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Effect of season and pregnancy on minerals serum variations of local rabbits in Tiaret, Algeria

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Abstract: *The present study aimed to assess the season and pregnancy influence on minerals serum of local rabbits raised in semi-arid climate type. Fifty-nine multiparous does was used in this study during 2019. The semi-intensive rhythm of reproduction was used. All pregnant does were at the late stage of pregnancy at the sampling date. Serum samples were collected in two seasons: winter and summer. In this study, biochemical parameters concentrations of pregnant rabbits were significantly higher ($p < 0,05$) compared with non-pregnant rabbit. The value of biochemical parameters total protein, albumin, triglyceride, cholesterol, calcium, and phosphorus changed significantly. In this study, most parameters were influenced by pregnancy.*

Keywords: Rabbits, Serum minerals, Season, Pregnancy

Introduction

Rabbits can be considered as an ideal meat-producing animal. The rabbit's meat is considered very healthy due to its low content in fat, cholesterol and sodium and rich in protein [1]. The rabbit has a short life cycle, a short gestation period, prolific and has a high feed conversion capacity [2]. Under Algerian

conditions, rabbit's production is affected by several factors such as the environment and management conditions [3].

The mineral level in animal body depends on a large number of factors such as species, breed, age, sex, nutritional and health status, mineral supplementation, seasonal and physiological variations [4]. The responses of animals to environmental stress during different seasons have profound effects on some serum biochemical parameters [5]. According to AL-Eissa [6], haematological and biochemical parameters are influenced by pregnancy and season. In this context, the present study aims to investigate the influence of season and pregnancy on some serum minerals variations in rabbits raised in Tiaret, Algeria.

Materials and methods

The study was carried out at the experimental farm of Ibn Khaldoun University in the region of Tiaret which lie south-west of the capital of Algiers in the western region of the Hautes Plaines, in the Tell Atlas, and about 150 km (93 mi) from the Mediterranean coast. The study was carried in 2019 on hot and cold season kept under semi-arid climate. The winter months are much rainier than the summer months in Tiaret. The climate here is classified as Csa by the Köppen-Geiger system. The average annual temperature is 14.7°C (58.5°F) in Tiaret. In a year, the rainfall is 529 mm (20.8 inch). This work involved fifty-nine multiparous healthy does, from local domestic population of rabbits (*Oryctolagus cuniculus*). Thirty-two pregnant and twenty-seven non-pregnant does weighing between 3-4 kg were used for mating (the rhythm of reproduction is 42 days).

The animals were housed in single rabbit cages, given ad libitum commercial pelleted rabbit food and drinking water, rabbits have enter 12 and 18 monthes. The reproductive status was determined by palpation and confirmed after birth.

Fifty-nine samples were collected from saphenous vein in heparinised vacutainers. Does were wrapped safely in a towel after warming the area over the vessel to promote vasodilation. Samples were brought to the biochemical laboratory within two hours for biochemical parameters analysis. Samples were collected from does and transferred directly to the laboratory for analyzes during both seasons (winter and summer) and were classed in two groups pregnant and non-pregnant. All samples were analyzed with a COBAS Integra® 400 Roche, France analyzer. The following parameters were determined: Potassium, Sodium, Chlore, total cholesterol, Triglycerides, Total protein, Albumine, Calcium, Phosphoruse and Magnisium. Mean and standard deviation values were determined for data and a statistical analysis using SPSS IMB 20. The analysis of variance ANOVA was performed to the influence of the pregnancy and season on the variation of the parameters.

Results and Discussion

All the results and the effects of pregnancy and season on the different parameters recorded in this work are reported in Table 1 and Table 2. In this study the potassium mean value for all does was $5,35 \pm 1,25$ mmol/l, a significant ($p < 0,05$) difference was recorded between pregnant and non-pregnant does. The mean value in pregnant does was significantly higher ($p < 0,05$) with $5,71 \pm 1,24$ mmol/l against $4,93 \pm 1,14$ mmol/l in non-pregnant ones.

Sodium and chlore mean values for all does were respectively $140,07 \pm 11,08$ mmol/l and $102,92 \pm 4,96$ mmol/l. For the two parameters no significant difference between non-pregnant and pregnant female was observed in this study. In contrast, the Cholesterol mean value in pregnant does was significantly higher ($p < 0,05$) with $0,62 \pm 0,59$ mg/dl than $0,38 \pm 0,23$ mg/dl in non-pregnant ones.

