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Effect of Seasons and Breeds on Selected Serum Parameters and Milk profile in Clinically Healthy Lactating Dairy Goats in Egypt

Mahmoud Saber[1*], Fatma M Tayeb[1], Ossama M Abdou[1], Ayah B Abdel-Salam[2] and Sabry A Mousa[1]

[1]Department of Medicine and Infectious Diseases, Faculty of Veterinary Medicine, Cairo University, Giza, 12211, Egypt
[2]Department of food hygiene and control, Faculty of Veterinary Medicine, Cairo University, Giza, 12211, Egypt
***Corresponding author:** mahmoud.saber@vet.cu.edu.eg

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ABSTRACT

This study evaluated the impact of seasons (Summer, Autumn, Winter and Spring) and breeds of dairy goats (Shami, Mixed boar and Baladi) on selected serum parameters and milk profile. Forty-nine apparently healthy lactating dairy goats belonging to a private farm in El-Beharah governate, Egypt, were used in this study. Their ages ranged from 3-4 years old and their body weights ranged from 30-40 kg. According to breeds, they were classified into 17 Shami, 14 Mixed Boar and 18 Baladi, and according to seasons, they were classified into 12 Autumn, 13 Winter, 12 Spring and 12 Summer. Goats were exposed to detailed case history and clinical examination to be ensure they are free from any illness. Serum and milk samples were collected from goats at the middle of each season. calcium increased significantly in Summer with variable results among groups. Regarding overall mean, inorganic phosphorous showed significant decline in Summer, while decreased significantly in Baladi than Shami. Seasons-breeds interaction showed that inorganic phosphorous increased significantly in Shami in Autumn than Shami, Mixed boar in Summer and Baladi in Autumn. Albumin in Mixed Boar significantly increased in Summer than Autumn. Milk profile revealed that fat % increased significantly in Mixed boar in Autumn than Shami in Spring, Baladi in Autumn and Summer. Lactose % increased significantly in Baladi than Shami and Mixed Boar. Milk Protein % increased significantly in Baladi than Mixed Boar. It could be concluded that there was a considerable effect of seasons and breeds on selected serum biochemical parameters and milk panel in lactating dairy goats in Egypt. Current findings are important for goat breeder and manufacturer of goat milk products to improve breed selection and crossbreeding program.

Key words: Seasons, Breeds, Serum, Milk profile, Dairy Goats, Egypt.

INTRODUCTION

Goats continue to play a substantial role in human nutrition. Their number is increasing more quickly comparatively to sheep, particularly in less developed parts of the world, indicating an increased role in food production systems (Skapetas and Bampidis, 2016).

In Africa, from 2000 to 2013 there was a conspicuous increase in goats total number representing 48.61% increase of total world increase (FAOSTAT). In Egypt, goats are considered one of the important economic sources for meat, milk, fibers and manure in rural and desert areas. Most Egyptian goats belongs to the Baladi breed (EL-SAYED *et al.*, 2016).

Goat milk has been shown to play an important role in human nutrition due to a vital relationship between goat milk nutritional values and human health. Goat milk is similar in composition to other types of milk as it contains fat, protein, carbohydrate, mineral and vitamin (Mohsin *et al.*, 2019).

Milk fat is one of the most important constituents of milk and is considered as a measure of economics of milk and milk products. Most price plans for milk and milk products are based largely on milk fat percent (Mehta, 2014). In normal circumstances, goat breeder will choose the animal breed according to yield and productivity, while food manufacturers will favor milk with high functional properties (Mohsin *et al.*, 2019).

Quality of milk is dependent on milk composition which may be affected by many factors such as breed, age, body size and weight, udder size, ration, stage of lactation, season, length of dry period, and environmental temperature (Solaiman, 2010). So, the aim of this study is to evaluate the impact of different seasons (Summer, Autumn, Winter and Spring) and different breeds (Shami, Mixed boar and Baladi) on selected serum parameters and milk profile, particularly milk fat %, in lactating dairy goats in Egypt.

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MATERIALS AND METHODS

Animals and study design

Forty-nine clinically healthy lactating dairy goats belong to a private farm in El-Behairah governate, Egypt, were used in the present study. Their ages ranged from 3 - 4 years old and their body weights ranged from 30- 40 kg. They were exposed to detailed case history and physical clinical examination to ensure that they are apparently healthy and free from any signs of illness. According to breeds, they were classified into 17 Shami, 14 Mixed Boar and 18 Baladi, and seasonally they were classified into (12) Autumn, (13) Winter, (12) Spring and (12) Summer. This study was performed during the period from September 2018 to August 2019. Goats were raised in semi-closed farm system with daily allowance of grazing on Egyptian crowfoot grass in addition to patent local concentrate mixture fed twice daily. Feed analysis of offered concentrate mixture in green seasons (Winter, Spring) and dry seasons (Autumn, Summer) was carried out in Animal Health Research Institute, Giza, Egypt, and presented in table no. (1).

