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Relationships Between Some Blood and Milk Components in Early Lactation in Non-Dairy Sheep

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In the present study, the relationships between plasma and milk parameters of non-dairy Karayaka sheep in early lactation period have been investigated. Two years old, twenty Karayaka sheep were used in the experiment. The study continued for 50 d after parturition. Sheep were fed a diet containing 135.1 g crude protein and 2.31 metabolized energy kcal/kg. The cholesterol in plasma was positively correlated with milk urea ($r = 0.52$; $p < 0.05$) and negatively with milk fat ($r = -0.56$; $p < 0.05$). A significant positive correlation ($r = 0.51$; $p < 0.05$) between plasma cholesterol and milk yield was found. There was also significant positive correlation ($r = 0.59$; $p < 0.05$) between plasma and milk urea in this study. But no correlation between body measurements and milk components could be established in this study. It was concluded that the relationships for many observed parameters between plasma and milk were not clear in non-dairy sheep as much as in dairy cows.

Key Words: Milk, Blood, Early lactation, Sheep.

INTRODUCTION

Usually lactating animals have a negative energy balance during the first weeks of lactation because of their high milk production. There are high nutrient requirements for increasing milk synthesis in this lactation period. High nutrient requirements for milk synthesis in mammary gland at the early lactation stage affect the blood and milk components such as protein and fat[1, 2]. Blood carries a lot of parameters such as insulin, glucose, prolactin, lipoproteins that control udder development, milk synthesis, regulation of milk components and the regeneration of the secretory cells during lactation and dry period[3, 4]. Mammary nutrient intake is determined by mammary gland biosynthetic activity, availability of nutrients and plasma parameters[5]. There are interactions between plasma and milk parameters. Milk production in the first month of lactation influences the production of later lactation periods. Therefore we must know the factors affecting milk production in early lactation. The interactions between plasma and milk

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parameters of dairy sheep have been investigated in a limited number of studies. But no research was found on non- dairy sheep in early lactation period. Jordan[6–8] reported the problems encountered in attempting to get non-dairy ewes to increase milk yield and alter milk composition when stimulated with increases in nutrient intake during a whole lactation period. But there were not enough reports about the reason of this problem for non-dairy sheep in his studies. Further research is needed to investigate on non-dairy sheep. Any correlations between milk and plasma parameters of non-dairy sheep in early lactation period are as yet unknown. In this study, the relationships between plasma and milk parameters in non-dairy Karayaka sheep in early lactation period have been investigated. Changes in body size or dimensions and relationships between dimensions and milk components may be important selection criteria for milk yields and components[9]. Therefore, a study was undertaken to determine the relationships between body dimensions and milk components for non-dairy sheep. Most coefficients of Pearson's correlations between the various blood and milk traits were in the well-known directions and reflected the well-orchestrated endocrine changes and metabolic adaptations in early lactation, *i.e.*, enhanced mobilization of depot fat, skeletal muscle breakdown and favoured partitioning of absorbed nutrients to the mammary gland to provide sufficient substrates for milk synthesis[10]. The correlations between milk, plasma and body measurements by using the Pearson correlation coefficients have been obtained in this study.

EXPERIMENTAL

In the experiment, two year old, twenty Karayaka ewes were used. The experiment continued 50 d after lambing. The lambs were single males and housed in separate rooms without their mothers. Lambs were suckled twice daily between 0830 and 0930 and between 1600 and 1700 in their mother's pen during the experiment. Milk consumed by the lambs was measured twice daily by weighing the lambs before and after suckling.

Animals were fed a diet containing 135.1 g crude protein (CP) and 2.31 ME kcal/kg (Table-1). Crude protein (CP) (Kjeldahl-N × 6.25) was determined by AOAC procedures[11]. Metabolizable energy (ME, Mcal/kg), Ca and P values of feeds were taken from feed composition tables[12]. The composition of the control diet was based on the nutritional requirements for lactating sheep[12].

