

The Effect of Environmental Variation on Feed Consumption and Some Physiological Parameters of Arabi Sheep and Local goats: Blood pictures and concentration of some hormones

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Abstract: This study was conducted in the animal field of the College of Agriculture - University of Basra between 1/10 to 12/29/2021, to investigate the influence of environmental variance on some blood pictures and the concentrations of some hormones in Arabi sheep and local goats, Six male of Arabi lambs breed and 6 male of the local black Iraqi goat breed at the age of (7-8) months and with an average weight of (20.85, 20.30) kg were divided into two groups (each type in one group). The daily temperatures and humidity were recorded throughout the study period (to extract the average temperature and humidity during the months of the experiment). The results indicated that there was no significant effect of animal type on blood pictures (white blood cells, red blood cells, hemoglobin concentration, packed cell volume), while the concentrations of vitamin C, thyroxine and cortisol increased in sheep compared with goats. Values of red blood cell count, hemoglobin concentration, packed cell volume, vitamin C and cortisol significantly ($P < 0.05$) decreased as temperature decreased. However, the concentration of thyroxine increased during low temperatures.

Key words: Environmental variation, Sheep, Goats, Temperature, Humidity, Blood pictures, Hormone

Introduction

Maintaining livestock production at the height of climate change has become a difficult mission (Sejian et al., 2018). It has direct negative effects on animal production, due to limited availability of pasture, drought and increased spread of disease (Thornton et al., 2009). In the environments observed in arid and semi-arid areas around the world, climate change has led to an increase in the dry season as in them, and the irregularity of environmental conditions has led to a reduction in the production of agricultural animals in those areas (Miller and Lu, 2019).

Body temperature is one of the physiological trials that ruminants and most living organisms with relative thermal stability try to maintain properly because of its importance in the continuation of these organisms in performing their biological functions (Hansen, 2009). Manish et al., (2010) and Phulia et al., (2010) found that the change in environmental temperature and humidity in arid and semi-arid areas leads to physiological changes in the animal's body, a decrease in feed consumption and an increase in respiratory rate and heart rate.

The blood pictures have a close relationship in the health status and productivity of agricultural animals, and the environmental variance surrounding the animal has a clear effect on blood volume, expansion and distribution of blood in peripheral vessels (Silanikove 2000; AL-Jassim et al., 2006). The level of thyroxine hormone is affected by the seasons of the year, as there is a negative relationship between the temperature and the concentration of the hormone in the serum (Starling et al., 2005). Many factors directly influence thyroid hormone levels, including changes in temperature, season, and physiological status (Georgiev and Nikolov 2004). There are many hormones that are secreted during the animal's exposure to changes in environmental conditions, one of those hormones is cortisol, which affect on the production and growth of the animal (Archer, 2005). However, all endocrine glands are sensitive to variations in temperature, and their secretions change according to the change in nutritional level and environmental conditions, these glands include the thyroid and adrenal glands (Huszenicza et al., 2002).

Therefore, this study aimed to find out the effect of the difference in temperature and humidity on blood pictures and the concentrations of some hormones in Arabi sheep and local goats in southern Iraq

Materials and methods

This study was carried out in the animal field of the College of Agriculture - University of Basra from 1/10/2021 to 29/12/2022. Six male lambs of Arabi sheep breed and 6 male of local black Iraqi goat breed at the age of (7-8) months with an average weight of (20.85, 20.30) kg, respectively were selected. The animals were divided into two groups (each into a single group) and placed in semi-shaded pens containing feeding troughs and drinking water pots. All animals were fed 3% of body weight barley with ad libitum hay throughout the experiment period, and the barley amounts were adjusted every 15 days according to the weight gain achieved. The temperature and relative humidity were recorded at 6 am (minimum temperature) and at 2 pm (maximum temperature) daily during the experimental period, the average monthly temperature and humidity is shown in Table 1. The following equation was used to estimate the temperature and humidity index (THI), which depends on temperature (Ta) and relative humidity (RH) (Gaughan et al., 1999).

$$THI = 0.8 \times Ta + \{(RH/100) \times (Ta - 14.3)\} + 46.4$$

Table (1): Average of maximum and minimum of temperatures (C°), humidity (%) and temperature and humidity index during the months of the experiment.

