aligned according to international buyer requirements.

Technical Tips

1. Always calibrate the LAQUAtwin meter before use to ensure the most accurate readings, using standard solutions included in the kit.
   a. Clear old calibration data before each new calibration and perform fresh calibration of instrument before use.
   b. Perform new calibration if sample readings start to fluctuate and become inconsistent.
2. Keep sample preparation consistent (e.g. always dilute coco peat in a 1:5 ratio with distilled water) and avoid contamination, for the most accurate reading.
3. Clean the LAQUAtwin sensor thoroughly with distilled/tap water after each sample measurement to avoid and minimise cross-contamination between different samples.
   a. Take caution to gently dab the sensor with lint-free paper after rinsing to not scratch the sensor by accident.
   b. Replace sensor if calibration standard readings start to fluctuate and/or become inconsistent.
4. Ensure temperature consistency during calibration and sample reading.
   a. Sample readings may be affected by slight temperature variations, minimise any temperature fluctuations wherever possible (e.g. taking readings in an air-conditioned room rather than outdoors under the sun).

References And Suggested Readings

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2. **Sri Lanka Export Development Board,** *"Industry Capability of Coconut and Coconut Based Product Sector in Sri Lanka,"* SriLankaBusiness.com, accessed June 2025, https://www.srilankabusiness.com/coconut/about/industry-capability.html
3. **Coco Coir Global,** *"Coco Coir vs Coco Peat: Differences and Similarities,"* CocoCoirGlobal.com, accessed June 2025, https://cococoirglobal.com/coco-peat-vs-coco-coir/
4. **Sri Lanka Standards Institution.** (2025). SLS 1219:2025 — Coir fibre pith substrate: Requirements and test methods. Sri Lanka Standards Institution.

LAQUAtwin Pocket Meters Lineup

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Nutrients in Mangoes and Mango Leaves

Application Note

Introduction

Measuring leaf and fruit sap ions with meters such as the HORIBA LAQUAtwin is extremely important for mango production.

Sap measurements provide a snapshot of the actual nutrients moving in the tree, not just what is present in the soil. Soil tests alone are insufficient because nutrient availability in mango changes rapidly with flowering, fruit set, vegetative flush, irrigation, and environmental stress..

The LAQUAtwin meters can measure K^+, NO_3^-, Ca^{2+}, Na^+, pH, and EC in fruits, leaves, soil, and water.

Why Ion, pH, and EC Meters Are Essential for Mango Farms

Modern mango production is no longer limited by fertilizer availability, but by nutrient balance, timing, and plant uptake efficiency. Disorders such as poor flowering, excessive vegetative growth, uneven fruit size, internal breakdown, soft fruit, jelly seed, low Brix, and poor shelf life are almost always the result of nutrient imbalances that occur during the growing season—not at harvest.

For this reason, real-time measurement tools—ion, pH, and EC meters—have become essential instruments for professional mango farms.

Why ion measurements matter

Ion-specific measurements (K^+, Ca^{2+}, NO_3^-, Na^+) provide direct insight into what the tree is actually absorbing and transporting at that moment. Unlike soil tests or traditional leaf tissue analysis, sap ion measurements reflect current physiological conditions, allowing growers to detect problems early—often weeks before visual symptoms or irreversible fruit damage occur.

Key advantages include:

- Early identification of K–Ca imbalance, a key driver of soft fruit and internal breakdown
- Improved control of nitrogen-driven vegetative growth versus flowering
- The ability to adjust fertigation and foliar programs proactively
- Reduced waste from unnecessary fertilizer applications

In high-value cultivars such as Kent, Keitt, Tommy Atkins, Ataulfo, and Alphonso, these measurements directly affect export quality and storage performance.

Why pH and EC are equally important

While ion meters show what nutrients are present, pH and EC explain why uptake succeeds or fails.

- pH governs nutrient availability and ion competition at the root and leaf level. Even optimal Ca or K levels are ineffective if pH conditions restrict absorption.
- EC (Electrical Conductivity) provides a rapid indicator of total salt concentration and osmotic stress. Elevated EC reduces water uptake, suppresses calcium movement to fruit, and often precedes sodium-related stress.

Together, pH and EC measurements allow growers to:

- Detect salinity stress early
- Diagnose irrigation and fertigation problems
- Interpret ion readings correctly and avoid misinformed decisions

Without pH and EC context, ion data alone can be misleading.

Preparing Sap from Stone Fruit or Stone Fruit Leaves

Sample Collection

1. Select leaves or fruits
   - For leaves: Choose healthy, fully expanded leaves from similar positions
   - Avoid shaded, diseased, or stressed leaves.

- For fruits: Sample fruit juice rather than sap from vascular tissue. Fruit juice works well for nitrate, potassium, sodium, and calcium measurements.

2. Extract the sap

- Leaves: Use a leaf petiole sap press (like a garlic press) or a small handheld sap press to squeeze out the sap.
- Fruits: Peel and chop fruit. Crush or blend flesh; filter out solids so the meter only contacts clear liquid.
- If needed, dilute samples with deionized or distilled water so that the ion concentration falls inside the calibrated range of the meter.

STEP-BY-STEP PROTOCOL

Mango Leaf Sap (Petiole Sap) — Recommended Method

1 Sampling

When: Morning (8–11 am), avoid drought or heat stress
Which leaves:

- Fully expanded leaves from mid-shoot position
- Avoid diseased or shaded leaves

How many: 20–30 leaves per block or variety
Remove the petioles (leaf stems). The blades dilute sap and increase variability.

2 Sap Extraction

Equipment

- Garlic press or handheld sap press
- Clean plastic cup
- Coffee filter or syringe filter (optional)

Procedure

1. Chop petioles into 5–10 mm pieces
2. Press firmly to extract sap
3. Collect ≥0.5 mL total sap

Typical yield: 20 petioles → ~0.4–0.8 mL sap.



3 Dilution (IMPORTANT for mango)

Mango sap is usually too concentrated for Ca and K meters.
Standard dilution (recommended starting point):

Meter	Dilution
NO_3^-	1:5
K^+	1:10
Ca^{2+}	1:10
Na^+	1:5

How to dilute (example 1:10)
Take 0.10 mL sap and add 0.90 mL distilled / deionized water.
Mix gently.
Use disposable pipettes or syringes for accuracy.

STEP-BY-STEP PROTOCOL

Mango Fruit Juice

1 Sampling

- 3–5 representative mangoes
- Avoid damaged or overripe fruit

2 Juice Extraction

1. Peel and chop fruit
2. Crush or blend
3. Filter solids
4. Collect clear juice

3 Dilution

- K, Ca: usually 1:5 or 1:10
- NO_3^-, Na^+: often no dilution needed

Measurement

Before mesaurement the instrument must be calibrated.

1. Turn on the meter
2. Rinse the sensor with demineralized or normal tap water and dry carefully with a tissue
3. Place some of the 150ppm solution on the sensor and press the CAL button
4. Rinse the sensor with demineralized or normal tap water and dry carefully with a tissue
5. Place some of the 2000ppm solution on the sensor and press the CAL button
6. Rinse and dry the sensor
7. Place the extracted sap or juice onto the sensor
8. Wait for the reading to stablize (takes a couple of seconds)

EXPECTED VALUES

⚠ These are typical working ranges, not absolute sufficiency standards. Mango sap varies strongly with:

- Cultivar
- Crop load
- Irrigation
- Weather
- Growth stage

Mango Leaf Petiole Sap (ppm, mg/L)

Status	NO_3^-	K^+	Ca^{2+}	Na^+
Low	<250	<1400	<180	–
Adequate	250–600	1400–2800	180–450	<50
High	600–1000	2800–4200	450–750	50–150
Excessive	>1000	>4200	>750	>150

Mango requires controlled nitrogen to balance flowering and vegetative growth.

High K suppresses Ca movement → soft fruit and internal disorders.

Sodium should remain very low.

Mango Fruit Juice (ppm, mg/L)

	Range	Note
NO_3^-	<30	High nitrate is undesirable
K^+	800–1200	Excess → soft fruit, poor shelf life
Ca^{2+}	>35	Low Ca → jelly seed, breakdown
Na^+	<20	Indicates salinity stress

Note: Fruit Ca is much lower than leaf sap Ca.

Practical, Stage-specific Sap Ranges

Below are practical, stage-specific sap ranges tailored for Mangoes using HORIBA LAQUAtwin NO_3^-, K^+, Ca^{2+}, and Na^+ meters. These are working target ranges designed for orchard decision-making rather than laboratory diagnostics.

Leaf Petiole Sap (ppm, corrected for dilution)
STANDARD MANGO CULTIVARS
Examples: Kent, Keitt, Tommy Atkins, Ataulfo, Alphonso

	NO_3^-	K^+	Ca^{2+}	Na^+
Pre-Flowering	200–400	1800–3000	350–600	<50
Flowering – Fruit Set	250–500	2000–3200	400–650	<50
Early Fruit Growth	300–600	2200–3500	450–700	<50
Mid-Season	250–500	1800–3000	500–750	<50

MANGO FRUIT JUICE TARGETS (AT HARVEST)

	NO_3^-	K^+	Ca^{2+}	Na^+
Desired Range	<30	800–1100	>40	<20
K:Ca ratio		< 20:1		

K : Ca ratio (leaf sap)

The ratio in mango leaf sap is critically important for fruit quality, impacting firmness, size, and preventing disorders like "jelly seed" or internal breakdown, as potassium (K) and calcium (Ca) compete for uptake; optimal ratios ensure proper cell wall strength (Ca) and fruit filling (K).

Stage	Target
Flowering	< 8 : 1
Mid-season	< 6 : 1
Pre-harvest	< 4 : 1

Tips for Mangoes & Leaves

What to Measure

- Leaves (Petiole Sap): Good for rapid assessment of nutrient status (especially nitrate and potassium) during growing season.
- Juice: Suitable for quick quality checks (e.g., potassium or calcium content that might relate to fruit quality), but values may not directly reflect plant physiological status like sap measurements do.

Consistency

- Sample at similar times of day and environmental conditions to reduce variability.

Dilution & Compensation

- If ion concentrations exceed the meter's range, dilute the sample and apply a correction factor. For example, diluted plant sap readings must be multiplied by the dilution ratio

What about pH and EC?

pH and EC are also important, but they serve a slightly different purpose than ion-specific measurements like K^+, Ca^{2+}, NO_3^-, and Na^+.

1 pH (Hydrogen ion concentration)

Why it matters:
pH affects nutrient availability. Even if you apply enough Ca or K, if the pH is too high or too low, the plant cannot take it up efficiently.

Typical ranges for mango sap or irrigation water:
Sap: Usually 5.5–6.5
Irrigation / fertigation water: 6.0–7.0

Extreme pH can cause:

- Reduced uptake of Ca, Mg, Fe, Mn
- Nutrient imbalances causing poor flowering and fruit quality

Takeaway: pH is not an ion itself, but controls how well the plant can use other nutrients.

2 EC (Electrical Conductivity)

Why it matters:
EC measures total soluble salts in water or sap.

High EC in water or sap indicates salinity stress, which can:

- Reduce water uptake
- Increase Na^+ accumulation
- Interfere with K^+ and Ca^{2+} uptake

Typical target ranges:
Leaf sap EC: 1,0–3,0 mS/cm (varies by growth stage)
Irrigation water: <0.75 mS/cm preferred for Mangoes.
Monitor EC in irrigation water and sap together to detect salt stress early.

3 How they complement ion measurements

Parameter	Use	Critical for
K^+, Ca^{2+}, NO_3^-, Na^+	Direct ion status	Nutrient balance, disorder prediction
pH	Nutrient availability	Ensures applied nutrients can be absorbed
EC	Total salts / salinity	Detects stress, Na^+ interference

In short:
- Always check pH and EC for irrigation water and sap.
- Ion meters + pH/EC = full picture of plant nutrient status and stress risk.

Advantages of LAQUAtwin instruments for mango farms

The HORIBA LAQUAtwin instruments are uniquely suited to orchard use because they combine laboratory-grade ion-selective technology with true field practicality.

Key advantages include:
- Direct measurement of plant sap and fruit juice with no complex preparation
- Extremely small sample volume requirements, ideal for petiole sap
- Fast, repeatable results that enable same-day management decisions
- Ion-specific accuracy, allowing precise tracking of K, Ca, NO_3^-, and Na
- Portable, durable design suitable for orchard and packhouse environments
- Proven reliability across agriculture, research, and advisory services worldwide

Importantly, LAQUAtwin meters make frequent monitoring realistic, which is critical because nutrient dynamics change rapidly during post-bloom, fruit expansion, and pre-harvest stages.

The practical bottom line
Mango farms that integrate ion, pH, and EC monitoring move from calendar-based fertilization to data-driven nutrient management.

This leads to:
- Better fruit quality and consistency
- Improved storage performance
- Lower input costs
- Reduced environmental impact
- Greater confidence in management decisions

In today's high-cost, high-risk mango production systems, ion, pH, and EC meters are no longer optional diagnostic tools—they are essential management instruments. The LAQUAtwin platform makes this level of precision practical, affordable, and actionable for modern mango growers.

