SHORT COMMUNICATION

The effect of lactating dairy ewes’ diet supplementation with ALIMET (liquid methionine) on milk yield and milk composition

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ABSTRACT

The objective of this work was to study the effect of the supplementation of dairy ewes’ diet with liquid methionine (ALIMET) on milk yield and milk composition, from late pregnancy to mid lactation period. Sixty 3-4 year old Boutsiko breed lactating dairy ewes with an average initial body weight 48±1.7 kg and good body condition (3.6), were divided into three groups (treatments), balanced according to milk yield. Ewes were fed 0.8 kg alfalfa hay and 0.8 kg of concentrate daily. Ewes in Group A were fed a usual concentrate for lactating ewes (control), in Group B the control concentrate +1 g ALIMET /kg concentrate, and in Group C the control concentrate +3 g ALIMET /kg concentrate. Ewes were milked twice daily, and milk weights (yield) were recorded every 4 weeks, while milk samples were taken, on a percent basis (10%), for compositional analysis. The results showed that the inclusion of ALIMET significantly increased (p<0.05) milk yield (by 6.8% in Group B and 12% in Group C), compared to control, FCM (6% fat) yield (by 5.5% in Group B and 13.6% in Group C), and milk fat, protein and non fat solids. The growth rate of lambs was 7% and 8% higher, for the suckling period of 42 days, for the Groups B and C, respectively, compared to control, but those differences were not significant. The average daily body weight change of ewes during the experimental lactation period was +0.6, +1.0 and -0.2 kg for Groups A, B and C, respectively. Thus, supplementing the ewes’ diet with ALIMET, at a level of 3 g /kg concentrate, had a positive effect on milk yield and milk composition.

Key words: Dairy ewes, Liquid methionine, ALIMET, Milk yield, Milk composition.

RIASSUNTO

EFFETTO SULLA PRODUZIONE E SULLA COMPOSIZIONE DEL LATTE DI PECORA DELLA SUPPLEMENTAZIONE DELLA DIETA CON ALIMET (METIONINA LIQUIDA)

L'obiettivo di questo lavoro è stato quello di valutare, nell'alimentazione della pecora da latte, l'effetto della supplementazione della dieta con metionina liquida (ALIMET) sulla produzione e sulla composizione del latte. La sperimentazione ha riguardato l'ultima fase della gravidanza e la prima metà della lattazione. Sessanta pecore da latte di razza Boutsiko, di 3-4 anni e del peso vivo medio iniziale di kg 48 ± 1,7, caratterizzate da un buon BCS (3.6), sono state divise in tre gruppi simili per la produzione di latte. Le pecore sono state alimentate giornalmente con 0,8 Kg di fieno di erba medica e 0,8 Kg di concentrato. Le pecore del gruppo A (controllo) sono state alimentate con un mangime commerciale per pecore da latte. Le pecore del gruppo B e del gruppo C hanno ricevuto il mangime di controllo con l’aggiunta, rispettivamente, di 1 g e di 3 g di ALIMET /Kg concentrato. Le pecore sono state munte due volte al giorno e la produzione di latte
individuale è stata registrata ogni 4 settimane; i campioni di latte sono stati presi ogni 4 settimane, su una base percentuale del 10%, per le determinazioni analitiche. I risultati hanno dimostrato che l’inclusione di ALIMET nella razione ha aumentato significativamente (P<0.05) la produzione di latte (+ 6,8% nel gruppo B e +12% nel gruppo C rispetto al gruppo controllo), e la produzione di latte corretto al 6% di grasso (+ 5,5% nel gruppo B e + 13,6% nel gruppo C, rispetto al gruppo controllo), nonché il tenore in grasso, in proteina e in residuo magro del latte. Il tasso di accrescimento degli agnelli allattati per 42 giorni dalle pecore trattate è risultato più elevato nei confronti di quello del controllo, in ragione del 7% e dell’ 8% rispettivamente per i gruppi B e C, ma le differenze fra i gruppi si sono rivelate statisticamente non significative. Le variazioni di peso vivo medio giornaliero delle pecore, durante il periodo sperimentale di lattazione, sono state pari a +0,6, a +1,0 e a -0,2 Kg per i gruppi A, B e C rispettivamente. ALIMET ha determinato un incremento degli aminoacidi disponibili, per l’assorbimento a livello di piccolo intestino, delle pecore in lattazione e ha migliorato l’utilizzazione della proteina ai fini della secrezione lattea.

