Chloride Requirements of Lactating Dairy Cattle

L. E. Chase,
Department of Animal Science
Cornell University
Ithaca, N.Y.
M. J. Fettman
Department of Clinical Pathology
College of Veterinary Medicine and
Biomedical Sciences
Colorado State University
Fort Collins, Colorado 80523

Chloride is the third most abundant mineral element in milk and the most common anion in the extracellular body fluids of mammals (Coppock and Fettman, 1977). Early studies regarding "salt deficiency" in dairy cattle indicated that sodium was probably the first limiting element (Aines and Smith, 1957; Babcock, 1905). Chloride is not currently listed as a required nutrient for dairy cattle (NRC, 1978).

An early study at Cornell found that cows fed a low chloride diet, containing .18% chloride, had lower chloride excretion in urine and feces (Coppock et al., 1979). Blood serum chloride decreased from about 100 to 93 meg/liter over an 11 week period. However, there were no effects on body weight, feed intake or milk production. In a short, intensive study, dairy cows fed a diet containing .1% chloride for 2 weeks exhibited metabolic alterations indicating a subclinical primary hypochloremic, secondary hypokalemic metabolic alkalosis (Fettman et al., 1984a, 1984d). Significant reductions in chloride concentrations of blood plasma, urine, saliva and synovial fluids were reported in young calves fed a diet containing .038% chloride (Burkhalter et al., 1979; Burkhalter et al., 1980; and Neathery et al., 1981). However, only a moderate alkalosis was observed.

Based on these observations, a trial was designed to examine the potential affects of a chloride deficiency in dairy cows (Fettman et al., 1984b, 1984c). Diets were formulated containing either .1 (low), .27 (medium) or .45 (high) % chloride on a dry matter basis. Cows were randomly assigned to these diets at 1 week postpartum. All animals were maintained on these diets for a minimum of 8 weeks. Weekly samples of blood, urine, milk, feces and saliva were collected. Milk production and dry matter intake were monitored daily. Body weights were determined weekly.

No differences in dry matter intake, milk production or body weight changes were detected between the medium and high diets (Fettman et al., 1984b, 1984c). However, significant decreases in these three measures were noted for cows on the low chloride diet.

Cows on the medium and high chloride diets did not differ in the metabolic parameters monitored. However, serum chloride decreased from about 105 to 70 meg/liter by week eleven postpartum for cows on the low chloride diet. Urine and milk chloride levels were also depressed for cows on the low chloride diet. Serum total CO_2 was significantly increased for cows on the low chloride diet while serum potassium and sodium decreased. Cerebrospinal chloride concentrations were also significantly depressed (Fettman et al., 1984d).

The clinical signs of the deficiency induced could be characterized as a depraved appetite, lethargy, hypophagia, emaciation, hypogalactiae, constipation and cardiovascular depression. The metabolic alterations could be described as a severe primary hypochlorenic, secondary hypokalemic, metabolic alkalosis.

At the end of the trial, the cows on the low chloride diet were repleted with 16 liters of an oral electrolyte solution containing 155 meg/liter of chloride. This solution also contained sodium, potassium, magnesium, calcium and dextrose. Feed intake, milk production and body weights began to change almost immediately and had improved significantly by 2 to 4 weeks into the recovery period. Serum chloride, sodium and potassium increased significantly within the first week.

The results of this study indicate that a dietary chloride content of .1% is too low for early lactation dairy cows. It would appear that a dietary chloride level of .25 to .3% on a dry matter basis should be used in practical ration formulation.

References

1. Aines, P.D., and S.E. Smith, 1957. Sodium versus chloride for the therapy of salt-deficient dairy cows. J. Dairy Sci. 40:682. 2. Babcock, S.M. 1905. The addition of salt to the ration of dairy cows. Pge 129 in 22nd Annual Rep. Wisconsin Agric. Exp. Stn. 3. Burkhalter, D.L., M.W. Neatlery, W.J. Miller, R.H. Whitlock, and J.C. Allen. 1979. Effects of low chloride intake on performance, clinical characteristics and chloride, sodium, potassium and nitrogen metabolism in dairy calves. J. Dairy Sci. 62:1895. 4. Burkhalter, D.L., M.W. Neatlery, W.J. Miller, R.H. Whitlock, J.C. Allen, and R.P. Gentry. 1980. Influence of a low chloride practical diet on acid-base balance and other factors of blood in young dairy calves. J. Dairy Sci. 63:269. 5. Coppock, C.E., R.A. Aguirre, L.E. Chase, G.B. Lake, E.A. Oltenacu, R.E. McDowell, and M.J. Fettman. 1979. Effect of a low chloride diet on lactating Holstein cows. J. Dairy Sci. 62:723. 6. Coppock,