Disclaimer: The sap value ranges and interpretations presented in this application note are **indicative guidelines only**. Actual optimal values may vary depending on cultivar, rootstock, orchard age, crop load, growth stage, climate, irrigation water quality, and management practices. Sap analysis should be used as a **decision-support tool**, not as a standalone diagnostic method. For critical nutrient management decisions, sap measurements should be interpreted together with visual assessment, soil analysis, irrigation water analysis, and periodic laboratory tissue testing.

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Nutrients in Oranges and Citrus Leaves

Application Note

Introduction

Measuring leaf and fruit sap ions with meters such as the HORIBA LAQUAtwin is extremely important for oranges and citrus crops.

Sap measurements provide a snapshot of the actual nutrients moving in the plant, not just what is present in the soil. Soil tests alone are insufficient because nutrient availability in citrus changes rapidly with irrigation, flush cycles, fruit load, temperature, and salinity stress.

The LAQUAtwin meters can measure K^+, NO_3^-, Ca^{2+}, Na^+, pH, and EC in fruits, leaves, soil, and water.

Why Ion, pH, and EC Meters Are Essential for Citrus Farms

Modern citrus production is no longer limited by fertilizer availability, but by nutrient balance, timing, and plant uptake efficiency. Disorders such as small fruit, thick rind, poor color, granulation, soft fruit, low Brix, and reduced shelf life are almost always the result of nutrient imbalances that occur during the growing season—not at harvest.

For this reason, real-time measurement tools—ion, pH, and EC meters—have become essential instruments for professional citrus farms.

Why ion measurements matter

Ion-specific measurements (K^+, Ca^{2+}, NO_3^-, Na^+) provide direct insight into what the tree is actually absorbing and transporting at that moment. Unlike soil tests or traditional leaf tissue analysis, sap ion measurements reflect current physiological conditions, allowing growers to detect problems early—often weeks before visual symptoms or irreversible fruit damage occur.

Key advantages include:

- Early identification of K–Ca imbalance affecting fruit firmness and rind quality
- Improved control of nitrogen-driven vegetative growth versus fruiting
- The ability to adjust fertigation and foliar programs proactively
- Reduced waste from unnecessary fertilizer applications

In high-value citrus such as Navel and Valencia oranges, mandarins, and export-grade grapefruit, these measurements can determine whether fruit meets market grade.

Why pH and EC are equally important

While ion meters show what nutrients are present, pH and EC explain why uptake succeeds or fails.

- pH governs nutrient availability and ion competition at the root and leaf level. Even optimal Ca or K levels are ineffective if pH conditions restrict absorption.
- EC (Electrical Conductivity) provides a rapid indicator of total salt concentration and osmotic stress. Elevated EC reduces water uptake, suppresses calcium movement, and often precedes sodium or chloride toxicity.

Together, pH and EC measurements allow growers to:

- Detect salinity stress early
- Diagnose irrigation and fertigation problems
- Interpret ion readings correctly and avoid misinformed decisions

Without pH and EC context, ion data alone can be misleading.

Preparing Sap from Citrus fruit or Leaves

Sample Collection

1. Select leaves or fruits
- For leaves: • Choose healthy, fully expanded leaves from similar positions
- For fruits: Typically sample fruit juice rather than sap from the leaf veins; this works especially well for nitrate, potassium, sodium, and calcium since the meters are compatible with juice.

2. Extract the sap

- Leaves:
  - Use a leaf petiole sap press (like a garlic press) or a small handheld sap press to squeeze out the sap.
  - Citrus leaves are thick and fibrous—use petioles, not leaf blades, for consistency
- Fruit: Squeeze and collect the juice; filter out solids so the meter only contacts clear liquid.
- If needed, dilute samples with deionized or distilled water so that the ion concentration falls inside the calibrated range of the meter.

STEP-BY-STEP PROTOCOL

Citrus Leaf Sap (Petiole Sap) — Recommended Method

1 Sampling

When: Morning (8–11 am), avoid drought or heat stress
Which leaves:

- Fully expanded leaves from mid-shoot position
- Avoid diseased or shaded leaves

How many: 20–30 leaves per block or variety
Remove the petioles (leaf stems). The blades dilute sap and increase variability.

2 Sap Extraction

Equipment

- Garlic press or handheld sap press
- Clean plastic cup
- Coffee filter or syringe filter (optional)

Procedure

1. Chop petioles into 5–10 mm pieces
2. Press firmly to extract sap
3. Collect ≥0.5 mL total sap

Typical yield: 20 petioles → ~0.6–1.0 mL sap.



3 Dilution (IMPORTANT for Citruss)

Citrus sap is usually too concentrated for Ca and K meters.
Standard dilution (recommended starting point):

Meter	Dilution
NO_3^-	1:5
K^+	1:10
Ca^{2+}	1:10
Na^+	1:5

How to dilute (example 1:10)
Take 0.10 mL sap and add 0.90 mL distilled / deionized water.
Mix gently.
Use disposable pipettes or syringes for accuracy.

STEP-BY-STEP PROTOCOL

Citrus Fruit Juice

1 Sampling

- 3–5 representative Citruss
- Avoid damaged or overripe fruit

2 Juice Extraction

1. Chop fruit (with peel)
2. Crush or blend
3. Filter solids
4. Collect clear juice

3 Dilution

- K, Ca: usually 1:5 or 1:10
- NO_3^-, Na^+: often no dilution needed

Measurement

Before mesaurement the instrument must be calibrated.

1. Turn on the meter
2. Rinse the sensor with demineralized or normal tap water and dry carefully with a tissue
3. Place some of the 150ppm solution on the sensor and press the CAL button
4. Rinse the sensor with demineralized or normal tap water and dry carefully with a tissue
5. Place some of the 2000ppm solution on the sensor and press the CAL button
6. Rinse and dry the sensor
7. Place the extracted sap or juice onto the sensor
8. Wait for the reading to stablize (takes a couple of seconds)

EXPECTED VALUES

⚠ These are typical working ranges, not absolute sufficiency standards. Citrus sap varies strongly with:

- Rootstock
- Crop load
- Irrigation
- Weather
- Growth stage

Citrus Leaf Petiole Sap (ppm, mg/L)

Status	NO_3^-	K^+	Ca^{2+}	Na^+
Low	<300	<1500	<200	–
Adequate	300–700	1500–3000	200–500	<50
High	700–1200	3000–4500	500–800	50–150
Excessive	>1200	>4500	>800	>150

Citrus generally prefers moderate nitrate.
High K often suppresses Ca uptake → soft fruit and rind disorders.
Sodium should be very low in citrus.

Citrus Fruit Juice (ppm, mg/L)

	Range	Note
NO_3^-	<30	High nitrate is undesirable
K^+	900–1400	Very high K → poor shelf life
Ca^{2+}	>40	Low Ca → softness, rind breakdown
Na^+	<20	Indicates saline stress

Note: Fruit Ca is much lower than leaf sap Ca.

Practical, Stage-specific Sap Ranges

Below are practical, stage-specific sap ranges tailored for citrus, using HORIBA LAQUAtwin NO_3^-, K^+, Ca^{2+}, and Na^+ meters, with cultivar adjustments where this really matters.
These are working target ranges, not textbook sufficiency levels. They're designed for decision-making in orchards, not lab diagnostics.

Leaf Petiole Sap (ppm, corrected for dilution)
STANDARD ORANGES & GENERAL CITRUS
Examples: Navel, Valencia, mandarins, grapefruit

	NO_3^-	K^+	Ca^{2+}	Na^+
Post-Bloom / Flush	500–900	2500–4000	300–600	<50
Early Fruit Expansion	400–700	2200–3500	350–650	<50
Mid-Season	300–600	1800–3000	400–700	<50
Pre-Harvest	<300	1500–2500	450–800	<50

CITRUS FRUIT JUICE TARGETS (AT HARVEST)

	NO_3^-	K^+	Ca^{2+}	Na^+
Desired Range	<30	900–1300	>50	<20
K:Ca ratio		< 20:1		

K : Ca ratio (leaf sap)

The K : Ca (potassium : calcium) ratio in citrus leaf sap is important because it strongly influences fruit quality, storage life, and physiological disorder risk

.

Stage	Target
Post-flush	< 8 : 1
Mid-season	< 6 : 1
Pre-harvest	< 4 : 1

Tips for Citruss & Leaves

What to Measure

- Leaves (Petiole Sap): Good for rapid assessment of nutrient status (especially nitrate and potassium) during growing season.
- Juice: Suitable for quick quality checks (e.g., potassium or calcium content that might relate to fruit quality), but values may not directly reflect plant physiological status like sap measurements do.

Consistency

- Sample at similar times of day and environmental conditions to reduce variability.

Dilution & Compensation

- If ion concentrations exceed the meter's range, dilute the sample and apply a correction factor. For example, diluted plant sap readings must be multiplied by the dilution ratio

What about pH and EC?

pH and EC are also important, but they serve a slightly different purpose than ion-specific measurements like K^+, Ca^{2+}, NO_3^-, and Na^+.

1 pH (Hydrogen ion concentration)

Why it matters:
pH affects nutrient availability. Even if you apply enough Ca or K, if the pH is too high or too low, the plant cannot take it up efficiently.

Typical ranges for Citrus sap or irrigation water:
Sap: Usually 5.5–6.5
Irrigation / fertigation water: 6.0–7.0

Extreme pH can cause:

- Reduced uptake of Ca, Mg, Fe, Mn
- Nutrient imbalances affecting fruit quality

Takeaway: pH is not an ion itself, but controls how well the plant can use other nutrients.

2 EC (Electrical Conductivity)

Why it matters:
EC measures total soluble salts in water or sap.
High EC in water or sap indicates salinity stress, which can:

- Reduce water uptake
- Increase Na^+ accumulation
- Interfere with K^+ and Ca^{2+} uptake

Typical target ranges:
Leaf sap EC: 1–3 mS/cm

Irrigation water: <0.75 mS/cm

Use in practice:

- Monitor EC in irrigation water and sap together to detect salt stress early.
- If EC is high, foliar Ca sprays may be less effective — you may need adjustments in irrigation or fertigation.

3 How they complement ion measurements

Parameter	Use	Critical for
K^+, Ca^{2+}, NO_3^-, Na^+	Direct ion status	Nutrient balance, disorder prediction
pH	Nutrient availability	Ensures applied nutrients can be absorbed
EC	Total salts / salinity	Detects stress, Na^+ interference

In short:

- Always check pH and EC for irrigation water and sap.
- Ion meters + pH/EC = full picture of plant nutrient status and stress risk.

Advantages of LAQUAtwin instruments for Citrus farms

The HORIBA LAQUAtwin instruments are uniquely suited to orchard use because they combine laboratory-grade ion-selective technology with true field practicality.

Key advantages include:

- Direct measurement of plant sap and fruit juice with no complex preparation
- Extremely small sample volume requirements, ideal for petiole sap
- Fast, repeatable results that enable same-day management decisions
  Ion-specific accuracy, allowing precise tracking of K, Ca, NO_3^-, and Na
- Portable, durable design suitable for orchard and packhouse environments
- Proven reliability across agriculture, research, and advisory services worldwide

Importantly, LAQUAtwin meters make frequent monitoring realistic, which is critical because nutrient dynamics change rapidly during post-bloom, fruit expansion, and pre-harvest stages.

The practical bottom line

Citrus farms that integrate ion, pH, and EC monitoring move from calendar-based fertilization to data-driven nutrient management. This leads to:

- Better fruit quality and consistency
- Improved storage performance
- Lower input costs
- Reduced environmental impact
- Greater confidence in management decisions

In today's high-cost, high-risk citrus production systems, ion, pH, and EC meters are no longer optional diagnostic tools—they are essential management instruments. The LAQUAtwin platform makes this level of precision practical, affordable, and actionable for modern citrus growers.

Disclaimer: The sap value ranges and interpretations presented in this application note are **indicative guidelines only**. Actual optimal values may vary depending on cultivar, rootstock, orchard age, crop load, growth stage, climate, irrigation water quality, and management practices. Sap analysis should be used as a **decision-support tool**, not as a standalone diagnostic method. For critical nutrient management decisions, sap measurements should be interpreted together with visual assessment, soil analysis, irrigation water analysis, and periodic laboratory tissue testing.

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Nutrient Monitoring in Hydroponic Tomato Production

Application Note

Introduction

Hydroponic tomato production is a high-precision agricultural system where plant performance depends entirely on the grower's ability to manage water, nutrients, and environmental conditions. Unlike soil-grown crops, hydroponic systems offer no natural buffering capacity, meaning that even small imbalances in nutrient supply or salinity can rapidly affect plant health and fruit quality.

In these systems, nutrient management is not simply about supplying fertilizers, it is about ensuring that nutrients are **absorbed, transported, and utilized efficiently by the plant**.

Traditional monitoring methods such as nutrient solution analysis or periodic laboratory leaf tissue testing provide useful information, but they do not reflect the **real-time physiological status of the plant**.

Leaf sap analysis bridges this gap by providing a direct measurement of nutrients currently moving within the plant.