Month	Temperature		Average temperature	Relative humidity		Average relative humidity	THI
	Maximum	Minimum		Maximum	Minimum		
First	45.04	27.80	36.42	43.02	24.04	33.53	83.05
Second	29.03	10.09	19.56	60.25	41.17	50.71	64.71
Third	16.23	8.43	12.33	65.04	45.02	55.03	55.17

Blood samples were collected from the jugular vein jugular using sterile medical syringes and placed into plastic test tubes, 2 ml in tubes containing anticoagulant to estimation of blood pictures and 8 ml tubes without anticoagulant to estimate the concentrations of hormones were centrifuged at 3000 rpm for 5 mins to separate the serum. The serum was stored at -20 C ° until it was analyzed.

White blood cells and red blood cells were estimated using the haemocytometer using the method described by Schalm et al. (Packed cell volume was measured by the hematocrit method (Dacia and Lewis 1974). Packed cell volume was measured by the Haematocrite method (Dacie and Lewis, 1974). Thyroxine and cortisol concentrations were determined by a procedure associated with Monobind Inc - USA Company kit. The concentrations of thyroxine and cortisol were determined using a procedure associated with Monobind Inc - USA Company kit.

The data were analyzed using a complete random design (CRD), based on a two-factor (the effect of animal type and temperature - humidity), and their interactions using the statistical program SPSS, (2019), and to test the significance of differences between the averages, the least significant difference test was used (LSD), at the level of significance (p<0.05). The data were analyzed by the mathematical model as follows:

$$Y_{ijk} = \mu + D_i + E_j + (DE)_{ij} + e_{ijk}$$

Where : yijk is the kth observation of the type of animal, and temperature – humidity j; μ, common mean; Di, the effect of the type of animal (sheep and goats); Ej, the effect of temperature – humidity (36.42 C° - 33.53%, 19.56 C° - 50.71%, 12.33 C° - 55.03%); (DE) ij., the effect of the interaction between the type of animal and temperature – humidity; eijk., the experimental error, randomly and naturally distributed on all observations.

Results and discussion

The results of Table (2) showed that there was no significant effect of animal type on some blood pictures except in the first month of the experiment, which significantly ($P < 0.05$) increased the number of white blood cells in goats compared to sheep, the reason of this result may be due to differences in the ability of the animals to immune response to the environmental changes (Egbe - Nwiyi et al., 2000). The result agreed with Tahas et al., (2012) who noticed that the number of white blood cells was significantly higher in the Pygmy goat breed when compared with the Cameroon sheep breed at the same age.

It was also noted that red blood cells, haemoglobin concentration and packaged cells volume significantly ($P < 0.05$) decreased in the second and third months compared to the first month. No significant effect of temperature or humidity was found in the number of white blood cells. The reason for the high number of red blood cells is related to the conditions that make the body produce many of these cells when the animal is exposed to an environment characterized by high temperatures (Addas et al., 2010). This result is consistent with those of Sivakumar et al. (2010). Mcmanus et al., (2009) suggested that there is a strong relationship between both of the concentration of hemoglobin and packed cell volume on the and the animal's ability to tolerate heat. Many studies indicate that lower temperatures result in decreased hemoglobin and packaged cells volume (Maurya et al., 2007 and Indu et al., 2014). The result agrees with the results of AL-Hidary, (2004), Abdelatif et al., (2009), Khalid et al., (2012) and Olayemi et al., (2015).

There was a significant effect of the type of animal in the concentration of vitamin C, as it significantly ($P < 0.05$) increased in sheep compared with goats at the first and second months (Figure 1). The concentration of vitamin C significantly increased in the first and second month compared to the third once, and the averages reached (4.61, 4.08, 2.03) $\mu\text{g/ml}$ for the three months at temperatures (36.42, 19.56, 12.33) $^{\circ}\text{C}$ and relative humidity (33.53, 50.71, 55.03)%, respectively. It is known that cortisol is the most effective hormone for elevated temperatures (Hassan et al., 2017). This result agreed with Singh and Merilan, (1957).

