**SHORT COMMUNICATION**

**Effects of rumen-protected methionine on milk production of dairy goats**

Adriana Flores¹, German Mendoza¹, Juan Manuel Pinos-Rodriguez², Fernando Plata¹, Salvador Vega¹, Ricardo Bárcena³

¹Departamento de Producción Agrícola y Animal. Universidad Autónoma Metropolitana, México City, México
²Instituto de Investigación de Zonas Desérticas. Universidad Autónoma de San Luis Potosí, México
³Colegio de Postgraduados en Ganadería. Montecillo, Mexico

Corresponding author: Dr. Juan M. Pinos-Rodriguez. Department of Large Animal Clinical Science. College of Veterinary Medicine, Michigan State University. East Lansing, MI 48824, USA - Tel. +1 517 3559593 - Fax: +1 517 4321042 - Email: jpinos@uaslp.mx

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**ABSTRACT**

Twelve lactating Saanen goats were fed with a total mixed ration (forage:concentrate 67:33) and directly supplemented (administered orally) with 0, 2.5 and 5.0g/head/day of rumen-protected methionine (RPM) for 30d.

Body weight was not affected by RPM. There were quadratic (P<0.05) effects on milk yield, fact-corrected milk, energy-corrected milk and milk protein as RPM increased; thus, the highest values of milk yield, fact-corrected milk, energy-corrected milk and milk protein were observed with 2.5g of RPM. Percentage of fat increased quadratically (P<0.05) as RPM doses increased, while fat expressed as grams per day was not affected with RPM.

It was possible to improve milk production and milk protein in dairy goats with a daily supplemented dose of 2.5g of RPM. Further studies with more animals should be developed.

**Key words**: Methionine, Milk yield, Milk composition, Dairy goats.

**RIASSUNTO**

Dodici pecore di razza Saanen in lattazione sono state alimentate con una razione mista (foraggio: concentrato 67:33) integrata con 0, 2,5 e 5g di metionina rumino-protetta (RPM) somministrata direttamente per via orale per 30 giorni.

Key words: Methionine, Milk yield, Milk composition, Dairy goats.
Il peso corporeo non è stato influenzato dalla somministrazione di RPM. Sono stati rilevati effetti quadratici (P<0.05), all’aumentare della quantità di RPM somministrata, per quanto concerne la produzione di latte, la quantità di latte corretta per la percentuale di grasso, la quantità di latte corretta per il contenuto energetico e il tenore proteico; i valori più alti si sono quindi osservati con la somministrazione di 2,5g di metionina rumino-protetta. La percentuale di grasso è aumentata in modo quadratico (P<0,05) all’aumentare dei dosaggi di RPM, mentre il tenore lipidico espresso in grammi/giorno non è stato influenzato dal trattamento.
È stato quindi possibile incrementare la produzione e la percentuale di proteine nel latte attraverso un supplemento giornaliero di 2,5g/capo di RPM. Dovrebbero essere sostenuti ulteriori studi incrementando il numero di animali.

Parole chiave: Metionina, Produzione di latte, Composizione del latte, Capre lattifere.

Introduction

Several studies have been carried out in the recent years in order to identify the limiting amino acids in milk production, in cows, ewes (Bequette et al., 1998) and goats (Madsen et al., 2005). Some of the most frequently reported limiting amino acids for milk production in lactating goats are lysine and methionine (NRC, 2006). In a number of studies supply of rumen bypass methionine has been shown to increase milk and milk protein production in dairy cows (Lara et al., 2006; Davidson et al., 2008) and ewes (Papadomichelakis et al., 2002). Supplementation of rumen protected lysine or methionine have, however, not always proven to be effective in lactating cows (Rulquin and Delaby, 1997) or ewes (Antongiovanni et al., 2002). The information in literature on dairy goats fed with rumen-protected amino acids is scarce, but Madsen et al. (2005) showed that the positive effects on milk yield in early lactation goats when lysine and methionine were given in combination, concluding that mammary supply of these two amino acids were limiting for milk production when the goats were fed the basal feed ration. The NRC (2006) indicates that is a common practice to supplement goats with rumen-protected methionine (RPM) in milking periods, but the optimal dose is unknown. Thus, the objective of this study was to evaluate the effect of graded levels of rumen-protected methionine (RPM) on milk yield, milk composition of dairy goats.

Material and methods

Animals and feeds

Twelve lactating multiparous Saanen goats (55.9±5.6kg) were fed with a total mixed ration (Table 1). Goats averaged 131±12d in milk at the beginning of the experiment. Goats were randomly assigned to the treatments, which consisted of three levels (0, 2.5 or 5.0g/d) of a commercial treatment (Mepron M85, Degussa Co, Allendale, NJ, USA) containing 832g of dl-Metionine/kg. Thus, goats received daily oral doses of around 0, 2 and 4g of dl-Metionine. The diet was fed to the goats twice a day at 700h and 1700h. Body weight was recorded at the beginning and at the end of the experiment. The animals were milked twice daily at the same time that feed and individual milk samples were taken in the morning and in the afternoon and were pooled in a single sample. The experiment was conducted over 30 days with daily measurements of milk production, and recording composition and changes in body weight every 15d.

Analytical methods

Feed samples were taken at the beginning and at the end of the experiment. Dry matter,
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Crude protein and ash were determined according to AOAC (1997), while neutral detergent fibre was determined according to Van Soest et al. (1991). Milk samples were analyzed for fat and protein by infrared analysis (MilkoScan, Foss Electric, Hillerød, Denmark).