Research has demonstrated strong correlations between sap nutrient concentrations (NO_3^-, K^+, Na^+) measured using portable ion meters and laboratory reference methods, validating their use as reliable tools for fertigation management

Why Nutrient Monitoring is Critical in Hydroponics

Hydroponic tomato production is not limited by fertilizer availability, but by precision in nutrient management. In these systems, success depends on the grower's ability to monitor, interpret, and adjust nutrient supply in real time based on plant uptake and environmental conditions. By integrating ion measurements with pH and EC monitoring, growers gain a complete understanding of nutrient balance and plant stress, allowing them to make informed decisions throughout the crop cycle. This approach leads to improved yield, enhanced fruit quality, reduced physiological disorders, and more efficient use of inputs. Ultimately, the key to successful hydroponic tomato production lies in managing the difference between what is supplied in the nutrient solution and what the plant actually absorbs.

Why ion measurements matter

In hydroponic tomato production, nutrient availability is fully controlled by the grower, but plant uptake is influenced by multiple factors such as irrigation, climate, and growth stage. As a result, the nutrient composition of the solution does not always reflect what the plant is actually absorbing.

Ion-specific measurements of leaf sap provide direct insight into the nutrients actively moving within the plant at a given moment. This is particularly important in hydroponic systems, where changes in nutrient balance or salinity can occur rapidly and impact crop performance within a short time.

By measuring key ions such as nitrate (NO_3^-), potassium (K^+), calcium (Ca^{2+}), and sodium (Na^+), growers can monitor the plant's real-time nutritional status and detect imbalances before visible symptoms develop.

In hydroponic tomatoes, this enables:

- Better control of vegetative growth versus fruit production through nitrate (NO_3^-) management
- Optimization of potassium and calcium balance, critical for fruit size, firmness, and prevention of blossom-end rot
- Early detection of salinity stress through sodium (Na^+) accumulation
- More accurate adjustment of fertigation programs based on plant demand rather than assumptions

Ultimately, ion measurements allow hydroponic tomato growers to move from managing nutrient solutions to managing plant performance, improving yield, fruit quality, and overall crop consistency.

From Fertilization to Precision Management

Conventional approach

➡ Apply nutrients based on a fixed schedule

In traditional hydroponic management, fertigation programs are often based on standard recipes and predefined schedules. While this ensures that nutrients are supplied consistently, it assumes that plant uptake remains stable throughout the

growing cycle. In reality, nutrient demand changes continuously depending on plant stage, climate conditions, and stress factors. As a result, this approach can lead to over-fertilization, nutrient imbalances, and inefficient use of inputs.

Modern approach

➡️ Monitor plant response → adjust in real time

Precision nutrient management shifts the focus from what is supplied to what the plant actually absorbs. By using tools such as leaf sap analysis and monitoring key parameters (NO_3^-, K^+, Ca^{2+}, Na^+, pH, and EC), growers can track plant response in real time and make targeted adjustments to fertigation strategies.

This dynamic approach allows for continuous optimization of nutrient balance throughout the crop cycle, ensuring that the plant receives the right nutrients at the right time and in the right proportions.

Benefits of this transition

By moving from routine fertilization to data-driven management, growers can:

- **Optimize nutrient efficiency**
  Apply only the nutrients required by the plant, improving uptake and reducing losses
- **Reduce fertilizer waste and input costs**
  Avoid over-application and unnecessary nutrient accumulation in the system
- **Improve fruit uniformity and quality**
  Maintain consistent nutrient balance, especially critical for calcium-related disorders
- **Respond quickly to stress conditions**
  Detect imbalances early and correct them before they affect yield
- **Increase overall productivity and profitability**
  Achieve higher yields with better quality and more efficient resource use.

NUTRIENT BEHAVIOR & INTERACTIONS

How Nutrients Move in Tomato Plants

Nutrient transport in plants is closely linked to water movement:

1. Nutrients are dissolved in the irrigation solution
2. Roots absorb water and ions
3. Water moves upward through the xylem
4. Nutrients are distributed to leaves and fruits

This process depends heavily on **transpiration (water movement)**. If transpiration is reduced (e.g. high humidity), nutrient transport, especially calcium, is also reduced.

Understanding Key Nutrients

Nitrate (NO_3^-) — Vegetative Growth Regulator

- Drives leaf and stem development
- Excess:
  - Dense canopy
  - Delayed fruiting
- Deficiency:
  - Reduced growth and vigour

Potassium (K^+) — Yield and Quality Driver

- Essential for:
  - Fruit size
  - Sugar transport
  - Colour development
- Excess:
  - Suppresses calcium uptake
- Deficiency:
  - Poor fruit development

Calcium (Ca^{2+}) — Structural Stability

- Critical for:
  - Cell wall formation
  - Fruit firmness
  - Shelf life

Key limitation:

- Calcium is **immobile** in the plant
- It depends entirely on continuous water flow

Any disruption in water movement leads to localized deficiency

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Sodium (Na^+) — Salinity Indicator

- Not essential for tomatoes
- Accumulates in recirculating systems
- Competes with K^+ and Ca^{2+}

Even moderate increases can reduce productivity

Key Nutrient Interactions

Interaction	What Happens	Impact on Crop	What to Monitor	Recommended Action
K^+ vs Ca^{2+}	High potassium reduces calcium uptake	Blossom-end rot, soft fruit, poor shelf life	K^+, Ca^{2+}, K:Ca ratio	Reduce K input, maintain/increase Ca, rebalance fertigation
Na^+ vs K^+ / Ca^{2+}	Sodium competes with essential nutrients	Reduced growth, nutrient imbalance, lower yield	Na^+, EC	Flush system, check water quality, reduce salinity
NO_3^- vs Ca^{2+}	Low nitrate reduces calcium transport	Increased risk of Ca deficiency in fruits	NO_3^-, Ca^{2+}	Maintain adequate NO_3^- levels for proper transpiration
EC vs All Nutrients	High EC limits water and nutrient uptake	Salt stress, leaf burn, poor Ca movement	EC, Ca^{2+}	Dilute solution, increase irrigation frequency
pH vs Nutrient Availability	Incorrect pH reduces nutrient uptake	Multiple deficiencies despite adequate supply	pH	Adjust to optimal range (5.5–6.5)

STEP-BY-STEP PROTOCOL

What to Measure

For effective monitoring:

- Nutrient solution (tank + irrigation lines)
- Leaf petiole sap
- Optional: fruit juice for quality validation

Sampling

When: Morning (8–11 am), avoid drought or heat stress
Which leaves:

- Fully expanded leaves
- Mid-shoot position
- Avoid diseased or shaded leaves

How many: 20–30 leaves per block or variety
Remove the petioles (leaf stems). The blades dilute sap and increase variability.

2 Sap Extraction

Equipment

- Garlic press or handheld sap press
- Clean plastic cup
- Coffee filter or syringe filter (optional)

Procedure

1. Chop petioles into 5–10 mm pieces
2. Press firmly to extract sap
3. Collect ≥0.5 mL total sap

Typical yield: 20 petioles → ~0.6–1.0 mL sap.



3 Dilution (IMPORTANT for apples)

Tomato sap is often highly concentrated..
Standard dilution (recommended starting point):

Meter	Dilution
NO_3^-	1:5 or direct
K^+	1:10
Ca^{2+}	1:10
Na^+	1:5

How to dilute (example 1:10)
Take 0.10 mL sap and add 0.90 mL distilled / deionized water.
Mix gently.
Use disposable pipettes or syringes for accuracy.

STEP-BY-STEP PROTOCOL

Tomato Juice

1 Sampling

- 3–5 representative tomatoes
- Avoid damaged or overripe or underripe fruit

2 Juice Extraction

1. Wash and cut the tomato into small pieces
2. Crush or blend the sample thoroughly
3. Filter the micture
4. Collect clear juice only

3 Dilution

- K, Ca: usually 1:5 or 1:10
- NO_3^-, Na^+: often no dilution needed

EXPECTED VALUES

⚠ These are **working ranges for decision-making**, not strict sufficiency limits. Values vary with cultivar, climate, and growth stage.

Nutrient solution (Hydroponics)

Parameter	Typical Range	Notes
pH	5.5 – 6.5	Controls nutrient availability
EC	2.5 – 3.5 mS/cm	Higher EC = higher stress risk
NO_3^-	150 – 250 ppm	Drives vegetative growth
K^+	250 – 350 ppm	Supports fruit development
Ca^{2+}	150 – 200 ppm	Critical for fruit quality
Na^+	<50 ppm	Keep as low as possible

In recirculating systems, Na^+ and EC should be closely monitored

Leaf Petiole Sap (ppm, mg/L)

	NO_3^-	K^+	Ca^{2+}	Na^+
Low	<300	<2000	<200	-
Optimal	300-800	2000–4000	200-600	<50
High	>800	>4000	>600	>50

Leaf sap values provide a **real-time snapshot of nutrient uptake inside the plant**. This is the most important dataset for decision-making during the growing cycle. Values outside the optimal range indicate imbalances that may not yet be visible but can quickly affect growth and fruit quality. Monitoring sap allows early intervention and more precise fertigation adjustments.

Stage Based Sap Targets

Growth	NO_3^-	K^+	Ca^{2+}	Focus
Vegetative	600–900	3000–4500	300–500	Growth
Flowering	400–700	2500–4000	350–600	Balance
Fruit set	300–600	2200–3500	400–700	Ca Supply
Pre-harvest	<300	1500–2500	500–800	Quality

Nutrient requirements change throughout the crop cycle. Higher nitrate supports vegetative growth, while calcium and balanced potassium are essential during fruiting to ensure quality and shelf life. Adjusting nutrients by growth stage is key for optimal performance..

Tomato Fruit Juice (ppm, mg/L)

Parameter	Typical Range	Interpretation
NO_3^-	<50	High values indicate excess vegetative growth
K^+	1500-2500	High K may reduce shelf life
Ca^{2+}	>40 – 80	Low Ca linked to soft fruit
Na^+	<30	Indicates salinity stress

Advantages of LAQUAtwin instruments:

Hydroponic tomato production is not limited by fertilizer supply, but by precision in nutrient management. By using HORIBA LAQUAtwin instruments, growers can adopt real-time monitoring and move toward data-driven decision-making. This approach improves fruit quality and consistency, reduces physiological disorders, optimizes fertilizer use, and provides greater control over crop performance. In high-value hydroponic systems, real-time monitoring is essential.

Disclaimer: The sap value ranges and interpretations presented in this application note are **indicative guidelines only**. Actual optimal values may vary depending on cultivar, rootstock, orchard age, crop load, growth stage, climate, irrigation water quality, and management practices. Sap analysis should be used as a **decision-support tool**, not as a standalone diagnostic method. For critical nutrient management decisions, sap measurements should be interpreted together with visual assessment, soil analysis, irrigation water analysis, and periodic laboratory tissue testing.

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Nutrient Monitoring in Hydroponic Cucumber Production

Application Note

Introduction

Hydroponic cucumber production is a fast-growing, high-demand system where plant performance depends on precise control of nutrient supply, water availability, and environmental conditions. Unlike soil-grown crops, hydroponics offers no buffering capacity, meaning that nutrient imbalances or salinity issues can rapidly affect plant growth and fruit quality.

Cucumber plants have rapid nutrient uptake and high water demand, making them particularly sensitive to fluctuations in nutrient balance. As a result, relying only on nutrient solution composition is not sufficient to ensure optimal crop performance.

What matters is not only what is supplied, but what the plant actually absorbs.

Leaf sap analysis provides a real-time snapshot of nutrient uptake, allowing growers to detect imbalances early and adjust fertigation strategies proactively.

Why Nutrient Monitoring is Critical in Cucumbers

Hydroponic cucumber production is not limited by fertilizer availability, but by precision in nutrient management. In these systems, success depends on the grower's ability to monitor, interpret, and adjust nutrient supply in real time based on plant uptake and environmental conditions.

Cucumber crops are particularly sensitive and prone to:

- Rapid growth imbalances
- Fruit deformation and poor shape
- Bitter taste development under stress
- Tip burn and leaf disorders
- Reduced yield under suboptimal conditions

These issues often result from:

- Nutrient imbalance
- Excess salinity
- Environmental stress (temperature, humidity)

Because these problems can develop rapidly and before visible symptoms appear, early detection through ion monitoring is essential to maintain crop uniformity, yield, and fruit quality.

Why Ion Measurements Matter

In hydroponic cucumber production, nutrient availability is fully controlled by the grower, but plant uptake is strongly influenced by irrigation, transpiration, and climate conditions.

As a result, the nutrient composition of the solution does not always reflect what the plant is actually absorbing.

Ion-specific measurements of leaf sap provide direct insight into nutrients actively moving within the plant at a given moment. This is particularly important in cucumber production due to the crop's rapid growth rate and high nutrient demand.

By measuring key ions such as nitrate (NO_3^-), potassium (K^+), calcium (Ca^{2+}), and sodium (Na^+), growers can:

- Control vegetative growth and fruit balance (NO_3^-)
- Optimize fruit quality and size (K^+)
- Prevent tip burn and leaf damage (Ca^{2+})
- Detect salinity stress early (Na^+)

Ultimately, ion measurements allow growers to move from managing nutrient solutions to managing plant performance.

