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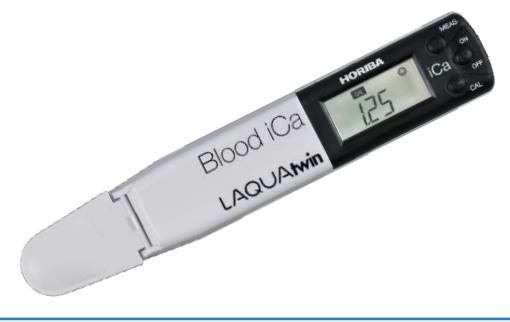


NOTAS DE APLICACIONES GANADERÍA



Ionized Calcium Measurement of Bovine Blood

Milk fever, or Sub Clinical Hypocalcemia (SCH) is a significant problem with dairy cows. Total calcium levels in the cows' blood drop after lactation. By measuring the ionized calcium levels of the blood directly cow side, the treatment can start sooner and is more effective.



Introduction

One of the biggest challenges for the periparturient dairy cow is the maintenance of ideal blood calcium concentrations to support milk production and immune function. Sub clinical hypocalcemia (SCH) is a prevalent condition afflicting approximately 50% of multiparous dairy cows in the early postpartum period (Reinhardt et al., 2011), and is a disorder being characterised by various research groups. Therefore, measurement of calcium to assess individual animal calcemic status and optimize preventative strategies for SCH is important.

Dairy cows experience important physiological changes around parturition. Due to the onset of lactation, leading to increased demand for Ca, blood Ca concentration decreases suddenly in the 2 to 3 days around calving (Quiroz-Rocha et al., 2009), in acute cases already in the first 6-12 hours after calving....so measuring at this point is very important to assess whether the cow might become a downer cow or not.

The animal is then affected by

hypocalcemia, which can be a clinical disease in about 5% of the cows (NAHMS, 2002), or a subclinical disease with an incidence of around 50% in cows with more than 2 lactations (Horst et al., 2003).

Despite the fact that the severity of the disease is greater in the clinical cases, subclinical cases are also important because (1) they are far more frequent, (2) they cannot be easily diagnosed, and (3) they may impair the longevity and productivity of the cow (Goff, 2008; Murray et al., 2008).

It is commonly assumed that dairy cows experience subclinical hypocalcemia (SCH) when total serum Ca is <2.0 mM (8.0 mg/dL) and clinical hypocalcemia when serum Ca levels are <1.5 mM (6.0 mg/dL; Goff, 2008), but other studies apply different ranges to determine the severity of hypocalcemia. For example, Chapinal et al. (2012) defined that a normocalcemic cow would have serum Ca levels >2.20 mM, Goff (2008) widened the criterion to a range from 2.12 to 2.50 mM, and Martinez et al. (2012) proposed >2.14 mM as the cutoff value for normocalcemia.

Current situation

Cow side calcium blood analyzer has so far not really been available for practical field conditions. The LAQUAtwin Ca-11C is currently the only reliable method for a low price per testing.

Before the release of the LAQUAtwin Ca-11-C, the only reliable alternative was the use of a Blood Gas Analyzer. These analyzers are expensive and can only be used in a laboratory. Samples must be sent to a laboratory for analysis, which takes precious time, the cost are also considerable.

The Alternative

The new LAQUAtwin CA-11C has been specially developed for cow side measurement of ionized calcium in blood. Ionized calcium reflects more accurately the current calcemic blood situation compared to total blood calcium as it equals the free available calcium ions.

The easy to use meter gives measurement results within seconds against a fraction of the cost of current measurement methods.

Research & Development

Research by the university of Cornell has proven the functionality of the LAQUAtwin Ca-11C meter for measurement of ionized calcium in bovine blood. The meters show a good relation compared to the laboratory gold standard benchtop blood-gas analyzer (fig.1).

