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A Comparative Study on the Normal Physiological and Hematological Parameters of Local Breeds of Goats and Sheep in Khartoum State

دراسه مقارنه علي القيم الفسيولوجية الطبيعيه والدم بين سلالات الماعز
و الضأن المحليه في ولاية الخرطوم

Graduation research projectB.V.M. (V) – 2016/2017

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بسمِ اللهِ الرَّحمنِ الرَّحِيمِ

قال الله تعالى في محكم تنزيله:

(142) ثَمَنِيَةَأزوَاجٍ منَ الضَأنِاثنَينِ وَمِنَ اَلمَعزِ اثنَينِ قُل ءآلذّكَرَينِ حَرَمَ أمِ الأُنثَيَينِ أمَّا اشتَمَلَتَّ عَلَيهِ أرحَامُ الأُنثَيَينِ نَبِئُوني بِعِلمٍ إن كُنتُمَّ صَدِقِينَ (143).

"صدق الله العظيم"

سُّورَة الأنعَام.

Dedication

We dedicate this work to our Mothers, Fathers, Brothers, Sisters and Friends with deep Love and Sincerity.

Acknowledgements

to conduct and finish this work. We thank our Allah who gave us the aptitude and patience

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Abstract

A comparative study was conducted on the normal physiologicalparametersand haematological constituents of local breeds of goats (Nubian) and sheep (Hamari) covering two locations in Khartoum State (Al-Kalakla farm and Gandahar market). The study was conducted with the objective of establishing base data and highlight the differences if any; between the normal physiological parameters and hematological constituents of these two species of livestock. The data included in the current study were obtained from apparently healthy animals (19 female Nubian goats and 16 female Hamari sheep) that were free of any clinically detectable abnormality and free of internal and external parasites. Both goats and sheep were in good body condition score (BCS), and were fed on a high plane of nutrition and allowed free access to drinking water. Both goats and sheep were approximately 4-6 years of age, and the data were collected under similar environmental conditions (9-10 AM).The animals were housed in semi-closed pens at the Al-Kalakla farm and Gandahar market. The data obtained were statistically analyzed using T- test. The normal rectal temperature of goats was 37.9 - 40.2 ºC, while that of sheep was 37.9 - 40 ºC. The normal pulse rate of goats and sheep was 70 – 90/min, and the normal respiratory rate of goats and sheep was 20-30/min.

The hematological parameters of goats and sheep revealed the following: The total red blood cell count (RBCs - $\times 10^6$) of goats was 10.37 ± 1.30, while in sheep it was 10.69 ± 1.20. The total white cell count WBCs ($\times 10^3$) in goats was 9.11 ±1.94, while that of sheep was 8.94 ± 1.18. The hemoglobin content (Hb g □ dl) of goats was 8.79 ± 1.03, while that of sheep was 9.88 ± 1.09. The packed cell volume (PCV %) in goats was 25. 47 ± 3.32, while that of sheep was 29.25 ± 2.82.

Key words: Physiological and hematological parameters, Nubian goats, Hamari sheep.

ملخص البحث

لقد اجريت دراسه مقارنة على القيم الفسيولوجية ومكونات الدم الطبيعية بين السلالات المحلية من الماعز النوبي والضان الحمري غطت موقعين (الكلاكلة، وسوق قندهار) بولاية الخرطوم. لقد اجريت هذه الدراسة بهدف توفير بيانات مرجعية للقيم الفسيولوجية ومكونات الدم الطبيعية في الماعز والضأن، والقاء الضوء على أي إختلافات إن وجدت بين القيم الطبيعية في الماعز والضأن.

من إناث (19 البيانات التي تضمنتها هذه الدراسة تم الحصول عليها من الماعز النوبي و 16 من إناث الضأن الحمري) بعد التأكد من أن جميعها خال من الأمراض والطفيليات الداخلية والخارجية، ويتوفر لها الغذاء الجيد وماء الشرب بصفة مستديمة. كما أن جميع الماعز والضأن الذي اجريت علية الدراسة يتراوح أعمارها بين 4-6 سنوات، وتم جمع البينات تحت ظروف بيئية مشابهة (9-10 صباحاً). لقد تم جمع البيانات وتحليلها إحصائياً باستخدام (T-test).