From Fertilization to Precision Management

Conventional approach

➡ Apply nutrients based on a fixed schedule

In traditional systems, fertigation follows standard recipes. However, cucumber nutrient demand changes rapidly depending on growth stage and environmental conditions, leading to inefficiencies and imbalances.

Modern approach

➡ Monitor plant response → adjust in real time

Precision nutrient management focuses on plant uptake rather than supply. By combining sap analysis with pH and EC monitoring, growers can continuously adjust nutrient delivery.

Benefits of this transition

- Optimized nutrient efficiency
- Reduced fertilizer waste
- Improved fruit uniformity
- Faster response to stress
- Increased productivity and profitability

Nutrient Behaviour & Interactions

How Nutrients Move in Cucumber Plants

Nutrient transport is driven by water movement:

- Nutrients dissolve in irrigation solution
- Roots absorb water and ions
- Water transports nutrients through the plant
- Nutrients reach leaves and fruits

This process depends on transpiration. Any reduction (e.g. high humidity) limits nutrient movement—especially calcium.

Key Nutrient Interactions

Interaction	What Happens	Impact on Crop
K^+ vs Ca^{2+}	High K reduces Ca uptake	Tip burn, poor quality
Na^+ vs K^+ / Ca^{2+}	Sodium competes with nutrients	Reduced growth
NO_3^- vs Ca^{2+}	Low nitrate reduces Ca transport	Tip burn risk
pH vs Nutrients	Incorrect pH limits uptake	Deficiencies
EC vs All	High EC reduces uptake	Salt stress

Maintaining balanced nutrient levels, controlling EC, and keeping pH within the optimal range (5.5–6.5) are essential for proper nutrient uptake. Regular monitoring allows timely adjustments such as reducing K, increasing Ca, flushing the system, or diluting the nutrient solution to maintain optimal crop health and performance.

STEP-BY-STEP PROTOCOL

What to Measure

- Nutrient solution
- Leaf petiole sap
- Optional: cucumber fruit juice

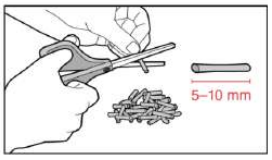
Cucumber Leaf Sap — Recommended Method

1 Sampling

When: Morning (8–11 am), avoid drought or heat stress
Which leaves:

- Fully expanded leaves
- Mid-shoot position
- Avoid diseased or shaded leaves

How many: 20–30 leaves per block or variety
Remove the petioles (leaf stems). The blades dilute sap and increase variability.



2 Sap Extraction

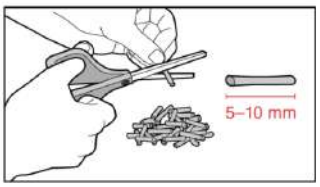
Equipment

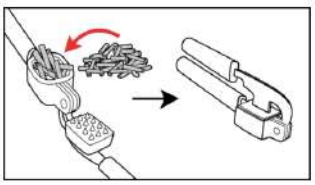
- Garlic press or handheld sap press
- Clean plastic cup
- Coffee filter or syringe filter (optional)

Procedure

1. Chop petioles into 5–10 mm pieces
2. Press firmly to extract sap
3. Collect ≥0.5 mL total sap

Typical yield: 20 petioles → ~0.6–1.0 mL sap.





3 Dilution

Cucumber sap can be quite concentrated and dilution is often recommended, but not always mandatory.:

Meter	Dilution
NO_3^-	1:5
K^+	1:10
Ca^{2+}	1:10
Na^+	1:5

How to dilute (example 1:10)
Take 0.10 mL sap and add 0.90 mL distilled / deionized water.
Mix gently.
Use disposable pipettes or syringes for accuracy.

STEP-BY-STEP PROTOCOL

Cucumber Juice

1 Sampling

• Select 3-5 cucumbers
• Avoid damaged or overripe cucumbers.

2 Juice Extraction

1. Chop cucumber (with peel)
2. Crush or blend
3. Filter solids
4. Collect clear juice & Measure

3 Dilution

Strongly recommended for consistent, high-quality measurements, especially for K and Ca

- K, Ca: usually 1:5 or 1:10
- NO_3^-, Na^+: often no dilution needed

EXPECTED VALUES

⚠ These are typical working ranges, not absolute sufficiency standards.

Nutrient Solution

Parameter	pH	EC	NO_3^-	K^+	Ca^{2+}	Na^+
Range	**5.5 – 6.5**	**2.0 – 3.0 mS/cm**	**120 – 200 ppm**	**200 - 300 ppm**	**120 - 180 ppm**	**<50 ppm**

Nutrient solution values define what is supplied to the crop, but they do not always reflect actual plant uptake. Since absorption is influenced by environmental conditions and nutrient interactions, solution monitoring should be combined with leaf sap analysis for accurate nutrient management.

Cucumber Leaf Sap (ppm, mg/L)

Status	NO_3^-	K^+	Ca^{2+}	Na^+
Low	<300	<1800	<150	-
Adequate	300-700	1800-3500	150-500	<50
High	>700	>3500	>500	>50

Leaf sap values provide a real-time indication of nutrient uptake and plant balance. Values within the optimal range support healthy growth and fruit development, while low or high values indicate potential deficiencies or imbalances that may affect crop performance. Results should be interpreted together, particularly the balance between K and Ca, and considered alongside EC and pH for accurate decision-making.

Cucumber Juice (ppm, mg/L)

	Range	Note
NO_3^-	<40	High values indicate excessive vegetative growth and may affect fruit quality
K^+	1200-2000	Supports fruit size and quality; excessive levels may reduce Ca uptake
Ca^{2+}	>30	Critical for fruit firmness and shelf life; low levels linked to tip burn
Na^+	<30	Indicator of salinity stress; should be kept as low as possible

Practical, Stage-specific Sap Ranges

Below are practical, stage-specific sap ranges tailored for hydroponic cucumber production using HORIBA LAQUAtwin NO_3^-, K^+, Ca^{2+}, and Na^+ meters.
These are **working target ranges**, not strict sufficiency levels. They are designed for **real-time decision-making in greenhouses**, not laboratory diagnostics.

Leaf Petiole Sap (ppm, corrected for dilution)
STANDARD HYDROPONIC CUCUMBER PRODUCTION

	NO_3^-	K^+	Ca^{2+}	Na^+
Early Vegetative (establishment)	600–900	2500–4000	200–400	<50
Rapid Growth / Pre-Flowering	500–800	2200–3500	250–450	<50
Early Fruiting	400–700	2000–3000	300–500	<50
Full Production (harvest phase)	300–600	1800–2800	350–550	<50

Cucumbers have **rapid growth and high nutrient demand**, especially during early development. As the crop transitions to fruiting, nitrate levels should decrease while calcium becomes increasingly important for maintaining leaf health and fruit quality.

HIGH-STRESS / HIGH-PERFORMANCE SYSTEMS
(High light, high density, recirculating systems)

Stage	NO_3^-	K^+	Ca^{2+}	Na^+
Vegetative	500–800	2200–3200	300–500	<40
Fruiting	300–600	1800–2600	350–600	<40
Peak Production	250–500	1500–2400	400–650	<40

Under high-performance conditions, maintaining **lower Na^+ and balanced K:Ca ratios** is critical. Stress conditions increase the risk of tip burn and reduced fruit quality, making monitoring even more important.

Cucumber JUICE TARGETS (AT HARVEST)

	NO_3^-	K^+	Ca^{2+}	Na^+
Desired Range	<40	1200–2000	> 30	<30

Fruit juice values reflect **final crop quality**. Low calcium or high potassium can indicate reduced shelf life or poor texture, while elevated sodium signals salinity stress affecting fruit development.

K : Ca ratio (leaf sap)

The K : Ca (potassium : calcium) ratio is critical in cucumbers because it directly affects Tip burn risk, Leaf health and fruit quality.

Stage	Target
Post-bloom	< 8 : 1
Mid-season	< 5 : 1
Pre-harvest	< 4 : 1

Even when calcium levels appear sufficient, excess potassium can block its uptake, leading to physiological disorders. Maintaining balance is more important than absolute values.

Practical Tips for cucumber Monitoring

What to Measure

- Leaves (Petiole Sap): Good for rapid assessment of nutrient status (especially nitrate and potassium) during growing season.
- Cucumber Juice: Suitable for quick quality checks (e.g., potassium or calcium content that might relate to fruit quality), but values may not directly reflect plant physiological status like sap measurements do.

Consistency

- Sample at the same time of day
- Avoid stress conditions (heat, drought)
- Use consistent leaf position

Dilution & Compensation

- Dilute when readings exceed meter range
- Apply correction factor based on dilution ratio

What about pH and EC?

pH and EC are essential complementary parameters that help interpret ion data correctly.

1 pH (Nutrient Availability)

Why it matters:

pH controls how easily nutrients are absorbed by the plant.

Typical ranges (hydroponic cucumbers):

- Nutrient solution: **5.5 – 6.5**
- Sap: typically similar range

Out-of-range pH can cause:

- Reduced Ca and Mg uptake
- Micronutrient deficiencies
- Imbalances despite correct nutrient supply

Takeaway: Correct pH ensures nutrients are usable.

2 EC (Electrical Conductivity)

Why it matters:

EC measures total salt concentration in the system.

High EC effects:

- Reduced water uptake
- Increased Na^+ accumulation
- Reduced Ca transport → tip burn

Typical ranges:

- Nutrient solution: **2.0 – 3.0 mS/cm**
- Drain monitoring recommended

Ion measurements show **what the plant absorbs**, while pH and EC explain **why uptake may be limited**. Together, they provide a complete picture of nutrient status and plant stress

Advantages of LAQUAtwin instruments for Hyroponic productions:

The HORIBA LAQUAtwin instruments make **frequent monitoring practical**, which is essential in hydroponic cucumbers where nutrient demand and plant response change rapidly during:

- Vegetative growth
- Flowering
- Fruit set and continuous harvest

Disclaimer: The sap value ranges and interpretations presented in this application note are indicative guidelines only. Actual optimal values may vary depending on cultivar, plant density, growth stage, climate conditions, irrigation water quality, and greenhouse management practices. Sap analysis should be used as a decision-support tool, not as a standalone diagnostic method. For critical nutrient management decisions, sap measurements should be interpreted together with visual crop assessment, nutrient solution analysis, irrigation water analysis, and, when necessary, periodic laboratory tissue testing.

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Nutrient Monitoring in Hydroponic Bell Peppers (Capsicum annuum)

Application Note

Introduction

Hydroponic bell pepper production requires precise control of nutrient balance, salinity, and plant uptake efficiency. Unlike soil-grown crops, nutrient availability in hydroponics changes rapidly with irrigation cycles, plant demand, and environmental conditions.

Real-time monitoring of nutrient solution and plant sap using ion, pH, and EC meters provides growers with immediate insight into plant health and nutrient dynamics—allowing faster and more accurate decision-making.

As seen in hydroponic systems, improper salt management can lead to physiological disorders such as **"Elephant's Foot"**, linked to sodium accumulation and high conductivity around the stem base

Why Ion, pH, and EC Monitoring Matters in Bell Peppers

Modern hydroponic pepper production is limited not by fertilizer availability, but by nutrient balance and uptake efficiency.

Common issues include:

- Blossom-end rot (Ca deficiency)
- Poor fruit firmness and shelf life
- Tip burn and leaf disorders
- Reduced yield due to salinity stress

Ion-specific measurements (K^+, Ca^{2+}, NO_3^-, Na^+), combined with pH and EC, allow growers to:

- Detect imbalances early (before visible symptoms)
- Optimize fertigation strategies
- Prevent salt accumulation and stress conditions
- Improve fruit quality and consistency

Why Calcium is Critical in Bell Peppers

Calcium plays a central role in cell wall strength, water transport, and fruit quality, and is essential for preventing physiological disorders such as blossom-end rot.

However, calcium is immobile in the plant, meaning a continuous supply and proper transport conditions are required.

Key interactions:

High K^+ or Mg^{2+} → reduces Ca uptake

High Na^+ → displaces Ca and increases stress

Low NO_3^- → reduces Ca transport

Maintaining the correct K:Ca balance is critical for pepper fruit quality and shelf life.

What to Measure

Key Parameters

- **K^+ (Potassium):** Fruit size, yield
- **Ca^{2+} (Calcium):** Fruit firmness, disorder prevention
- **NO_3^- (Nitrate):** Vegetative growth balance
- **Na^+ (Sodium):** Salinity and toxicity indicator
- **pH:** Nutrient availability
- **EC:** Total salt concentration and stress indicator

Method

Sample Collection

1. **Nutrient solution**

- Collect from reservoir and irrigation lines
- Ensure representative sampling across the system

2. **Leaf petiole sap**

- Select fully expanded leaves (mid-plant)
- Avoid stressed or diseased plants
- Sample at consistent times (morning recommended)

STEP-BY-STEP PROTOCOL

Leaf Sap (Petiole Sap) — Recommended Method

1 Sampling

When: Morning (8–11 am), avoid drought or heat stress
Which leaves:

- Fully expanded leaves
- Mid-shoot position
- Avoid diseased or shaded leaves

How many: 20–30 leaves per block or variety
Remove the petioles (leaf stems). The blades dilute sap and increase variability.