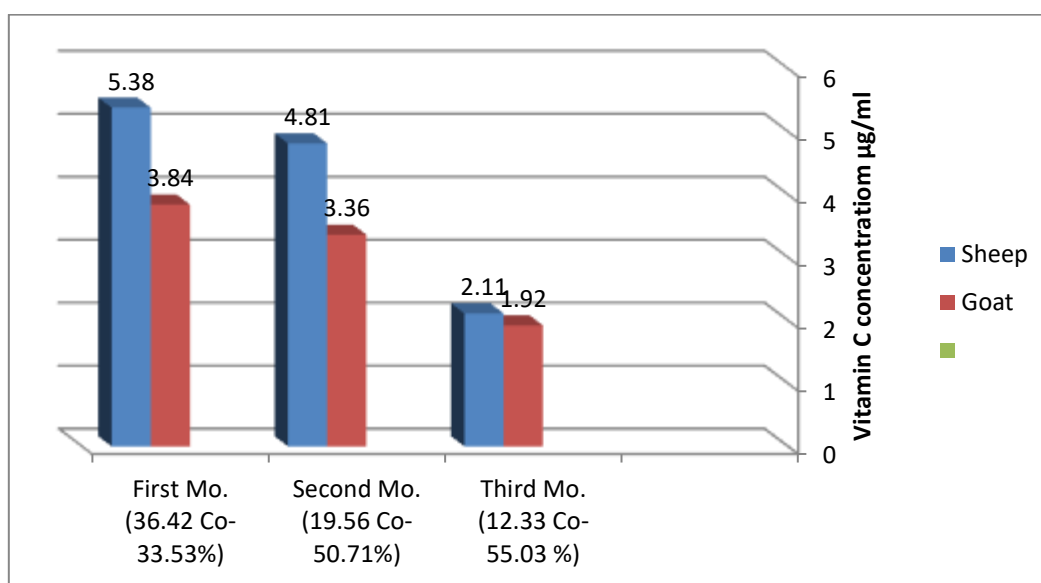


Figure (1): Effect of animal type, temperature and humidity on vitamin C concentration ($\mu\text{g/ml}$) in male lambs and local goats.

Significant differences ($P < 0.05$) were observed between Arabi lambs and local goat kids in the concentration of thyroxine hormone (Figure 2). Sheep had a significantly higher hormone concentration ($P < 0.05$) compared to goats in the third month. The results also showed that there were significant differences in the effect of temperature and the humidity on the concentration of thyroxine, since, the concentration of thyroxine significantly ($P < 0.05$) increased when temperatures decreased in the third month compared with the second and first months of the study, and the averages were recorded (30.06, 25.93, 18.66) ng/ml , respectively, at degrees (12.33, 19.56, 36.42) $^{\circ}\text{C}$ and humidity (55.0, 50.71, 33.53) %, respectively. This can be attributed to the fact that high temperatures lead to decreased thyroid gland activity in the thyroxine synthesis (Nazifi et al., 2003). The animal tends to consume higher quantities of food at lower temperatures because it requires more energy, which increases thyroid secretions to increase

metabolic rate (Squires, 200). These results were similar to those observed by Alok et al., (2014) and Babe et al., (2015).

