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Influence of Feeding Different Concentration of Fish Oil on Milk Composition of Awasi Goats

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Abstract: Five Awasi goats (18-24 month old) during their first lactation were used in this study. All goats were fed a partial basal diet for one week, before supplementation with fish oil at 1 and 2% rates was commenced. Milk samples were collected and analysed for their protein, lactose and milk fat contents. The results of this study disclosed no significant changes in protein and lactose content for both treatments. While, there was a 7-4 and 14.8 % decrease in milk fat content for the 1 and 2% treatments, respectively. The fatty acid composition of milk fat showed a small increase about 7.9% in total n-3-fatty acids with the 2% supplementation rate.

Key words: Milk, goats, fatty acids, milk composition, Conjugated Linoleic Acid (CLA)

INTRODUCTION

The dairy industry in Saudi Arabia is well progressing and cow milk is the backbone of this industry. Although the world production of goat milk is small compared to the cow milk market, goat cheese is widely consumed in Europe such as France and some Mediterranean countries (Wolff, 1994). It is therefore essential to obtain more information about composition of goat milk and its nutritive value. The Awasi breed is a known dairy goat breed in Saudi Arabia. Information evaluating the nutrition and composition of the Awasi goat milk is lacking. Dietary manipulation has great influence on milk yield and milk composition. Previous studies have shown a positive correlation between both the amount and the concentration o f metabolizable energy and either milk protein content or protein yield (Sporndly,1989). Goetsh *et al.* (2001) reported that high levels of concentrate diet (65%) depressed milk yield in goats in late lactation compared with 50% concentrate diet. Increasing the amount of concentrate fed from 175 to 350 gm/kg milk resulted in more milk of reduced fat content. Ramos and Juarez (1981) reported that milk yield and fat percentage were not affected by proportion of concentrate to forage in the diet , however , a decrease of short chain fatty acids an increase in stearic and oleic oils with high concentrate diets fed to dairy goats was noticed (Morand-fehr and Sauvant, 1980). Protein and SNF percentages were significantly increased by reducing the crude fiber content of the diet , whereas, fat and total solids percentage significantly increased by increasing the crude fiber content in the diet(Abdel-Rahman and Mehaia, 1996). Dietary fiber concentration and type of fat had significant effects on milk fat. Effects were more pronounced when unsaturated fat was added to the fiber diet. When low fiber diet plus unsaturated fat was fed, milk fat percentage was decreased by 30% in lactating cows (Griinari *et al.*, 1998). Certain isomers of Conjugated Linoleic Acid (CLA) and/or Transvaccenic Acid (TVA) have been implicated in causing a reduction in milk fat concentration in dairy cattle (Baumgard *et al.*, 2000; Piperova *et al.*, 2000). Previously, feeding of marine algae (Franklin *et al.*, 1999) or fish oil (Donovan *et al.*, 2000) increased both CLA and TVA in milk fat. However, such diets can also depress intake, milk yield and yield or concentration of milk fat. Milk fat concentration and milk yield were lowered when cows were fed diet with supplanted fish oil (Whitlock *et al.*,2002). This decrease in milk fat concentration and yield has been noticed before (Cant *et al.*,1997; Donovan *et al.*, 2000) with fish oil supplementation. The intra-abomasal infusion of cow with CLA being fed oleic or linoleic oil at 2.5% DM did not affect milk yield and dry matter intake. Protein ,lactose and SNF in milk were not affected by such treatment (Loor and Herbein, 1998). However, the effect of changes in diet on milk composition is minimal compared with the effect on milk yield (Min *et al.*, 2005).

The objective of this study is to investigate the effect of feeding graded levels of fish oil in the composition of Awasi milk goat.

MATERIALS AND METHODS

Five Awasi goats (18-24 month old)in their first lactation were used in this exiperiment. The five goats were fed a pretrial basal diet which was formulated according to the requirements of the NRC (1990) for lactating dairy goats for one week. Thereafter, these goats were fed basal diet supplemented with 1% fish oil and this continued for three weeks. The rate of supplementation

Table 1: Milk composition of Awasi goat milk supplemented with fish oil

Week	Supplement rate	SNF (mean±SD)	T.S (mean±SD)	Lactose (mean±SD)	Protein (mean±SD)	FAT (mean±SD)
1st week(control)	0%	7.6±0.3	10.4±0.4	3.9±0.2	2.7±0.3	2.7±0.5
1st week post-trial	1%	6.3±0.97	9.7±1.3	3.1±0.7	2.3±0.7	3.6±1.6
2nd week post-trail	1 %	7.3±0.5	9.96±0.7	3.7±0.4	2.5±0.1	2.7±0.5
3rd week post-trail	1%	7.8±0.6	9.97±1.2	4.2±0.4	2.8±0.3	2.5±0.3
4th week post-trail	2%	7.1±0.2	10.7±0.5	3.5±0.2	2.6±0.2	3.5±0.5
5th week post-trail	2%	7.7±0.3	10.3±0.7	3.5±0.4	2.8±0.2	2.6±0.6
6th week post-trail	2%	7.8±0.2	10.3±0.4	3.9±0.2	2.8±0.2	2.4±0.6
7th week post-trail	2%	7.5±0.3	9.9±0.4	3.9±0.2	2.6±0.2	2.3±0.4

Table2: Omega3-Fatty Acids and Omega-6-Fatty Acids content of Awasi goat milk fed control and fish oil diets

Omega Fatty Acids	Diet 0%	Diet 1%	Diet 2%
Total n-3-Fatty acids (mg 100^{-1} gm FA)	38.0±0.8	38.0±1.2	41.0±0.4
Total n-6-Fatty acids (mg 100^{-1} gm FA)	97±3.7	97±3.8	104±4.3
n6: n3	2.5 :1	2.5 :1	2.5 :1