2 Sap Extraction

Equipment

- Garlic press or handheld sap press
- Clean plastic cup
- Coffee filter or syringe filter (optional)

Procedure

1. Chop petioles into 5–10 mm pieces
2. Press firmly to extract sap
3. Collect ≥0.5 mL total sap

Typical yield: 20 petioles → ~0.6–1.0 mL sap.



3 Dilution (IMPORTANT for Hydroponics Bell peppers)

Bell pepper (especially in hydroponics) can be highly concentrated, particularly for:

- K^+ (Potassium)
- Ca^{2+} (Calcium)

If the concentration is too high:

- It can **exceed the meter's measurement range**
- Readings become **inaccurate or unstable**
- You risk **underestimating or overestimating nutrient levels**

This is why dilution is commonly recommended in sap analysis

Standard dilution (recommended starting point):

Meter	Dilution
NO_3^-	1:5
K^+	1:10
Ca^{2+}	1:10
Na^+	1:5

How to dilute (example 1:10)
Take 0.10 mL sap and add 0.90 mL distilled / deionized water.
Mix gently.
Use disposable pipettes or syringes for accuracy.

TARGET RANGES (Hydroponic Bell Peppers)

⚠️ These are typical indicative working ranges, not absolute sufficiency standards. Adjust by cultivar and stage.

Nutrient Solution

- pH: 5.5 – 6.5
- EC: 2.0 – 3.5 mS/cm

Leaf Sap (ppm, mg/L)

Status	NO_3^-	K^+	Ca^{2+}	Na^+
Low	<300	<2000	<200	-
Optimal	300-800	2000-4000	200-600	<50
High	>800	>4000	>600	>50

Low values indicate nutrient deficiency or limited uptake → may reduce growth and yield

Optimal range reflects balanced nutrition → supports healthy growth, fruit set, and quality

High values suggest excess or imbalance → can lead to antagonism (e.g., high K reducing Ca uptake)

Very high Na^+ or EC signals salinity stress → may restrict water and calcium movement

➢ For best results, interpret values together (not individually), especially **K:Ca balance**, and always consider pH and EC to understand nutrient availability and plant stress.

Common Problems & Diagnosis

The "Common Problems & Diagnosis" table helps identify likely causes, but **effective management depends on confirming the full nutrient picture.**

Always interpret:

- **Ion values together (not in isolation)**

- **K:Ca balance** (critical for fruit quality)
- **EC and Na^+** (salinity and stress indicators)
- **pH** (controls nutrient availability)

For example:

- Low Ca^{2+} alone suggests deficiency
- But **low Ca^{2+} + high EC** → transport limitation (not supply issue)
- **High K^+ + normal Ca^{2+}** → potential Ca suppression

➡️ The goal is not just to detect problems, but to **understand the underlying cause** before adjusting fertigation.

Symptom	Likely Cause	What to check
Blossom-end rot	Low Ca or poor transport	Ca^{2+}, EC, K:Ca ratio
Soft fruit	High K, low Ca	K^+ vs Ca^{2+} balance
Leaf burn / tip burn	High EC or salt stress	EC, Na^+
Elephant's Foot	Sodium accumulation	EC, Na^+ levels
Excess vegetative growth	High nitrate	NO_3^-

Practical Recommendations

1. Monitor Regularly

- Measure **nutrient solution + leaf sap weekly**
- Increase frequency during:
  - Fruit set
  - Rapid growth stages
  - Stress conditions (heat, salinity)

2. Maintain Nutrient Balance (Not Just Levels)

- Avoid focusing on single nutrients
- Pay close attention to:
  - **K:Ca ratio** → key for fruit firmness and shelf life
  - Excess K can suppress Ca uptake
- Adjust formulations gradually to avoid shock

3. Control EC and Salinity

- Keep EC within optimal range (2.0–3.5 mS/cm)
- If EC is high:
  - Increase irrigation frequency
  - Reduce fertilizer concentration
- Monitor **Na^+ accumulation**, especially in recirculating systems

4. Optimise Calcium Uptake (Critical for Peppers)

- Ensure consistent water supply (Ca moves with transpiration)
- Avoid:
  - High EC
  - Excess K^+ or Mg^{2+}
- Maintain stable climate conditions to support transpiration

5. Manage pH for Nutrient Availability

- Keep pH between **5.5 – 6.5**
- Outside this range:
  - Ca, Mg, and micronutrient uptake may be reduced
- Adjust using appropriate acid/base dosing

6. Act Early, Not Reactively

- Use sap data to detect imbalances **before symptoms appear**
- Small early corrections are more effective than late interventions

7. Combine Sap and Fruit Monitoring

- Use **leaf sap** for real-time decisions
- Use **fruit analysis** to confirm quality outcomes
- Adjust strategy based on both

- Ion meters + pH/EC = full picture of plant nutrient status and stress risk.

Leaf Sap vs Fruit Measurement (Big Difference)

Measurement	What it tells you	When it's useful
Leaf sap	What the plant is absorbing ***now***	Decision making during the season
Fruit (pepper)	What actually ended up in the fruit	Quality control & post harvest insight

Advantages of measuring bell pepper fruit

1. Direct fruit quality indicator
Fruit measurement tells you:

- Calcium levels → firmness, shelf life
- Potassium levels → size, taste
- Nitrate levels → excessive vegetative push

2. Early detection of quality issues
You can catch problems like:

- Low Ca → risk of blossom-end rot
- High K / low Ca → soft fruit, poor storage
- High Na → salinity stress affecting quality

3. Validate your fertigation strategy
Leaf sap tells you what's happening today
Fruit tells you if your strategy worked.

4. Post-harvest & export quality control
For large hydroponic operations:

- Ensures fruit meets **export standards**
- Predicts **shelf life and storage performance**
- Helps reduce **rejections and waste**

5. Diagnose hidden imbalances
Sometimes leaf readings look fine, but fruit reveals:

- K suppressing Ca
- High EC limiting Ca movement
- Poor nutrient partitioning

"Leaf sap tells you how the plant is performing. Fruit analysis tells you if your management decisions delivered market-quality produce."

Advantages of LAQUAtwin instruments for Hydroponic Peppers

The HORIBA LAQUAtwin instruments are uniquely suited for your measurements because they combine laboratory-grade ion-selective technology with true field practicality.

Key advantages include:

- Direct measurement of nutrient solution and plant sap
- Minimal sample volume required
- Fast, on-site results for real-time decisions
- Portable and easy to use in greenhouse environments
- Enables proactive nutrient management
- Proven reliability across agriculture, research, and advisory services worldwide

The practical bottom line

Hydroponic pepper growers who adopt ion, pH, and EC monitoring move from reactive to **data-driven nutrient management**.
This results in:

- Improved fruit quality and consistency
- Reduced physiological disorders
- Optimized fertilizer use
- Greater control over crop performance

In high-value hydroponic systems, real-time monitoring is no longer optional it is essential.

Disclaimer: The sap value ranges and interpretations presented in this application note are indicative guidelines only. Actual optimal values may vary depending on cultivar, plant density, growth stage, climate conditions, irrigation water quality, and greenhouse management practices. Sap analysis should be used as a decision-support tool, not as a standalone diagnostic method. For critical nutrient management decisions, sap measurements should be interpreted together with visual crop assessment, nutrient solution analysis, irrigation water analysis, and, when necessary, periodic laboratory tissue testing.

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Nutrients in Blueberries and Blueberry Leaves

Application Note

Introduction

Measuring leaf and fruit sap ions with meters such as the HORIBA LAQUAtwin is extremely important for blueberry production.

Sap measurements provide a snapshot of the actual nutrients moving in the plant, not just what is present in the soil. Soil tests alone are insufficient because nutrient availability in blueberries changes rapidly with spring growth, flowering, fruit set, harvest cycles, irrigation practices, and environmental stress.

The LAQUAtwin meters can measure K^+, NO_3^-, Ca^{2+}, Na^+, pH and EC in fruits, leaves, soil and water.

Why Ion, pH, and EC Meters Are Essential for Blueberry Farms

Modern blueberry production is no longer limited by fertilizer availability, but by nutrient balance, timing, and plant uptake efficiency. Disorders such as poor vigor, small berries, uneven ripening, soft fruit, low firmness, short shelf life, and inconsistent yields are almost always the result of nutrient imbalances that occur during the growing season—not at harvest.
For this reason, real-time measurement tools—ion, pH, and EC meters—have become essential instruments for professional blueberry farms.

Why ion measurements matter
Ion-specific measurements (K^+, Ca^{2+}, NO_3^-, Na^+) provide direct insight into what the tree is actually absorbing and transporting at that moment. Unlike soil tests or traditional leaf tissue analysis, sap ion measurements reflect current physiological conditions, allowing growers to detect problems early—often weeks before visual symptoms or irreversible fruit damage occur.

Key advantages include:

- Early identification of K–Ca imbalance affecting fruit firmness and storage
- Improved control of nitrogen-driven vegetative growth versus fruit development
- The ability to adjust fertigation and foliar programs proactively
- Reduced waste from unnecessary fertilizer applications

In high-value fresh-market blueberries, these measurements directly affect market grade and postharvest performance.

Why pH and EC are equally important

While ion meters show what nutrients are present, pH and EC explain why uptake succeeds or fails.

- pH governs nutrient availability and ion competition at the root and leaf level. Blueberries are especially sensitive to pH, requiring acidic conditions for efficient nutrient uptake. Even optimal Ca or K levels are ineffective if pH is too high.
- EC (Electrical Conductivity) provides a rapid indicator of total salt concentration and osmotic stress. Elevated EC reduces water uptake, suppresses calcium movement, and often precedes sodium or chloride toxicity.

Together, pH and EC measurements allow growers to:

- Detect salinity stress early
- Diagnose irrigation and fertigation problems
- Interpret ion readings correctly and avoid misinformed decisions

Without pH and EC context, ion data alone can be misleading.

Preparing Sap from Blueberries or Blueberry Leaves

Sample Collection

1. Select leaves or fruits
- For leaves: Choose healthy, fully expanded leaves from similar positions.
- For fruits: Gather some fruits. Crush or blend. Filter solids to collect clear juice

2. Extract the sap
- Leaves: Use a leaf petiole sap press (like a garlic press) or a small handheld sap press to squeeze out the sap.

- Fruits: Crush or slice the Blueberry and collect the juice; filter out solids so the meter only contacts clear liquid.
- If needed, dilute samples with deionized or distilled water so that the ion concentration falls inside the calibrated range of the meter.

STEP-BY-STEP PROTOCOL

Blueberry Leaf Sap (Petiole Sap) — Recommended Method

1 Sampling

When: Morning (8–11 am), avoid drought or heat stress
Which leaves:

- Fully expanded leaves from mid-cane position
- Avoid diseased or shaded leaves

How many: 20–30 leaves per block or variety
Remove the petioles (leaf stems). The blades dilute sap and increase variability.

2 Sap Extraction

Equipment

- Garlic press or handheld sap press
- Clean plastic cup
- Coffee filter or syringe filter (optional)

Procedure

1. Chop petioles into 5–10 mm pieces
2. Press firmly to extract sap
3. Collect ≥0.5 mL total sap

Typical yield: 20 petioles → ~0.6–1.0 mL sap.



3 Dilution (IMPORTANT for Blueberry)

Blueberry sap is usually too concentrated for Ca and K meters.
Standard dilution (recommended starting point):

Meter	Dilution
NO_3^-	1:5
K^+	1:10
Ca^{2+}	1:10
Na^+	1:5

How to dilute (example 1:10)
Take 0.10 mL sap and add 0.90 mL distilled / deionized water.
Mix gently.
Use disposable pipettes or syringes for accuracy.

STEP-BY-STEP PROTOCOL

Blueberry Juice

1 Sampling

- 3–5 representative berries
- Avoid damaged or overripe fruit

2 Juice Extraction

1. Crush berries gently
2. Filter solids
3. Collect clear juice

3 Dilution

- K, Ca: usually 1:5 or 1:10
- NO_3^-, Na^+: often no dilution needed

Measurement

Before mesaurement the instrument must be calibrated.

1. Turn on the meter
2. Rinse the sensor with demineralized or normal tap water and dry carefully with a tissue
3. Place some of the 150ppm solution on the sensor and press the CAL button
4. Rinse the sensor with demineralized or normal tap water and dry carefully with a tissue
5. Place some of the 2000ppm solution on the sensor and press the CAL button
6. Rinse and dry the sensor
7. Place the extracted sap or juice onto the sensor
8. Wait for the reading to stablize (takes a couple of seconds)

EXPECTED VALUES

⚠ These are typical working ranges, not absolute sufficiency standards. Blueberry sap varies strongly with:

- Cultivar (highbush vs rabbiteye)
- Bush age
- Crop load
- Irrigation
- Weather
- Growth stage

Blueberry Leaf Petiole Sap (ppm, mg/L)

Status	NO_3^-	K^+	Ca^{2+}	Na^+
Low	<250	<1200	<150	–
Adequate	250–600	1200–2500	150–400	<50
High	600–1000	2500–3800	400–650	50–150
Excessive	>1000	>3800	>650	>150

Blueberries prefer moderate nitrate.
Excess K suppresses Ca uptake → soft berries and reduced shelf life.
Sodium should be very low.

