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Evaluation of Body Temperature, Respiration, Heart Rate and Serum Biochemical Parameters in Arabian Sheep

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ABSTRACT

Arabian sheep breeds play an important role in the livestock economy. These breeds are of great importance due to their adaptability to hot, dry climates, water and fodder shortages, and their ability to produce meat, milk, and wool. This study was conducted to determine the normal values of clinical and serum biochemical indices in Arabian sheep. For this purpose, 30 purebred Arabian sheep were selected from the Breeding Center of Ramin University in Khuzestan Province. The studied sheep were divided into three groups based on age: under one year (4 animals), one to two years (15 animals), and over two years (11 animals), all of which were non-pregnant. The health status of the sheep was confirmed based on history, clinical, ultrasonographic, and laboratory examinations. The results obtained in the present study showed that the heart rate (per minute) and body temperature of the sheep, regardless of age, were 79.03 ± 13.88 beats/min and 39.33 ± 0.53 °C, respectively. Also, in the present study, the values of BUN, creatinine, ALP, and AST were 26.06 ± 7.43, 1.28 ± 1.48, 365.27 ± 154.69, and 105.89 ± 24.34, respectively. Given that all the sheep studied were purebred Arabian sheep, the findings obtained in this study can be considered reference values for Arabian sheep and can be used as a basis for clinical evaluations and the assessment of pathological conditions. The results obtained in the present study showed that heart rate and some blood biochemical factors (blood glucose level) were lower than those reported in studies conducted by other researchers. Also, the BUN value obtained in the present study was higher than that reported in other studies. Considering the differences observed in some of the indicators obtained in the present study, as well as the importance and distribution of this breed in different regions and the significance of clinical and blood biochemical indicators, the availability of normal reference values for each region is of great importance.

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INTRODUCTION

Arabian sheep breeds, including important breeds in Saudi Arabia and neighboring regions (such as southwestern Iran and Jordan), play an important role in the livestock economy of the Middle East [1,2]. These breeds include Najdi, Naimi, Harri, Sawakni, Rufidi, and sometimes Awassi (as a

related breed), which have been noted for their adaptability to hot and dry climatic conditions, water and fodder scarcity, and their ability to produce meat, milk, and wool [1,2]. The Najdi breed is native to central Saudi Arabia (the Najd region) and has been bred in desert areas for centuries [1]. The Naemi and Harri breeds are mainly found in northern Saudi Arabia (near the Jordanian border), while the Rufidi and Sawakni breeds are common in the south (Yemen and Oman regions). In Iran, the Arabian breed is raised in Khuzestan Province and is adapted to tropical conditions [5]. The Awassi breed, although native to Syria and Iraq, is used as an imported breed for dairy production in Saudi Arabia [3]. The distribution of these breeds has been maintained through traditional trade and government genetic conservation programs (such as the Saudi Gene Bank) [2]. Arabian breeds are mainly fat-tailed sheep with hair coats and medium to large body sizes [6].

The Najdi breed, weighing 50–60 kg for males and 40–45 kg for females, has a white and black coat and a coarse hair covering [7]. The prominent features of this breed include a convex head, drooping ears, and a thick fat tail [7]. The Naemi breed, weighing 45–50 kg for males and 35–40 kg for females, has a completely white coat and short hair. This breed has a slender body conformation and high resistance to heat [8]. The Harri breed, weighing 55–60 kg for males and 40–45 kg for females, has a brown and white coat with a coarse, medium-length hair covering [2]. Distinctive features of this breed include long ears and suitability for meat production [2]. The Awassi breed, weighing 70–90 kg for males and 50–60 kg for females, has a white and brown coat and a medium-length wool covering [9]. It has a fat tail and a high milk production capacity [9]. These breeds are usually hornless or have small horns in males and show high adaptation to temperatures above 40°C through skin sweating and shade-seeking behavior [10].

