Effect of feeding two different forms of supplemental methionine on the lactation performance and health status of dairy cows

Session 30 "Free Communications in Animal Nutrition", Abstract no. 7193
Author: Kudrna, V., Cermakova, J.
cermakova.jana@vuzv.cz

Abstract:

The objective of this experiment was to assess the effect of a newly developed form of methionine – isopropylester 2-hydroxy-4 (methylthio) butanoic acid, called MetaSmart™ on the lactation performance, in particular the production of milk protein, and on the physiological status of dairy cows. At the same time, the efficiency of this supplement was compared with ruminally protected form of methionine, Smartamine™ M. The experiment of 3x3 Latin square design was conducted with a total of 30 high-yielding dairy cows, divided into three well balanced groups. Each period lasted four weeks – three weeks of the preliminary period and one week of experimental period during which the samples of milk, blood and rumen fluid were collected. A total mixed ration (TMR) based on maize silage, lucerne silage, lucerne hay, brewer's grains and concentrate mixture was offered *ad libitum* four times a day. The experimental diets contained MetaSmart™ (42.5 g/d), and Smartamine™ M (19 g/d), respectively. The control diet was supplemented with soybean meal to achieve the same concentration of crude protein. The highest average daily milk yields (31.34 kg) and simultaneously the highest production of milk protein and milk fat were found for the diet with MetaSmart™. Inclusion of both Smartamine™ M and MetaSmart™ in the diet increased milk protein content by 0.11% (3.45%) and 0.07% (3.41%), respectively, in comparison with the control group. But, no significant differences ($P > 0.05$) were found for milk production, and within the values of basic parameters of rumen fluid and blood plasma. However, the concentrations of methionine in blood plasma were about 7.36 and 0.17 μmol/l higher for diets with Smartamine™ M and with MetaSmart™, respectively, than for the control group. The inclusion of both Smartamine™ M and MetaSmart™ in the diet can increase milk production and improve the methionine status of dairy cows.

Key words: methionine, milk production, dairy cows

INTRODUCTION

Feed rations for high-yielding dairy cows should be formulated to supply such amount of crude protein which is necessary for maintenance, possibly growth of the fetus, optimal growth of rumen microorganisms, and for the appropriate milk protein synthesis. Excess of nitrogen substances in a diet is degraded to ammonia and the part of ammonia which is not used by rumen bacteria has to be detoxicated in the liver. Next to the quantity, the quality of protein as its degradability and amino acid (AA) composition are important factors. From data by Baudet (1995) it is clear that much of the feeds for ruminants contain sufficient level of lysine in contrary to insufficient content of methionine (Met) in most of the feeds. This means that most of the diets for high-yielding dairy cows, particularly at the early lactation, are deficient in methionine content which is the limiting factor for the milk protein synthesis, eventually also milk yields. Therefore, new methods of methionine protection before ruminal degradation have been developed.

One of the examples of ruminally protected methionine is Smartamine™ M. However, this product is quite susceptible to mechanical disturbance of protective coating, which makes it less suitable for mixing into the feeding mixtures and it is not suitable for granulation. Next to the ruminally protected form of AA also the analogs and derivatives of methionine are used

in dairy nutrition. A newly developed analog of methionine is an isopropylester 2-hydroxy-4-(methylthio)-butanoic acid (HMBi), called MetaSmart™. The MetaSmart™ is the source of methionine from which about one half (50%) is absorbed through the rumen wall and provides metabolizable methionine to increase the milk protein content, milk yields and improve health status of the cow. Remaining 50% of HMBi is available for ruminal microorganisms, thus milk yields and milk fat content could increase.

The objective of this experiment was to assess the effect and efficiency of inclusion of two different forms of supplemental methionine - MetaSmart™ and Smartamine™ M on the lactation performance, in particular production of milk protein, and on the physiological status of dairy cows.

MATERIAL AND METHODS

Experimental design, animals and diets

The experiment of 3x3 Latin square design was conducted with 30 high-yielding dairy cows (22 Holstein and 8 Czech Fleckvieh breeds), allocated into three well balanced groups according to breed, lactation performance, live body weight, etc. At the beginning of the experiment cows were in the average on 87th day of lactation. Each group was assigned to one of three dietary treatments which were: the control (C), Smartamine™ M (S), and MetaSmart™ (M). Each period lasted four weeks in a total including three preliminary weeks and one experimental week. During the experimental week the samples of milk, blood and rumen fluid for analysis were taken.

The composition of diets is recorded in Table 1. Cows were fed total mixed ration (TMR) *ad libitum*. The supplement of Smartamine™ M was added directly into the vertical mixing wagon instead in the concentrate mixture due to its susceptibility to mechanical disturbance of protective coating.