Table 1: Analysis of concentrate mixture fed in green and dry seasons

Parameters [1]	Winter and Spring	Summer and Autumn
Moisture	8.27	8.19
DM % [2]	91.74	91.82
Ash %	4.85	4.90
OM %	95.14	95.09
EE %	15.97	11.93
CP %	16.99	10.20
CF %	15.26	15.24
NFE %	46.89	57.73
TDN %	94.95	91.38

[1] Feed Analysis results on dry matter basis. [2] DM; dry matter, OM: organic matter, EE: ether extract, CP: crude protein, CF: crude fiber, NFE: nitrogen free extract, TDN: total digestible nutrient.

Samples and laboratory investigations

All procedures of animal handling and sampling were approved by the Ethics of Animal Experiments Committee, Faculty of Veterinary Medicine, Cairo University, Egypt. Blood serum and milk samples were collected at the middle of each season at 8 a.m. before morning meal. The blood samples were collected by puncture of jugular vein, using plain vacutainers for separation of serum for biochemical analysis. Milk samples were collected manually for analysis of milk composition on the day of sampling using milk analyzer.

Analysis of serum samples including total protein, albumin, calcium (Ca), magnesium (Mg) and inorganic phosphorous (P) were carried out using specific kits produced by SPECTRUM Company, Egypt, according to the method described by (Young and Friedman, 2001) and (Tietz, 1986). Serum globulin and A/G ratio were calculated. Milk composition including fat %, lactose %, Solid Not Fat (SNF) %, protein % and salt % were measured using (LCD display-4 lines x 16 characters, 100-240V-1.6A max., Bulgaria).

Statistical analysis

Statistical analysis was performed with SAS® version 9.4. We used Two ways ANOVA to test for effects of seasons, breeds and their interaction on the variables of serum and milk with Tukey as post hock test and data were summarized as mean±standard error of mean.

RESULTS AND DISCUSSION

Calcium, inorganic phosphorous, magnesium, total protein, albumin, globulin and A/G ratio were recorded in tables no. (3) and (4). Regardless the effect of breed, serum Ca revealed significant increase in Summer, while Baladi breed showed significant increase irrespective the effect of seasons. Regarding seasons-breeds interaction, serum Ca recorded highly significant variations among seasons and breeds since Shami in Autumn and Mixed Boar in Autumn, Spring decreased significantly than Shami in summer, Mixed Boar in summer and Baladi in autumn, summer. Shami in winter decreased significantly than in Sham in Summer and Baladi in Autumn, Summer. Shami in Spring and Baladi in Winter decreased significantly than Shami in summer and Baladi in Autumn. Mixed Boar in Autumn significantly decreased than Baladi in Autumn. Overall mean of Serum Ca disagreed with values reported by (Kelany, 2002), (Casamassima *et al.*, 2007), (Ikhimioya and Imasuen, 2007), (Waziri *et al.*, 2010), (Mozaffari *et al.*, 2011), (Olafadehan, 2011), (Pugh and Baird, 2012) and (Olafadehan *et al.*, 2014) and this could be referred to variation in breeds, nutrition and raising circumstance.

Inorganic phosphorous revealed significant decrease in Summer, while regardless the effect of seasons, Baladi decreased significantly than Shami. Concerning seasons-breeds interaction, serum P increased significantly in Shami in Autumn than Shami in summer, Mixed Boar in Summer and Baladi in Autumn. Overall mean of inorganic P disagreed with values reported by (Kelany, 2002), (Ikhimioya and Imasuen, 2007), (Mozaffari *et al.*, 2011), (Olafadehan, 2011), (Pugh and Baird, 2012) and (Olafadehan *et al.*, 2014) and this could be referred to variations in breed, nutrition and raising circumstance.

Serum magnesium, total protein, globulin and A/G ratio reported non-significant differences among seasons and breeds. Overall mean of serum magnesium agreed with (Kelany, 2002), (Casamassima *et al.*, 2007) and (Olafadehan, 2011), while (Mozaffari *et al.*, 2011), (Olafadehan, 2011) and (Pugh and Baird, 2012) recorded higher values.