The Najdi and Naemi breeds are suitable for meat production, with a daily growth rate of 200–250 g in lambs and a carcass yield of 40–50% of live weight [11,12]. The Harri breed has better meat quality (tenderness and flavor) than the Awassi breed, whereas the Najdi breed shows the lowest cooking losses [2]. In terms of milk production, the Awassi breed is dominant, producing 100–200 liters per lactation season, whereas the Najdi breed produces approximately 50–80 liters [4]. The composition of Najdi milk (6–8% fat) is suitable for cheese production [4]. The coarse hair and wool (2–3 kg/year) are used for traditional carpets but have limited economic value [2]. A fertility rate of 90–120% and a non-seasonal breeding pattern are considered key advantages of these breeds [3]. Arabian breeds are adapted to low-quality forage diets (e.g., dry sorghum) and are commonly managed under extensive (nomadic) systems [9]. Challenges include parasitic diseases (e.g., fasciolosis), water scarcity, and climate change. Maternal behavior in the Najdi breed is relatively poor under harsh conditions (score 2.5 out of 5), which may require management interventions [2]. Genetic conservation programs have been implemented in Saudi Arabia to address these challenges [2].

Blood tests are among the most common methods used to assess the health status of body organs, including the measurement of enzymes, proteins, and other markers related to liver and kidney function, as well as other physiological processes [13]. Liver enzymes such as alanine aminotransferase (ALT) are found primarily in hepatocytes, and elevated levels usually indicate liver cell damage, such as hepatitis or fatty liver disease [13]. Aspartate aminotransferase (AST), which is present in the liver as well as in other tissues such as the heart and skeletal muscles, may also indicate liver damage when elevated in conjunction with ALT [13]. Increased alkaline

phosphatase (ALP) activity may indicate biliary obstruction, such as gallstones or cholangitis, as well as bone disorders. Gamma-glutamyl transferase (GGT) is another sensitive indicator of biliary disease, and elevated levels together with ALP may suggest biliary obstruction or liver disease [13]. Blood urea nitrogen (BUN) is a product of protein metabolism excreted by the kidneys, and increased concentrations may indicate impaired renal function, dehydration, or gastrointestinal bleeding [13]. In addition, measurement of electrolytes such as sodium, potassium, calcium, and phosphate is important in kidney diseases because electrolyte disturbances, such as hyperkalemia or hypocalcemia, are common in these conditions. Identification of these imbalances may aid in the diagnosis of renal failure or specific syndromes such as nephrotic syndrome [13].

This study aimed to evaluate the health status of Arabian sheep using clinical examinations and blood biochemical analyses. For this purpose, 30 purebred Arabian sheep were selected from the breeding center of Ramin University in Khuzestan Province. The studied sheep were divided into three age groups: less than one year (4 animals), one to two years (15 animals), and more than two years (11 animals), all of which were non-pregnant. The health status of the sheep was confirmed based on history, clinical examination, ultrasonography, and laboratory evaluations. The findings obtained in this study may be considered reference values for Arabian sheep and may serve as a basis for clinical evaluations and the assessment of pathological conditions.

MATERIALS AND METHODS

This study was conducted in accordance with the guidelines and regulations for the ethical treatment of animals established by the Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz. In this study, 30 apparently healthy female Arabian sheep from different age groups, located at the Animal Husbandry Department of Khuzestan University of Agricultural Sciences and Natural Resources (Molathan), were examined. The sheep were divided into three groups based on dental formula: less than one-year-old (4 animals), one to two years old (15 animals), and more than two years old (11 animals).

Animal health assessment

The health status of the sheep was confirmed based on clinical examinations and abdominal ultrasonography. Although the livestock manager reported no problems with appetite, defecation, or urination and the animals appeared normal and healthy, their health status was further confirmed through clinical evaluation. In addition to measuring body temperature, the digestive, cardiovascular, and respiratory systems, as well as the mucous membranes, were examined (Fig. 1).

Fig. 1. Clinical examinations

Biochemical Tests

To evaluate the health status of the sheep, 10 mL of blood was collected from each animal. The blood samples were transported on ice to the Department of Large Animal Internal Medicine. After centrifugation, the sera were separated and stored in microtubes at −20°C until hematological and biochemical analyses were performed. Hematological and biochemical tests were conducted in the laboratory of the Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz.

Biochemical parameters, including AST, GGT, ALP, BUN, creatinine, total bilirubin, glucose, albumin, total protein, calcium, phosphorus, and magnesium, were measured using commercial biochemical kits and an autoanalyzer (Fig. 2).

Fig. 2. Blood sampling and serum separation for biochemical analyses

Statistical Analysis of Data

The results were analyzed using SPSS software version 24 (IBM Corporation, NY, USA) and were expressed using descriptive statistics and one-way analysis of variance (ANOVA).

RESULTS

Clinical Findings

Sheep with no problems in appetite, defecation, or urination and in good physical condition were selected for this study. They were examined visually and showed no abnormal clinical signs.