* mean±SD

was then increased to 2% starting from week 4-post trail until the end of the experiment on week 6-post-trail. Milk samples were collected once from each goat during the control period and afterwards. Each milk sample was divided into aliquots. One aliquot (50 mL) containing Bronopol (D andF control systems, San Ramon,CA) was stored at 4°C until analysed for fat, protein, lactose, total solids and SNF by infrared analysis (Milkscan FT120-Type 71200,Foss Electric Denmark). An additional aliquot (50 mL) of milk without a preservative was frozen and stored at -20°C until analyzed at the end of the experiment. The samples were thawed and centrifuged at 10,000 Xg for 1 hr to harvest milk fat for fatty acids analysis. Fatty acids in milk fat were trans-methylated by in situ transterification (Park and Goins, 1994). Undecenoate (Nu-Check Prep, Elysian, Mn), was used as the internal standard , samples were injected by auto-sampler into a Hewlett Parked 5890A gas chromatography equiped with a flame ionization detector (Hewlett Packard, Sunnyvale, (A). Methyl esters of fatty acids were separated on a 30mX0.25 mm i.d. fused silica capillary column (SP-2380, Supleco, Bellafonte, PA). The injector temp. was maintained at 225°C and the detector temp. at 275°C. The initial column temperature was 205 °C(held for 12 min) and was programmed to increase 2 °C per minute to a final temp. of 220°C (held for 2 min) Peak identification was based on relative retention times of a commercial standard (Nu-check Prep, Elysian , MN). Statistical analysis was performed by using analysis of variance (ANOVA) and difference between the means, Minitab 12 (Minitab Inc., State College, PA, USA).

RESULTS

The results of this study were summarized in Table 1 and Table 2. Feeding fish oil to lactating Awasi goats at two different concentrations did not bring any significant changes in S.N.F., T.S, Lactose and proteins for both treatments. There was a 7.4or and 14.8 % decrease in milk fat content for the 1 and 2% treatments, respectively. The fatty acids composition of milk fat was not affected by fish oil supplementation at both treatments. The highest concentration of saturated fatty acids were capric (C10), Myristic (C14), Palmitic (C16) and Stearic acids (C18) which were 9.02±0.04, 11.1±0.2, 26.4±0.5 and 9.23±0.2 g 100^{-1} g of total fatty acids, respectively. A small increase 7.9 % in total n-3-fatty acids was observed for the 2% supplementation rate. The ratio of n-6F to n-3 F was found to be 2.5:1 all treatments.

DISCUSSION

Data from the current experiment were used to evaluate the effects of fish oil supplementation on gross composition of milk of the Awasi dairy breed being fed a basal diet which was formulated according to the requirements of the NRC (1990) for lactating dairy goats. The supplementation of fish oil started as 1% which contained for 3 weeks and then increased to 2 % until the end of the experiment on the 7th week post-trail. The effects of fish oil supplementation were also evaluated in terms of its effects on fatty acid composition of milk fat in particular its effects on n-3-FA. Data obtained during the control period were compared with previous work. Total solids, Lactose, Protein and Fat reported for the Awasi dairy goat in this study are lower than those reported for the Saanens in Australia (Ranawana and Kellaway, 1977), Saanens, Red SoKoto, African dwarf in Nigeria (Mba *et al.*,1975; Akinsoyinu *et al.*, 1977), improved Fawn in Jermany (Graf *et al.*, 1971) and Pygmy goats in the United States of America (Jenness, 1979). Also, values for total solids, fat and crude proteins for British-Alpine and Anglo-Nubian goats in Trindad (Devendra, 1972) were higher than that reported for Awasi goat in this study. Fat content, crude protein and lactose for the Barbari and Jamunapari Indian breed (Sachdera *et al.*, 1974) were also higher than the values

reported for the Awasi dairy goat in this study. The reason for these variation between the Awasi and other breeds mentioned earlier in this report in their milk composition is mostly related to genetic factors or it could be due to environmental differences. Sauvant *et al*., (1973), Sauvant and Morand-Fehr (1978) attributed differences in fatty acid composition of goat milk to genetic factors. Devendra, (1972) and Mba *et al*. (1975) noted lower fat content produced by British –Alpines, Anglo-Numians and Saanens in tropical environments as compared to that produced by the same breeds in temperature climates. Akinosoyinu *et al*. (1977) reported high contents of fat, protein and lactose in the milk of West African dwarf goats. The supplementation of fish oil in the study resulted in a reduction in the fat content (Table 1) of Awasi goat milk after three weeks following the 1% supplementation rate which was equivalent to 7.4 and 14.8% reduction in milk fat for the 2% supplementation rate in the 7th week post-trail. There was no significant changes in total solid, proteins and lactose following fish oil supplementation. The decreased milk fat associated with fish oil supplementation may be related to the higher amounts of PUFA fish oil. Altered rumen environment and the presence of UFA in the diet are necessary conditions for a substantial decrease in the percentage of milk fat (Griinari *et al*., 1998). In this study, supplementation of fish oil led to a 7.9% increase in total n-3-FA content with the 2% supplemented may have stimulated the conversion of n-3-FA precursor in the diet leading to an increase in the total n-3-FA synthesis in the mammary gland and hence their excretion in goat milk. However, n-6-FA were also elevated following the supplementation of fish oil. The reason for this is unclear.

CONCLUSION

The fish oil supplementation in this study decreased milk fat percentages and led to a small increase in the n-3-FA content of the Awasi goat milk.

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