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Ketonuria in Holstein Friesian Milking Cows in Chiang Mai, Thailand

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Abstract

Ketonuria tests on Holstein Friesian milking cows were performed at a farm in Chiangmai, Thailand.

Test 1: 20 cows were tested for ketonuria at 2, 4, 6, 8, 10, 12 and 14 weeks postpartum. 45% of the cows showed negative results and 78% of these were low milkers (cumulative 14-week milk production, < 2000 kg). Cows testing positive for ketonuria were more at week 2 and 4 than at week 6, 8, 10 and 12 postpartum (30, 30, 5, 10, 10 and 15% respectively). There was no ketonuria detected at 14 weeks postpartum. Fifty percent of ketonuria cows at weeks 2 and 4 postpartum were high milkers (cumulative 14-week milk production, 3001-4000 kg). Variations in the number of ketonuria cows from week 2 to 14 postpartum among low, moderate (cumulative 14-week milk production, 2001-3000 kg) and high milkers were not significant (χ^2 = 7.57, $p>0.05$). There was no correlation between ketonuria cows and milk production (contingency coefficient: C = 0.78, $p>0.05$).

Test 2: 24 cows were tested monthly for ketonuria at 3 periods postpartum: 0-4, 5-8 and 9-12 weeks. 62.5% of the cows were negative at all testing periods. There were more cows with ketonuria at 0-4 weeks than at 5-8 and 9-12 weeks postpartum (21, 17 and 17% respectively). The correlation between ketonuria occurrence and milk production at 0-4 and 9-12 weeks sampling period were significant ($p<0.05$, ρ = 0.41 and 0.44 respectively) but not at 5-8 weeks postpartum (ρ = 0.39, $p>0.05$).

Key words : Ketonuria, Milking cow.

Introduction

Ketosis is a metabolic disease of lactating cows which occur within a few days to a few weeks after calving. During early lactation the cows do not consume as much feed as they do during later lactation, although their levels of milk production may be the same. Dry matter intake is on the average depressed 15% during the first 3 weeks of lactation

relative to later lactation. The greatest depression occur during the first days of lactation (NRC, 1989). Ketosis is characterized by hypoglycemia, ketonemia, ketonuria, in-appetite, either lethargy or excitability, loss of weight and depressed milk production occasionally with more factors in combination. In most areas, the incidence is highest among stall-fed high producers (Fraser, 1986).

In Thailand, Satis *et al.* (1990) reported that out of a herd of 27 milking cows belonging to the Agriculture College in Khon Khaen Province five crossbred cows were diagnosed to suffer from subclinical ketosis. All sick cows were at 1-10 weeks postpartum, average milk production were 12.2 liter/cow/day (9.0-15.0 liter/cow/day). The processed milk was found unpleasantly in odor and deviating in other tasks.

This study investigate the incidence of ketonuria among Holstein Friesian milking cows in Thailand and the correlation between ketonuria cows or ketonuria level and milk production.

Materials and Methods

Animal: Holstein Friesian milking cows at 1^{st} - 4^{th} lactation period originating from Canada at a farm in Chiangmai Province.

Feed management: The cows were fed with a total mixed ration, based on the nutrient requirements of dairy cows (NRC, 1989). The ration consisted of 20-25 kg corn silage with 32% dry matter, 7% protein and 67% total digestible nutrients, 2.5 kg cotton seed and 7 kg concentrate with 88% dry matter, 21% protein and 73% total digestible nutrients per cow per day. The total mixed ration was fed to the cows two times a day (8.30 a.m. and 3.00 p.m.). Cows producing more than 30 kg milk per day got additional 1-5 kg concentrate at 8 p.m.

Ketonuria test: The cows were tested for ketonuria by the ketostix reagent strip method. Urine of the cows were collected in test tubes and the test end of the strip dipped in the fresh urine. After 1 minute color of the dipped end was compared with the color chart on the bottle label. Tests were negative when color of the test strip remain unchanged or appeared cream colored from wetting with urine. Tests were positive when the test end of the strips developed warning colors from pink to purple, representing low, moderate or high levels of ketone bodies in the urine.

Ketone bodies levels (mmol/L)		**Color of test strip**
0	(negative)	cream
0.5	(trace)	
1.5	(low)	pink
4	(moderate)	
8,16	(high)	purple

Data collection and statistical analysis:

Group 1: 20 cows were divided into 3 groups by accumulative 14 weeks milk production: 1001-2000 kg, 2001-3000 kg and 3001-4000 kg. Results of the ketonuria tests were recorded for each cow at 2, 4, 6, 8, 10 and 14 weeks postpartum.

