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Milk production in Holstein cows supplemented with different levels of ruminally protected methionine

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Abstract

Forty multiparous cows (599 kg ± 18 kg BW) were fed with a basal diet (19.6% CP, 35% RUP, and 1.7 Mcal kg^{-1} NEl) with alfalfa, corn silage and concentrate (49% forage: 52% concentrate). After calving, cows were randomly assigned to the treatments, which consisted in four levels of ruminally protected methionine (RPM): 0, 8, 16 and 24 g d^{-1} of Mepron®M85 (Degussa Co.). Experiment was conducted for 120 days with measurements of milk production, composition, body weight, body condition score and DM intake every 15 days (3 consecutive days) starting on day 5 postpartum. Data were analyzed with the repeated measures model (four treatments in 8 periods through lactation). No treatment effects were detected on DM intake (20.38 ± 2.51 kg d^{-1}), body weight (599.78 ± 19.78 kg), body condition score (2.51 ± 0.19 units) and milk fat. However, milk production and protein yield were increased with addition of RPM ($P<0.01$). Milk production responded quadratically to methionine level. Holstein cows with a mean production of 35 kg d^{-1} milk require addition of ruminally protected methionine (16 g d^{-1}) to improve milk production.

Keywords: Methionine; Milk composition; Milk production; Dairy cow

1. Introduction

It is well known that the high producing cow needs bypass protein to meet essential amino acid requirements to maximize milk production. Methionine and lysine have been considered as the main limiting amino acids for milk protein synthesis (Schwab et al., 1992; Rulquin and Delaby, 1997). Ruminally protected amino acids have been used to increase duodenal flow of essential amino acids to improve milk production. There are several studies with ruminally protected methionine (RPM) which show increments in milk production (Ferguson et al., 2000),

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milk fat (Xu et al., 1998) and milk protein (Wu et al., 1997a,b). However, other studies do not show effects (Dinn et al., 1998).

Dairy cows fed with alfalfa hay and heat treated soybean meal may meet lysine requirement but not methionine (Armentano et al., 1997); diets with soybean meal or cotton seed are deficient in methionine and lysine, therefore, a positive response in milk production and composition can be observed in ruminally protected amino acids (Rulquin and Delaby, 1997). The same response can be expected in rations with moderate amounts of blood meal, fishmeal, or meat meal, which presumably are low in bypass methionine (Xu et al., 1998). The objective of this research was to study the effect of graded levels of ruminally protected methionine on milk yield, milk composition and body condition of Holstein cows fed with alfalfa, corn silage and meat meal as protein source in the concentrate.

2. Materials and methods

Forty multiparous cows in their second or fourth lactation, weighing an average of 599 ± 18 kg BW, were randomly assigned to the treatments after calving, which consisted in four levels of ruminally protected methionine 0, 8, 16 and 24 g d^{-1} of Mepron®M85 (Degussa Co.) for 120 days postpartum. Cows were individually fed three times per day (8:00, 14:00 and 20:00 h) with a basal diet (19.6% CP, 35% RUP, 1.7 Mcal kg^{-1} NEl, 1.5% Ca, and 0.9% P). Diet consisted in (DM basis): fresh alfalfa (28%), corn silage (20%), corn grain (24%), soybean meal (16%) molasses (4.83%), meat meal (4.39%), inert fat (1.18%), NaCl (0.4%), dicalcium phosphate (0.2%), mineral premix (0.7%) and vitamins (0.3%). Methionine was dosed in the first meal and cows were milked at 07:00 and 18:00 h.

Dry matter intake and milk production were measured each for 15 days (3 consecutive days) starting on day 5 postpartum. Milk samples were collected in the same days (07:00 and 18:00 h). Body weight and body condition score scale 1 to 5 was registered every 15 days (Wildman et al., 1982). Total tract digestibility was estimated using chromic oxide as an external marker with a dose of 5 g/d for 15 days, taking fecal grab samples every 2 h during the last five days of each period. Chromium was measured by atomic absorption spectroscopy (Williams et al., 1962).

Morning and afternoon samples of milk were analyzed for fat (Gerber) and protein (AOAC, 1995). Feeds were analyzed for DM (oven-drying), total N (Kjeldhal), ashes, ether extract (AOAC, 1995), NDF and ADF (Van Soest et al., 1991). Nitrogen degradation of feeds and RPM was estimated previously by in situ ruminal incubation (Lara et al., 2003).

Data were analyzed as a completely randomized design with four treatments and 10 replications, using repeated measures for variables registered through lactation (8 periods). Linear and quadratic effects were tested for methionine-graded levels (Draper and Smith, 1981) on milk production and protein concen-

Table 1
Effect of methionine level on productive performance of Holstein cows

Variable	Ruminally protected methionine, g d^{-1}			
	0	8	16	24
Body weight (kg)	599.3 ± 18.3	606.9 ± 18.6	592.9 ± 19.3	597.5 ± 18.2
Body condition score	2.56 ± 0.18	2.54 ± 0.18	2.47 ± 0.18	2.71 ± 0.18
DM intake (kg/d)	20.87 ± 0.33	20.46 ± 0.30	20.02 ± 0.35	20.38 ± 0.32
DM intake (% BW)	3.48 ± 0.17	3.37 ± 0.16	3.38 ± 0.18	3.41 ± 0.17
DM digestibility (%)	73.84 ± 0.85	74.55 ± 0.76	74.57 ± 0.89	74.48 ± 0.82
Milk production (kg/d)*	31.4 ± 1.7^{c}	33.6 ± 1.7^{b}	35.8 ± 1.8^{a}	33.7 ± 1.6^{b}
Fat (%)	3.13 ± 0.12	3.10 ± 0.13	3.11 ± 0.13	3.16 ± 0.12
Protein (%)*	3.35 ± 0.09^{b}	3.58 ± 0.09^{a}	3.49 ± 0.09^{a}	3.50 ± 0.09^{a}
Milk fat (g/d)	1005 ± 55	1017 ± 59	1072 ± 57	1059 ± 55
Milk protein (g/d)*	1094 ± 49^{b}	1187 ± 51^{a}	1252 ± 50^{a}	1166 ± 49^{ab}

^{abc}Means with no common superscript in a row differ ($P < 0.01$).
*Quadratic effect to methionine level ($P < 0.05$).