Top Ten Uses of a pH Meter in Practice

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A pH meter can be a useful tool to a bovine veterinarian. Small sturdy pH meters that require only a few drops of sample are available.[1]

Rumen Fluid Samples

The pH of rumen fluid can be very useful in the diagnosis of subacute rumen acidosis. Subacute rumen acidosis should be suspected in dairy herds with presenting clinical signs of laminitis, butterfat suppression, intermittent diarrhea, poor appetite or cyclic feed intake, high herd cull rates for poorly defined health problems, poor body condition in spite of adequate energy intake, unexplained abscesses, and hemoptysis or epistaxis from caudal vena caval thrombosis.[2] The sample can be collected via rumenocentesis[2,3,4] or an oral probe.[5,6] An advantage of rumenocentesis over rumen probe techniques is that saliva contamination of the samples is eliminated. Since saliva is alkaline, a little contamination can artificially raise the pH of the sample. Nordlund has suggested the following: (≤5.5 is abnormal, 5.6-5.8 is marginal, and ≥5.8 is normal).[2,3,4]

Close-up Dry Cow Urine

The pH of close-up dry cow urine can be used to monitor anionic salt programs.[7,8] Anionic salts probably exert their influence on calcium metabolism by causing a slight compensated metabolic acidosis.[9] Acidosis may prevent milk fever by making parathyroid hormone receptors more active.[9] The acidosis leads to acidic urine. Essentially, urine acidifiers are fed to prevent milk fever. Table 1 shows how urine pH data can be interpreted.

Table 1. Suggestions for Interpretation of Urine pH Collected from Close-up Dry Cows[7]

Urinary pH	Interpretation
>8	Normal cow urine (no metabolic acidosis achieved); risk of milk fever remains
6-7 (5.5-6.5 for Jerseys)	Optimum level of metabolic acidosis to prevent milk fever
<6 (< 5.5 for Jerseys)	Acidification probably excessive; removal of some salts should be considered

Urine pH may also be useful in monitoring the effectiveness of urine acidifiers in the treatment and prevention of urolithiasis in male ruminants and of course, tom cats.

Fecal pH

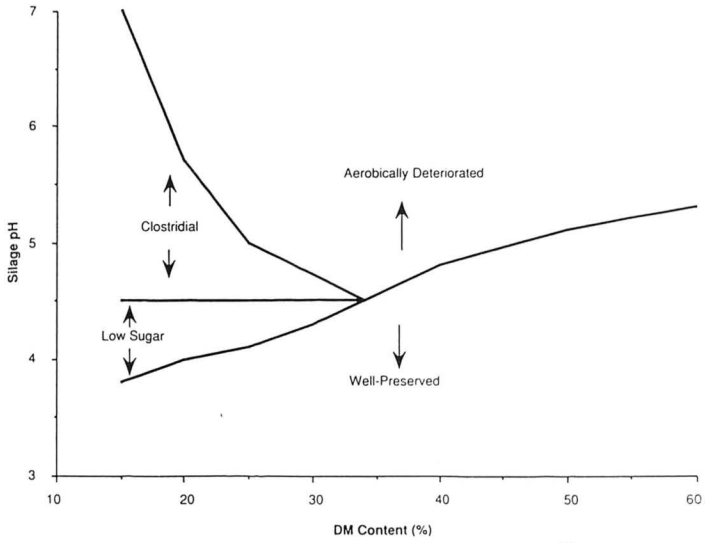
Manure pH should be greater than 6.0.[10,11] Lower values indicate that some starch was still available after digestion in the small intestine. Acids are formed by fermentation of the excess starch in the large intestine. Causes of acid fecal contents include too much grain, high rate of passage, and grain that is ground incorrectly.[11]

Silage pH

The pH of silage reflects good fermentation, correct moisture level and stage of crop maturity, with adequate levels of fermentable carbohydrates.[11-15] One rule of thumb states that the pH of corn and cereal grain silages should be less than 4.2 and the pH of legume silages should be less than 5.0.[13] Silages with a high pH have not fermented properly for some reason. They are more prone to excessive spoilage and a shorter bunk life. The sample can be collected by placing a silage sample in a plastic bag and squeezing it in a vise. A slurry can also be made by adding a small amount of distilled water. Figure 1 shows how pH and dry matter can be used to determine the quality of silage preservation.

Teat Dip pH

Teat dip pH varies with products. Some teat dips must be acidic in order to be bacteriocidal. Chlorous acid/chlorine dioxide[16] and dodocyl benzene sulfonic acid (DBSA)[17] are examples. If pH levels vary from a company's stated normal level for their product there may have been mistakes in formulation or chemical changes during storage. These changes may affect germicidal activity and teat skin irritation. Table 2 gives some pH ranges for some commercial teat dips. Some companies with neutral products claim that the acidic dips may be irritating. Companies with acidic ones say that this is not the case and bacteriocidal activity is increased with acidic pH.[16] They point out that the pH of



1. Silage pH as an Indicator of Preservation[12].

normal skin is around 5 and the pH of many innocuous substances (orange juice and cola drinks are lower). The pH value is only one of the properties of teat dips that may affect germicidal activity and teat irritation and should not be the only criteria in determining the quality of the dip.[21] Other factors such as the type and quantity of emollients, and the active ingredients are also important.