درجة الحراره الطبيعيه للماعز كانت 37.9 - 40.2 درجه مئويه, بينما في الضأن كانت 37.9 – 40 درجه مئويه. معدل النبض الطبيعي في الماعز والضأن 70 – 90 في الدقيقه, ومعدل التنفس الطبيعي في الماعز والضأن 20 – 30 في الدقيقه.

لقد تبين من تحليل الدم أن مكونات الدم في كل من الماعز والضأن كانت على النحو التالي: العدد الكلي لكريات الدم الحمراء (10^6 x) في الماعز كان 10.37 ± 1.30 بينما كان العدد الكلي لكريات الدم الحمراء في الضأن 10.69 ± 1.20 ، والعدد الكلي لكريات الدم البيضاء (10^3 x) في الماعز كان 9.11 ± 1.94 بينما كان العدد الكلي لكريات الدم البيضاء في الضأن 8.94 ± 1.18، وكان تركيز الهيموقلوبين (جم/ديسلتر) في الماعز 8.79 ± 1.3 بينما كان تركيز الهيموقلوبين في الضأن 9.88 ± 1.09، و كانحجم خلايا الدم المرصوصة (%) في الماعز 25.47 ± 3.32 بينما كان في الضأن 29.25 ± 2.82.

كلمات مفتاحيه : القيم الفسيولوجيه الطبيعيه والدم, الماعز النوبي, الضأن الحمري.

List of Contents

List of Contents- Continued

Introduction and Research objectives

In the Sudan the goat population is estimated to be about 42.5 million head, composed of four major breeds namely: Nubian, Desert, Nilotic and Dwarf. According to FAO statistics (1992), the population of Nubian goats in the Sudan is estimated to be 2.5 million. Nubian goats form about 46% of the goat population in Sudan. It is widely distributed in 12 N mainly in the Riverine environments.

Information on the performance of the main Sudanese dairy goat is very limited. Goats produce milk, meat and skins. However, goats have been neglected by research workers for a long time, and have been subjected to poor management and nutrition.

Sheep are raised under traditional system that depend mainly on natural grazing, which make them suffer serious seasonality in feed supply both in quantitatively and qualitatively especially during the summer month due to dryness (Mohammed *et al*., 2015).

Sheep in the Sudan are classified into eight distinct ecotypes according to locality, tribe and origin. Of these ecotypes desert sheep constitute 65% of the sheep population in the country (Elminshawi, 2015).

Hamari and Kabashi are subtypes of desert sheep. They are similar in their management, nutrition and most of their general

character. Hamari sheep are dominantly red, Kabashi sheep are mostly brown, light brown or spotted black or red (Mohammed *et al.*,2015). Desert sheep include Meidob, Bija, Butana, Gezira and Kababish (Elmenshawi, 2015).

Sheep in the Sudan play an important role in meat production. Sheep meat is export to numerous countries. A total of 76,728.000 head of sheep were slaughtered in period 2000 - 2004 and the local consumption was only 881,000 (Bakhiet, 2008).

Research Objectives

1) To establishing base data on the normal physiological parameters of local breeds of goats and sheep.
2) To establish base data on the normal hematological constituents of local breeds of goats and sheep.
3) To highlight differences in these normal parameters if any; between the two species of animals.

Chapter1

Literature Review

1-1 Domestications of goat and sheep

Domestication of animals is defined as being bred in captivity for purposes of economic profit and providing feed and diet to human community (Solaiman, 2010). The goat was domesticated about 10,000 years ago (Solaiman, 2010) in association with three of the oldest civilizations (Nile in Northern Africa, Tigris Euphrates in West Asia and Indic's in India).

1.2 Geographic Distributionof Goats and Sheep:

The highest densities of sheep are found in the semiarid parts of the tropics and sub-tropics. Africa is most important sheep – rearing continent (South Africa, Sahara, Senegal, Upper Volta, Nigeria, and several countries in East and Northeast Africa Sudan, Ethiopia and Somalia, (Gatenpy, 1986).

1.3 Goat and Sheep Distribution in the Sudan:

Hamari sheep are raised in Western Kordofan and Darfur, and Kabashi sheep are raised in Northern and Eastern parts of North Kordofan with different grades of crosses between subtypes (Gall, 1996).

