Introduction

The developing countries in Africa and Asia contain the predominant share of the world's goat population (≈610 millions) mostly (80%) located in the tropics and subtropics (Knight and Garcia, 1997). According to the FAO (1999) estimate of livestock, the Sudan maintains about 37.5 million head of goats.

The goat is a multipurpose animal. It produces meat, milk, skin and hair, and is unique in its ability to maintain itself in the harsh tropical environments. Goats play an important role in commercial and subsistent system in Sudan. For the commercial purpose, goats are mainly kept for meat production. In the subsistent system, goats are considered as a source of meat and income, as well as a source of milk (Devendra and Burns, 1983).

The indigenous goats in Sudan, namely Desert and Nubian goats, which are among the best known dairy breeds in Africa, especially in Sudan, comprise 47% of the total goat population (AOAD, 1990).

Objectives:

1. General objective:

- To establish some hematological and clinical parameters of Boer goat under Sudan conditions.

2. Specific objective:

To determine Erthrocytic count (Erythrocytic count, Hemoglobin concentration, packed cell volume, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration.

To determine Leukocytic profile (Neutrophils, Lymphocyctes, Basophils, Esonophils).

To measure some clinical parameters that is rectal temperature, pulse rate, heart rate, and respiratory rate.

Chapter One

Literature Review

Chapter one

Literature Review

1.1 Goat:

The goat is a multipurpose animal. It produces meat, milk, skin and hair, and is unique in its ability to maintain itself in the harsh tropical environments. Goats play an important role in commercial and subsistent system in Sudan. For the commercial purpose, goats are mainly kept for meat production. In the subsistent system, goats are considered as a source of meat and income, as well as a source of milk (Devendra and Burns, 1983).

1.1.1. Evolution and domesticatin of goats

Evolutionary biology indicates that the goat was domesticated about 10,000 years ago at the dawn of the Neolithic age. Domestication was associated with three of the oldest civilizations: the Nile in northeast Africa, the Tigris – Euphrates in west Asia, and the Indus in the Indian subcontinent. Archeological investigations of relics from past civilizations show that links between goats and people and their livelihoods were very close. Archeologists indicate that the goat was first domesticated in the “Fertile Crescent ” of the eastern Mediterranean. This landmass stretches between the Black and Caspian seas along the coast of Palestine, and curves like a quarter moon toward the Persian Gulf. This is the site where agriculture originated — in the narrow strip bounded by the Euphrates and Tigris rivers (Devendra and Solaiman, 2010)

Domestication of wild goats was evident first in Jericho (Jordon) around 7000 BC as well as in the Zagros Mountains in Gangi Dareh (Iran) around 8000 BC (Zeuner,1963). Since then, the goat has been involved in many aspects of human culture including religion, tradition, folklore, nutrition, livelihood, and economics (Boyazoglu *et al*, 2005).

1.1.2 Goat Population

Accurate statistics are required to determine the future outlook of the goat populations and their productivity. They are also needed before any improvement policies can be planned on a realistic basis and implemented with confidence. Africa has the second largest population after Asia which is 291.1 million while Asia has staggering 586 million (FAOSTAT, 2014).

1.2 Uses of goat

The uses for rearing goat include milk production, meat production, skin or hides and fiber productions (Solaiman, 2010). Milk production in Boer goats is generally considered adequate for rearing multiple kids. Little difference in growth rate at weaning was reported between single and multiple births. Lactation length is shorter for meat breeds compared to dairy breeds and milk solids are generally higher in meat breeds (Christopher, 2002).

1.3. Goat in Sudan:

Goats belong, scientifically, to the Bovidae family with in the suborder of ruminants (chevrotain, dear, elk, caribou, moose, giraffe, okapi, antelope) which beside the other suborders of camels, swine and hippopotamuses make up the order of even toed hoofed animals called Artiodactyla (French, 1970). With sheep, they belong to the tribe Carpini, but alone to genus Capra (French1970). The goat is unique in its ability to adapt and maintain itself in the harsh tropical environment. In addition, the goat is resistant to disease and dehydration, endowed with inquisitive feeding habit and high digestive efficiency for cellulose (Devendra and Mcleroy, 1987).