Blueberry Juice (ppm, mg/L)

	Range	Note
NO_3^-	<30	High nitrate is undesirable
K^+	700–1100	Excess → soft fruit
Ca^{2+}	>25	Low Ca → poor firmness
Na^+	<20	Indicates saline stress

Note: Fruit Ca is much lower than leaf sap Ca.

Practical, Stage-specific Sap Ranges

Below are practical, stage-specific sap ranges tailored for Blueberrys, using HORIBA LAQUAtwin NO_3^-, K^+, Ca^{2+}, and Na^+ meters, with adjustments where this matters most (for example between highbush and rabbiteye types, and in cultivars prone to soft fruit and poor shelf life).
These are working target ranges, not textbook sufficiency levels. They're designed for decision-making in orchards, not lab diagnostics.

Leaf Petiole Sap (ppm, corrected for dilution)
STANDARD HIGHBUSH & RABBITEYE BLUEBERRIES

	NO_3^-	K^+	Ca^{2+}	Na^+
Budbreak – Early Growth	450–800	2200–3500	250–500	<50
Flowering – Fruit Set	350–650	2000–3200	300–550	<50
Early Fruit Growth	300–600	1800–3000	350–600	<50
Mid-Season / Harvest	250–500	1500–2600	400–650	<50
Late Season	<300	1300–2200	450–700	<50

BLUEBERRY JUICE TARGETS (AT HARVEST)

	NO_3^-	K^+	Ca^{2+}	Na^+
Desired Range	<30	700–1000	>30	<20
K:Ca ratio		< 20:1		

K : Ca ratio (leaf sap)

The K : Ca (potassium : calcium) ratio in Blueberry leaf sap is important because it strongly influences fruit quality, storage life, and physiological disorder risk.

Stage	Target
Post-bloom	< 8 : 1
Mid-season	< 6 : 1
Pre-harvest	< 4 : 1

Tips for Blueberry & Leaves

What to Measure

- Leaves (Petiole Sap): Best for rapid assessment of bush nutrient status during the growing season, especially for nitrate and potassium.
- Petiole sap reflects current uptake and transport and is the most useful tool for in-season management decisions in blueberries.
- Blueberry Juice: Suitable for quick quality checks (for example, potassium or calcium levels related to firmness and shelf life), but juice values do not reflect plant physiological status as directly as sap measurements.

Consistency

- Sample at similar times of day and environmental conditions to reduce variability.
- Morning sampling (8–11 am) under non-stress conditions provides the most repeatable results

Dilution & Compensation

- If ion concentrations exceed the meter's range, dilute the sample and apply a correction factor. For example, diluted plant sap readings must be multiplied by the dilution ratio

What about pH and EC?

pH and EC are also important, but they serve a slightly different purpose than ion-specific measurements like K^+, Ca^{2+}, NO_3^-, and Na^+.

1 pH (Hydrogen ion concentration)

Why it matters:
pH affects nutrient availability. Even if you apply enough Ca or K, if the pH is too high or too low, the plant cannot take it up efficiently.

Typical ranges for Blueberry sap or irrigation water:
Sap: Usually 5.0–6.0
Irrigation / fertigation water: 5.0–6.0

Extreme pH can cause:

- Reduced uptake of Ca, Mg, Fe, Mn
- Poor growth and fruit quality

Takeaway: pH is not an ion itself, but controls how well the plant can use other nutrients.

2 EC (Electrical Conductivity)

Why it matters:
EC measures total soluble salts in water or sap.

High EC in water or sap indicates salinity stress, which can:

- Reduce water uptake
- Increase Na^+ accumulation
- Interfere with K^+ and Ca^{2+} uptake

Typical target ranges:
Leaf sap EC: 1–3 mS/cm (varies by cultivar and growth stage)
Irrigation water: <0.75 mS/cm preferred for Blueberrys

Use in practice:

- Monitor EC in irrigation water and sap together to detect salt stress early.
- If EC is high you may need adjustments in irrigation or fertigation.

3 How they complement ion measurements

Parameter	Use	Critical for
K^+, Ca^{2+}, NO_3^-, Na^+	Direct ion status	Nutrient balance, disorder prediction
pH	Nutrient availability	Ensures applied nutrients can be absorbed
EC	Total salts / salinity	Detects stress, Na^+ interference

In short:

- Always check pH and EC for irrigation water and sap.
- Ion meters + pH/EC = full picture of plant nutrient status and stress risk.

Advantages of LAQUAtwin instruments for Blueberry farms

The HORIBA LAQUAtwin instruments are uniquely suited to orchard use because they combine laboratory-grade ion-selective technology with true field practicality.
Key advantages include:

- Direct measurement of plant sap and fruit juice with no complex preparation
- Extremely small sample volume requirements, ideal for petiole sap
  Fast, repeatable results that enable same-day management decisions
- Ion-specific accuracy, allowing precise tracking of K, Ca, NO_3^-, and Na
- Portable, durable design suitable for orchard and packhouse environments
- Proven reliability across agriculture, research, and advisory services worldwide

Importantly, LAQUAtwin meters make frequent monitoring realistic, which is critical because nutrient dynamics change rapidly during post-bloom, fruit expansion, and pre-harvest stages.

The practical bottom line
Blueberry farms that integrate ion, pH, and EC monitoring move from calendar-based fertilization to data-driven nutrient management.

This leads to:

- Better canopy balance
- Improved fruit size and firmness
- Enhanced storage performance
- Lower input costs
- Reduced environmental impact
- Greater confidence in management decisions
- In modern blueberry production, ion, pH, and EC meters are no longer optional—they are essential management instruments.

In today's high-cost, high-risk Blueberry production systems, ion, pH, and EC meters are no longer optional diagnostic tools—they are essential management instruments. The LAQUAtwin platform makes this level of precision practical, affordable, and actionable for modern Blueberry growers.

Disclaimer: The sap value ranges and interpretations presented in this application note are **indicative guidelines only**. Actual optimal values may vary depending on cultivar, rootstock, orchard age, crop load, growth stage, climate, irrigation water quality, and management practices. Sap analysis should be used as a **decision-support tool**, not as a standalone diagnostic method. For critical nutrient management decisions, sap measurements should be interpreted together with visual assessment, soil analysis, irrigation water analysis, and periodic laboratory tissue testing.

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CONSEJOS TÉCNICOS DE MANTENIMIENTO

HORIBA

Consejo técnico 01

Procedimientos de mantenimiento del sensor de pH LAQUAtwin

Es importante mantener un uso adecuado y un buen mantenimiento del medidor LAQUAtwin de pH, especialmente el sensor de pH el cual entra en contacto con las muestras, para así mantener la precisión y prolongar la vida útil del instrumento.

Materiales necesarios

Solución de calibración a pH 7
Part no. (3999960109)

Agua limpia (ej. destilada, desionizada)

Bastoncillos de algodón

Paño suave

Solución de limpieza 220 (Part no. 3014028653) - contiene 10% de Thiourea y 1% de ácido hidroclórico (HCl) para eliminar los residuos inorgánicos sobre la membrana del sensor y el **punto de junción.**

Solución de limpieza 250 (Part no. 3200366771) contiene < 0.5% de enzima proteasa, < 0.1% de azida de sodio y otros ingredientes (ver SDS) para eliminar los residuos de proteinas sobre la membrana del sensor y el **punto de junción**.

Acondicionamiento

Un sensor de pH seco puede dar resultados errático o tomar tiempo para estabilizarse. Condicionar el sensor de pH antes usarlo por la primera vez o después un largo tiempo de almacenamiento. Si aparece unos cristales blancos en el punto de junción eso es normal, simplemente enjuágalo con agua.

1. Coloca unas gotas de la solución a pH 7.00 sobre el sensor de pH. Asegúrese de cubrir la superficie entera del sensor con la solución.
2. Deje la solución de calibración sobre el sensor por lo menos una hora para bien hidratar la membrana.
3. Enjuaga el sensor con agua y sécalo con un paño suave sin aplicar presión en la membrana.
4. Realizar la calibración con solución estándar fresca antes de medir las muestras.

Limpieza

Un sensor de pH limpio es necesario para realizar una medición de pH precisa. La solución de limpieza depende de la naturaleza de la muestra medida en el sensor.

Lea la ficha de seguridad (SDS) de la solución de limpieza que será utilizada para usar los propios equipamientos de protección. Descarga las fichas SDSs de la solución de limpieza HORIBA en nuestra página www.horiba-laqua.com.

1. Saca los residuos de muestra indeseados que quedan en el sensor de pH usando la solución de limpieza apropiada. Para la mayoría de la muestras usa un detergente suave (neutral) y agua limpia. Para las muestras que contienen aceite, proteínas y sustancia que provoca manchas, usa las soluciones de limpieza siguientes.
   - Aceites – coloca unas gotas de solución de agua caliente con un detergente suave (5%) sobre el sensor. Nunca usar un solvente orgánico (e.g., acetona, etanol, etc.) para limpiar el sensor de pH porque puede causar danos y reducir la vida útil del sensor. El uso de este tipo de muestra invalida la garantía.
   - Proteínas – coloca unas gotas de solución de limpieza 250 sobre el sensor y déjelas 30 minutos.
   - Manchas - coloca unas gotas de solución de limpieza 220 o HCl a 0.1M sobre el sensor y déjelas 30 minutos.
2. Limpie ligeramente el sensor usando un bastoncillo de algodón, asegúrese de no aplicar ninguna presión sobre el sensor. Repite esa operación si necesario.
3. Enjuagar el sensor el sensor y acondicionarlo (ver el parágrafo acondicionamiento).

Si la calibración con solución de calibración fresca falla y que la limpieza no mejora el funcionamiento del sensor de pH, eso significa que el sensor tiene que ser reemplazado con un nuevo (Modelo S010, Parte no. 3200459834). El sensor es un consumible u su funcionamiento se deteriora con el tiempo aun con un uso normal y apropiado.

Si, la desinfección es necesaria, limpie la superficie del cuerpo del medidor y del sensor con un tejido limpio mojado con etanol o usa toallita de alcohol. Para el sensor plano, coloca unas gotas de solución de hipoclorito de sodio a 5% (NaClO) de 5 hasta 30 minutos y luego enjuagar el sensor con agua estéril.

Almacenamiento

Almacenar el sensor de pH limpiado seco, nunca dejar agua destilada o deionisada sobre el sensor de pH por un tiempo largo porque los sales internos (KCl) puede gotear a fuera de la membrana lo que reduce la vida útil del sensor. Acondicionar el sensor antes del próximo uso.

HORIBA

Consejo técnico 02

Procedimientos de mantenimiento del sensor de ion LAQUAtwin

Es importante mantener un uso adecuado y un buen mantenimiento del medidor LAQUAtwin Ion, especialmente el sensor de iones el cual entra en contacto con las muestras, para así mantener la precisión y prolongar la vida útil del instrumento.

Materiales necesarios

2000 ppm
Solución Ion
Standard

Agua limpia
(ej. destilada,
desionizada)

Bastoncillos
de algodón

Paño suave

Blanqueador
(<5% de hipoclorito de
sodio o NaClO)

Detergente Suave

Acondicionamiento

Un sensor de iones seco puede dar una lectura errática o una respuesta lenta. Acondicione el sensor de iones antes de usarlo por primera vez y después de almacenarlo en seco. Si hay polvo blanco o acumulación de sal en la unión después del almacenamiento en seco, es normal, simplemente enjuague con agua.

1. Coloque unas gotas de solución estándar de ión de 2000 ppm en el sensor de iones. Asegúrese de que todo el sensor plano esté cubierto con la solución.
2. Deje la solución estándar en el sensor de iones de 10 minutos a 1 hora.
3. Enjuague el sensor de iones con agua y séquelo con un paño suave.
4. Realice la calibración con soluciones estándar de iones nuevos antes de la medición de la muestra.

Limpieza

El rendimiento del sensor de iones puede deteriorarse, especialmente cuando se usa para analizar muestras sucias como tierra, savia, tejido vegetal, etc. Para restaurar el rendimiento del sensor de iones, elimine cualquier residuo de muestra no deseado en la superficie plana del sensor limpiándolo con detergente suave y agua. Si quedan manchas o depósitos resistentes, realice lo siguiente:

1. Coloque unas gotas de lejía de uso doméstico con menos del 5% de hipoclorito de sodio en el sensor y déjelas durante 5 a 30 minutos (como máximo).
2. Limpie suavemente el sensor con un bastoncillo de algodón. Evite aplicar presión y repita el paso 1, si es necesario.
3. Enjuague el sensor de iones con agua y acondicionelo (consulte Acondicionamiento).

La sal de hipoclorito de sodio (NaClO) es el ingrediente activo del blanqueador, que a menudo se usa en la desinfección y eliminación de manchas. En general, el blanqueador doméstico en el mercado contiene de 3 a 8% de NaClO. Para limpiar el sensor, se recomienda una solución de limpieza con menos del 5% de NaClO, así que diluya el blanqueador si es necesario. Nunca use ningún solvente orgánico (por ejemplo, acetona, etanol, etc.) para limpiar el sensor, ya que puede causar daños y acortar la vida útil del sensor. Este uso también anulará la garantía del sensor.