In Sudan goats were estimated at 42.5 million head forming about 31.7% of ruminants in the countries, 18.2% of the goats in

Africa and 3.5% of the world goat population. Nubian goat is considered as milk production.

In Sudan, goats and sheep play an important integral component in most traditional production systems. They provide milk, meat, skin and cash income from sales (Ebrahiem, 2015).

1.4 Breeds of goats and sheep:

Breeds develop by the genetic isolation from larger population, and are achieved by mating only with animals of the same breed and preventing mating with members of other breeds or population. Once a breed has been developed then distinctive characteristics will tend to keep pure.

Goat breeds are recognizable by their physical appearance and performance. Because of the great variation within the breeds, many of the data given cannot be but a rough indication of breeds conformation and performance. Nubian goats are breeds of North eastern African goats (Gall, 1996). They have a small backward, curved horn in both sexes, small ears which may be erect or dropping; the hair is long and black or black and white in color.

Sheep are multi-purpose animals. Almost all sheep are classified as being best in certain products. Other characteristic when classifying sheep include: face color (generally white or black), tail longs, presence or lack of horns. A sheep may also be of a fat- tailed type which is common in Africa and Asia with

larger deposits of fat around its tail. Sheep are also classified on how well they are producing (Manton, 2013).

1.5 Goat and Sheep Breeding:

Goats are seasonally polyestrous, the smell of males stimulate the onset of estrous cycle in females (Hume, 1971), and breeding may be natural at pasture or artificial and hand mating (Battaglia, 2007). Most sheep are seasonally polyestrous, adequate preparation of sheep before the breeding season is important (Battaglia, 1998). There are opportunities to breed annually, but some factors like weight in breeding time and nutrition can affect ovulation (Hume, 1971).

1.6 Goats and Sheep Feeding:

Feed is single largest cost, typically accounting for 60% or more of the total production cost. The animal's requirement varies according to the animal state like: late- gestation, reproduction and milk production which are critical periods for doe and ewe nutrition.

1.6.1 Extensive System:

This system includes free range grazing pasture. In this system low level of productivity emerges from poor nutritional availability.

1.6.2 Semi-intensive System:

This system is a combination of limited free range grazing and feeding in stalls, during morning for 4-6 hours and supplemented with crop, tree leaves and kitchen wastes in the evening.

1.6.3 Intensive System:

In this system animalsgraze in developing pasture or are completely fed in stalls. The animal's production is higher than in other systems (Gupta and Singhal, 2011).

1.7 Feeding and Nutritional Requirements of Goats and Sheep:

Goats and sheep may survive despite loss of most their body fat and up to 40% -50% body protein. However, water loss of only 10% of body weight may prove fatal. The demand for water is increased in summer and decreased in winter. Energy requirements vary greatly depending on the level and stage of production, activity and intended animal use. Energy is found in concentrates (Pugh and Baird, 2002).

Colostrum is essential for newborn kids and lambs for normal rumen bacterial growth, growth and immunity. Goats and sheep require macro-minerals ([calcium, phosphorus, sodium, chloride, magnesium, potassium and sulfur], and micro-minerals [copper, molybdenum, cobalt, iron, iodine, zinc] to be incorporated in their

diet for maintenance, wellbeing and production(Pugh and Baird, 2002).

1.8 Goat and Sheep Management:

Good dairy farming practice ensures that milk and meat for human consumptionis produced by healthy animals and animal is health is responsible from animal welfare (FA0 and IBF, 2004).

Proper management entails the choice of good breeds, provision of good environmental conditions, ensuring proper nutrition, supplementation of minerals and vitamins, provision of clean water*ad libitum,* excellent health care for prevention and treatment of disease, and finally restriction of movement of animals from one farm to another to avoid transmission on of disease (IUROT, 2008).

1.9 Blood Function:

Blood transports O_2 from the lung to the circulatory system for oxygenation of all body tissues and cells during inhalation and CO_2 from all body tissues and cells to the lungs during exhalation. Blood also transports nutrients absorbed from digestive track, and carry excretory products of organs resulting from metabolic processes (Duke, 1997).Blood plays an important role in heat regulation, water balance and regulates (pH) concentration (Prosser and Brown, 1961). The platelets in the blood are transported to the site of damaged vessels, and the white blood cells are carried from

the bone marrow to tissues as a defensive mechanism against foreign bodies, and endocrine hormones to target organs (Colville and Bassert, 2002).