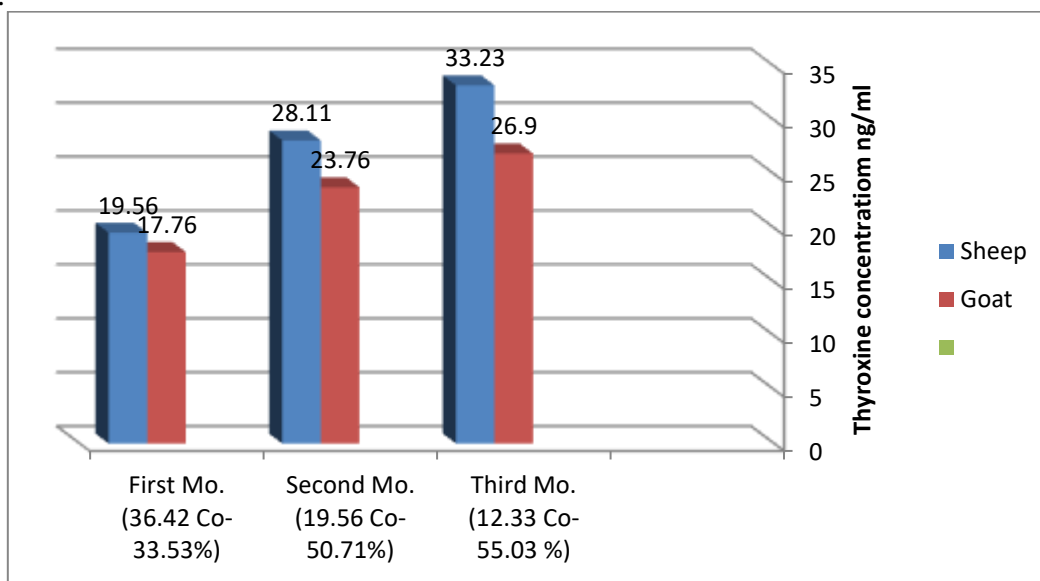


Figure (2): Effect of animal type, temperature and humidity on thyroxine hormone concentration (ng/ml) in male lambs and local goats.

Sheep showed a significant increase ($P < 0.05$) of cortisol concentration compared to goats during the first month compared to other months (Figure 3). Furthermore, cortisol levels significantly ($P < 0.05$) decreased when the temperature decreased in the third month compared to the second and the first months of the study. Average values were (25.54, 13.20, 7.16) ng/ml at temperatures (36.42, 12.33, 19.56) C° and relative humidity (33.53, 55.03, 50.71%), respectively. The reason for the high concentration of cortisol when the temperature rises may be due to that this hormone has an important role in helping the animal physiologically to overcome the negative effects of high temperature by regulating body temperature, increasing breathing rates, expanding blood vessels, increasing the amount of blood in the layers of the skin and reducing metabolism (Abdel-Samee et al., 2000). These results agree with those of Sejian, (2013), Alok et al., (2014) and El-Zaher, (2016) who showed an increase in hormonal concentration when the temperature was increased.

Table (2): Effect of animal type, temperature and humidity on the white blood cells, red blood cells, hemoglobin concentration and packed cell volume of male lambs and local goats (mean ± standard error)

Animal type Month	White blood cells (n X 10 ³ / L)			Red blood cells (n X 10 ⁶ / L)			Hemoglobin concentration (gm/100ml)			Packed cell volume (%)		
	Sheep	goat	Overall mean	Sheep	goat	Overall mean	Sheep	goat	Overall mean	Sheep	goat	Overall mean
first month (36.42 C° - 33.53%)	3.90 ± 0.27 b	5.11 ± 0.63 a	4.50 ± 0.44	8.32 ± 0.97	7.32 ± 0.90	7.82 ± 0.77 A	10.97 ± 1.80	9.10 ± 1.45	10.03 ± 1.23 A	31.41 ± 2.97	29.81 ± 2.90	30.61 ± 1.77 A
second month (19.56 C° - 50.71%)	4.32 ± 0.48	4.79 ± 0.66	4.55 ± 0.49	6.37 ± 0.88	5.84 ± 0.90	6.10 ± 0.87 B	9.85 ± 1.31	8.24 ± 1.20	9.04 ± 1.19 A	28.58 ± 1.88	27.38 ± 1.90	27.98 ± 1.87 B
third month (12.33 C° - 55.03%)	4.46 ± 0.76	4.76 ± 0.75	4.61 ± 0.32	5.42 ± 0.80	5.47 ± 0.47	5.44 ± 0.59 B	8.04 ± 1.07	7.59 ± 1.08	7.81 ± 1.32 B	26.38 ± 1.80	26.23 ± 1.47	26.30 ± 1.59 B

Small letters within the same row and capital letters within the same column indicate to a significant differences (P<0.05) between animal type and months, respectively.

