The effect of rumen protected methionine (RPMet) on milk composition of lactating Cashmere Rayeni goat

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Abstract:

BACKGROUND: Methionine has been suggested as the first-limiting amino acid for milk production in ruminants. It is important how to increase milk protein yield and milk fat in dairy ruminants. **OBJECTIVES:** This study was set to investigate the effect of rumen protected methionine (RPMet) on milk composition of lactating Cashmere Rayeni goats. **METHODS:** 40 healthy singleton Cashmere Rayeni goats about 3 to 4 years of age, at the first day of lactation, were randomly divided into 2 equal control and experimental groups. The experimental group was supplemented with 5 gr/day RPMet for 60 days. Milk samples of 2 groups were taken on 30th and 60th days of the study. Milk protein, milk fat, milk lactose, and milk Solids-not-Fat (SNF) were determined using automatic analyzer. The results were statistically evaluated with SPSS. **RESULTS:** The supplementation with RPMet did not effect all of the above mentioned parameters during the 60 days of the experiment ($p>0.05$), except for the milk fat percentage of the experimental group which showed significant increase after 60 days ($p<0.05$). **CONCLUSIONS:** Our results about milk protein, milk lactose, and SNF were in agreement with previous studies that had not shown significant differences. Results about milk fat on the 30th day were in agreement with the results of several authors who reported that RPMet did not affect milk fat percentage or yield; however, in the present study milk fat increased significantly on the 60th day ($p<0.05$). To the best of the authors' knowledge, no study about the effects of RPMet on milk composition of Cashmere Rayeni goat has been done.

Introduction

The immense amount of nutrition-based research on dairy cows has been done with the primary goal to increase milk production and eventually to manipulate milk protein and milk fat yield.

Protein available for absorption in the ruminant intestine is derived from ruminal microbes and dietary protein that escapes degradation during passage through the rumen. Protein is one of the major limiting nutrients in the diets of lactating dairy cows (Yang et al., 2010). In the pasture fed dairy cow and goat, more than 50% of the protein ingested is degraded in the rumen into ammonia, and this extensive protein degradation may limit the amount of protein passing to the small intestine (Pacheco-Rios et al., 1999).

Methionine has been most often suggested as the first-limiting amino acid for milk production in ruminants; however, other amino acids have been

proposed as first limiting or co limiting with methionine (Andereas et al., 2013; Izumi et al., 200; Leonardi et al., 2003; Yang et al., 2003). This is largely because of their low concentrations in feed protein as compared to their concentrations in milk and ruminally synthesized bacterial protein (Benefield et al., 2009; Bequette et al., 1998; Doepel et al., 2004; Lapierre et al., 2006). Supplementation of methionine postruminally has had positive effects on milk production and milk protein concentration (Armentano et al., 1997; Dinn et al., 1996; Noftsger et al., 2003). The implement of the protected amino acids in dairy cows' diet showed improvements of the production of milk and milk proteins (Overton et al., 1996; Pisulewski and Kowalski, 1999; Poljicak-Milas and Marenjak, 2007).

It is important how to increase milk protein yield and the efficiency of protein utilization and to avoid protein deficiency in early lactation (Yang et al., 2010). Several studies have been conducted to determine the effects of supplementation with Met on milk protein yield and composition, with varied responses. In some cases, an increase in milk protein and protein yield has been observed (Izumi et al., 2000; Koch et al., 1996; Robert et al., 1996), whilst in others there has been no response in milk protein yield (Overton et al., 1996; Papas et al., 1984). In this regard, some studies have suggested that supplementary dietary Met was associated with an increase in milk fat production (Robinson et al., 1998; Socha et al., 2008); whereas, some researchers have emphasized that Met had no effect on milk fat (Brodrick et al., 2008; Leonardi et al., 2003; Noftsger et al., 2003; Preynat et al., 2009). However, most of the studies have been undertaken with mixed rations, using different types of preserved forage and different ratios of forage to concentrate (Pacheco-Rios et al., 1999).

Although the data are rather variable regarding the amino acid supplements and their influence on the milk protein and milk fat synthesis in dairy cows, it could be suspected they have a similar effect on dairy goat performance (Kijora et al., 2002; Oliviera et al., 2001: Overton et al., 1996; Wang et al., 2003).

The objective of this study was to evaluate the effect of rumen protected methionine on the protein, fat, lactose, and SNF contents in milk of Cashmere Rayeni goat at two months of lactation.