Group 2: 24 cows were tested monthly for ketonuria at 3 periods: 0-4, 5-8 and 9-12 weeks postpartum. The results of the ketonuria test and milk production of each cow were recorded at the sampling day.

Friedman two-way ANOVA was used for analysing variances of number of ketonuria cows amongst groups of milk production and contingency coefficient was used for assessing correlation. The correlation between ketonuria level and milk production at the sampling day was analysed by the Spearman Rank Correlation Method (Snedecor and Cochran, 1982; Siegel, 1956).

Results

Group 1: 20 cows were tested for ketonuria at 2, 4, 6, 8, 10, 12 and 14 weeks postpartum. 9 cows (45%) showed negative results at any tests and 77.8% of these cows (7 from 9 cows) were low milk producers with an accumulative 14-wk milk production less than 2000 kg (Table 1). More cows with ketonuria were found at 2 and 4 weeks than at 6, 8, 10 and 12 weeks postpartum (6, 6, 1, 2, 2 and 3 cows respectively). The test also showed no ketonuria cow at 14 weeks postpartum. Fifty percent of ketonuria cows at 2 and 4 weeks postpartum (3 cows) were high milk producers with an accumulative 14-wk milk production of 3001-4000 kg (Table 1, 2). At higher accumulative 14-wk milk production more positive ketonuria test were seen than at lower milk production (25.7%, 20% and 5.7% for 3001-4000, 2001-3000 and 1001-2000 kg. accumulative 14-wk milk production respectively) (table 2). By 50% (10 from 20) of the positive ketonuria tested cows, the ketonuria level were only traceable (0.5 mmol/L) and at 40% (8 from 20) low (1.5 mmol/L) while together moderate (4 mmol/L) and high (8 mmol/L) level of ketonuria only accounted for 5% (1 from 20) (Table 1). No cow showed any symptoms of ketosis. The variations of the number of ketonuria cows at 2 to 14 weeks postpartum among the 3 groups of accumulative 14-wk milk production were not significant different ($\chi^2 = 7.57$, $p > 0.05$) and the analysis indicated no correlation between ketonuria cows and milk production (Contingency coefficient : C – 0.78, $p>0.05$).

Group 2 : 24 cows were tested monthly for ketonuria at 3 periods : 0-4, 5-8 and 9-12 weeks postpartum. Fifteen cows (62.5%) indicated negative results at any tests. There were more cows with ketonuria at 0-4 weeks postpartum than at 5-8 and 9-12 weeks postpartum (5, 4 and 4 cows respectively). At 0-4 weeks postpartum there were more ketonuria cows with higher ketonuria level among cows with high milk production (>30 kg/day) than among lower producers (< 30 kg/day). A cow with retained placenta and metritis problems (Cow No. 17) had high ketonuria (8 mmol/L) at the three test periods but didn't show any signs of ketosis (Table 3). The correlation between ketonuria level and milk production at sampling day of the cows at 0-4 and 9-12 weeks postpartum were significant ($p<0.05$) ($\rho = 0.41$ and 0.44 respectively) but the correlation at 5-8 weeks postpartum was not significant ($\rho = 0.39$, $p>0.05$).

Discussion

There were more ketonuria cows during the first 4 weeks of lactation in both tests. Since feeding of cows in early lactation presents a particular problem where either the cows are not offered adequate amounts of feed or can not consume enough feed to supply the energy and protein needed for maximum milk production. When the cows intake is less than body requirement for energy and protein she draws from body stores of fat and protein to supply energy and amino acids for milk production. If the cow has to rely too heavily on body stores of energy and protein, either milk production will be held to the level of nutrient availability or ketosis will develop (Radostits and Blood, 1995).

The analysis indicates no correlation between ketonuria cows and accumulative 14-week milk production but there is correlation between ketonuria levels and milk production at sampling day of the cows at 0-4 and 9-12 weeks postpartum. Grohn *et al.,* (1999) reported that ketosis had no effect on the 305-day milk yield but ketotic cows yielded significantly less milk per day both before and immediately after diagnosis than non-ketotic cows. Ketolac BHB strip test is the most useful and suitable milk test for routine monitoring program to detect subclinical ketosis or for monitoring the energy status of high yielding dairy cows in early lactation (Geishauser, *et al*., 1998; Gutzwiller, 1998; Jarritsma, *et al*., 1998; Geishauser, *et al* ., 2000).