The animal population in Sudan was estimated around 140.909 million of which 51.555 heads were sheep, 41.563 million heads were cattle, 43.270 million heads were goat and 4.521 million heads were camel. In River Nile State, the animal population was estimated at about 2. 428579 million of which 1,020789 million heads were sheep, 99,751 were cattle, 1,198579 million heads were goat, and 109,408 heads were camel. Goats represent about 49.4% of total animal population (Ministry of Animal Resources and Fisheries, 2009).

1.4. Feeds and Feeding Management:

Specific feeds are not required. Instead, the nutrients from feeds, for example, protein, energy, minerals, and vitamins, are required and must be provided by feed ingredients provided in the diet. Feed ingredients include those provided by humans as well as feed components gleaned by animals from available forage or browse. First, protein is needed. Protein may come partly from nonprotein nitrogen sources like urea. Next, energy is required; that typically is obtained from dietary carbohydrates (sugars, starches, and fiber), fats, and to a lesser degree, excess protein. Accurate feed management is a three - step process. First, nutrient requirements of the animal must be estimated; second, the composition of available feeds must be assessed; and third, one seeks to provide appropriate amounts of nutrients from specific feeds to meet the nutrient requirements (Solaiman, 2010).

1.4.1 Energy Concentrates

Energy concentrates are defined as feeds with less than 20% protein and less than 18% fiber. High - energy feeds include all cereal grains, some root crops, flourmill and bakery by-

products, and many other food manufacturing by - products such as beet pulp and citrus pulp (Solaiman, 2010).

1.4.2. Protein Concentrates

When forage is low in protein content or availability, additional protein supplements are needed for maximum production or performance. Protein concentrates usually contain at least 20% crude protein. High - protein feeds include alfalfa hay, alfalfa meal or cubes, and other high-protein concentrates such as oilseed by - product meals (cottonseed, peanut, soybean, etc.) (Solaiman, 2010).

1.4.3 Minerals and Vitamins Supplements

Minimum requirements of minerals and vitamins must be provided for optimum goat performance, but the need for supplements will vary with composition of diet ingredients. Mineral supplements can be as simple as salt alone or may be a complex mix consisting of several macro and trace elements plus vitamins provided free choice in the form of either a loose mixture or a block. Some mineral/ vitamin mixtures can be included in a total grain mix to be fed as part of a totally mixed ration (TMR). Generally calcium, phosphorus, and sodium are supplemented to diets for goats, but the need for each will differ with the diet ingredients being fed. Normally, calcium is present at adequate levels in most forage for gazing ruminants, but salt (or some source of sodium) must be supplemented. Phosphorus may be deficient in forage at certain times of the year, and a phosphorus deficiency can reduce reproductive performance. If grass tetany is a regional problem with forage, seasonal supplementation with magnesium may be necessary. In early spring or when animals are consuming fresh green and rapidly growing pastures fertilized with N, P, and K, high levels of potassium and nitrogen with low levels of magnesium and salt may lower the ratio of magnesium: potassium and provoke grass tetany. Trace mineralized salt provides a mixture of micro minerals, and vitamins A and E are supplemented in vitamin premixes (Solaiman, 2010).

1.5. Boer goat:

The Boer goat is a red-headed large framed goat with a white body. The ideal is an average sized heavy goat for maximum meat production. A desirable ratio between length of leg and depth of body should be achieved at all ages. It is a goat with a fine head, lob ears, round horns that are bent backwards, a loose, supple skin with folds (especially in bucks). The doe must be feminine, wedging slightly to the front, which is a sign of fertility. The buck is heavier in the head, neck and forequarters and must be masculine. A variety of color patterns occur, but the ideal is a white goat with a red head and ears, a white blaze and fully pigmented skin. Shadings between light and dark red are permissible. It has short, smooth, glossy hair (Synman, 2014.)

1.5.1 Origin of Boer goat:

The Boer goat has an established reputation as a meat producer. The opinion of Devendra and Burns (1970) that the breed has excellent meat conformation was reiterated by (Owen *et al*,1978) who, in their appraisal of the meat production characteristics of Botswana goats and sheep, concluded that Boer goats are considerably superior meat producers than indigenous goats.