Si es necesaria la desinfección, limpie la superficie del cuerpo del medidor y el sensor con un paño limpio humedecido con etanol o use toallitas con alcohol. Para el sensor plano, enjuague bien con agua estéril después de limpiar con NaClO.

Si la calibración con soluciones estándar de iones nuevos falla repetidamente y la limpieza no restablece el rendimiento del sensor iónico, reemplace el sensor por uno nuevo (consulte los números de pieza a continuación). El sensor de iones es un producto consumible y su rendimiento se deteriora con el tiempo incluso en condiciones normales de funcionamiento.

- S022 Part no. 3200459867 – Sensor ión Sodio
- S030 Part no. 3200459868 – Sensor ión Potasio
- S040 Part no. 3200459870 – Sensor ión Nitrato
- S050 Part no. 3200459869 – Sensor ión Calcio

Almacenamiento

Guarde el sensor de iones limpio en seco. Asegúrese de acondicionar el sensor antes del próximo uso (ver Acondicionamiento).

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LAQUAtwin Conductivity Sensor Maintenance Procedures

Proper usage and maintenance of the LAQUAtwin conductivity meter, especially the conductivity sensor that comes in contact with samples, is important to maintain the accuracy and prolong the life span of the instrument.

Materials Needed

Conditioning Solution (Part no. 3999960114) - contains 5% surfactant for removing dirt on sensor surface

Clean water (e.g. distilled, deionized, tap)

Soft tissue

Cleaning Solution 220 (Part no. 3014028653) - contains 10% thiourea and 1% hydrochloric acid (HCl) for removing stubborn deposits on sensor surface

Mild detergent solution (5ml liquid detergent diluted to 100ml with water)

Conditioning

Condition the conductivity sensor before using it for the first time.

1. Place few drops of the conditioning solution onto the conductivity sensor. Make sure that the whole sensor is covered with the solution and there are no bubbles formed or trapped on the sensor.
2. Leave the conditioning solution for 10 to 30 minutes.
3. Rinse the conductivity sensor with water and blot it dry with soft tissue.
4. Perform calibration with fresh conductivity standard solutions prior to sample measurement.

Cleaning

A clean conductivity sensor is necessary for performing an accurate conductivity measurement. If the meter reading is incorrect or an error appeared on the display, the conductivity sensor requires cleaning.

1. Remove dirt or unwanted sample residues on the sensor by performing the conditioning procedure above. If conditioning solution is not available, a diluted detergent solution (e.g., 5ml liquid detergent diluted to 100ml with water) can be used.
2. If the conditioning procedure failed to restore the sensor performance and there are stubborn deposits on the sensor surface, use a stronger cleaning solution such as cleaning solution 220 and follow the procedure above.
   - Download and read the safety data sheet (SDS) of cleaning solution 220 at www.horiba-laqua.com before handling.
   - Never use any organic solvent (e.g., acetone, ethanol, etc.) to clean the conductivity sensor as it may cause damage and shorten the sensor lifespan. This usage will also void the sensor warranty.
3. If calibration with fresh conductivity standard solutions failed repeatedly and cleaning did not restore the conductivity sensor performance, replace the sensor with a new one (Model S070, Part no. 3200459672). The conductivity sensor is a consumable product and its performance deteriorates over time even under normal operating condition.
4. If disinfection is needed, wipe the surface of meter body and sensor with a clean cloth wet with ethanol or use alcohol wipes. For the flat sensor, place drops of 5% sodium hypochlorite (NaClO) solution for 5 to 30 minutes then rinse thoroughly with sterile water.

Storage

Store the clean conductivity sensor in dry condition.

pH Electrode Care and Maintenance Procedures

Your pH electrode will eventually reach the end of its useful life as its performance naturally degrades over time. To maximize the performance of your pH electrode and extend its life span, proper care and regular maintenance are equally required.

- Part no. 3014028653 Cleaning Solution 220 - contains 10% thiourea and 1% hydrochloric acid (HCl) for removing inorganic residues on glass membrane and junction

- Part no. 3200366771 Cleaning Solution 250 - contains less than 0.5% enzyme protease, less than 0.1% sodium azide, and other ingredients (See SDS) for removing protein residues on glass membrane and junction

- Part no. 3999960023 525-3 3.33M KCl pH electrode filling solution (for liquid-filled electrodes)

- Part no. 3999960031 500-7 pH 7.00 buffer

- Part no. 3999960029 500-4 pH 4.00 buffer

- Clean water (e.g., tap, distilled or deionized water) in a squirt bottle

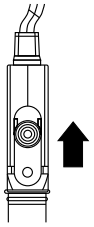
- Mild detergent

- Soft lint-free tissue

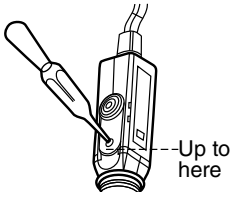
Refer to the safety data sheet (SDS) of the chemical solution to be used in cleaning and wear the appropriate personal protective equipment for safe handling. Download the SDSs of HORIBA solutions at www.horiba-laqua.com.

Refilling

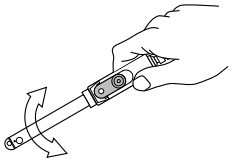
The pH electrode may be filled with either an ionic liquid solution (refillable or liquid-filled pH electrode) or ionic gel solution (sealed or gel-filled pH electrode). Gel-filled pH electrodes do not require routine refilling and typically require less maintenance than liquid-filled electrodes. Liquid-filled pH electrodes are constructed with refilling port, which is securely covered with a slider. The refilling port allows you to fill or empty the reference chamber.



- To top up or re-fill the reference chamber of liquid-filled pH electrode, push the slider upward to uncover the refilling port and insert a dropper containing fresh 3.33M potassium chloride (KCl) solution. The filling solution should reach the bottom of the refilling port.

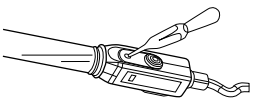


- The filling solution level must be maintained just below the refilling port and higher than the pH buffer or sample level during calibration and measurement. This creates a positive head pressure forcing the filling solution to leak into pH buffer or sample through the junction and preventing the reverse.



- Bubbles may form and get trapped within the solution of the sensing tip or reference chamber during transportation. This can affect the operation of your pH electrode. To dislodge the bubbles, gently shake the electrode body.

- If the filling solution inside the reference chamber gets contaminated with sample or microbial growth or the reading is drifting, change the filling solution. Tilt the pH electrode, uncover the refilling port, and draw out the old solution using a dropper before refilling it with fresh 3.33M KCl solution.



Conditioning

Nowadays, combination and 3-in-1 pH electrodes are commonly available. Both types of pH electrodes consist of glass electrode and reference electrode built in one body, but the latter is integrated with temperature sensor for detecting the temperature of the solution being measured.

The glass electrode has a silver-based electrical wire suspended in a neutral solution with KCl contained inside a special glass. The surface of the glass bulb or membrane at the tip of the electrode must be hydrated to function properly. This can be accomplished by immersing the glass membrane in an aqueous solution, where a hydrated layer that is responsible for the pH response of the glass, is developed.

Another component of the pH electrode that must remain hydrated is the junction of the reference electrode. The junction is made of porous material such as ceramic or sintered polyethylene, which allows filling solution of the electrode to leak into the solution being measured. Keeping the reference junction hydrated will prevent precipitation of KCl from the filling solution which may clog it and cause erratic or slow electrode response.

- All pH electrodes come with white protective cap. A sponge wet with pure water is positioned at the bottom of the cap to keep the glass membrane and junction moist. If you find KCl salts formed on the junction or refilling port of your pH electrode, simply rinse off using clean water. This KCl creep from the filling solution is normal.

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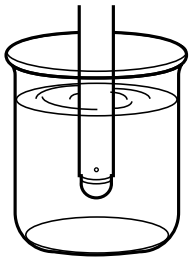
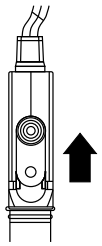


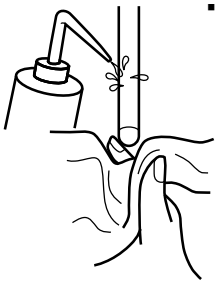
- A dry pH electrode will give inaccurate reading in pH measurement. Condition a dry pH electrode by soaking the glass membrane and junction in pH 7.00, 4.01 buffer, or tap water for at least 1 hour to regenerate the hydrated layer. Note: High salt solutions such as 3.33M KCl and the like are not recommended for conditioning our pH electrodes. After conditioning, rinse the pH electrode with clean water and proceed with calibration.

- Never touch the glass membrane with fingers as oil or dirt may coat the glass and interfere with measurement.

Calibration and Measurement

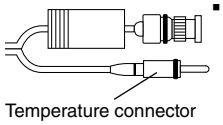


- If a liquid-filled pH electrode is in use, the refilling port must be uncovered and the filling solution level must be higher than the pH buffer or sample level. These conditions will ensure smooth outward flow of filling solution through the junction during calibration and measurement.

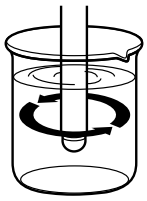


- Before and after measurement, rinse the pH electrode with clean water and/or with a portion of the next solution to be measured and blot with soft lint-free tissue to remove excess water or solution. Rinsing between measurements prevents contamination by carry-over on the electrodes. Avoid wiping or rubbing as this can scratch the glass membrane, remove the hydrated layer, and cause static charge, resulting in inaccurate pH readings.

- Calibrate frequently using at least two fresh pH buffers that bracket the expected sample pH value. Make sure that the glass membrane and junction of pH electrode are both immersed in pH buffer or sample.



- To compensate for temperate effect on pH, use either 3-in-1 pH electrode or combination pH electrode and temperature probe. If temperature probe is not available, check the solution temperature using a calibrated thermometer and input the reading into the meter.

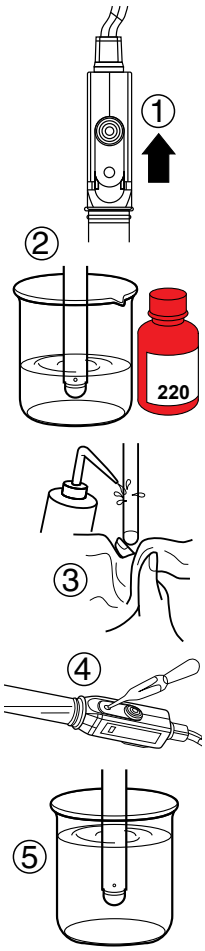


- Stir pH buffers and sample at same rate. Stirring provides representative pH value of a solution and faster electrode response. If stirring is not possible due to measurement noise, limited sample volume or other reasons, it may be abandoned in both calibration and measurement.

- There is a wide selection of pH electrodes and each model is designed to suit specific applications. Choose the best pH electrode suitable for your sample.

Cleaning

A clean, hydrated glass membrane and free-flowing junction are necessary in performing an accurate measurement of pH. The choice of cleaning solution should effectively remove all contaminants based on sample tested without damaging your pH electrode.

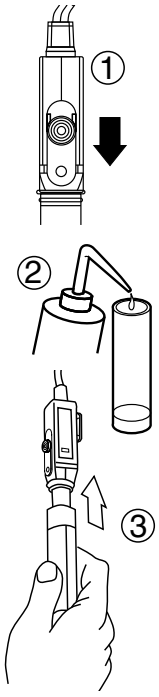


1. If the pH electrode is liquid-filled, uncover the refilling port.
2. Clean the tip of your pH electrode using the appropriate cleaning solution. Make sure that the glass membrane and junction are both immersed in cleaning solution.
   - General samples – Soak the pH electrode in diluted detergent solution for 5 to 10 minutes, while moderately stirring the solution. A strong cleaning solution is needed for clogged junction, stains, and electrodes exhibiting slow response. Soak the pH electrode in cleaning solution 220 or 0.1M HCl for at least 1 hour.
   - Oily samples – Soak the pH electrode in warm, diluted detergent solution for 5 to 10 minutes, while moderately stirring the solution. Alternatively, rinse the pH electrode with methanol or ethanol. Note: Alcohol is only applicable for glass-body electrodes. Never use organic solvents such as alcohol, acetone etc. to clean any plastic-body electrode as they may damage the body and shorten the life span. Use of organic solvents will void the electrode warranty.
   - Protein-containing samples – soak the pH electrode in cleaning solution 250 for at least 1 hour.
3. Rinse the pH electrode with clean water.
4. If the pH electrode is liquid-filled, draw out the old filling solution from the reference chamber and refill it with fresh 3.33M KCl (See Refilling).
5. Condition the pH electrode (See Conditioning).

If calibration with fresh pH buffers failed repeatedly and cleaning failed to restore the performance, replace the pH electrode with a new one.

Storage

pH electrodes must be clean before they are stored for any length of time.



1. If the pH electrode is liquid-filled, cover the refilling port with the slider to prevent evaporation of filling solution.
2. Wash the protective cap with clean water to wet the sponge and remove KCl salts.
3. Insert the pH electrode into the protective cap with wet sponge. The water will not dissipate easily as the cap fit snugly on the electrode body. This environment is enough to keep the glass membrane and junction moist. It is not necessary to fill the cap with clean water and soak the pH electrode tip.