1.9.1 Blood and Blood Constituents:

Blood is a fluid in which blood cells and cell fragments are suspend in the plasma and compounds such as oxygen, electrolytes, hormones, nutrients and drugs are either dissolved or suspended (Colville and Bassert, 2002).

1.9.2 Erythrocytes (RBCs):

Erythrocytes are the red blood cells (RBCs). The mammalian erythrocytes are non-nucleated and the biconcavity of these cells increases the surface area for carriage of oxygen. Erythrocytes are capable of changing shape in the circulatory system during passage through capillaries (Mishra, 2004).The number of red blood cell varies greatly in different species, and between individuals of the same species. In sheep the total red cell count range from 10-14 (x 10^6)/mm^3. Hemoglobin is the pigment of erythrocytes (Mishra, 2014). The concentration of Hemoglobin also varies depending on many factors such as pregnancy, sex, nutrition, age, breed and time of the sample collection (Swenson and Reece, 1993).

1.9.3 Leukocytes (WBCs):

Leukocytes differ from erythrocytes in several respects. They contain mitochondria and nuclei, and can move in an amoeboid

fashion, and can squeeze through pores in the capillary walls (Colville and Basset, 2002).

1.9.3.1 Types of Leukocytes:

1.9.3.1.1 A granulocytes

Are white blood cells such as lymphocytes and monocytes which are without obvious cytoplasmic granules when viewed under the Microscope.

1.9.3.1.2 Granulocytes

Are white blood cells such as neutrophils, eosinophil and basophils having colored granules in their cytoplasm (Colville and Basset, 2002).

1.10 Platelets

Thrombocytes are the smallest of the formed elements in the blood, formed in the red bone marrow by fragmentation of megakaryocytes, the largest of the bone marrow cells. Platelets are related to the clotting of blood (Prosser and Brown, 1961).

1.11 Principles of Hematologic Diagnosis:

Examination of peripheral blood is conducted as a routine part of patient evaluation by most physicians, regardless of specialty. This is because of its ease of accessibility and its close proximity to all tissue.Examination of peripheral blood often provides the earliest evidence of changes in the state of health and the development of illness. Knowledge of the mechanisms of blood alterations, supported by medical history and physical

examination, provide proper diagnosis and accurate therapeutic choices (Emmanuel et *al.*, 1992).

1.12 Normal Physiological Parameter of Goats and Sheep:

Kelly (1984) reported that the normal rectal temperature of goats was 38.6-40.2 C and 38.9- 40.0 C in sheep. Kelly (1984) added that the normal pulse rate of both goats and sheep was 70-90/min, and the normal respiratory rate of both goats and sheep was 20-30/min.

Chapter 2
Materialand Methods

2.1. Study Area:

The study was conducted in two locations in Khartoum Province (Al-kalakla` and Gandahar market).

Khartoum state is located between 15º 15´-16º 45´ N and 31º 45´-34º 15´E constituting an area of 22,122 km². Khartoum state climate is characterized by desert and semi desert environment, being hot to very hot in summer, short rainy season and warm to cold and dry winter (UNDP, 2011). The hot summer extends from March to June, where the mean daily maximum and minimum temperatures are 40 ºC and 24.8 ºC, respectively. May is the warmest month with a mean maximum and minimum temperature of 41.9 ºC and 27.3 ºC, respectively.

November to February, the winter month, is relatively cold months, where the mean maximum and minimum temperatures are 32.6 ºC and 17.6 ºC, respectively. January is the month with the mean maximum and minimum temperatures of 30.7 ºC and 15.6 ºC, respectively (WMO, 2016).

Sandstorms (Habob) are common in the region during the months May to August (UNDP, 2011).

2.2 Animals:

Nineteen female Nubian goats (Fig.1) and sixteen female Hamari sheep (Fig.2) were included in this study. All animals were free of any clinically detectable abnormality and free of internal and external parasites. Both goats and sheep were in good body condition score (BCS), were fed on a high plane of nutrition and allowed free access to drinking water. Both goats and sheep were approximately 4-6 years of age, and the data were collected under similar environmental conditions (9-10 AM).

