Effect of cobalt extra-supplementation on milk production and composition of heat stressed lactating Holstein dairy cows

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Introduction In ruminants, Vitamin B_{12} is produced with cobalt by rumen microbes. Complete replacement of cobalt by Vitamin B_{12} in ruminant diets is not possible due to the positive effect of cobalt on the feed digestibility. The aim of this study was to assess the effect of different levels of inorganic cobalt supplementation on milk production and composition of lactating Holstein cows in Iran under heat stress condition. Cobalt supplementation may improve feed digestion when heat stress causes significant depression in feed digestibility, fat yield and milk yield.

Material and methods In this experiment the response to cobalt supplementation was evaluated. Twelve multiparous Holstein cows were assigned to one of four diets in a completely randomized 3×3 Latin square design with four 24 d periods. Cows experienced heat stress conditions throughout the experiment (37 ± 6 ^{o}C). The pre-experimental average milk yield of cows was 30.2 ± 4.98 and all of cows were in mid lactation (134 ± 27 DIM). The experiment involved in two phases, the first phase was 10 days, the adaptation period. During this stage cows were fed treatment diets and there was no sampling or milk recording. In the second stage, the experimental phase, in addition to feeding treatment diets, sampling was carried out. Cows were milked three times daily. During the experimental phase, in each period, total milk yield was recorded and milk samples were taken. Animals received diets containing 53.28% concentrate and 46.72% forage DM basis. The base diet contained 15.3% CP, 1.55 Mcal/Kg NEl. Animals were fed 3 times a day, and had free access to water. Treatments were C0) control, C1) control + 30 mg/d cobalt, C2) control + 40 mg/d cobalt and C3) control + 50 mg/d cobalt. Milk samples were analyzed for milk lactose, fat, protein, total solid (TS), solid non-fat (SNF) by Milkoscan system. The data was analysed by multiple regression analysis. The statistical model was: $Y_{ijklmn} = \mu + R_i + C_j + T_k + M_l + RE_m + e_{ijklmn}$ In this model, Y_{ijklm} is the amount of each observation; μ Total average; R_i effect of time period; C_j effect of diet; T_k effect of cow; M_l effect of square (replication of experiment); RE_m residual effect of previously diet and e_{ijklmn} effect of factors that were not controlled. Data were analyzed by SAS (version 8) statistical software and residual effect of last ration was corrected. Comparison between means was done by Duncan's multiple range test.

Results are presented in Table1. There was no significant difference in milk fat, protein, lactose, TS and SNF percent between treatments. There was a significant difference in milk yield and FCM 3.5% between all treatments. In addition, there were significant differences between all of treatments for milk fat yield and milk protein yield.

Table 1 Means of milk yield and composition in experimental diets

	Control	Control diet			SEM
		+ 30mg Cobalt	+40mg Cobalt	+ 50mg Cobalt	
Milk yield, (kg/d)	27.15 ^{d}	28.22 ^{a}	28.09 ^{b}	27.51 ^{c}	0.74
FCM 3.5%, (kg/d)	23.10 ^{d}	23.96 ^{c}	24.11 ^{b}	24.21 ^{a}	0.60
Fat, %	2.37	2.35	2.37	2.50	0.04
Protein, %	3.11	3.08	2.92	3.05	0.06
Lactose, %	5.26	5.24	5.05	5.25	0.06
Total solids, %	11.34	11.27	11.17	11.40	0.07
Solid non fat, %	8.97	8.68	8.80	8.90	0.09
Fat yield, (kg/d)	0.632 ^{d}	0.653 ^{c}	0.664 ^{b}	0.688 ^{a}	0.02
Protein yield, (kg/d)	0.833 ^{b}	0.853 ^{a}	0.818 ^{d}	0.831 ^{c}	0.02

Within rows, means with different superscripts differ (P<0.05).

Conclusions Observed significant improvements in FCM %3.5 and milk fat production could be attributed to improvement of ruminal B_{12} vitamin that has a major role in milk fat synthesis (Kincaid, *et al*., 2003) or increase in cellulose digestion (Allen, 1986) which can improve energy intake. Therefore, cobalt supplementation up to 50 mg/d is recommendable, but studies with liver and serum cobalamin status or ruminal fiber digestion under these conditions might be useful.

References

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