Total protein level in wet season (winter) showed non-significant difference in comparing with that in dry season (summer), while on the contrary (Askar *et al.*, 2014) reported that total protein level was significantly higher in wet season than in dry season in grazing sheep at arid area. Overall mean of total protein agreed with (Waziri *et al.*, 2010), (Mozaffari *et al.*, 2011), (Olafadehan, 2011) and (Pugh and Baird, 2012), while (Casamassima *et al.*, 2007), (Ikhimioya and Imasuen, 2007), (Abdelatif *et al.*, 2010) and (Sadjadian *et al.*, 2013) reported higher values, but (Al-Habsi *et al.*, 2007) and (Sharma and Puri, 2013) recorded lower values.

Regarding seasons-breeds interaction, serum albumin in Mixed Boar increased significantly in Summer than Autumn. The same finding was recorded by (Inbaraj *et al.*, 2018) in Andaman local goat in India this increase may be referred to prolonged exposure of the goats to direct sun rays resulting in vasodilatation followed by vasoconstriction leading to reduced plasma volume and thus,

Table 2: Overall mean of selected serum biochemical parameters in lactating dairy goats during the period from September of 2018 to August 2019 in Egypt

*Variables	Seasons				Breeds			Overall
	Autumn	Winter	Spring	Summer	Shami	Mixed Boar	Baladi	mean
Calcium mmol/l	2.38±0.23 b	2.29±0.10 b	2.21±0.14 b	3.44±0.16 a	2.38±0.16 b	2.37±0.17 b	2.92±0.19 a	2.57± 0.11
Inorganic phosphorous mmol/l	2.13±0.34 a	2.28±0.21 a	2.09±0.27 a	0.74±0.13 b	2.26±0.27 a	1.66±0.24 ab	1.53±0.23 b	1.82± 0.15
Magnesium mmol/l	0.93±0.10 a	1.13±0.16 a	0.74±0.05 a	0.71±0.13 a	0.99±0.15 a	0.86±0.09 a	0.80±0.08 a	0.88± 0.06
Total protein g/l	69.96±4.52a	71.89±2.76a	77.48±1.94a	82.01±3.40a	71.77±3.26 a	75.12±3.50 a	78.67±2.25 a	75.26±1.77
Albumin g/l	28.48±1.01a	30.33±0.99a	32.53±0.86a	31.53±1.75a	30.10±0.74 a	31.00±1.72 a	31.05±0.84 a	30.71±0.64
Globulin g/l	41.48±4.28a	41.56±2.98a	44.95±1.77a	50.48±3.53a	41.68±3.17 a	44.11±3.42 a	47.62±2.18 a	44.56±1.71
Albumin/globulin ratio	0.80±0.10 a	0.79±0.07 a	0.74±0.04 a	0.70±0.11 a	0.81±0.07 a	0.79±0.10 a	0.68±0.04 a	0.75±0.04

*Means within the same row, among seasons or breeds, having common letter are not statistically different at P<0.05.

Table 3: Selected serum parameters in different breeds of lactating dairy goats under effect of seasons-breeds interaction in Egypt

Variables	Shami				Mixed Boar				Baladi			
	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer
Calcium mmol/l	1.97± 0.09 e	2.20± 0.09 de	2.30± 0.22 cde	3.58± 0.46 ab	1.95± 0.04 e	2.40± 0.18bcde	1.80± 0.25 e	3.30± 0.32abcd	3.64± 0.43 a	2.24± 0.35cde	2.37± 0.19 bcde	3.44± 0.24 abc
Inorganic Phosphorous mmol/l	2.86± 0.44 a	2.38± 0.40 ab	2.42± 0.61 ab	0.71± 0.19 b	2.18± 0.10 ab	2.32± 0.22 ab	1.25± 0.61 ab	0.44± 0.11 b	0.61± 0.12 b	2.05± 0.69 ab	2.35± 0.31 ab	0.91± 0.25 ab
Magnesium mmol/l	0.90± 0.08 a	1.38± 0.42 a	0.73± 0.06 a	0.75± 0.44 a	1.09± 0.28 a	1.05± 0.08 a	0.66± 0.08 a	0.50± 0.10 a	0.81± 0.32 a	0.83± 0.12 a	0.78± 0.09 a	0.80± 0.20 a
Total protein g/l	63.60± 5.32 a	70.85± 7.04 a	75.49± 5.14 a	85.93± 2.30 a	65.06± 10.80 a	70.44± 2.76 a	80.00± 5.04 a	88.08± 8.21 a	87.57± 4.99 a	76.03± 3.56 a	77.21± 2.35 a	77.01± 5.55 a
Albumin g/l	29.18± 0.64 ab	30.61± 1.57 ab	29.24± 1.89 ab	31.95± 3.02 ab	25.28± 2.88 b	29.04± 2.21 ab	33.49± 1.62 ab	37.51± 5.00 a	30.29± 2.62 ab	32.00± 0.65 ab	33.69± 0.86 ab	28.32± 1.49 ab
Globulin g/l	34.43± 5.12 a	40.25± 7.57 a	46.25± 3.99 a	53.98± 2.21 a	39.78± 10.37 a	41.40± 3.68 a	46.51± 5.07 a	50.57± 12.80 a	57.28± 4.89 a	44.03± 3.22 a	43.52± 2.21 a	48.69± 4.91 a
Albumin/ globulin ratio	0.95± 0.16 a	0.86± 0.15 a	0.64± 0.05 a	0.60± 0.07 a	0.75± 0.26 a	0.74± 0.13 a	0.74± 0.09 a	0.97± 0.45 a	0.54± 0.08 a	0.73± 0.05 a	0.79± 0.05 a	0.61± 0.06 a