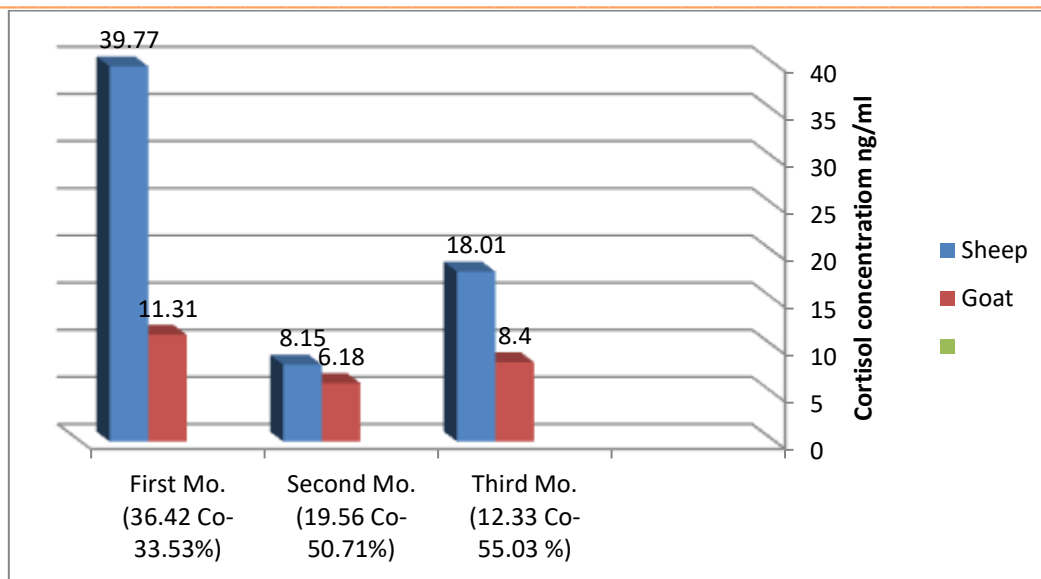


Figure (3): Effect of animal type, temperature and humidity on cortisol concentration (ng/ml) in male lambs and local goats.

Conclusions

This study concluded that levels of vitamin C, thyroxine and cortisol were higher in Arabi sheep compared to local goats. At the same time, blood pictures were stable in both types. The difference in temperature and humidity over the study period had a clear effect on blood pictures and concentrations of vitamin C, thyroxine and cortisol. The values of the blood pictures and the concentration of vitamin C and cortisol increased at high temperatures (36.42 C°), while, the concentration of thyroxine increased when it decreased to 19.56 C°.

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تأثير التباين البيئي في استهلاك العلف وبعض المعايير الفسلجية للأغنام العراقية والماعز المحلي : صور الدم وتركيز بعض الهرمونات
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الخلاصة : أجريت هذه الدراسة في الحقل الحيواني التابع لكلية الزراعة - جامعة البصرة للفترة بين 2021/10/1 ولغاية 2021/12/29 ، لمعرفة تأثير التباين البيئي في بعض صور الدم وتركيز بعض الهرمونات المعايير الفسلجية للأغنام العراقية والماعز المحلي ، اذ اختير 6 حملان ذكورية من سلالة اغنام العراقي و 6 جءاء ذكورية من سلالة الماعز المحلي الاسود العراقي بعمر (7-8) اشهر وبمتوسط وزن (20.85, 20.30) كغم على التوالي . قسمت الحيوانات الى مجموعتين (كل نوع في مجموعة واحدة) . وسجلت درجات الحرارة والرطوبة اليومية طيلة فترة الدراسة (لاستخراج متوسط درجات الحرارة والرطوبة خلال اشهر التجربة) . اشارت النتائج عدم وجود تأثير معنوي لنوع الحيوان في صور الدم (خلايا الدم البيض ، كريات الدم الحمر ، تركيز خضاب الدم ، حجم الخلايا المضغوطة) بينما ارتفعت تراكيز كلا من تركيز فيتامين C في وهرموني الثايروكسين والكورتيزول في الاغنام مقارنة مع الماعز. انخفضت قيم كلا من عدد كريات الدم الحمر و تركيز خضاب الدم وحجم الخلايا المضغوطة وتركيزي فيتامين C وهرمون الكورتيزول معنوياً ($P<0.05$) مع انخفاض درجات الحرارة. وبالعكس فقد ارتفع تركيز هرمون الثايروكسين عندما سجلت درجات الحرارة مستويات متدنية .