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EFFECT OF PROTECTED FAT INCLUSION ON LACTATIONAL PERFORMANCE OF BALADI GOATS, UNDER WINTER AND SUMMER CONDITIONS OF EGYPT

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SUMMARY

Two equal groups of lactating Baladi goats (10 each) in the 3rd parity were utilized in this experiment to examine the effect of protected fat on their lactational performance. Samples of blood (0 and 4 hrs post feeding) were taken for determining thyroid hormones as well as hemoglobin (Hb) and hematocrite (Ht), while milk samples were collected biweekly for milk composition determination. Milk production was tested biweekly for six weeks postpartum.

Thyroxine (mg/dl) and triiodothyronine (ng/dl) in blood were the highest in winter ($P<0.01$) and there were no significant effects of the diet except for T3 ($P<0.05$). Blood samples after 4 hrs from feeding had the highest Hb and Ht values ($P<0.05$) in protected fat diet (CFA) and in summer than in winter.

Milk yield was reached the peak 2 weeks postpartum. Summer season was accompanied by lower milk yield ($P<0.05$), protein and lactose % ($P<0.05$) as compared to cold season. Feeding protected fat increased milk yield ($P<0.05$) over than control diet.

Inclusions of protected fat in ordinary diets increased percentages of protein, lactose and fat ($P<0.05$) except milk of the six week postpartum comparing with control diet in summer only.

Better lactational performance of lactating goats was observed in winter season and with the Inclusion of protected fat in diets.

Keywords: Goat, protected fat, season, milk composition, thyroid hormones, blood

INTRODUCTION

Goats are a promising small ruminant in the dairy sector particularly in desert areas. At such areas, ambient temperature during summer may stress the animals and reduce their feed intake. Recent research efforts were forwarded to improve their lactational performance through covering the required energy. Feeding practice in summer should cover the animal requirement and help lactating goats to remain without heat load as much as possible. Protected fat supplementation to diets of lactating goats has increased recently. Protected fat helps in meeting the energy requirements of these animals without causing any metabolic disorders often observed when large amounts of grains are fed.

Coppock and Wilks (1991) reported that the product of the calcium salts of palm oil fatty acids was shown to have a net energy for lactation of more than three times that of corn.

Protection of fat was made to prevent its digestion in reticulorumen. Rumen fermentation is indeed not affected by protected fat because it is insoluble in the rumen provided that rumen pH is maintained in its normal values (Palmquist *et al.*, 1986). Protected fat supplementation has a variable effect on the galactopiotic function of the mammary gland (Doreau and Chilliard, 1992), and blood constituents (El-Bedawy *et al.*, 1994).

The objective of this study was to determine the suitability of calcium salts of long chain fatty acids supplemented in diets fed in hot climate as a source of energy with reference to some blood constituents and lactational performance of Baladi goats.

MATERIALS AND METHODS

Two experiments, one in summer (35°C) and the other in winter (15° C), six weeks each were conducted using two rations (Table 1).

A total of 20 lactating Baladi goats in the 3rd parity of the second week postpartum were utilized in this study. Goats were divided into two equal groups (n=10). Goats of the first group (G1) were fed a designed ration without protected fat as a control, while the 2nd group (G2) were fed the designed ration with a commercial protected fat (CFA, Megalac ®, Church & Dwight Co., Inc., Princeton, NJ, USA), (Table 1).

Goats were similar in age and body weight with the average of 3.5 - 4 years and 23 - 25 Kg, respectively. A 2 X 2 factorial design was utilized to examine the protected fat supplementation as a fed supplement suitable for feeding lactating goats under summer and winter conditions of Egypt.

Blood samples were taken before and 4 hrs post-feeding from the jugular vein, centrifuged at 9000 rpm for 20 minutes and the serum was frozen for later assays of hemoglobin % (Hb), hematocrite (Ht) %, and thyroxine (T_4) (mg/dl) and triiodothyronine (T_3) (ng/dl). Plasma thyroxine (T_4) (mg/dl) and triiodothyronine (T_3) (ng/dl) were assayed by using a solid phase I^{125} single antibody radio-immunoassay commercial kits (Coat & Count, DPC, Los Angelos, CA, USA). The procedure can detect as little as 0.25 ng/dl. The antiserum is highly specific with very low crossreactivity to other compounds that might be present in samples. The assay is accurate over a broad range of the values of the hormones.

Biweekly composite milk samples were analyzed for fat, protein and lactose determination (%) using Milkoscan ® 133 B, Foss electronics. Test day milk yield were recorded on a biweekly bases.
Data were statistically analyzed according to Snedecor and Cochran (1980). Differences among means with a significant F ratio were separated by Duncan procedure.