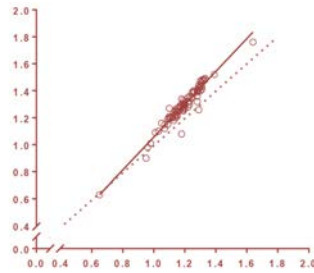
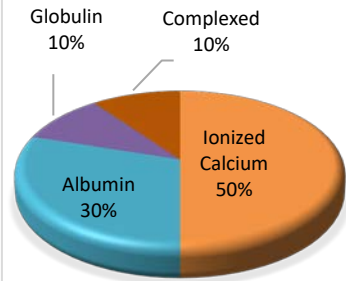


Fig. 1 Relation between reference analyzer (ABL-800 FLEX, Radiometer Medical) and the HORIBA LAQUAtwin Ca-11C @ 22°C

tCa vs iCa

The tCa value is most commonly measured, but this does not measure the active calcium (iCa) properly as iCa can transfer to and from the other bound calcium ions (complexed, Albumin, Globulin). tCa consists for about 50% out of iCa.



Method



Calibrate the meter after maximum 10 measurements. Highest accuracy when calibrated after each measurement.



Scan the QR code to watch the full measurement procedure at YouTube.

Hints & Tips

The accuracy and repeatability of the measurements depend on the how the meter is operated and maintained. This is also important for the lifetime of the Ion Selective Electrode, good care and maintenance will result in better results.

Calibration

- The more often the meter is calibrated to more accurate the readings will become.
- Always use the two standards supplied by HORIBA, other standards will not work!
- Calibrate first with 1.25 mmol/L [StP1] followed by 2.50 mmol/L [StP2]
- Only 0.5 to 1 ml of each solution is required.
- Be sure to cover the complete sensor with the solution.
- Rinse the sensor with the protein cleaning solution after each calibration point.
- Never re-use the calibration solutions.

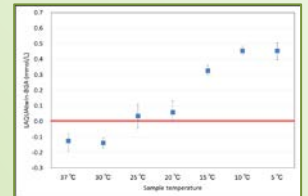
Sampling

- Whole blood and serum can be measured.
- Use lithium heparin as Anticoagulant to preserve the sample.
- Only 0.5 to 1 ml of each sample is required.

Temperature

Best results are obtained when the sample and meter are at the same temperature. Best performance will be achieved at

25 °C. In cold conditions, keep the sample in your pocket to prevent it from cooling down before taking the measurements. In hot conditions it is advised to perform the reading in a temperature-controlled location.



Storage

Store the meter in a dry place and preferably do not expose it to temperatures below 0 °C and above 40 °C. The measurement results are temperature dependent; it will take longer to get accurate measurements due to the time it takes for the electrode to reach best operating conditions.

Maintenance

- Always rinse the sensor with the cleaning solution after each measurement or calibration.
- Wipe off any residues from the sensor with a lint free tissue. Be careful as the glass sensor is only 0.8 mm thick.

Unit conversion

Conversion of ionized calcium to total calcium is roughly calculated by 2. There is no fixed and correct formula as the amount of ionized calcium is influenced by other calcium binding proteins like Albumin. Other conversions are:

To mg/L = mmol/L x 40.08

To mg/dL = mmol/L x 4.008

To mEq. = mmol/L / 2



With over 70 years of engineering excellence, HORIBA's diverse range of water quality analyzers and electrodes are ideal for everyday laboratory needs through to the most demanding of applications. Visit our website for a wealth of useful information and water quality measurement tips to help you obtain the best results in your work.



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Cow-side measurement of ionized calcium made possible!

LAQUAtwin

Compact Bovine Blood iCa Checker



Calcium is an important macromineral for dairy cows. Measurement of iCa cow-side can be of great value to veterinarians and producers. An innovative and lower cost instrument could help with more timely decisions and avoid submission of blood samples to a laboratory.