*Means within the same row with common letter are not statistically different at P<0.05.

Table 4: Overall mean of milk profile parameters in lactating dairy goats during the period from September 2018 to August 2019 in Egypt

Variables	Seasons				Breeds			Overall
	Autumn	Winter	Spring	Summer	Shami	Mixed	Baladi	mean
fat	6.62±0.88 a	6.46±0.62 a	5.88±0.87 a	4.45±0.31 a	5.33±0.45 a	7.21±0.73 a	5.32±0.65 a	5.87± 0.37
lactose	4.28±0.17 a	4.27±0.23 a	4.57±0.37 a	4.21±0.12 a	4.03±0.10 b	4.11±0.13 b	4.80±0.27 a	4.33± 0.12
SNF	8.98±0.34 a	8.61±0.41 a	9.16±0.72 a	8.68±0.23 a	8.38±0.19 a	8.65±0.28 a	9.45±0.54 a	8.85± 0.23
protein	2.77±0.14 a	2.67±0.12 a	2.92±0.23 a	2.88±0.09 a	2.67±0.08 ab	2.60±0.10 b	3.09±0.16 a	2.81± 0.08
salt	0.75±0.03 a	0.72±0.03 a	0.77±0.06 a	0.74±0.02 a	0.71±0.02 a	0.72±0.02 a	0.80±0.05 a	0.75± 0.02
Freezing point	-0.53 ±0.02 a	-0.47± 0.01 a	0.47±0.01 a	-0.51 ±0.01 a	-0.49±0.01 a	-0.51 ±0.02 a	-0.49 ±0.01 a	-0.50±0.01

*Means within the same row, among seasons or breeds, having common letter are not statistically different at P<0.05

Table 5: Milk profile parameters in different breeds of lactating dairy goats under effect of seasons-breeds interaction in Egypt

Variables	Shami				Mixed Boar				Baladi			
	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer
Fat %	6.08± 1.07 ab	5.95± 0.18 ab	3.66± 0.09 b	4.47± 1.06 ab	10.48± 0.94 a	6.67± 0.92 ab	7.17± 2.23 ab	4.89± 0.65 ab	3.83± 0.62 b	6.96± 2.74 ab	6.34± 1.41 ab	4.23± 0.36 b
Lactose %	4.11± 0.20 a	3.80± 0.07 a	3.92± 0.04 a	4.35± 0.34 a	4.47± 0.60 a	3.96± 0.09 a	3.84± 0.06 a	4.29± 0.14 a	4.44± 0.21 a	5.60± 0.60 a	5.26± 0.67 a	4.11± 0.18 a
SNF %	8.60± 0.38 a	7.96± 0.15 a	8.04± 0.08 a	8.95± 0.68 a	9.64± 1.23 a	8.24± 0.15 a	8.14± 0.07 a	8.86± 0.33 a	9.07± 0.38 a	10.28± 1.66 a	10.23± 1.43 a	8.44± 0.33 a
Protein %	2.68± 0.18 a	2.45± 0.06 a	2.72± 0.03 a	2.98± 0.27 a	2.62± 0.44 a	2.53± 0.06 a	2.40± 0.20 a	2.91± 0.07 a	3.09± 0.20 a	3.24± 0.37 a	3.29± 0.44 a	2.81± 0.15 a
Salt %	0.72± 0.03 a	0.67± 0.01 a	0.69± 0.01 a	0.76± 0.06 a	0.79± 0.11 a	0.70± 0.02 a	0.68± 0.01 a	0.75± 0.03 a	0.78± 0.04 a	0.87± 0.13 a	0.87± 0.12 a	0.72± 0.03 a
Freezing point	-0.50± 0.03 a	-0.46± 0.01 a	-0.46± 0.01 a	-0.52± 0.04 a	-0.58± 0.09 a	-0.47± 0.01 a	-0.48± 0.01 a	-0.52± 0.02 a	-0.53± 0.02 a	-0.51± 0.02 a	-0.47± 0.02 a	-0.49± 0.02 a