Table 2. Normal pH Levels for Selected Commercial Teat Dips

Teat Dip	pH
Fort Dodge's Nolvasan® Teat Dips[18]	6.0 to 7.0
ABS/Alcide Chlorous/Chlorine Dioxide Teat Dips (Udder Gold®)[16,19,20]	2.6 to 3.2
West Agro's Iodine Teat Dips[21]	5.0 to 6.0
ImmumoVet Actidine® Iodine Teat Dips[22]	5.0 to 6.5
BioSafe's Silk Armour® (Chlorhexidine gluconate and Triclosan)[23]	6.4 to 6.8

Dairy System Clean-up Evaluation

The pH of many cleaning solutions are dependent on pH. The manufacturer's recommendations should be followed.[24]

Some normal pH values

Some common items have surprising pH values as shown in Table 3. Notice that tap water is not 7. This is because there are small amounts of minerals and other substances dissolved in it. Even distilled water is very seldom exactly 7.0.

Table 3. Common Items and Their pH Levels

Item	pH
Bleach[16]	13.0
Household ammonia[25]	11.9
Tap Water[16]	8.0 to 9.0
Marine fish tank[27]	8.0 to 8.5
Blood[26]	7.4
Freshwater fish tank[27]	6.8 to 7.3
Milk[25]	6.4
Skin[16]	5.0
Beer[25]	4.0 to 4.5
Carbonated Water[25]	3.9
Gastric juice[25]	1.0 to 3.0
Cola Drinks[16, 26]	2.5
Lemon juice[25]	2.2 to 2.4

References

1. Cardy Twin Waterproof pH Meter; Spectrum Technologies Inc. Plainfield, Illinois 60544, (800) 248-8873. 2. Nordlund KV and EF Garrett. Rumenocentesis: A technique for collecting rumen fluid for the diagnosis of subacute rumen acidosis in dairy herds. *Bov Pract* 28: 109-112, 1994. 3. Nordlund KV. Questions and answers regarding rumenocentesis and the diagnosis of herd-based subacute rumen acidosis. *Proc Am Assoc Bovine Pract* 28:75-81, 1995. 4. Nordlund KV, EF Garrett, and GR Oetzel. Herd-based rumenocentesis: A clinical approach to the diagnosis of subacute rumen acidosis. *Compend Contin Educ Pract Vet* 17(8): S48-S56, 1995. 5. Geishauser T. A probe for collection of ruminal fluid in juvenile cattle and cows. *Bov Pract* 28:113-116. 1994. 6. Dirksen G, and MC Smith. Acquisition and analysis of bovine rumen fluid. *Bov Pract* 22:108-116, 1987. 7. Jardon PW. Using urine pH to monitor anionic salt programs. *Compend Contin Educ Pract Vet* 17(6): 860-862, 1995. 8. Davidson J, L Rodriguez, T pilbeam, and D Beede. Urine pH check helps avoid milk fever. *Hoard's Dairyman* 140(16) 634, 1995. 9. Goff JP. Cation-anion difference of diets and its influence on milk fever and subsequent lactation: the good and bad news. *Proc Cornell Nutr Conf* 1992. 10. Mahana WC. Feeding thumbrules revisited. *Hoard's Dairyman* 140(16) 618-620, 1995. 11. Hutjens MF. Put your feeding program to the acid test. *Hoard's Dairyman* 135(12) 600, 1990. 12. Pitt RE. The biology of Silage Preservation. *Silage and Hay Preservation* NRAES-5, 152 Riley-Robb Hall, Cornell Univ, Ithaca, NY 14853 5-20, 1990. 13. Chase LE. What should we analyze silage for? *Silage: Field to Feedbunk* NRAES-99, 257-261, 1997. 14. Mahana WC. Proper management assures high-quality silage and grain. *Feedstuffs*. Jan 10, 1994 p. 12-15/19-23 and Jan 17 1994 p. 17-20/56. 15. Mahana WC. Troubleshooting silage problems with "seed to feed" considerations. *Silage: Field to Feedbunk* NRAES-99, 346-375, 1997. 16. Good or bad? You decide. *The Gold Standard*. ABS Global, Inc, 6908 River Rd, DeForest, WI 53532. 17. Pankey JW, RJ Eberhart, AL Cuming, RD Daggett, RJ Farnsworth, and CK McDuff. Update on postmilking antisepsis. *J Dairy Sci* 67(6):1336-1353, 1984. 18. Hall J. Personal Communication. Fort Dodge Animal Health, 9401 Indian Creek Pkwy. #1550, Overland Park, KS 66210. 19. Bessoff HJ. Personal Communication. ABS Global, Inc. 6908 River Rd, P.O. Box 459, DeForest, WI 53532. 20. Morse C. Personal Communication. Alcide Corp, 8561 154th Av NE, Redmond, WA 98052. 21. Hemling T. Personal Communication. West Agro, Inc., 11100 N. Congress Ave., Kansas City, MO 64153-1296. 22. Talbot R. Personal Communication. Vetoquinol, 5910-G Breckenridge Parkway, Tampa, Fl 33610-4253. 23. Steward H. Personal Communication. Biosafe, 4120 SE International Way, Suite 112, Milwaukie, OR 97222. 24. Blackmer P. Personal Communication. Veterinarian's Outlet, Chino, Ca. 25. Ebbing DD and MS Wrighton. *General Chemistry*, Houghton Mifflin Co Boston. p. 578. 26. Lehninger AL. *Biochemistry*, Worth Publishers, Inc. New York, p. 46, 1975. 27. Boyd KW. *The Complete Aquarium Problem Solver!*, Tetra Press, Blacksburg, VA p. 59, 1993.