Current situation

The dairy veterinary field is progressively studying subclinical hypocalcemia. To detect this condition real time using the iCa Checker can make a significant improvement in an animal's health.

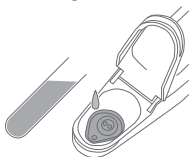


Beyond Water with You

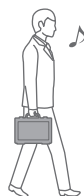
HORIBA iCa checker performance ...

Quick and Easy measurements

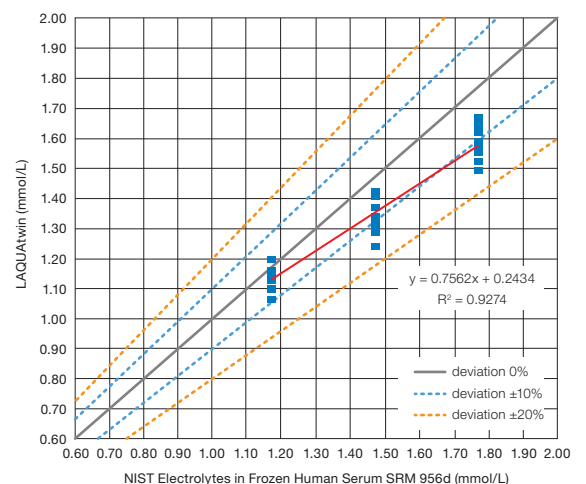
- (1) Place a drop of sample and close the light cover
- (2) Press MEAS button
- (3) The measurement is complete when the ☺ is lit up



Portable and results are complete in seconds on-site



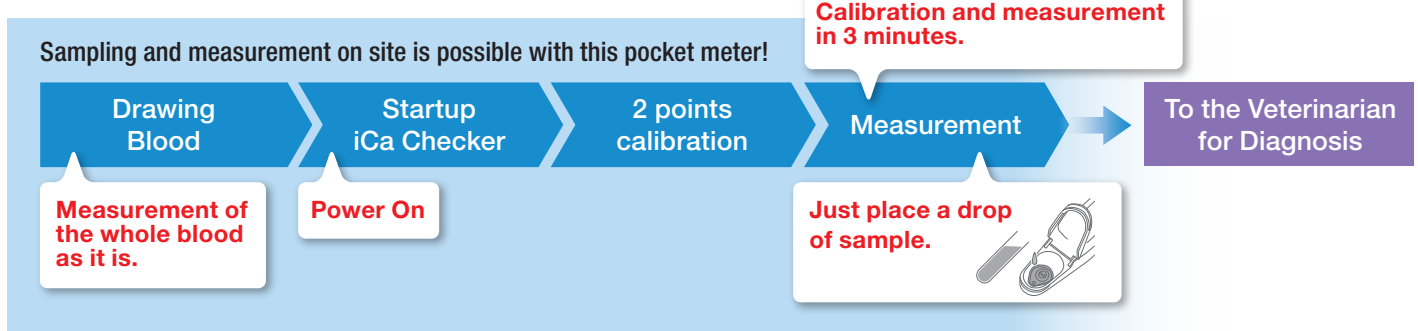
Measurement results shows high correlation with NIST standard.



*An internal investigation

* In Japan, only a qualified person is allowed to draw the blood as the act itself is considered as a form of medical practice

Measurement procedure



Items in package

Items	Quantity
Sensor	1
Meter	1
Batteries	2
Standard solution 1.25mmol/L	25 mL×2 bottles
2.50mmol/L	25 mL×2 bottles
Cleaning solution	250 mL×3 bottles
Wash bottle for cleaning solution	1
Instruction manual (Operation)	1
Instruction manual (Before use)	1
Quick manual	1
Carrying case	1