The digestive system (rumen motility and quality) was examined and found to be normal; however, the frequency of rumen contractions was not recorded. The ocular mucous membranes were evaluated and found to be normal in all animals. There was no nasal discharge and no history of cough. The health status of the sheep was also confirmed by abdominal ultrasonography.

The mean ± standard deviation of heart rate (per minute) and body temperature of the studied sheep, regardless of age, were 79.03 ± 13.88 beats/min and 39.33 ± 0.53 °C, respectively, and are presented by age in Table 1. Other clinical parameters such as respiratory rate, rumen movements, and mucous membrane status were normal in all studied sheep. One-way analysis of variance showed that there were no significant differences among age groups in terms of heart rate and body temperature ($P > 0.05$). The mean ± standard deviation of heart rate (HR) and body temperature in the studied Arabian sheep, regardless of age and compared with previous studies by other researchers (14,15), are presented in Table 2.

Table 1. Heart rate (HR) (beats/min) and body temperature (°C) in the studied Arabian sheep, regardless of age.

Measured index	Mean ± standard deviation the sheep in the present study	Normal values in sheep (Constable et al, 2017)	Normal values in sheep (Badakhshan and Abshenas 2015)
Heart rate/minute	79.03 ± 13.88	70-90	118.72±1.08
Body temperature (Celsius)	39.33 ± 0.53	39-40	40.10±0.6

Means with different lowercase letters in the same row are significantly different ($P < 0.05$).

Table 2. Heart rate (HR) (beats/min) and body temperature (°C) in the studied Arabian sheep by age.

Measured index	Mean ± standard deviation			
	Less than a year	1-2 years	Older than 2 years	P-value
Heart rate/minute	82.67 ± 21.38a	87.20 ± 8.67a	76.68 ± 13.59a	0.286
Body temperature (Celsius)	39.40 ± 0.10a	39.82 ± 1.18a	39.21 ± 0.24a	0.071

Means with different lowercase letters in the same row are significantly different ($P < 0.05$).

Results Related to Laboratory Findings

The results of biochemical tests of the studied sheep, regardless of age, which reflect the health status of various body organs, including the kidneys and liver, are presented in Table 3. In addition to the results of the present study, this table also includes the normal reference values for sheep, regardless of sex, age, and breed, for comparison purposes.

Table 3. Biochemical parameters measured in the studied Arabian sheep, regardless of age.

Measured index	Standard deviation ± mean	Normal values (Constable et al, 2017)
BUN (mg/dL)	26.06 ± 7.43	8-20
Cr(mg/dL)	1.28 ± 1.48	1.2–1.9
ALP(units/L)	365.27 ± 154.69	70–390
GGT(units/L)	63.27 ± 17.77	20–52
AST(units/L)	105.89 ± 24.34	60–280
B.T(mg/dL)	0.22 ± 0.05	0.1–0.5
Mg(mg/dL)	2.35 ± 0.42	2.2–2.8
Pro(g/dL)	6.71 ± 0.52	6.0–7.9
Ca(mg/dL)	7.47 ± 1.23	11.5–13
Alb(g/dL)	2.64 ± 0.25	2.4–3
Glu(mg/dL)	26.95 ± 7.3	50–80
P(mg/dL)	6.32 ± 1.32	5–7.3

The results of biochemical tests of the studied sheep according to age are presented in Table 4. Among the above factors, a significant difference between sheep of different age groups was observed only in ALP levels using one-way analysis of variance ($P = 0.026$).

Table 4: Biochemical factors measured in Arabian sheep under study by age

Measured index	Less than a year	1-2 years	Older than 2 years	P-value
	Mean ± standard deviation			
BUN (mg/dL)	35.6 ± 4.1a	26.6 ± 7.4a	24.7 ± 7.0a	0.052
Cr(mg/dL)	1.1 ± 0.1a	1.1 ± 0.1a	1.4 ± 1.7a	0.915
ALP(units/L)	519.0 ± 201.1a	466.6 ± 165.1a	321.3 ± 127.1a	0.026
GGT(units/L)	59.0 ± 19.9a	63.2 ± 20.8a	63.9 ± 17.7a	0.912
AST(units/L)	107.26 ± 21.7a	119.7 ± 39.0a	102.6 ± 20.7a	0.376
B.T(mg/dL)	0.20 ± 0.04a	0.26 ± 0.1a	0.21 ± 0.04a	0.247
Mg(mg/dL)	2.20 ± 0.27a	2.45 ± 0.28a	2.35 ± 0.47a	0.733
Pro(g/dL)	6.67 ± 0.19a	6.62 ± 0.68a	6.74 ± 0.53a	0.891
Ca(mg/dL)	7.55 ± 0.26a	7.85 ± 1.45a	7.37 ± 1.29a	0.741
Alb(g/dL)	2.83 ± 0.25a	2.75 ± 0.32a	2.59 ± 0.23a	0.172
Glu(mg/dL)	33.00 ± 5.50a	28.22 ± 7.08a	25.83 ± 7.36a	0.264
P(mg/dL)	7.01 ± 0.56a	6.80 ± 1.10a	6.11 ± 1.41a	0.382