In this study, triglycerides mean value for all does was $0,83 \pm 0,79$ mmol/l, with no difference between non-pregnant and pregnant female. The mean value of triglycerides in pregnant does was $0,77 \pm 1,01$ mmol/l and about $0,91 \pm 0,41$ mmol/l in non-pregnant ones.

Proteins area fundamental component of animal tissues, certain hormones and all enzymes. In this work, protein mean value for all does was $63,71 \pm 8,25$ g/l, a significant ($p < 0,05$) difference was recorded between pregnant and non-pregnant does. The mean value in pregnant does was significantly lower ($p < 0,05$) with $0,60,41 \pm 8,05$ g/l than $67,63 \pm 6,73$ g/l recorded in non-pregnant ones. In this study, albumine mean value for all does was $39,68 \pm 5,34$ g/l, no important variations in this values between non-pregnant and pregnant rabbits with respectively with $19 \pm 5,78$ g/l and $25 \pm 4,99$ g/l.

Calcium is an important mineral in homeostasis in all vertebrate animals. It is the most abundant one in the body. In our work, Calcium mean value for all does was $139,07 \pm 16,33$ mg/dl. The mean value in pregnant does was significantly lower ($p < 0,05$) with $133,44 \pm 18,37$ mg/dl against $145,74 \pm 10,38$ mg/dl in non-pregnant females.

Phosphorus is major component of the skeletal system, in this study, phosphorus mean value for all does was $40,66 \pm 8,48$ mg/dl, no significant differences between non-pregnant with $40,85 \pm 8,09$ mg/dl and pregnant with $40,50 \pm 8,92$ mg/dl rabbits was observed.

In our study Magnesium mean value for all does was $26,70 \pm 8,05$ mmol/l but no significant difference was recorded among pregnancy.

Table 1. Mean±SD values of serum minerals variation within pregnancy in rabbits

<i>Parameters</i>	<i>Not pregnant (n=27)</i>	<i>Pregnant (n=32)</i>	<i>Total (n=59)</i>	<i>norms</i>
K (m mol/l)	4,93±1,14*	5,71±1,24	5,35±1,25	4-6.5
Na (m mol/l)	142,82±3,48	137,75±14,41	140,07±11,08	130-155
Cl (m mol/l)	103,07±5,81	102,78±4,19	102,92±4,96	92-120
Cholesterol (mg/dl)	0,38±0,23*	0,62±0,59	0,51±0,47	10-80
Triglyceride (mmol/l)	0,91±0,41	0,77±1,01	0,83±0,79	1.4-1.76
Proteine (g/l)	67,63±6,73*	60,41±8,05	63,71±8,25	50-75
Albumine (g/l)	40,19±5,78	39,25±4,99	39,68±5,34	25-40
Ca (mg/dl)	145,74±10,38*	133,44±18,37	139,07±16,33	5.5-12.5
P (mg/dl)	40,85±8,09	40,50±8,92	40,66±8,48	4-6
Mg (m mol/l)	25,04±8,00	28,10±7,95	26,70±8,05	0.8-1.2

*Refers to a significant difference in the same line ($p<0,05$)

Table 2. Mean±SD values of serum minerals variation within season in rabbit's females

<i>Parametes</i>	<i>Fresh Seasn (n=25)</i>	<i>Hot Seasn (n=34)</i>	<i>Total (n=59)</i>	<i>norms</i>
K (m mol/l)	5,33±0,82	5,37±1,5	5,35±1,25	4-6.5
Na (m mol/l)	142,91±3,57	137,98±14	140,07±11,08	130-155
Cl (m mol/l)	106,6±3,89	100,21±3,78	102,92±4,96	92-120
Cholesteol (mg/dl)	0,39±0,24*	0,59±0,58	0,51±0,47	10-80
Triglycerides (mmol/l)	0,58±0,31*	1,02±0,97	0,83±0,79	1.4-1.76
Proteine (g/l)	60,52±10,09*	66,06±5,68	63,71±8,25	50-75
Albumine (g/l)	42,48±4,98*	37,62±4,66	39,68±5,34	25-40
Ca (mg/dl)	139,12±23,18	139,03±8,84	139,07±16,33	5.5-12.5
P (mg/dl)	41,76±10,28	39,85±6,92	40,66±8,48	4-6
Mg (m mol/l)	29,84±8,72*	24,39±6,76	26,70±8,05	0.8-1.2

*Refers to a significant difference in the same line ($p<0,05$)

In our study no significant difference was recorded among season for potassium, sodium, chlor, calcium and phosphorus for all does. However, cholesterol, triglyceride, total protein, albumin and magnesium are changed significantly. In this study, most parameters were influenced by season.