The origins of Boer goats are somewhat vague and are most probably rooted in ancestors kept by the Namaque Hottentos and the migrating tribes of the "Southern Bantu" people (Barrow, 1801; Epstein, 1971; Mason, 1981; Campbell, 1984). Influence from other continence also cannot be ruled out. Pegler (1886) offered the opinion that India had been a source of origin and Schreiner (1898) maintained that European goats had been the ancestors. It is possible that none of the others, despite their differing opinions, are entirely wrong and that the Boer goat does contain genes from these pools, especially if the migratory and trade practices of the early inhabitants of Southern Africa are taken into account (Casey, 1986).

1.5.2. Adaptability:

The versatility of farm animals in the adaptability to various climates and production system is an economically important characteristic. Adaptability has a direct bearing on production, the demand for breeding stock and son the return on investment. Adapted animals are in perfect harmony with their environments, hence they have high resistance to endemic disease, are heat tolerant in the tropics and look flourishing (Bonsma,1970). The Boer goat is regarded as being extremely adaptable. This is illustrated by its thriving in all the climatic regions of southern Africa which includes a Mediteranean climate, a tropical and subtropical bush and the semi-desert regions of the Karoo and greater Kalahari (Casey, 1986).

1.5.3. Growth

Goats do not demonstrate a high growth rate, and particularly when compared with lambs and sheep. Under favourable nutritional conditions, Boer goats may attain a growth rate of more than 200 g/day. Naude and Hofmeyr (1981) reported a pre-weaning growth rate of 227 g/day

by 54 kids. These were born of 30 does kept under intensive conditions in a barn with free access to a complete ration (60% digestible dry matter, 14% crude protein). These kids also had free access to a creep (70% digestible dry matter, 14% crude protein) over a 12 week period (Casey, 1984).

1.6. General Composition and Function of Blood:

The blood is a non–Newtonian, fluid, consisting of cellular components suspended in plasma. The cellular elements of blood are red blood cells (erythrocytes), white blood cell (leukocytes) and platelets (thrombocytes) (Jain, 1986).

The main functions of blood are transport of oxygen (O_2) and nutrients to the cells of the body and removal of carbon dioxide (CO_2) and waste material to the excretion organs. The erythrocytes are the main agent of O_2 transport, leukocytes are involved in the reaction to infections, and thrombocytes are involved in prevention of loss of blood (Bell *et al;* 1980). The blood helps to regulate body temperature, maintain a constant concentration of water and electrolytes in the cells, regulates the body's hydrogen ion concentration (pH) and the secretion of endocrine glands are spread throughout the body (Swenson, 1993).

1.6.1. Erythrocytic profile:

The erythrocytic series includes the erythrocytes count, packed cell volume (PCV) of erythrocyte and hemoglobin concentration (Hb). It also comprises mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and erythrocyte sedimentation rate (ESR). In mammals, erythrocytes are non-nucleated – circular biconcave discs (Kelly, 1984). The normal ranges for erythrocytes count is $8\text{-}18\times10^6$ /µl, with average of 13×10^6/µl in goats (Jain, 1986).

In the goat the life span is 125 days. The main function of erythrocyte is that it enables the blood to carry 100 times the amount of O_2 more than can be carried in plasma alone, the erythrocyte also carries CO_2 from the tissues to the lungs buffering the carbonic acid formed in the red cell (Jain 1986).

1.6.1.1. Hemoglobin:

Hemoglobin, the pigment of erythrocytes, is a complex iron-containing conjugated protein composed of a pigment and simple protein. The protein is a globin, a histone (Swenson, 1993). Studies of hemoglobin's tetramer peptides A and B chains are the foundation of

population and molecular genetics. Ruminant hemoglobin is of particular interest because of the large amount of polymorphism, which occurs between species, breeds and within the individual as it develops from embryo to adult (Kitchen, and Brett, 1974).

1.6.1.2. Packed Cell Volume (PCV):-

The PCV is expressed as a percentage volume of packed cell of the whole blood after centrifugation. The volume of cell in the circulating blood is usually less than plasma volume.The goat has the lowest PCV of common domestic animals. When normal goat blood is properly centrifuged to reduce trapped plasma to a minimum, the PCV falls within a range of 22-38%. Some apparently clinically normal goats may have PCV values of 19-20% (Jain, 1986). The author reported that the values of PCV, MCV, MCH and MCHC in goats are influenced by degree of relative centrifugal force and time of centrifugation (Swenson, 1993).