*Means within the same row with common letter are not statistically different at P<0.05

increased protein concentration (Helal *et al.*, 2010). Overall mean of albumin agreed with (Latimer, 2011), (Pugh and Baird, 2012) and (Sharma and Puri, 2013) ,whereas (Casamassima *et al.*, 2007), (Ikhimioya and Imasuen, 2007), (Abdelatif *et al.*, 2010), (Sadjadian *et al.*, 2013) and (Al-Bulushi *et al.*, 2017) recorded higher values and this might be attributed to different nutrition and health statuses of goats. Overall mean of A/G ratio disagreed with (Sharma and Puri, 2013) who reported higher ratio. Overall mean of globulin agreed with (Olafadehan, 2011) and (Olafadehan

et al., 2014), while (Ikhimioya and Imasuen, 2007) mentioned higher value, but (Pugh and Baird, 2012) and (Sharma and Puri, 2013) estimated lower value and this could be referred to different nutrition, vaccination programs and subclinical conditions.

The quality of milk is dependent on milk composition which may be affected by varies factors such as breed, age, body size and weight, udder size, diet, stage of lactation, season, length of dry period, and environmental temperature (Solaiman, 2010). Effect of breed on goat milk composition was showed in table no. (4). Baladi breed may have a low average milk yield but, in our study, it showed the highest lactose and protein percentages over the other breeds regardless the seasons without significant difference in fat percentages between breeds. Significant increases in protein in Baladi breed explained that the dependence of farmers on it to produce traditional cheese. Current findings are important to improve breed selection and crossbreeding program since high protein percentage is an important technological milk property affecting milk product quality. On the other hand, Mixed Boar breed showed significant lower protein %, with average milk profile parameters occurred between Shami and Baladi breeds.

According to (Egyptian Standards, 2005); raw goat milk shall contain not less than 3.25% of milk fat and 8.5% of non-fat milk solids. The fat contents of all breeds in this study were complied with Egyptian Standards, while SNF concentration in Shami breed failed to meet the prescribed minimum limit of these standards. Lower SNF concentration in Shami breed may be attributed to low lactose and protein content (overall means 4.03±0.10 & 2.67±0.08%, respectively). Lactose is the most stable constituent of goat's milk. Low lactose concentration may indicate subclinical intra-mammary infection or late lactation period. The protein and fat in this study agreed with (Mohsin *et al.*, 2019) and (Sabri *et al.*, 2018).

There were no significant difference in between different seasons for all examined parameters in all breeds. While regarding the effect of seasons-breeds interaction showed on table no. (5); the only affected parameter was fat content. Fat % increased significantly in Mixed boar in Autumn than Shami in Spring, Baladi in Autumn and Summer. Wide variation in fat content is due to mid-lactation period, when fat is expected to be low, usually comes in mid-summer and Autumn when climatic conditions favor the production of low-fat milk (Guo *et al.*, 2001). This statement explains the fluctuations of fat contents in this study for Mixed Boar and Baladi breed. The significant decrease in fat % during summer indicated that Baladi and Mixed boar goats were very prone to heat stress, which implied the decrease of chemical characteristics during hot summers as explained by (Kljajevic *et al.*, 2018). Fat content in milk is recognized as the most important one in terms of cost, nutrition and physical and sensory characteristics of the dairy product; Goat's milk lowest fat level coincides with the highest production period, around May (Margatho *et al.*, 2018). This recorded fact explains the significant decrease in fat % for Shami breed during spring (3.66±0.09%).

Conclusions

It could be concluded that there was a considerable effect of seasons and breeds on some serum biochemical parameters and milk panel in lactating dairy goats in Egypt. Current findings are important for goat breeder and manufacturer of goat milk products to improve breed selection and crossbreeding program.

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