Means with different lowercase letters in the same row are significantly different ($P < 0.05$).

DISCUSSION

A study conducted on sheep during the warm season showed that heat, in addition to increasing respiratory rate and body temperature, also increases glucose, BUN, and creatinine levels (14). The present study was also conducted at the beginning of the warm season; however, it did not show increases in glucose, BUN, and creatinine levels. Nevertheless, it cannot be concluded that heat has no effect on these indices, because normal reference values for these parameters in Arabian sheep have not yet been established. Therefore, this study was conducted with the aim of evaluating clinical and biochemical blood factors to determine normal reference values in Arabian sheep in Khuzestan Province.

For this purpose, the health status of the studied sheep was first assessed through history taking, clinical examinations (temperature, respiratory rate, heart rate, examination of mucous membranes, and rumen movements), and abdominal ultrasonography. The results of these evaluations indicated that all studied sheep were clinically healthy. The animals' history, clinical examination findings, and laboratory results were within normal ranges, and comparisons with other sheep breeds were performed [14–17]. Accordingly, it can be stated that the studied sheep were in apparent clinical and laboratory health. However, the clinical and laboratory findings of this study may be used as reference values for assessing the health status of this breed and for comparison with other breeds or pathological conditions.

Respiratory rate, heart rate, and body temperature are among the first parameters that change in response to heat stress [14]. In many scientific reports, changes in metabolites such as creatinine, urea, and glucose have also been used to evaluate the animal's response to heat stress [18–21]. Given the importance of clinical indicators and the widespread distribution of Arabian sheep in Khuzestan Province and neighboring countries, the present study is of considerable importance for meat and milk production in these regions, and accurate identification of vital parameters is essential.

In a study conducted in 2021 on 15 local Awassi ewes to investigate the effect of age and body weight on some biochemical blood parameters, a significant effect of age on total protein and globulin was reported [16]. However, age and body weight did not affect other biochemical parameters such as albumin, AST, and ALT [16]. In the present study, which evaluated normal values of clinical and biochemical blood indices in female Arabian sheep, values obtained at different ages varied, but no statistically significant differences were observed.

The temperature recorded in the present study was 39.33 °C, which is slightly lower compared to the study of Badakhshan and Abshenas (2015), where it was reported as 40.10 °C. The heart rate in the present study was 79.03 beats per minute, which is lower compared to the study conducted in Jiroft (118.72 ± 1.08) [14]. These differences in clinical parameters compared with other studies highlight the importance of establishing normal reference values specific to each breed and region.

Regarding biochemical serum indices, comparison with studies conducted in 2017 [13] showed consistency in some parameters, including total protein, AST, creatinine, phosphorus, ALP, magnesium, calcium, and albumin. However, BUN, GGT, and bilirubin values in the present study were slightly higher than those reported in the aforementioned study [13]. In addition, glucose levels in the present study were lower compared to the same study [13].

Comparison of the effect of age on serum biochemical indices (Table 4) showed that age had a significant effect on most measured parameters. In a study conducted on Omani and Australian Merino sheep to investigate the effects of heat stress on various indices, it was reported that increasing environmental temperature increased creatinine, respiratory rate, and body temperature. However, calcium, CPK, AST, and BUN increased in Omani sheep and decreased in Merino sheep [20]. Considering the impact of clinical indicators such as respiratory rate, temperature, and heart rate on body physiology and metabolism, as well as their effects on meat and milk production, it is essential to establish normal reference values for sheep in each region.

CONCLUSION

It is highly important to establish clinical and biochemical reference values for sheep in each region, which can be used as a standard reference for clinical evaluation and comparison with other breeds and pathological conditions.

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