1.6.1.3. Erythrocyte Sedimentation Rate (ESR):-

Erythrocyte sedimentation rate (ESR) is a test performed on the blood to help in the determination of the health status of an animal. The ESR varies greatly among different species of animals (Swenson, 1993).

ESR is not applied to the goat because there is no setting of goat erythrocyte within the 1-hour interval prescribed for the Wintrobe method. However, ESR values of 2.0-2.5 mm can be observed in normal goat blood kept for 24 hrs (Smith and Sherman, 1994).

1.6.2. Leukocyte profile:

The leukocyte measurements include the total leukocyte count (TLC) and differential leukocyte count (DLC). The leukocytes are much less numerous than the erythrocytes in the blood of animals, there are approximately 1300 erythrocyte to every leukocyte in blood stream of goats (Swenson, 1993).

The leukocytes are motile, nucleated and larger than the erythrocytes. Generally the leukocytes are classified into three categories; granulocytes, monocytes and lymphocytes. The granulocytes are characterized by specific granules in their cytoplasm; according to their staining reaction they are neutrophils, eosinophils and basophils (Swenson, 1993).

The neutrophilic leukocyte is forming the first line of the circular defense against microorganisms (Williams and Bunch, 1981).

The lymphocytes produced in the various lymphogenous organs including the spleen, thymus, tonsils and various lymphoid tissues All lymphocytes, including T-lymphocyte and B-lymphocytes .The life span of B-lymphocytes is 3-4 days on the average with some living a few hours, while T-lymphocytes may live 1-3 years in the tissues (Swenson, 1993).

Monocytes originate in cells of the mononuclear phagocytic system (MPS) in the spleen and bone marrow. The ruminants monocyt is a round to convoluted shaped cell (Kramer, 2000).

Chapter Two

Material and Method

Chapter Two

Material and method

This study was conducted in Sudan University of Science and Technology, Center of Animal Production at Hilla Kuku, Khartoum State, from March to October, 2016.

2.1. Experimental Animals:

Thirty female non pregnant, non-lactating Boer goats were randomly selected with an average age (4-7years), and average body weight (35-40) kg.

2.2. Feeding and housing

The goats were fed twice daily with a maintenance ration composed of crushed grains and Abu 70. Water, supplements, and limestone were available all the time. The goats were kept in pens with good ventilation.

2.3. Collection of blood samples:

The hair of the specific part of the neck was clipped closely and the area was wiped with a disinfectant (70% ethanol) before the jugular vein puncture. 10 ml samples of blood were drawn from the jugular vein using plastic disposable syringes once in early morning. Immediately after withdrawal, 2 ml of blood sample was transferred to a capped test tube containing disodium ethylene diamine tetra acetate (Na_2-EDTA) as an anti-coagulant for hematological analysis, that is red blood cells (RBC), white blood cells (WBC) counts, hemoglobin (Hb), packed cell volume (PCV), Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) and differential leukocytes count and analyzed immediately using Sysmex auto-analyzer.

2.4. Measurement of some clinical parameters:

2.4.1 Rectal temperature (RT): the rectal temperature was taken using digital rectal thermometer (Delta Tract) which was inserted into the rectum and positioned there after reading was recorded.

2.4.2 Respiratory rate (RR): The respiration rate was recorded as the number of frequency of nose breathing per 15 seconds and was later calculated as breaths/minute.

2.4.3 Pulse Rate (PR): the pulse rate was measured as the number of beats per 15 seconds by placing the hand on the femoral artery and later calculated as beats/minute.

2.4.4 The heart rate (HR): The heart rate was taken by placing the stethoscope on the chest of the goat for 15 seconds to determine the rhythmic beats of the heart which was later calculated as beat/minute.

2.5. Statistical analysis:

Data was presented as means with standard deviation of the specific hematological and clinical values using descriptive test according to (Gomez and Gomez, 1984). The Statistical Package for Social Sciences Program (SPSS) version 16 was used for the analysis.