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Table 1. Result of ketonuria test at 2-14 weeks postpartum with accumulative 14-wk milk production

Cow no.	Accumulative 14-wk milk production	Ketonuria level (mmol/L) at postpartum (wk)							No. of ⊕test
		2	4	6	8	10	12	14	
1[a]	1191	0	0	0	0	0	0	0	0
2	1251	0	0	0	0	0.5	0	0	1
3[a]	1366	0	0	0	0	0	0	0	0
4	1546	8.0	0	0	0	0	0	0	1
5[a]	1549	0	0	0	0	0	0	0	0
6[a]	1556	0	0	0	0	0	0	0	0
7[a]	1609	0	0	0	0	0	0	0	0
8[a]	1743	0	0	0	0	0	0	0	0
9[a]	1836	0	0	0	0	0	0	0	0
10	1940	0	0	0.5	0	0	0.5	0	2
11	2126	1.5	1.5	0	0	0	1.5	0	3
12	2227	0	0	0	0.5	0	0	0	1
13	2725	0	0.5	0	0	0	0	0	1
14[a]	2738	0	0	0	0	0	0	0	0
15	2939	0.5	0.5	0	0	0	0	0	2
16	3222	1.5	4	0	1.5	0.5	0	0	4
17	3244	0	0	0	0	0	1.5	0	1
18	3366	0.5	0.5	0	0	0	0	0	2
19[a]	3499	0	0	0	0	0	0	0	0
20	3940	1.5	1.5	0	0	0	0	0	2
Total ⊕ test (%)		6 (30)	6 (30)	1 (5)	2 (10)	2 (10)	3 (15)	0 (0)	20 (14.3)

Remark : a = the cow with negative result at any tests
= 9 cows (45%)

Table 2. Number of ketonuria cows at 2-14 weeks postpartum among 3 groups with different levels of accumulative 14-week milk production.

Accumulative 14-wk milk production	**No. of kelomuria cows postpartum (wk)**							**Total⊕ test/ total test (%)**
	2	**4**	**6**	**8**	**10**	**12**	**14**	
1001-2000 (n = 10)	1	0	1	0	1	1	0	4/70 (5.7)
2001-3000 (n = 5)	2	3	0	1	0	1	0	7/35 (20.0)
3001-4000 (n = 5)	3	3	0	1	1	1	0	9/35 (25.7)
Total N = 20	6	6	1	2	2	3	0	20/140 (14.3)

$\chi^2 = 7.57$ ($p>0.05$), $C = 0.78$ ($p>0.05$)

Table 3 Ketonuria level (mmol/L) and milk production (kg/day) at sampling day of the cow at 0-4, 5-8 and 9-12 weeks postpartum

Cow No.	0-4 wk pp.		5-8 wk. pp.		9-12 wk. pp.		Total ⊕ test
	Milk prod. (kg/d)	Ketonuria (mmol/L)	Milk prod. (kg/d)	Ketonuria (mmol/L)	Milk prod. (kg/d)	Ketonuria (mmol/L)	
1	7	0	15	0.5	14	0	1
2[b]	11	0	11	0	21	0	0
3[b]	12	0	13	0	17	0	0
4[b]	15	0	19	0	11	0	0
5[b]	17	0	24	0	18	0	0
6[b]	17	0	16	0	16	0	0
7	19	0	23	0	16.0	0.5	1
8	19	0.5	33	0	34	0	1
9	22	0	23	4	23	1.5	2
10[b]	22	0	21	0	21	0	0
11[b]	24	0	26	0	26	0	0
12[b]	24	0	22	0	24	0	0
13[b]	25	0	23	0	17	0	0
14	27	0.5	29	0	26	0	1
15[b]	27	0	11	0	12	0	0
16[b]	28	0	26.6	0	20.6	0	0
17	30	8.0	38	8.0	35	8.0	3
18	31	1.5	36	0	30	0	1
19	31	4	36	0	28	0	1
20[b]	32	0	29	0	29	0	0
21[b]	36	0	38	0	33	0	0
22[b]	36	0	34	0	33	0	0
23	38	0	34	1.5	36	0.5	2
24[b]	39	0	34	0	33	0	0
Total ⊕ test (%)	5 (20.8)		4 (16.7)		4 (16.7)		13 (18.1)
Spearman rank correlation (ρ)	ρ = 0.41 P < 0.05		ρ = 0.39 P > 0.05		ρ = 0.44 P < 0.05		

Remark : b = the cow with negative result at any tests
= 15 cows (62.5%)