Figure 1: Normal Nubian goats Selected for the study (In AL-kalakla Farm in khartoum Province).

Figure 2: Normal Hamari Sheep Selected for the study (In Gandahar Market in Khartoum Province).

2.3 Animal Housing:

The animals were housed in semi-closed pens at Al-Kalakla farm and Gandahar market.

2.4 Normal Physiological Parameters:

All these parameter were applied according to Kelly (1984).

2.4.1 Rectal Temperature (RT):

The rectal temperature was measured using a digital thermometer which was inserted after lubrication in the rectum resting on the rectal mucosa at an inclination of 45°, and left in situ for one minute, and the reading was recorded.

2.4.2 Respiration Rate (RR):

The respiratory rate was recorded by number of frequency of nostrils breath, flank movement, and by auscultation of the lungs.

2.4.3 Pulse Rate (PR):

The pulse rate was recorded as number of waves per minute from the femoral artery by placing the hand on the medial aspect of the thigh.

2.5 Blood Sampling:

Two milliliters of blood was collected from the jugular vein using 5 ml disposable syringes and sterile needles following

aseptic techniques. The blood samples were put in sterile glasses tubes containing EDTA, and transported in ice boxes for hematological examination (Total RBCs [$x10^6$] and WBCs [$x10^3$], Hb concentration [G/dl], and packed cell volume [PCV %]) following standard techniques (Coles,1967; Jain, Schalm, and Carroll, 1975; Kelly, 1984; Blood and Studdert, 1999).

2.6 Haematological parameters:

2.6.1 Total Red Blood Cell (RBCs) and White Blood Cell (WBCs) Counts:

The total red blood cell and white cell counts were conducted using an improved Neubaur-hemacytometer (Neubaur improve-Germany), using Hayem solution as a diluent for the former and Turkey's solution as diluent for the latter.

2.6.2 Packed Cell Volume (PCV):

The packed cell volume of erythrocytes was determined by using a micro-hematocrit- centrifuge (Hematocrit 2010 - Germany) at 12000 rpm for 5 min and the PCV was measured as a percentage of whole blood using the micro-hematocrit reader.

2.6.3 Hemoglobin Concentration (Hb):

The blood Hb was estimated using Spectrophotometer (Janway– England). According to cyanmethoglobin in (Jain, 1975).

Principle of the method:

Hemoglobin is oxidized by potassium ferricyanide in to methaemoglobin which is converted in to cynomethaemoglobin by potassium cyanide.

Reagents:

- Potassium ferricyanide 0.60 MMOL/ L
- Potassium cyanide 77 MMOL/L
- Dihydrogen potassium phosphate 2MMOL/ L

Calculation:

A sample □ A standard * (standard conc.) = g/ dl hemoglobin in the sample.

2.7 Statistical Analysis:

The data collected from this study (19Nubian goats and 16 Hamari sheep) were analyzed using statistical package Social Science *(SPSS version 16). The data were analyzed by simple* and descriptive statistics (Independent T-TEST) to detect the normal range of the hematological parameters and calculate the maximum / minimum means, standard deviation and standard error for all parameters measured in sheep and goats in the different location in Khartoum state.

Chapter 3
Results

3.1 Normal Physiological Parameters:

The data obtained from the normal physiological parameters (Temperature, pulse and respiratory rates) were similar in both Nubian goats and Hamari sheep raised under similar environmental and management conditions. The normal rectal temperature of goats was 37.9 - 40.2 ºC, while that of sheep was 37.9 - 40 ºC, the normal pulse rate of goats and sheep was 70 – 90/min, and the normal respiratory rate of goats and sheep was 20-30/min.

3.2 Normal Hematological Parameters:

Table 1: Showing some haematological parameters in Nubian goats compared to Hamari sheep in Khartoum Province.