Specification

Model	LAQUAtwin-Ca-11C
Part No.	3200772940
Target	Calcium ions (Ca ²⁺)
Measurement principle	Ion Electrode Method
Minimum sample volume	More than 0.3 mL
Measurement range	0.1 to 5.0 mmol/L
Resolution	0.1 mmol/L *1
Calibration	2 points calibration (1.25 mmol/L, 2.50 mmol/L)
Accuracy *2	±20% of reading value
Waterproof	IP67 (no failure when immersed in water at a depth of 1m for 30 min) *3
Display	Custom (monochrome) digital LCD with backlight
Operating environment	Temperature: 5°C to 40°C Humidity: 85% relative humidity or less (no condensation)
Power	CR2032 batteries (x2)
Battery life	Approx. 150 hours *4
Material	ABS epoxy (main material)
Dimensions	164×29×20 mm (excluding projections)
Mass	Approx. 50 g (excluding batteries)

*1 It is possible to change the resolution to 0.01 mmol/L. (This value is reference value.)

Refer to page 3 of this manual for the resolution setting.

*2 The accuracy of agreement between a measured value and an actual value of standard reference material after 2 points calibration using Y052L and Y052H standard solutions.

It is obtained under the following conditions.

- NIST Electrolytes in Frozen Human Serum SRM 956d was used as a standard reference material.

- The calibration and measurement are performed at the same temperature.

- The error of standard solutions and rounding error (±1 digit) are not included.

*3 The meter cannot be used underwater.

*4 When backlight is used, battery life will shorten.

Consumable parts sold separately

Items	Specifications	Part No.
Sensor S051	—	3200772945
Standard solution kit Y053	1.25 mmol/L, 25 mL×2 bottles	3200774921
	2.50 mmol/L, 25 mL×2 bottles	
	Cleaning solution #251 250 mL×3 bottles	



The HORIBA Group adopts IMS (Integrated Management System) which integrates Quality Management System ISO9001, Environmental Management System ISO14001, and Occupational Health and Safety Management System OHSAS18001. We have now integrated Business Continuity Management System ISO22301 in order to provide our products and services in a stable manner, even in emergencies.



Please read the operation manual before using this product to assure safe and proper handling of the product.

Nitrate Measurement in Hybrid Sudangrass and Pearl Millet Hays

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 ($\text{NO}_3\text{-N}$) 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

Continued at the back

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.

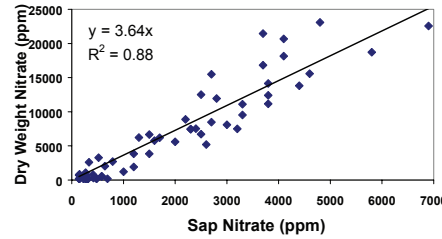


Figure 1: Correlation between sorghum-sudangrass sap nitrate measured with LAQUAtwin B-743 nitrate ion meter and sorghum-sudangrass dry-weight based nitrate obtained from laboratory.

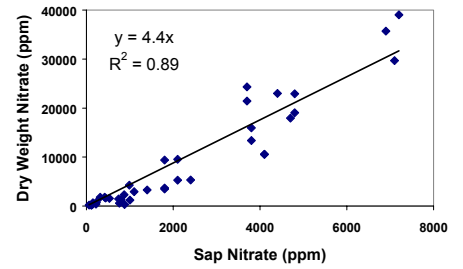


Figure 2: Correlation between pearl millet sap nitrate measured with LAQUAtwin B-743 nitrate ion meter and pearl millet dry-weight based nitrate obtained from laboratory.

References and Suggested Readings

- 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].
- 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/ll/laql/pss2903.pdf> [Accessed on 18 October 2016].

Revision 1.0, 18 October 2016

B-743 Nitrate Ion Meter

B-743 Nitrate Ion NO₃⁻



Features

IP67 Rated pocket meter with flat nitrate ion sensor capable of 2-point calibration and temperature compensation for quick and direct measurement of micro volume samples

Applications include

Soil Testing, Crop Growth and Fertilization Management, Food Quality Control



LAQUAtwin Pocket Ion Meters Lineup



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