The results of our study pregnancy haven't affected sodium, chlor, triglycerides, albumin, phosphorus and magnesium concentrations of rabbits which are in agreement with other research conducted using other animals [7, 8]. According to some authors [9, 10 and 11] the most obvious limitation to rabbit production in hot climate area, is the susceptibility of this species to heat stress, which evokes a series of drastic changes in their biological functions that lead to impairment of production and reproduction. The difference of temperature between winter and summer produce some changes in various blood plasma parameters.

The Cholesterol mean value for all does was $0,51 \pm 0,47$ mg/dl a significant difference ($p < 0,05$) was recorded between fresh season and hot season. The mean value in fresh season was significantly lower ($p < 0,05$) with $0,39 \pm 0,24$ mg/dl against $0,59 \pm 0,58$ mg/dl in hot season.

Cholesterol concentration also decreases markedly with exposure to high environmental temperature [12-14]. Abdel-Samee [15] confirmed that exposure of farm animals to heat stress is accompanied by a decrease in cholesterol concentration. However, Salem [16] reported that serum cholesterol concentration was significantly higher during summer than in winter. The decline in cholesterol concentration during exposure to heat stress may be due to the increase in total body water or to the decrease in acetate concentration which is the main precursor for the synthesis of cholesterol [17, 18].

The total protein content is affected by the environmental temperature [19]. In this work, the total protein mean value for all does was $63,71 \pm 8,25$ g/l with a significant ($p < 0,05$) between fresh season and hot season. The mean value in fresh season was significantly lower ($p < 0,05$) with $60,52 \pm 10,09$ g/l against $66,06 \pm 5,68$ g/l in hot season.

Serum total protein decreased significantly between summer and winter [20]. Values decreased on average, by 19,9% in Cal rabbits [21], 6,7% and in New Zealand and Californian rabbits [22], 10,9% in NZW rabbits [23] and 16,8% in NZW and 15,3 in Cal rabbits [24]. However, Marai [22] reported that total proteins decreased insignificantly between summer and winter. Moreover, Ibrahim [25] indicated that serum total protein concentration was slightly higher, without significant difference between summer and winter. The significant decline in serum protein with rising temperature seems to be due to a dilution of plasma proteins caused by the increase in water consumed, decrease of protein synthesis as a result of the depression of anabolic hormonal secretion [26]. Significant changes in the concentration of plasma total protein either due to species differences or seasonal variations have been thought to be related to changes in albumin or globulin concentrations [27-29].

The albumin mean value for all does was $39,68 \pm 5,34$ g/l with a significant ($p < 0,05$) difference was recorded between winter and summer. The mean value in Fresh Season was significantly higher ($p < 0,05$) with $42,48 \pm 4,98$ g/l against $37,62 \pm 4,66$ g/l in Hot Season. Previous studies agreed that albumin level decreased significantly when the animals were exposed to heat stress conditions [20, 21, 22, 30 and 10], which may be due to a decrease in feed utilization and consequently, to a decrease in protein and fat biosynthesis [21].

Whereas potassium, sodium, chlor, calcium and phosphorus levels were not influenced by seasons, this match with the works of Cetin [31], who found that calcium and phosphorus levels were not influenced by seasons.

Exposure of adult female rabbits to severe heat stress adversely affects their growth and reproductive rates [32]. The adverse effect of high ambient temperature on rabbits may be due to a decrease in feed consumption, dehydration of animals, tissue catabolism [33]. The thermoneutral zone in rabbits is around 18–21°C [18]. According to Al-Eissa [6] pregnancy of rabbits and season influenced haematological and biochemical parameters.

Conclusion

In this investigation, we concluded that pregnancy and season influence the biochemical parameters in rabbits. The heat stress in hot season negatively reflected on the biochemical parameters, So according to the obtained data winter is the best season for breeding and conservation of domestic rabbit in Tiaret (Algeria). Furthermore, our work provide the reference values for comparison in the local population raised in the north west of Algeria.

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