Parole chiave: Pecore da latte, Metionina liquida, ALIMET, Produzione di latte, Composizione del latte

Introduction

The amino acid profile of microbial protein is of high biological value for lactating ruminants. However, experiments carried out with high-yielding cows have shown that the methionine and lysine content of microbial protein is insufficient to meet optimal performance. Such deficiencies can be corrected via supplementation with methionine (Met) and/or lysine (Lys) in forms that are stable in the rumen.

Met is considered the first limiting amino acid for milk protein synthesis (Rogers et al., 1984; Storm and Orskov, 1984), and studies with lactating dairy cows have shown that rumen-protected Met was effective in delivering Met postruminally, which resulted in an increased Met concentration in plasma (Papas et al, 1984; Succi et al., 1997).

Increased performance has also been observed when sheep have been given supplements of rumen-stable methionine (Lynch et al., 1991; Baldwin et al., 1993; Sevi et al., 1995, 1996, 1998; Goulas, 2000).

The objective of this experiment was to use ALIMET as a means to improve the methionine supply of lactating dairy ewes, and to determine its effects on milk production and milk composition.

Material and methods

Sixty 3 to 4 year old Boutsiko breed lactating dairy ewes with an average initial weight 48±1.7 kg and good body condition (3.6), were divided into three groups (treatments), balanced according to milk yield. Ewes were fed 0.8 kg alfalfa hay and 0.8 kg of concentrate daily. Ewes in Group A were fed a usual concentrate for lactating ewes (control), in Group B the control concentrate +1 g ALIMET /kg concentrate, and in Group C the control concentrate +3 g ALIMET /kg concentrate. ALIMET feed supplement (NOVUS International Inc.), an hydroxy-analogue of methionine (CH₃-S-CH₂-CH₂-CHOH-COOH), is an organic acid readily available as a liquid source of methionine and constitutes an alternative means of methionine supplementation for the diets of ruminant animals. The concentrate used consisted of maize (45%), barley (5.4%), wheat middlings (23.5%), soybean meal (13%), CaCO₃ (2.4%), NaCl (0.5%) and Vitamins + Minerals premix (0.2%). Water was freely available. All ewes were fed individually, twice a day (two equal meals at 07.00 and 15.00 h). Diet selectivity did not occur, and no orts were left from hay or concentrates after each feeding.

The experiment started at late pregnancy (mid October - 4 weeks before lambing) and terminated at the mid lactation period (late in April). Body weights of ewes were recorded at monthly intervals and those of lambs at birth and at weaning (42 days of age). Ewes were milked twice daily and milk weights (yield) were recorded for each ewe every 4 weeks on 2 successive days. Milk samples were taken on each milking for each collection week, and composited on a percent volume basis (10%) for compositional analysis.

Samples of alfalfa hay and concentrates were
analyzed for dry matter (DM), organic matter (OM), crude protein (CP), ether extracts (EE) and ash, according to the Weende procedure, and for NDF and ADF according to Van Soest et al., 1991. Milk fat, protein and lactose were determined by infrared spectroscopy on a MILCOSCAN 131 (A/S N. Foss Electronic, Denmark) after adjustment according to Gerber, Kjeldahl and Chloramin-T methods, respectively.

Fat corrected milk yield (FCM), at 6% fat, was calculated using the equation: $\text{FCM} = (0.28 + 0.12f)Y$, where $f$= milk fat percentage and $Y$= milk yield in g (Kalaisakis, 1982).

One-way ANOVA was used for data statistical analysis, while significance was defined as $P<0.05$ according to methods described by Steel and Torrie (1960).

Results and discussion

The chemical composition of alfalfa hay and concentrate was: Dry matter (DM, %) 90.5 and 87.2, Organic matter (OM, % DM) 91.6 and 93.8, Crude protein (CP, % DM) 17.2 and 17.1, Ether Extracts (EE, % DM) 1.9 and 3.1, NDF (% DM) 46.5 and 15.9, ADF (% DM) 32.5 and 9.0, Hemicelluloses (% DM) 14.0 and 6.9, Cellulose (% DM) 25.3 and 4.3 and Lignin-Coutin (% DM) 6.1 and 3.7 for alfalfa hay and concentrates, respectively. The concentrate had a CP content almost similar to that of alfalfa. Considering the forage to concentrate ratio, which was 1:1, the three treatments (groups) had the same CP level and more or less the same CP intake. The only difference among the three rations was their methionine content.

The composition of milk produced by ewes subject to the three treatments was in the same range reported in the literature for the sheep breed used in this trial (Simos et al., 1996). However, the inclusion of ALIMET in the ewes’ concentrate diets increased, though not significantly ($P>0.05$), milk and fat corrected (at 6% fat) milk yield by 6.8 % and 5.5 %, respectively, when added at 1 g /kg (Group B) and by 12 % and 13.6 % ($P<0.05$), respectively, when added at the level of 3 g /kg (Group C), compared to control Group A (Table 1).