Materials and Methods

40 healthy singleton Cashmere Rayeni goats about 3 to 4 years of age, at the first day of lactation, were randomly divided into 2 equal control and experimental groups. The experiment started at the beginning of the lactation period. Both groups were fed on the pasture. The experimental group was supplemented with 5 gr/day rumen protected methionine (RPMet) (3 gr/day pure RPMet; Mepron® M85, Degussa Corporation, Germany) manually for 60 days. The RPMet consisted of a DL-methionine core coated with pH sensitive copolymer to protect them from ruminal breakdown (Andereas et al., 2013).

Milk samples of the 2 groups were taken on the 30^{th} and 60^{th} days of the experience. Milk protein, milk fat, milk lactose, and milk SNF were determined using automatic analyser "Milcoscan 605" (A.S.N. Foss Eletronic). The results were statistically evaluated with SPSS (SPSS 16 Chi. USA, 2004).

Results

The results of the effect of RPMet on milk compositions measurements are reported in Tables 1 and 2.

The supplementation with RPMet did not influence milk protein, lactose, and SNF percentage during the 60 days of the study in Cashmere Rayeni goats ($p>0.05$). Also, no treatment effects were observed on the yields of milk fat on the first 30 days; however, 60 days from the beginning of the experience, there was a significant increase in milk fat percentage of the experimental group ($p<0.05$).

Discussion

Although AA utilization by dairy cows has received considerable attention from different research groups all over the world, there is relatively little published data on the effect of AA supplementation on milk production in pasture-fed animals.

Protein is one of the most valuable milk components, both in an economic and nutritional sense. The largest fraction of the milk proteins,

Table 1. Milk components in control and experimental group on 30th day. (*) p<0.05.

Milk components	Control group	Experimental group (RPMet)
	Mean±SE	Mean±SE
Protein (%)	3.41±.07	3.41±.07
Fat (%)	3.57±.45	2.82±.29
Lactose (%)	4.90±.10	4.96±.11
SNF (%)	9.28±.19	9.32±.18

Table 2. Milk components in control and experimental group on 60th day. (*) p<0.05.

Milk components	Control group	Experimental group (RPMet)
	(mean±SEM)	(mean±SEM)
Protein (%)	4.14±.06	4.23±.13
Fat (%)	2.46±.10*	2.92±.14*
Lactose (%)	5.80±.10	5.99±.18
SNF (%)	10.79±.16	11.15±.33

casein, determines the yield and quality of numerous products (Pacheco-Rios et al., 1999). Percentage of milk protein may be more sensitive index than milk yield to estimate the effect of RPMet on cows (Samuelson et al., 2001). Several studies have been carried out to determine the effect of RPMet on milk protein. The results of these studies differ and the values of RPMet are not yet clear (Izumi et al., 2001).

Casper et al. (1988) conducted a study on cows and found that supplementation of ruminally protected Met increased milk protein percentages. They concluded that methionine increased in mammary synthesis; nonetheless, it was not the first factor limiting milk production. RPMet tended to increase protein percentage in milk, which agreed with the data from other experiments (Casper et al., 1987; Misciatteilli et al., 2003; Rogers et al., 1987; Schingoethe et al., 1988; Wu et al., 1997).

Supplemental RPMet enhanced the production of milk protein (Armentano et al., 1997; Casper et al., 1988; Dinn et al., 1998; Misciatteilli et al., 2003), milk yield, and milk protein content (Illg et al., 1987). Kijora et al. (2002) in their research found a strong relationship between feed intake and protein content in the ration of dairy goats. On the other hand, supplementation with RPMet has also been reported to have no effect (Papas et al., 1984; Yang et al., 2010).

Our results about milk protein in this study were in agreement with previous studies that had not shown significant effect on milk protein. No significant effect of PRMet on protein percentage in milk may be due to low bioavailability of methionine from PRMet for protein synthesis (Yang et al., 2010).

Some researchers have shown that Met deficiencies have most often been suggested to affect milk fat synthesis because Met is a methyl donor in the transmethylation reactions of lipid biosynthesis (Robinson et al., 1998; Yang et al., 2010). Addition of methionine hydroxy analog to diets of dairy cows frequently has resulted in increased fat content of milk (Lundquist et al., 1983). Socha et al. (2008) reported that duodenal infusion of Met increased milk fat percentage and yield in cows during early lactation. Also, Misciatteilli et al. (2003) determined that early lactation cows fed RPMet had increased milk fat percentage compared with control cows. Specific mechanisms by which Met supplementation may affect milk fat, including ruminal effects (Soltan et al., 2012) or post absorption effects on lipid metabolism, remain largely speculative (Soltan et al., 2012).