Table 1. Composition of diets (kg)

Ingredient	Diet		
	C	S	M
Maize silage	20.0	20.0	20.0
Lucerne silage	9.0	9.0	9.0
Ensiled maize cobs (LKS)	4.5	4.5	4.5
Lucerne hay	1.5	1.5	1.5
Brewer's grains (fresh)	6.0	6.0	6.0
DO1[1]	8.5	8.5	8.5
Extracted soybean meal	0.16	---	---
Methipass Smart[2]	---	0.19	---
Methipass Meta[3]	---	---	0.17

[1] DO1 contained (%): wheat - 20.4, barley - 20.0, extracted rapeseed meal - 14.1, extracted soybean meal - 24.6, Soypass - 10.0, Lactoplus - 5.0, limestone - 1.1, bicarbonate - 0.8, DMK 4 - 4.0

[2] Methipass Smart contained: 10 % of Smartamine™ M and 90 % of extracted soybean meal → 19 g of Smartamine™ M in the diet

[3] Methipass Meta contained: 25 % of MetaSmart™ and 75 % of extracted soybean meal → 42.5 g of MetaSmart™ M in the diet

Variables measured

- Feed consumption and intake of nutrients (DM, crude protein, crude fibre, NDF, ADF, PDIE, PDIN, NE_L, minerals and vitamins)
- Daily milk yield
- Milk composition (fat, protein, lactose, urea and amino acids)
- Production of milk fat, protein, lactose, FCM and ECM
- Live (body) weight
- Concentrations of blood metabolites (glucose, lipids, total protein, amino acids)
- Average parameters of rumen fluid (pH, NH_3, total and individual content of VFA)

Analyses and calculations

The data was calculated and analyzed using Microsoft Excel or Quattro (Corel Wordperfect Office) software. Statistical analyses were performed using the GLM procedure of SAS software.

RESULTS AND DISCUSSION

The highest milk yields were recorded when feeding MetaSmart^{TM} (31,34 kg; M) which was about 1.41 and 0.93 kg more than for diets C and S, respectively. The milk production with Smartamine^{MT} M (S) was about 0.48 kg higher than in control group (C). Concentrations of milk protein had increasing tendency with experimental diets and was by 0.11 and 0.07 % higher for diets S and M, respectively, in comparison with C. The milk production data demonstrates Table 2. Concentrations of methionine in the milk were not different between all three groups.

However, the concentrations of methionine in blood plasma were about 7.36 and 0.17 μmol/l higher for diets with Smartamine^{MT} M and with MetaSmart ^{TM}, respectively, than for the control group (Table 3).

There were no conclusive differences ($P > 0.05$) in basic parameters of ruminal fluid and blood plasma.

Table 2. Average milk production

Milk production	Diet		
	C	S	M
Milk yield (kg)	29.93	30.41	31.34
Milk protein (%)	3.34	3.45	3.41
Milk fat (%)	3.80	3.78	3.77
Lactose (%)	4.78	4.76	4.79
Total casein (%)	2.60	2.65	2.64
Urea (mg/l)	416.59	434.34	431.62
FCM (kg)	29.03	29.41	30.26
ECM (kg)	29.06	29.70	30.48
Protein production (kg)	1.00	1.05	1.07
Fat production (kg)	1.14	1.15	1.18
Lactose production (kg)	1.43	1.45	1.50

Table 3. Average parameters of blood plasma

Parameter	Diet		
	C	S	M
Glucose (mmol/l)	3.56	3.51	3.58
Protein (g/l)	88.72	88.6	90.88
Urea (mmol/l)	6.48	7.66	7.05
NEFA (mmol/l)	0.121	0.118	0.114
Methionine (μmol/l)	19.47	26.83	19.64

CONCLUSION

The inclusion of both Smartamine^{MT} M and MetaSmart^{TM} in the diet increased milk yields and insignificantly ($P > 0.05$) increased percentage of milk protein. There was no effect on the health and physiological status of the cows however, supplementation of methionine, particularly of preparation Smartamine^{MT} M, increased concentrations of methionine in their blood.

Acknowledgement

This study was supported by Ministry of Agriculture of the Czech Republic, the project No. QH 81309.

REFERENCES

Baudet H.M. (1995): Nouvelles tables INRA, Alimentation 228, 119-121.

Kudrna V., Illek J., Marounek M., Nguyen Ngoc A. (2009): Feeding ruminally protected methionine to pre- and postpartum dairy cows: effect on milk performance, milk composition and blood parameters. Czech J. Anim. Sci., 54 (9), 395–402.

Kudrna V., Illek J., Ngoc Anh N., Poláková K. (2006): Chráněné aminokyseliny a jejich vliv na mléčnou užitkovost dojnic. Krmivářství, 10 (4), 22-24.

Majzlík I. (2000): Chov zvířat I. Česká zemědělská univerzita.

National Research Council. (2001): Nutrient requirements of dairy cattle. 7th rev. ed. National Academy Press, Washington. D.C.

Rulquin H., Graulet B., Delaby L., Robert J.C. (2006): Effect of different forms of methionine on lactation performance of dairy cows. J. Dairy Sci., 89, 4387-4394.

Vyas D., Erdman R.A. (2009): Meta-analysis of milk protein yield responses to lysine and methionine supplementation. J. Dairy Sci., 92, 5011-5018.

Yang W.R., Sun H., Wang Q.I., Liu F.X., Yang Z.B. (2010): Effects of rumen-Protected methionine on dairy performance and amino acid metabolism in lactating cows. American Journal of Animal and Veterinary Sciences, 5 (1), 1-7.