To determine milk composition, samples were obtained 1 day each week by hand milking. Milk samples were composites of milk collected at consecutive morning and afternoon. The samples were collected into plastic vials preserved with microtabs, stored 4°C until analysed for determination of parameters. The MUN was determined by an enzymatic (urease and glutamate dehydrogenase) colorimetric method (Boehringer-Mannheim). The milk total protein was determined by Kjeldahl method (N × 6.38). The milk fat was determined by Roese-Gottlieb Method[13].

TABLE-1
COMPOSITION OF THE CONTROL DIET

Ingredients	Rate (%)	ME (Mcal/kg)	CP (%)	Ca (%)	P (%)
Barley	53.00	2.60	10.87	0.07	0.42
Wheat bran	20.50	2.30	14.69	0.15	0.32
Sunflower meal	14.00	2.01	28.77	0.40	1.25
Lentil straw	10.00	1.80	7.05	1.20	0.20
Marble powder	1.50	–	–	37.00	–
$NaHCO_3$	1.00	–	–	–	–
Total	100.00	2.31	13.51	0.80	0.48

Jugular blood samples were collected from each animal by disposable syringe through vein and were placed in heparinized tube at the end of each week. Immediately after sampling, the samples were placed on ice and transported to the laboratory. Then the samples were centrifuged at 3500 rpm for 5 min. The plasma obtained in each tube was separated and immediately frozen to –20°C until it was analysed. The plasma was analyzed for urea N and total protein using automated colorimetric procedures previously described [14]. Insulin was assayed as described by Davies and Beck[15]. The following techniques were used to determine the other biochemical parameters: an enzymatic colorimetric test for total plasma cholesterol (mg dL^{-1}; Boehringer Mennheim CHOD-PAP method) and triglycerides (mg dL^{-1}; Boehringer Mennheim GPO-PAP method)[16]. Plasma glucose was measured with an auto analyzer (Advia™ 1650, Japan).

At the end of the study, the following live animal allometric measurements were recorded: Body measurements were defined as heart girth (HG), circumference of sheep's barrel measured immediately behind the front legs; chest depth (CD), vertical distance from the narrowest part of the chest floor to the back; height of withers (HW) vertical distance from the ground to the highest point of the withers; body length (BL) the distance from the point of the shoulders to the ischium.

All of the data are indicated as mean ± SEM. Correlations between milk, plasma and body measurements were calculated using the Person correlation coefficients. All the data analyses were performed with the help of SPSS[17].

RESULTS AND DISCUSSION

Body measurements, plasma parameters and milk components of sheep are given in Table-2. Table-2 summarizes the average measurements obtained for all the traits studied.

Body measurements of two years old Karayaka sheep are compatible with the report of Atasoy *et al.*[18] Plasma parameters and milk components (except fat) of Karayaka sheep in this study are consistent with normal values for sheep announced by Koneko and Cornelius[19]. Milk fat of Karayaka sheep was found lower than normal values (6–9%). The reason of decrease in milk fat was high energy of diet. Samuelsson[20] mentioned that cows with a high plane of nutrition generally have a reduced fat content in the milk whereas cows with low energy intake have an increased fat content. There has been reported a depression in milk fat content in diets containing high amounts of grain (fermentable starch) such as barley, wheat and maize[21, 22]. Barley rate (55%) was higher in diet in this study to meet the energy needs of sheep in early lactation period. We concluded that low milk fat resulted from high energy intakes and high rate of barley (fermentable starch) in diet.

TABLE-2
BODY MEASUREMENTS, PLASMA AND MILK COMPONENTS

	Parameters	Mean	Std. Error
Body measurements	BW (kg)	56.30	1.20
	HW (cm)	67.60	0.70
	CD (cm)	34.10	0.40
	BL (cm)	54.50	0.60
	HG (cm)	103.20	0.95
Plasma	Insulin (ng/mL)	1.61	0.23
	Glucose (mg/dL)	51.47	1.66
	Cholesterol (mg/dL)	40.12	1.65
	Triglyceride (mg/dL)	61.18	4.55
	T otal protein (g/dL)	7.12	0.22
	Urea (mg/dL)	17.18	0.45
Milk	Yield (kg)	471.20	19.30
	Fat (%)	5.15	0.12
	Total protein (%)	5.47	0.08
	Urea (mg/dL)	10.30	0.94

According to Spicer *et al.*[23], plasma insulin and glucose concentrations were negatively correlated with milk fat and protein for dairy cows in early lactation period. But, no relationship was found between plasma insulin, glucose and milk components. Jordan[6–8] reported the problems encountered in attempting to get non-dairy ewes to increase milk yield and alter milk composition.