Blood parameter	Goat (n=19)	Sheep (n=16)	P. value
RBCs ($\times 10^6$)	10.37±1.30	10.69±1.20	0.458
WBCs ($\times 10^3$)	9.11±1.94	8.94±1.18	0.756
Hb g/dl	8.79±1.03	9.88±1.09	0.005*
PCV%	25.47±3.32	29.25±2.82	0.001*

*=significant differences at $P<0.01$

As shown in table 1 the statistical analysis of the normal blood parameters (Total RBCs and WBCs, Hb concentration and PCV) of goats and sheep showed significant differences at

($p<0.01$) in both hemoglobin concentration and packed cell volume, but no significant differences were observed in the total RBCs, and WBCs counts. Sheep had higher values of Hb, and PCV (Hb = 9.88±1.09, PCV=29.25± 2, 82) than goats (Hb = 8.78± 1.03, PCV =25.47±3.32).

Chapter 4
Discussion and conclusion

The 19 female of Nubian goats and the16 female Hamari sheep selected for this investigation were thoroughly examined and ensured that they were normal and free from internal and external parasites. They were free from any clinically detectable abnormality. Both goats and sheep were in good body condition score (BCS), housed in semi-closed pens, and were fed on a high plane of nutrition and allowed free access to drinking water. All animals were approximately 4-6 years of age, and the data were collected under similar environmental conditions (9-10 AM). This resulted in homogenous data which gave us the opportunity to compare the normal physiological and hematological parameters of the two species of animals.

In the current investigation the statistical analysis of the normal blood parameters (Hb concentration and PCV) of goats and sheep showed significant differences at ($p<0.01$), but no significant differences were observed in the total RBCs, and WBCs counts. Sheep had higher values of Hb, and PCV (Hb = 9.88±1.09,

PCV=29.25± 2, 82) than goats (Hb = 8.78±1.03, PCV =25.47±3.32).

In this study Hamari sheep had higher PCV % (29.25±2.82) and Hb concentration (9.88±1.09) than Nubian goats with PCV (25.47±3.32) and Hb (8.79±1.03). Standard techniques (Coles, 1967; Kelly, 1984; Blood and Studdert, 1999) were adopted in this investigation to ensure sound and accurate comparison of the results obtained.

The findings recorded in this investigation were in contrast to those reported by Babeker and Elmansury (2011), and Njidda *et al*., (2013) who recorded lower PCV in female Sudanese desert sheep (23.80±1.41%) and lower Hb concentration (8.47± 0.86 gd/l). These differences in values were probably due to breed and/or the animals are being watered short time before collection of samples. The Hamari sheep used in the current investigation had good body score; being fed on high plane of nutrition.

Our findings were also contrary to Egbe- Nwiyi *et al.* (2000) who recorded higher values of PCV 42.1±1.87 %, and Hb concentration 14.18±0.78 g/dl in female goats of arid areas of Nigeria. Our findings were also contrary to Babeker and Elmansury (2011) in Sudanese desert sheep, and Njidda, *et al*., (2013) in Borno white females in northern Nigeria; who also recorded higher values of total RBCs in Sudanese desert sheep.

The reason for these high values in PCV, Hb and RBCs were probably due to heat stress, variation in time of sample collection, differences in physiological conditions and/or breed difference.

In this study Sudanese Nubian goats had higher total WBCs count (9.11±1.94) $x10^3$/ ml than Hamari sheep (8.94±1.18) $x10^3$ /ml, but the difference was not significant. Egbe-Nwiyi, *et al.* (2000) have also reported that female goats had higher total WBCs (12.38±0.69)10^3/ml than female sheep (11.69±1.19)10^3 /ml of the same age.

Conclusions

In conclusion the results presented in this investigation showed that goats and sheep of the same sex and age; kept under similar environments and management was similar in all normal physiological parameters (temperature, pulse and respiratory rates). However, the PCV% and Hb concentration were higher in sheep than in goats and the differences were significant at $P<0.01$, but no significant differences were observed in the total RBCs and WBCs counts of the two species of animals.

It is hoped that he base data recorded in the current investigation will benefit practicing veterinarians as well as research workers interested in the different aspects of research work involving these species of animals.

Recommendations

1) Further studies at a wide scale are warranted to investigate the effect of management and nutrition in Sudanese local breeds of goats and sheep from different areas in the Sudan.
2) Intensive research work need to be conducted for the proper classification of the Sudanese local breeds of goats and sheep, and extensive management and selection programs need to be conducted and implemented targeting towards obtaining pure breeds with high genetic potentials for milk and meat production.

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