Table 1: Ingredients and chemical composition of the experimental rations

Item	Control g /h/d	CFA diet* g/h/d
Alfa alfa hay	123	350
Barley grains**	230	50
CFA***	-	75
Chemical composition (% of the ingredients used in ration formulation)		
	Barley grains	*Alfa alfa* hay
DM	90.7	88.9
CP	11.7	10.7
CF	08.1	32.3
NFE	65.9	29.2
Ash	02.7	15.8

*Protected fat supplemented diet. ** Given as whole not processed. *** Ca salt of long chain fatty acids Megalac®

RESULTS AND DISCUSSION

Combined it Table 2, are the values of some blood parameters as affected by season and CFA inclusion in diets of Baladi goats.

No significant effect of season on the values of Hb % and Ht % were found, the expected effects of hot climate on these values did not appear clearly which can be attributed to the excess availability of drinking water all over the day, in addition to the adaptability of Baladi goats to the Egyptian seasonal variations. The values of Hb % and Ht % denote the seasonal adaptation of lowering O_2 intake and metabolic heat production during hot conditions, this physiological phenomenon may clarify the lower milk yields in hot conditions than the cold one's.

Thyroxine (T_4) values were increased significantly ($P<0.05$) in winter comparing their values in summer. These results are in agreement with the finding of Cunningham (1997) who found that, concentration of plasma thyroxine (T_4) in cows decreased as a result of solar radiation. Thyroxine (T_4) increased, insignificantly, with CFA supplementation. Triiodothyronine (T_3) values were increased ($P<0.01$) in winter than summer. This most probably attributed to the increase of metabolic rate during winter to keep body temperature within the normal range (38 – 38.5 C°). But CFA inclusion decreased T_3 concentration ($P<0.05$) in summer and increased ($P<0.05$) its concentration in winter, which reflects its suitability as a source of energy in hot conditions.

This physiological phenomenon can be discussed as T_3 is the more active hormonal form in the blood that regulates the general metabolism as a feed back with the surrounding environmental temperature to maintain the basal metabolic rate and cause a kind of metabolic adaptation needed for lactogenesis.

Lower values of T_4 and T_3 in the group, supplemented with CFA, express a low heat increment when compared with the control group. Meanwhile, control diet may result in a higher heat increment which elevate the internal heat load, consequently the animal will reduce the heat production as a feedback to regulate its body temperature by reducing the levels of T_3 and T_4 hormones specially the active form (T_3) in summer.

Consequently, it is recommended to supplement ordinary diets as a substitution of part of energy with CFA especially in hot climates due to their low heat increment and make the animal more comfortable and more capable to increase its production.

Table 2. Effect of season (S) and protected fat inclusion (CFA) on some blood parameters in Baladi goats

Item	Winter		Summer		P		
	Control	CFA	Control	CFA	S	CFA	S x CFA
Hemoglobin, (%)							
0 hr.	$16.31^{a}\pm0.50$	$15.74^{b}\pm1.01$	$12.64^{b}\pm0.98$	$11.11^{c}\pm0.57$	ns	ns	*
4 hr.	$18.00^{a}\pm0.23$	$11.02^{b}\pm1.80$	$10.84^{b}\pm0.57$	$12.35^{c}\pm0.28$	*	*	*
Heamatocrite, (%)							
0 hr.	$39.81^{a}\pm1.91$	$33.00^{a}\pm1.20$	$36.67^{a}\pm1.71$	$32.33^{a}\pm1.71$	ns	ns	ns
4 hr.	$40.83^{a}\pm1.65$	$30.67^{b}\pm1.96$	$34.00^{b}\pm2.23$	$30.67^{b}\pm2.23$	*	*	ns
Thyroxine, (ng/dl)							
0 hr.	$5.61^{a}\pm0.47$	$5.73^{a}\pm0.43$	$3.43^{b}\pm0.28$	$3.93^{b}\pm0.18$	**	ns	*
4 hr.	$5.93^{a}\pm0.49$	$5.53^{a}\pm0.46$	$3.83^{b}\pm0.41$	$4.13^{b}\pm0.28$	*	ns	ns
Triiodothyronine, (ng/dl)							
0 hr.	$111.67^{a}\pm9.19$	$100.0^{a}\pm1.57$	$61.17^{b}\pm7.32$	$72.00^{c}\pm4.02$	**	*	*
4 hr.	$98.330^{a}\pm4.71$	$80.83^{b}\pm5.54$	$58.16^{b}\pm4.90$	$65.33^{a}\pm5.30$	**	*	*

Each value is presented from 60 observations
* P< 0.05 ** P< 0.01 ns = not significant