There was found negative correlation between plasma cholesterol and milk fat ($r = -0.56$; $p < 0.05$) and positive correlation between plasma cholesterol and milk urea ($r = 0.52$; $p < 0.05$). These results are compatible with the report of Spicer and Francisco[24] studied on same parameters in dairy cows in early lactation period. But Spicer and Francisco[24] expressed that further research will be needed to determine the specific reason for significant correlations between plasma cholesterol and milk fat and urea. We can explain negative correlation between plasma cholesterol and milk fat for our study that starch intakes are significantly and inversely related to plasma cholesterol levels[25] and positively related to milk urea[26]. Negative correlations between plasma cholesterol and milk fat probably depend on high starch intakes of sheep in this lactation period. Barley includes high amount of starch. In this lactation period, high starch intakes of experimental sheep occurred because of high barley content (53%) of diet. There was no correlation between plasma triglyceride and milk yields but significant correlation between plasma cholesterol and milk yield ($r = 0.51$; $p < 0.05$) in this study. These results confirm the report of Puppione *et al.*[27] for dairy cattle in early lactation period.

TABLE-3
CORRELATION COEFFICIENTS BETWEEN EXPERIMENTAL DATA

		Milk			
		Yield	Protein	Fat	Urea
Plasma	Insulin	NS	NS	NS	NS
	Glucose	NS	NS	NS	NS
	Cholesterol	0.51 *	NS	–0.56*	0.52*N
	Triglyceride	NS	NS	NS	NS
	Protein	NS	NS	NS	NS
	Urea	NS	NS	NS	0.59*
Body measurements	BW	NS	NS	NS	NS
	HW	NS	NS	NS	NS
	CD	NS	NS	NS	NS
	BL	NS	NS	NS	NS
	HG	NS	NS	NS	NS

* $P < 0.05$; NS: Not significant.

Significant positive correlation between plasma urea and milk urea ($r = 0.59$; $p < 0.05$) was found. Rios *et al.*[28] reported that there were high and significant correlations between plasma and milk urea in early lactation in dairy goats. The urea in milk arises primarily from massive transfer of urea from the blood[29]. Several authors have reported in dairy cattle a significant correlation between concentrations of urea in blood and milk[30–32].The equilibration between blood urea and milk urea is relatively rapid; urea is equilibrated with serum with a time lag[33] of 1 to 2 h. Due to its rapid and passive diffusion through cell membranes[34], equilibration may be explained by diffusion of urea along the mammary ducts and through the mucosa in the alveoli[33].

In the study there was not found any the correlation between body measurements and milk components as reported by Spicer and Francisco[24] for dairy cows in early lactation period. It is understood that there were no correlations between body measurements and milk components of non-dairy sheep and these findings were similar to dairy cows in early lactation period. Bonczek *et al.*[9] reported that changes in body size or dimensions and relationships between dimensions and milk components may be important selection criteria for milk yields and components. According to results in this study, this statement is not valid for non-dairy sheep. But further researches are needed to confirm the findings obtained from non-dairy sheep in this study.

In conclusion, there were significant correlations between some blood and milk constituents under the effect of a stable diet in early lactation period in non-dairy sheep. Researchers who studied with dairy cows observed clearer relationships for most of the parameters between plasma and milk. But the same thing can not be said for non-dairy sheep in this research. Further data on non-dairy sheep are also needed to improve the interpretation of the interrelationships between plasma and milk components under intensive farming conditions in early lactation period.

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