Chapter Three

Results

Chapter three

Results

3.1. **Erthyrocytes count and indices of Boer Goat**

Table (1) shows that the mean RBCs count was10.22 ± 2.51(10^6/µl), HGB count was 8.52 ± 1.11(mg/dl), the PCV count was 24.54 ± 4.88 (%), MCV count was 38.55 ± 7.73**(fl)**, MCH count was 6.01 ± 0.27 (pg) and MCH count was 39.13 ± 8.13**(%)**.

3.1.2 (Table 2): Total Leucocytes and differential count of Boer Goat

Table (2) shows the T.L.C count was 14.44 ± 2.35(10^3/µl), the Neutrophils count was 26.55 ± 3.15 (%), the Lymphocyte count was 66.00 ± 3.4(%), the Monocyte count was 4.65 ± 0.08(%), the Bashophil count was 1.05 ± 0.04 (%), and the Acidophil count was 1.75 ± 0.01 (%).

3.1.3 (Table 3): Clinical Parameters of Boer Goat. (Mean ± SD)

Table (3) shows the RT(rectal temperature) was 40 .00± 0.44**(C°)**, the PR(pulse rate) was 77.80 ± 7.47 (beats/min), and HR(heart rate) was 77.40 ± 6.21 (beats/min), and RR(respiratory rate) was 28.30 ± 1.72 (breath/min).

Table(1): Erthyrocytes count and indices of Boer Goat

Parameters	Mean ± SD
RBCs(10^6/μl)	10.22 ± 2.51
HGB (mg/dl)	8.52 ± 1.11
PCV (%)	24.54 ± 4.88
MCV**(fl)**	38.55 ± 7.73
MCH(pg)	6.01 ± 0.27
MCHC**(%)**	39.13 ± 8.13

- Values mean ± SD
- Number of observation = 2

3.1.2 (Table 2): Total Leucocytes and differential count of Boer Goat

Parameters	Mean ± SD
T.L.C x (10^3/μ*l*)	14.44 ± 2.35
Neutrophil (%)	26.55 ± 3.15
Lymphocyte (%)	66.00 ± 3.4
Monocyte (%)	4.65 ± 0.08
Basophil (%)	1.05 ± 0.04
Acidophil (%)	1.75 ± 0.01

- Values mean ± SD
- Number of observation = 2

3.1.3 (Table 3): Clinical Parameters of Boer Goat. (Mean ± SD)

Parameters	Mean ± SD
RT**(C°)**	39 .00± 0.44
PR(beats/min)	77.80 ± 7.47
HR(beats/min)	77.40 ± 6.21
RR(breath/min)	28.30 ± 1.72

Rectal temperature = RT

Heart rate = HR

Pulse rate = PR

Respiration rate = RR

Values mean ± SD

Number of observation = 2

3.2 Discussion

From the study, the red blood cells (10^6/µl), Hb (mg/dl) MCV(fl), MCH(pg), MCHC**(%)** and PCV (%) showed decrease in number compared to another study **(**Ghanem, *et al*, 2015) and (Othman, *etal*, 2014). This may be due to the difference climate (summer) therefore the animals suffering from stress and depression which lead to food intake reduction. All this reasons caused a drop in hematological parameters.

The present Leucocytes and Neutrophils values results obtained in this study are higher than those recorded by (Ghanem, *et al* 2015) who obtained WBCS count values (12.06×10^6/µl), Neutrophils values (21.23%) for mature female Boer goats, this variation can be attributed to genetic factors, breed , age or climatic conditions, and inter-laboratories variations(Abou El-Gheit, 2000).

The clinical parameters are comparable to the values obtained by Popoola *et.al* (2014). All the studied parameters were within the normal range (Ribeiro *et al*, 2009) which indicates that the animals got adapted to the climatic conditions of the Sudan.

Conclusion

The erythrocytes count (Hb concentration,PCV,MCV,MCH and MCHCvalues) the Total Lucocytic count, Rectal Temperature, Pulse Rate, Respiratory Rate, and Heart Rate of Boer goats under Sudan conditions were within the normal range.

Boer goats seem to be well adapted to the environmental conditions of the Sudan.