C.E., and M.J. Fettman. 1977. Chloride as a required nutrient for lactating dairy cows. Page 43 in Proc. Cornell Nutr. Conf. 7. Fettman, M.J., L.E. Chase, J. Bentinck-Smith, C.E. Coppock, and S.A. Zinn. 1984a. Restricted dietary chloride with sodium bicarbonate supplementation for Holstein cows in early lactation. J. Dairy Sci. 67:1457. 8. Fettman, M.J., L.E. Chase, J. Bentinck-Smith, C.E. Coppock, and S.A. Zinn. 1984b. Nutritional chloride deficiency in early lactation Holstein cows. J. Dairy Sci. 67:2321. 9. Fettman, M.J., L.E. Chase, J. Bentinck-Smith, C.E. Coppock, and S.A. Zinn. 1984c. Effects of dietary chloride restriction in lactating dairy cows. J.A.V.M.A. 185:167. 10. Fettman, M.J., L.E. Chase, J. Bentinck-Smith, C.E. Coppock, and S.A. Zinn. 1984d. Restricted dietary chloride and sodium bicarbonate supplementation in early lactation Holstein cows: Cerebrospinal fluid electrolyte alterations. An. J. Vet. Res. 45:1403. 11. National Research Council. 1978. Nutrient requirements of domestic animals. No. 3 Nutrient requirements of dairy cattle. 5th ed. Natl. Acad. Sci., Washington, D.C. 12. Neathery, M.W., D.M. Blackmon, W.J. Miller, S. Heinmiller, S. McGuirre, J.M. Tarabula, R.P. Gentry, and J.C. Allen. 1981. Chloride deficiency in Holstein calves from a low chloride diet and removal of abomasal contents. J. Dairy Sci. 64:2220.

The Use of An Elisa Milk Progesterone Test As an Aid to Oestrus Prediction in Dairy Cows

R. G. Eddy, *B. Vet. Med., F.R.C.V.S.*
Shepton Mallet
Somerset, England

Introduction

Oestrus detection in dairy cows has been the subject of many studies and various methods of improving oestrus detection have been investigated and reviewed by Boyd (1984). Poor oestrus detection will extend the calving to conception interval by prolonging both the calving to first service and first service to conception intervals (Eddy 1980). It is known that each one day extension of the herd calving interval beyond 365 days represents a potential loss of £3.00 per cow (see HMSO publication: Dairy Herd Fertility). The availability of the enzyme immunoassay (EIA) for progesterone in milk presents the possibility of a useful aid to oestrus detection. Foulkes, Cookson and Sauer (1982) measuring progesterone in milk samples taken daily from 42 days post calving demonstrated a significant reduction in calving to first service interval. Here fixed time insemination was employed on the third day of low progesterone. Stimpson (1984) using the same test before and after first service demonstrated both the feasibility of performing the test in a practice laboratory and significant improvements in oestrus detection rates and calving to conception intervals in two herds.

The availability of a commercially produced EIA test kit (Ovucheck; Cambridge Veterinary Sciences) stimulated the setting up of trials to study oestrus detection rates and detection efficiency after first service. This paper reports the results of these trials.

Materials and Methods

Trial 1A

Herd T.W.C. consisted of 250 cows calving September to June. Foremilk samples were taken from all cows 16 to 24 days post service. All the sample was taken from one teat with the first 5 teatfuls of milk discarded before sampling. The trial took place in August and September 1984.

Trial 1B

Herd 229 consisted of 104 cows mainly summer calving. Samples were taken daily on days 17 to 23 post service during the period August to December 1984.

Samples were transported to the practice laboratory six days a week for progesterone assay using EIA and the progesterone values plotted for each cow. If a level less than 5ng/ml was recorded the farmer was notified by telephone of the cows identity and instructed to apply a heat mount detector (HMD) (Kramer Inc.). Cows were inseminated immediately following an observed oestrus or a HMD colour change. Pregnancy was confirmed by rectal palpation 7-8 weeks post service. Cows with low progesterone and not detected in oestrus were presented at the first veterinary herd health visit after 25 days post service and where possible treated with Prostaglandin to induce oestrus.

Trial 1C

Using the data gained from trials 1A and 1B the day post service on which Progesterone fails and the time lapse from Progesterone fall to service will be observed in order to determine the minimum number of samples that could be considered practical.

Results

The distribution of inter-service intervals before and after the introduction of the EIA regime can be seen in Figs. 1 and 2. Fig. 1 (herd TWC) demonstrates considerable improvement in oestrus detection as the percentage of intervals occurring 18-24 days improved from 38 to 67. All other intervals were reduced in number. Fig. 2 (herd 229) shows an improvement of the 18-24 day intervals from 21 to 45 percent.