Increased percentage of milk fat when RPMet was fed to cows or abomasal infusion of methionine was obtained in some experiments (Oldham et al., 1984; Overton et al., 1996; Robinson et al., 1998; Rogers et al., 1987; Yang et al., 2010). Clark and Oldham had suggested that supplementary dietary Met was associated with an increase in milk fat production (Clark et al., 1975; Oldham et al., 1984).

Our results about milk fat on the 30th day were in agreement with those obtained by several authors (Brodrick et al., 2008; Leonardi et al., 2003; Noftsger et al., 2003; Overton et al., 1996; Preynat et al., 2009) who reported that RPMet supplementation did not affect milk fat percentage or yield.

According to our results, after 60 days, only milk fat increased significantly (p<0.05).The specific reason for the increased percentage of milk fat in our experiment was unknown; however, several possibilities had been suggested in the literature. McCarthy et al. (1968) reported that Met might be important for synthesis of serum lipoprotein and as a methyl donor for synthesis of phospholipids, suggesting that a post-absorptive effect of Met on lipid metabolism is possible. Sharma and Erdman (1988) speculated that choline synthesized from Met was likely to have been at least partially responsible.

In this study, the percentages of lactose and SNF

in milk were not significantly affected when RPMet was fed, which was in agreement with the results found by other researches (Overton et al., 1996; Yang et al., 2010).

Differences in results from these experiments might have been caused by differences in the status of Met or other AA of the cows, the amount of methionine supplied in the protected product, and the efficacy of the protection scheme in delivering methionine to the small intestine (Yang et al., 2010).

The presented results indicate that the supplementation of the protected methionine (Mepron®, Degussa) cannot lead to an increase in milk components, total milk protein, and milk fat during the 30 days; however, after the 60th day, milk fat increased significantly ($p<0.05$). The results at the end of the 30th and 60th days (except milk fat on the 60th day) are in agreement with those of previous experiments conducted on Alpine goats (Bacar-Huskic et al., 1998; Poljicak-Milas and Marenjak, 2007) and the results obtained by some other researches in this field (Poljicak-Milas and Marenjak, 2007).

It is worth mentioning that parity and live weight of animals could have had an impact on the production results.

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بررسی تاثیرمتیونین خوراکی پوشش دار بر ترکیبات شیر بز کرکی راینی

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چکیده

زمینه مطالعه: متیونین به عنوان اولین اسیدآمینه محدودکننده و ضروری برای تولید شیر در نشخوارکنندگان است. از طرفی پیداکردن راهی مناسب برای افزایش تولید پروتئین و چربی شیر حائز اهمیت می باشد. **هدف:** این مطالعه به منظور بررسی اثر متیونین خوراکی پوشش دار بر ترکیبات شیر بزکرکی راینی انجام گرفت. **روش کار:** ۴۰ رأس بز راینی ماده سالم تک قلوزاییده ۳ تا ۴ ساله، در روز اول پس از زایمان به طور تصادفی به دو گروه مساوی کنترل وتیمار تقسیم شدند به طوریکه گروه تیمار به مدت دو ماه روزانه ۳g متیونین به صورت دستی دریافت کردند. نمونه ی شیر از دو گروه در پایان ماه اول و دوم اخذ گردیده و فاکتورهایی همچون درصد پروتئین، درصد چربی، درصد لاکتوز و مواد جامد غیرچربی اندازه گیری شدند. سپس داده ها توسط نرم افزار اس پی اس اس مورد تجزیه و تحلیل آماری قرار گرفتند. **نتایج:** نتایج حاصل از این بررسی نشان می دهدکه استفاده از متیونین به عنوان مکمل خوراکی اثر قابل توجهی برهیچ یک از فاکتورهای ذکرشده به جز درصد چربی شیر پس از ۶۰ روز از انجام مطالعه نداشته است و تنها درصد چربی شیر در گروه تیمار پس از ۶۰ روز به طور معنی داری افزایش یافته بود. **نتیجه‌گیری نهایی:** یافته های حاصل از این مطالعه در مورد پارامترهایی همچون درصد پروتئین شیر، لاکتوز، مواد جامد غیرچربی و نیز درصد چربی در روز ۳۰ مطابق با یافته های حاصل از مطالعات قبلی می باشد اما همانطورکه بیان شد افزایش درصد چربی شیر در روز ۶۰ پس از انجام آزمایش در گروه تیمار نکته حائز اهمیتی می باشد. از طرفی تاکنون هیچ مطالعه‌ای در مورد اثر متیونین خوراکی بر فاکتورهای مذکور در شیر بر روی بزکرکی راینی انجام نگرفته است.

واژه های کلیدی: ترکیبات شیر، بزکرکی راینی، متیونین خوراکی پوشش دار

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