Table 3. Effect of season (S) and protected fat inclusion (CFA) on milk yield and composition in Baladi goats

Item	Winter		Summer		P		
	Control	CFA	Control	CFA	S	CFA	SxCFA
Milk yield (ml/day)							
2^{nd} week	$930^{a}\pm20$	$1010^{b}\pm40$	$620^{c}\pm80$	$910^{d}\pm120$	**	*	*
4^{th} week	$490^{a}\pm31$	$500^{a}\pm38$	$302^{b}\pm50$	$400^{c}\pm75$	*	*	*
6^{th} week	$300^{a}\pm50$	$300^{a}\pm50$	$180^{a}\pm61$	$250^{c}\pm62$	*	*	*
Protein %							
2^{nd} week	$13.9^{a}\pm2.1$	$14.8^{a}\pm3.0$	$10.2^{b}\pm2.1$	$12.3^{a}\pm4.0$	*	ns	ns
4^{th} week	$12.2^{a}\pm2.5$	$12.9^{a}\pm2.1$	$8.7^{b}\pm3.3$	$10.5^{c}\pm3.5$	*	ns	ns
6^{th} week	$10.1^{a}\pm3.0$	$11.4^{a}\pm3.1$	$7.2^{b}\pm2.9$	$8.3^{b}\pm1.9$	*	*	*
Lactose %							
2^{nd} week	$7.9^{a}\pm0.3$	$8.5^{a}\pm1.5$	$6.1^{b}\pm2.1$	$7.2^{a}\pm1.6$	ns	*	*
4^{th} week	$8.2^{a}\pm0.9$	$8.9^{a}\pm1.3$	$5.9^{b}\pm2.8$	$7.0^{c}\pm1.5$	*	*	*
6^{th} week	$7.3^{a}\pm1.2$	$8.0^{a}\pm2.0$	$5.2^{b}\pm1.8$	$7.5^{a}\pm2.2$			
Fat %							
2^{nd} week	$4.0^{a}\pm0.9$	$8.5^{a}\pm1.5$	$4.5^{b}\pm0.9$	$4.8^{a}\pm1.0$	ns	ns	*
4^{th} week	$4.6^{a}\pm1.2$	$8.9^{a}\pm1.3$	$5.1^{b}\pm1.1$	$4.9^{a}\pm0.8$	ns	ns	*
6^{th} week	$4.95^{a}\pm1.8$	$5.3^{a}\pm1.2$	$4.7^{a}\pm1.2$	$5.0^{a}\pm0.9$	ns	ns	ns

Each value is presented from (10) observations
* P< 0.05 ** P< 0.01, ns = not significant

Data in Table 3. present the lactational performance of Baladi goats as affected by season and inclusion of protected fat in the ordinary diet. Milk yield peaked two weeks post-partum and decreased thereafter.

Diet supplemented with protected fat caused a significant ($P<0.05$) increase in milk yield over than the control diet (562 ml/day vs. 472 ml/day). The magnitude of the increase was higher in winter than in summer (590 ml/day in winter vs. 444 ml/day in summer).

West and Hill (1990), Canale *et al.* (1990) and Kowalski *et al.* (1999) reported an increase in milk yield when CFA was added to the diets of lactating cows. The same trend was observed for goats (Gulati *et al.*, 1997).

Feeding CFA in summer increased the percentages of protein, lactose and fat ($P<0.05$). The overall trend noticed that the changes in protein and fat percentages as affected by CFA inclusion was not significant.

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Lactose %							
2nd week	$7.9^{a}\pm0.3$	$8.5^{a}\pm1.5$	$6.1^{b}\pm2.1$	$7.2^{a}\pm1.6$	ns	*	*
4th week	$8.2^{a}\pm0.9$	$8.9^{a}\pm1.3$	$5.9^{b}\pm2.8$	$7.0^{c}\pm1.5$	*	*	*
6th week	$7.3^{a}\pm1.2$	$8.0^{a}\pm2.0$	$5.2^{b}\pm1.8$	$7.5^{a}\pm2.2$			
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Feeding CFA in summer increased the percentages of protein, lactose and fat (P<0.05). The overall trend noticed that the changes in protein and fat percentages as affected by CFA inclusion was not significant.

Gulati *et al.* (1997) stated that milk parameters is regulated by metabolic activities known to be occurring in the rumen and in the mammary gland and the magnitude of these effects is more clear in long term feeding trials.

On the contrary, West and Hill (1990) and Wu and Huber (1994) reported that increasing fat content of diets has generally decreased milk protein concentrations.

Also, Chillard and Doreau (1997) stated that CFA increased milk yield in cows by approximately one kg/day, and decreased milk protein content by 1.2 g/kg milk, however milk butterfat increased.

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