Short-term storage:

Between measurements, the pH electrode can be soaked in pH 7.00 buffer or clean water (e.g., tap, distilled or deionized).

Conductivity Cell Care and Maintenance Procedures

Conductivity cells, also called conductivity electrodes or probes, are constructed with metal electrodes placed at a fixed distance in either glass or plastic body and surrounded by an outer tube. The distance between the electrodes divided by their surface area is known as cell constant. HORIBA offers two-electrode conductivity cells with cell constants expressed in cm^{-1} and m^{-1} units.

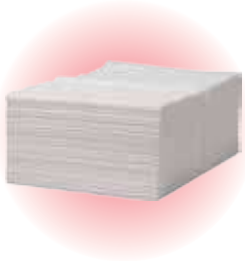
The cell constant and performance of a conductivity cell may degrade over time due to fouling of electrodes or peeling of their platinum black coating. To maximize the performance of a conductivity cell and extend its life span, proper care and regular maintenance are equally required.

Materials Needed

- 1M Hydrochloric acid (HCl)

- Clean water (e.g., tap, distilled or deionized water) in a squirt bottle or beaker

- Mild detergent



- Soft lint-free tissue

Refer to the safety data sheet (SDS) of any chemical solution that will be used in cleaning and wear the appropriate personal protective equipment (PPE) for safe handling.

Selection

1. Cell Type

HORIBA has two types of conductivity cells—submersible and flow-through. The differences between the two conductivity cells are outlined in the table below.

Submersible Cells

- Designed for measuring sample in a beaker or cup
- Require large volume of sample
- Sample is exposed to air

Flow-through Cells

- Designed for measuring flowing sample in a closed liquid system
- Require small volume of sample
- Sample is protected from air

2. Cell Constant

Each type of conductivity cell has four models with 0.1 cm^{-1} (10 m^{-1}), 1.0 cm^{-1} (100 m^{-1}) and 10 cm^{-1} (1000 m^{-1}) cell constants. When selecting a conductivity cell, check the expected conductivity of the sample and then look at the cell constants of conductivity cells. Choose a conductivity cell that covers the expected sample conductivity. The higher the conductivity value of sample, the higher the cell constant required. A conductivity cell with 1.0 cm^{-1} (100 m^{-1}) cell constant is the most commonly used because it measures low to high conductivity.

Conductivity	Cell Constant	Measurement Range
Low	0.1 cm^{-1} (10 m^{-1})	0.1 µS/cm – 10 mS/cm (10 µS/m – 1 S/m)
Normal	1.0 cm^{-1} (100 m^{-1})	1 µS/cm – 100 mS/cm (0.1 mS/m – 10 S/m)
High	10 cm^{-1} (1000 m^{-1})	10 µS/cm – 1 S/cm (1 mS/m – 100 S/m)

- Typically, a low conductivity solution is measured with a flow-through cell having a 0.1 cm^{-1} (10 m^{-1}) cell constant to prevent absorption of carbon dioxide (CO_2) from air, which can affect the conductivity value.
- A high conductivity solution is measured with a submersible cell having a 10 cm^{-1} (1000 m^{-1}) cell constant in a beaker.

3. Body Materials

To avoid compromising the appearance and performance of a conductivity cell, check the chemical components of the sample. The

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chemical components of the sample must be compatible to the wetted materials of the conductivity cell body. All HORIBA conductivity cells are glass-body, except 9382-10D.

Glass-body Cells	Plastic-body Cells
• Intended for laboratory use • Measures aqueous samples and mixed aqueous / organic samples • Electrodes are platinum metals coated with platinum black	• Intended for laboratory and field use • Measures aqueous samples • Electrodes are titanium metals coated with platinum black

- Glass-body conductivity cells are chemical-resistant. They can be used in aqueous samples as well as in samples containing organic solvents.
- Plastic-body conductivity cells are durable and rugged, making them ideal for field measurements.
- Conductivity cells with platinum electrodes are the best choice for chemically reactive solutions whereas those with titanium electrodes are suitable for low reactive aqueous solutions.

4. Temperature Sensor

Conductivity is highly temperature-dependent. A conductivity cell with built-in temperature sensor allows simultaneous measurement of conductivity and temperature. All HORIBA conductivity cells have built-in temperature sensor, except 3573-10C and 3574-10C.

- The temperature sensor detects the temperature of the solution being measured.
- The conductivity meter accepts the temperature reading to automatically correct or normalize the conductivity reading.

Conditioning

The electrodes of conductivity cells are coated with a layer of platinum black. The platinum black creates a higher effective surface area for the electrodes and eliminates polarization error. If the platinum black is dry, dirty, or peeled off, it will adversely affect the conductivity measurement.

- Prior to use, soak the conductivity cell in clean water (e.g., tap, distilled, or deionized water) for at least 1 hour, if the platinum black is dry. Make sure that the water level is right on the mark indicated in the cell body or it fully covers the electrodes.
- Note that the 9382-10D plastic conductivity cell is soaked in pure water when shipped to prevent the platinum black from drying.

Calibration and Measurement

- Prior to calibration, select the desired measurement unit and enter the cell constant (indicated on the cap of the conductivity cell) into the meter settings.
- Before and after measurement of each solution (standard or sample), rinse the conductivity cell with clean water and/or with a portion of the next solution to be measured. If water is used in rinsing, wipe the conductivity cell with a tissue to remove excess water. Rinsing between measurements prevents cross contamination.
- When immersing the conductivity cell in a solution, make sure that the solution level is right on the mark indicated in the conductivity cell body. If there is no marking indicated in the body, make sure that the metal electrodes are completely immersed in a solution.
- Calibrate at least once a day using a fresh standard solution that has a conductivity value as close as possible to the expected sample value. After calibration with a standard solution, the meter will display a calibrated cell constant. The calibrated cell constant should be within ±10% of the nominal cell constant. The conductivity standard solution should give a reading of expected value ± 5%.
- HORIBA meters allow calibration within ±30% of the nominal cell constant.
- To detect temperature and compensate its effect on conductivity, use a conductivity cell with built-in temperature sensor. If the conductivity cell has no built-in temperature sensor, check the solution temperature using a calibrated thermometer and enter that temperature into the meter.
- Stir conductivity standards and sample at same rate. Stirring provides representative conductivity value of a solution. If stirring is not possible due to limited sample volume or other reasons, it may be abandoned in both calibration and measurement.
- Dislodge any bubbles formed inside the conductivity cell.

Cleaning

A clean conductivity cell is necessary in performing an accurate conductivity measurement. The choice of cleaning solution should effectively remove all contaminants based on sample tested without damaging the conductivity cell.

Clean the part of conductivity cell in contact with sample using the appropriate solution and then rinse it thoroughly with clean water. Abrasive objects should never be used in cleaning. A piece of cotton soaked in a cleaning solution can be used with caution.

- General samples – Simply wash the conductivity cell with clean water. If there are sample residues clinging to the conductivity cell, immerse the conductivity cell in diluted detergent solution for 5 to 10 minutes while moderately stirring the solution.
- Oily samples – Immerse the conductivity cell in warm, diluted detergent solution for 5 to 10 minutes while moderately stirring the solution. Alternatively, wash or wipe the conductivity cell with acetone or ethanol.

  Note: Never soak the plastic-body conductivity cell in organic solvents such as alcohol, acetone etc. because these solutions may damage it. Also, this action will void the warranty.
- Lime or hydroxide-containing samples – Soak the conductivity cell in 1M HCl for 30 minutes. Alternatively, soak the conductivity cell in detergent solution containing 5% household bleach for 30 minutes.

Storage

Conductivity cells should be clean before they are stored for any length of time.

- Short-term: Between measurements and overnight, store the conductivity cell in clean water. Before inserting the conductivity cell into the protective cap, place sufficient amount of clean water to cover the metal electrodes. Those conductivity cells without protective cap (i.e., 3551-10D & 3553-10D) can be soaked in a beaker containing clean water.
- Long-term: Store the conductivity cell dry. Make sure to perform conditioning before use (See Conditioning).
- Avoid storing the conductivity cell in places with direct sunlight or high temperature and humidity.

29 June 2017, Rev. 0

Procedure for Setting mmol/L Unit in LAQUAtwin Ion Pocket Meters

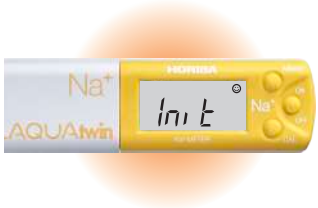
This procedure is only applicable for LAQUAtwin Na-11, K-11, NO3-11, and Ca-11 models, which have special set-up mode to show reading in mmol/L unit. Note that the mmol/L unit itself is not indicated in the special set-up mode and will not appear on the LCD after following this procedure.

Scan QR code with your mobile device to know more about LAQUAtwin Ion Pocket Meters

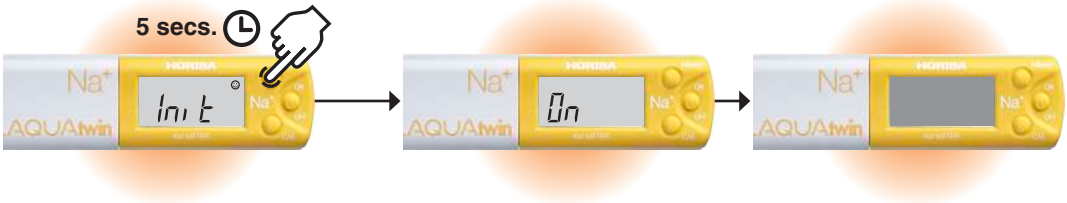
1. Press ON/OFF button to switch off the meter.

2. Press and hold MEAS, CAL, and ON/FF buttons simultaneously for 3 seconds.

3. Wait for the meter to display Init.



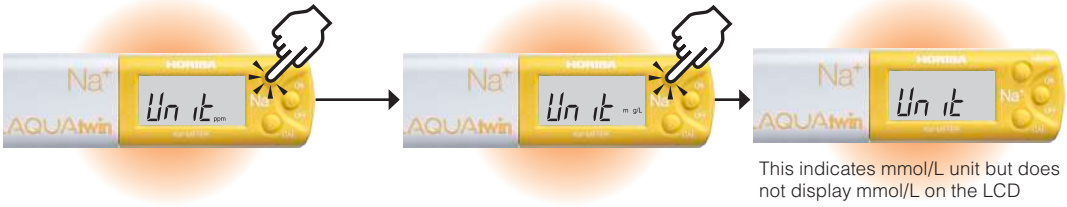
4. Press and hold MEAS button for 5 seconds. The meter will display ON and switch off automatically.



5. Press MEAS and ON/OFF buttons simultaneously for 3 seconds.

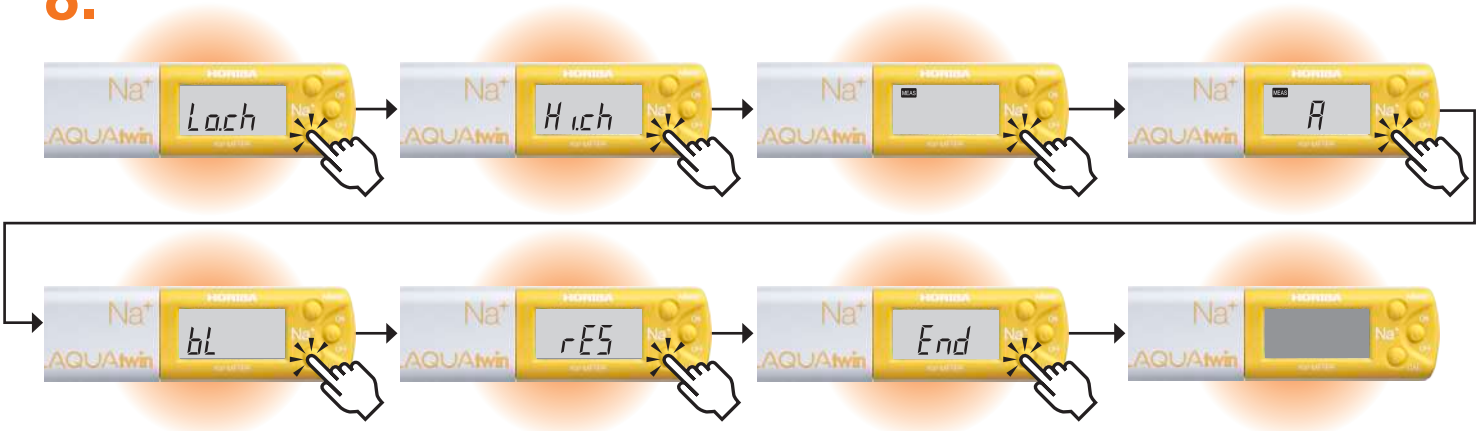
6. Wait for the meter to display unit setting.

7. Press MEAS button repeatedly until both ppm and mg/L units disappear and Unit alone is displayed.



This indicates mmol/L unit but does not display mmol/L on the LCD

8. Press CAL button repeatedly until the meter switches off.



30 August 2017, Rev. 0