

EFFECT OF HOT ENVIRONMENT ON CA AND P METABOLISM IN DAIRY COW

S. Kume, S. Takahashi, M. Kurihara and T. Aii

Kyushu National Agricultural Experiment Station, Kumamoto 861-11, Japan

Introduction

Heat stress in summer reduces the feed intake, milk yield and milk composition of dairy cattle. In the previous papers (Kume et al., 1986; Kume et al., 1987), we suggest that Ca and P absorption in dry and lactating cows may be affected by heat stress and decrease under hot environment. However, Ca and P metabolism in dairy cows under hot environment has not been well investigated. Also, lactating cows may require large amounts of Ca and P, since large amounts of Ca and P were secreted in milk. The objectives of this study were, therefore, to determine Ca and P content in milk and colostrum of Holstein dairy cows under hot environment, and to evaluate the effects of hot environment on Ca and P metabolism in dairy cows.

Materials and Methods

In Expt. 1, milk samples of 20 Holstein cows calved in 1987 at this station were collected in every 2nd week from February 1987 to May 1988. In Expt. 2, milk samples of 5 cows calved in February to March 1988 were collected in every 2nd week from April to October 1988. Also, serum samples of 5 cows were obtained almost about the same day as milk sampling in every 4th week from April to June and every 2nd week from July to October. Milk was a composite sample of morning (9:00) and evening (17:00) milking in Expts. 1 and 2.

In Expt. 3, colostrum samples of 22 Holstein cows calved in winter and summer 1988 were collected in calving day, 1, 3, and 7 days after parturition. Also, serum samples of 10 cows in 22 cows were obtained about 1 week prepartum and 1 week postpartum. Cows were milking at 9:00, 14:00, and 20:00 within a week after parturition and thereafter at 9:00 and 17:00. Colostrum was a milking sample in calving day and 1 day after parturition, and a composite sample in 3 and 7 day after parturition.

Calcium contents in milk and serum were determined by atomic absorption spectrophotometry, and P content in milk and serum Pi concentration were done by colorimetric analysis.

Results and Discussion

Milk yields of cows under hot environment (mean temp. of month: 22.5-27.2°C) were higher than those under optimum environment (mean temp. of month: 5.1-20.1°C) in Expt. 1. However, Ca and P contents in milk under hot environment were lower than those under optimum environment (table 1). Also, heat stress in summer reduced Ca and Pi concentrations in serum, and the decreased rate of Ca and P in milk under hot environment was almost similar to that in serum in Expt. 2. Thus, Ca and P metabolism in lactating cows may be affected by heat stress.

TABLE 1. MEAN \pm S.D. OF CA AND P CONTENT IN MILK

	Environment	
	Optimum	Hot
Number of samples	184	99
Milk yield (kg/day)	21.9 \pm 5.7	23.2 \pm 3.6*
Ca (%)	0.120 \pm 0.011	0.114 \pm 0.010**
P (%)	0.090 \pm 0.007	0.085 \pm 0.007**

Mean temp.: Optimum, 5.1-20.1°C; Hot, 22.5-27.2°C, ** P < .01, * P < .05.

In Expt. 3, Milk yields of cows calved in summer (mean temp. of month: 23.1-27.2°C) were lower than those of cows calved in winter (mean temp. of month: 5.1-7.7°C) for a week after parturition. Except for the lowest Ca and P contents in colostrum of 2 cows, Ca and P contents in colostrum of cows calved in summer were lower than of cows calved in winter (table 2). Daily secreted amounts of Ca and P in colostrum of cows calved in summer were smaller than

TABLE 2. MEAN CONTENT OF CA AND P IN COLOSTRUM OF COWS CALVED IN WINTER AND SUMMER

	Number of cows	Sampling time after parturition				
		0	12hr	24hr	3day	7day
Ca (%)						
Winter	11	0.227 ^a *	0.176	0.149 ^a	0.129 ^a	0.127 ^c
Summer	9	0.186 ^b	0.156	0.135 ^b	0.121 ^b	0.115 ^d
P (%)						
Winter	11	0.193 ^c *	0.152 ^a	0.130 ^a	0.102	0.093
Summer	9	0.150 ^d	0.129 ^b	0.116 ^b	0.101	0.093

Mean temp.; Winter, 5.1-7.9°C; Summer, 23.1-27.2°C
^{a,b} $p < .05$, ^{c,d} $p < .01$. *10 samples

those of cows calved in winter, although large amounts of Ca and P were secreted in colostrum for 24 hrs after parturition. Also, serum Ca and Pi concentrations of cows calved in summer were lower than those of cows calved in winter before parturition. Thus, Ca and P metabolism in prepartum cows may be affected by heat stress.

In these experiments, Ca and P metabolism in dairy cows may be affected by heat stress and those contents in milk and colostrum may decrease under hot environment. Also, the reduced amounts of Ca and P in milk and colostrum under hot environment may be due to the decrease of those concentration in serum.

(Key Words: Dairy Cow, Ca and P, Hot Environment)

Literature Cited

- Kume, S., M. Kurihara, S. Takahashi, M. Shibata and T. Aii. 1986. Effect of hot environmental temperature on major mineral balance in dry cows. *Jpn. J. Zootech. Sci.* 57:940-945.
- Kume, S., M. Kurihara, S. Takahashi, M. Shibata and T. Aii. 1987. Effect of hot environmental temperature on major mineral balance in lactating cows. *Jpn. J. Zootech. Sci.* 58:764-770.