Calculations and statistical analysis
Fat-corrected milk was calculated so that
\[
\text{FCM} = \left( \text{milk(kg/d)} \times 0.432 \right) + \left( \text{fat(kg/d)} \times 16.216 \right)
\]
(Dairy Records Management Systems, 2006). Energy-corrected milk was calculated so that
\[
\text{ECM} = \left( \text{milk(kg/d)} \times 0.327 \right) + \left( \text{fat(kg/d)} \times 12.86 \right) + \left( \text{protein(kg/d)} \times 7.65 \right)
\]
(Dairy Records Management Systems, 2006). Data were analyzed as a Completely Randomized design with 3 treatments and 4 goats by treatment, using the Mixed procedure of SAS (1999). The model included the effects of animal (random), treatment (fixed, df=2), time (fixed), the interaction of time and treatment (fixed), and the residual error (random). The heterogeneous compound symmetry covariance structure was selected for analysis with repeated measures based on Akaike’s information criterion. Linear and quadratic effects were tested for methionine level.

Results and discussion
Results are presented in Table 2. Initial and final body weights were not affected (P>0.05) by RPM. There were quadratic effects (P<0.05) on milk yield, fat-corrected milk, energy-corrected milk, and milk protein (expressed as % or g per day) as RPM increased; thus, the highest (P<0.05) milk yield, fat-corrected milk, energy-corrected milk, and milk protein values were observed with 2.5g of RPM. Percentage of fat increased quadratically (P<0.05) as RPM doses increased, while fat expressed as grams per day was not affected with RPM.

As expected, RPM increased milk production and milk protein. Response in goats confirms the NRC (2006) supposition that methionine is one of the first limiting amino acids for milk synthesis, such as observed in dairy cows (Lara et al., 2006) and ewes (Antongiovanni et al., 2002) where RPM increased milk production and fat corrected milk. The experiment from Lara et al. (2006) showed that the optimal dose in dairy cows was 16g/d with a milk output of 35kg/d where dose represented 0.0026% of metabolic body

| Table 1. Ingredients and chemical composition of experimental diet. |
|---------------------------------------------------------------|
| Ingredients (DM basis, %):                                      |
| Oat straw 28.07                                                 |
| Alfalfa 26.78                                                   |
| Corn silage 11.81                                               |
| Wheat middlings 6.69                                           |
| Soybean meal, 44% CP 2.89                                       |
| Coconut meal 0.71                                               |
| Sorghum grain 8.45                                             |
| Corn grain 8.47                                                 |
| Molasses 4.75                                                   |
| Salt 0.78                                                      |
| Sodium bicarbonate 0.60                                        |
| Chemical composition:                                          |
| Dry matter % 71.9                                                |
| Crude protein % DM 14.4                                         |
| Neutral detergent fibre % 44.3                                  |
| Ash % 10.1                                                     |
| Metabolizable energy Mcal/kg DM 2.44                            |
weight (BW). In the current experiment, the best response in milk production was observed with 2.5g of methionine with 1.689kg/d milk, with an equivalent dose of 0.0045% of metabolic BW. As observed in dairy cows, higher doses of rumen-protected methionine, negatively affects milk production in dairy goats presumably because the lysine:methionine ratio was reduced (Lara et al., 2006). In addition, some studies in dairy ewes (Papadomichelakis et al., 2002) and cows (Younge et al., 2001) have demonstrated increments in milk protein. The positive effect found with 5g methionine on milk fat percentage was found in dairy cows (Samuelson et al., 2001) and ewes (Papadomichelakis et al., 2002). However, in dairy goats methionine supplementation had a negative effect on milk fat synthesis. Methionine plays a central role in lipoprotein synthesis in the liver as the key intermediate in methyl group transfer (Lobley et al., 1996), and it has been suggested that a methionine positive effect on lipoprotein synthesis could stimulate milk fat production (Emmanuel and Kennelly, 1984). In addition, that reduction of methyl group demands from the methionine pool may offer production benefits to dairy ruminants and might be achieved by nutritional manipulation other than alteration of the methionine supply (Lobley et al., 1996).

**Conclusions**

More research is needed to determine optimum doses of rumenally protected methionine in lactating goats in different stages of lactation and with a higher number of animals than those used in this experiment; however, the results indicate that it is possible to improve milk production and milk protein in dairy goats with a daily doses of 2.5g of rumen-protected methionine.

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**Table 2.** Rumen-protected methionine on milk production and composition of goats.

| Methionine (g/d) | 0 | 2.5 | 5.0 | SEM |
|------------------|---|-----|-----|-----|
| Initial body weight | kg | 57.8 | 56.9 | 53.3 | 4.09 |
| Final body weight | " | 56.8 | 54.8 | 54.7 | 4.11 |
| Dry matter intake | " | 1658.9 | 1701.7 | 1691.0 | 100.3 |
| Milk yield | g/d | 1441.2 | 1689.0 | 1390.1 | 78.37 |
| Fat-corrected milk | " | 1177.2 | 1378.3 | 1317.3 | 70.42 |
| Energy-corrected milk | " | 1261.5 | 1565.5 | 1342.7 | 75.77 |
| Protein | " | 45.8 | 65.2 | 41.8 | 2.01 |
| Fat | " | 34.2 | 40.0 | 44.2 | 2.12 |
| Protein | % | 3.2 | 3.9 | 3.0 | 0.18 |
| Fat | " | 2.4 | 2.4 | 3.2 | 0.14 |

*Quadratic (P<0.05).*
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