Sevi et al., 1998 found that ewes supplemented with rumen-protected amino acids (RPAA) lysine (0.75%) and methionine (0.25%) had an 8% greater daily milk yield than the non-supplemented ewes, but there was no interaction of RPAA supplementation and the diet CP level (18.5% vs. 14%). On the other side, Lynch et al., 1991 obtained similar milk production in crossbred black-faced ewes receiving 0.28% encapsulated lysine plus 0.11 % encapsulated methionine in diets with protein content from 10.2 to 16.2 %. The lack of difference in milk yield was attributed to a greater use of protein for maintenance of tissue reserves by the ewes receiving the high CP level diet.

The milk fat and the non-fat solids content were not significantly different between Groups A

| Table 1. Mean milk yield and milk composition of ewes per treatment, during the whole experimental period. |
|---------------------------------------------------------------|
| Treatment | A | B | C | SEM | Signif. level |
|-----------|---|---|---|-----|--------------|
| Milk yield g.day$^{-1}$ | 740$^{ab}$ | 790$^{ac}$ | 827$^a$ | 21  | *            |
| 6% FCM | 824$^{ab}$ | 869$^{a}$ | 936$^b$ | 24  | *            |
| Fat % | 6.9$^{ac}$ | 6.8$^{b}$ | 7.1$^a$ | 0.1  | *            |
| Protein | 5.6$^a$ | 5.5$^b$ | 5.8$^a$ | 0.05 | *            |
| Lactose | 5.2 | 5.2 | 5.2 | 0.02 | ns           |
| Non fat solids (NFS) n.1000/ml | 11.5$^{ab}$ | 11.4$^{a}$ | 11.6$^a$ | 0.04 | *            |
| Somatic cells | 570 | 426 | 911 | 214 | ns           |

* $P<0.05$;  ns: not significant
and B or between Groups A and C. However, the calculated yield of milk fat and non-fat solids was greater by 5% and 15% for Groups B and C respectively, compared to control Group A, due to higher milk yield. The protein content of milk was increased significantly ($P<0.05$) in Group C compared to control Group A (Table 1), whilst the calculated milk protein yield was greater by 5% and 16% for Groups B and C, respectively. There was no significant difference between treatments in milk lactose content and somatic cell counts (Table 1).

The ewes in the ALIMET supplemented Groups B and C may have had a higher gross efficiency of dietary N utilization than those of Group A, probably as a consequence of a more balanced amino acid composition of the proteins available for absorption in the small intestine. The same was observed by Lynch et al., 1991 and Sevi et al., 1998 who supplemented ewes’ diets with RPAA lysine and methionine.

The live weight of lambs at birth was not significantly different among treatments, but was higher at weaning ($P<0.05$) in lambs of Groups B and C (with ALIMET) compared with that of lambs of the control Group A (Table 2). The growth rate (in g/kg) of lambs, during the 42 day suckling period, was 7% and 8% higher in Groups B and C, respectively, compared to control Group A, but these differences were not significant (Table 2). Lynch et al., 1991 reported greater ($P<0.05$) growth rate (by 18.6%) for lambs nursing ewes fed diet supplemented with amino acids.

Finally, the average change in live weight of ewes from weaning (beginning of January) to the end of April was +0.6, +1.0 and –0.2 kg /ewe for Groups A, B and C, respectively. This may have been the result of a less advantageous partitioning of nutrients between the mammary gland and the other body tissues, particularly for the ewes of Group C who gave more milk.

The results of this experiment suggest that supplementing the ewes’ diet with methionine, by means of ALIMET, may enhance the amount of amino acids available for absorption in the small intestine and improve protein utilization for milk secretion, perhaps as a consequence of a more balanced amino acid composition of the absorbable protein (Chen and Orskov, 1994; Bertoni, 1996). Protein utilization by the mammary gland occurs more efficiently when essential amino acids, not synthesized in the mammary gland, are available in more optimal proportions (Susmel et al., 1996), thus permitting a more advantageous partitioning of nutrients between the mammary gland and body reserves (Bertoni, 1996) and reducing N losses, which are one of the main sources of environmental impact by ruminants. In conclusion, the supplementation of lactating ewes’ diet with methionine, by means of ALIMET at the level of 3 g/kg concentrate, significantly increased ($P<0.05$) milk yield as well as milk fat, protein and non fat solids content.

The paper must be attributed equally to the authors.

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