Recommendations

Further studies are recommended by using larger number of goat to put a database for the different physiological parameters of the Boer goat in Sudan.

Additional work must be done to evaluate the economical value of this breed in Sudan

References

Abou El-Gheit, A.I.A. (2000). Liver and kidney functions in healthy and diseased small ruminant M.V.Sc. thesis Faculty of Veterinary Medicine, Zagazig University.

Arab Organization of Agricultral Development (AOAD, 1990). Goat Resources

in Arab Countries. Khartoum, Sudan. p 105.

Barrow, J. (1801). Travels into the interior of Southern Africa in the years 1779 and 1778. Part One. Stratham Printers Street, London.

Bell, G.H. Smith, F.G. and Paterson, C.R. (1980). The blood. In : Textbook of physiology .

p 104. Longman group Ltd. London.

Bonsma, J. (1990). live stock production in the sub-tropical and tropical African countries. S. Afr.J.Sci.

Boyazoglu , J. , I. Hatziminaoglu , and P. Morand - Fehr . (2005), The role of the goat in society: past, present and perspectives for the future . Small Rumin. Res. 60 : 13 – 24.
Campbell, Q.P. (1984). The development of a meat producing goat in South Africa. In: Proc. 2nd world Congress on Sheep and Beef Cattle Breeding (1984).

Casey, N. (1986). Producation and meat quality from Boer goats. University of Pretoria. South Africa.

Christopher, D. Lu, (2002). Boer goat production: Progress and perspective. University of Hawaii. USA.

Devendra, C, and Burns, M., (1970). Goat production in the tropics. Commonw. Bur. Agric. Tech. Commun.

Devendra, C. and M. Burns, (1983). Goat Production in the Tropics (Revised Edition.).

Technical Communication Bureaux of Animal Breeding and Genetics,

Commonwealth Agric. Bureau, England, pp. 183.

Devendra, C. and Mcleroy, G. B. (1987). Goat and sheep production in tropics PP. 11 – 17

Longman Scientific and Technical England.

Epstein, H. (1971). The origin of Domestic Animals of Africa. Revised with I.L. Mason, African Publishing Corporation, Vol. 11, pp 261-263. New York, London, Munich.

FAOSTAT (2014): http://faostat.fao.org/beta/en/#data/QA

Feldman B.F, Zinkl J.G and Jain V.C. Schalm's Veterinary Hematology .5th ed. Lippincott Williams and Wilkins. Canada (2000); PP: 1145-1146.

Food and Agriculture Organization of the United Nations, FAO (1999). Production Handbook, Vol. 53. Rome, Italy. P 251

French, M.H. (1970). Serration on the goat, animal production and health, 14.Goat breed of the world chapter 3, P. 47 Goat production in the tropics, Common Wealth Agricultural Bureaux Famham Royal Buks, England, 184.

Ghanem, M.M.1, Yousif, H.M.2, Abd El-ghany, A.H.I, Abd ElRaof, Y.M.1, El-Attar, H.M.1, (2015), Evaluation of pulmonary function tests with hemato-biochemical alterations in Boer Goats affected with Klebsiella pneumonia, Behna Veterinary Medical Journal, Vol 29, NO.1:53-62.

Gomez, K.A. and Gomez, A.A. (1984) Statistical Procedures for Agricultural Research. 2nd Edition, John Wiley and Sons, New York.

Jain, N. C. (1986). Heamatological techniques.In: Schalm's veterinary hematology pp. 20 – 86. Lea and febiger. Philadelphia. 4th edition.

Kitchen H and Brett I. (1974). Embryonic and fetal Hb in animals . Ann NY Acad Sci 1974; 241 : 653-671

Knight, M, and Garcia, G. W. (1997). Characteristic of goat (Capra hircus) and its potential rate as a significant milk producer in the tropics: A review : Small Rumin. Res., 26 : 203 – 215.

Kramer, J.W. Normal hematology of cattle, sheep, and goats. in: B.F. Feldman, J.G. Zinkl, N.C. Jain (Eds.) Schalm's veterinary hematology. 5th edition. Lippincott Williams and Wilkins, Philadelphia: (2000):1075–1084.

Marai, I.F.M., Daader, A.H., Abdel-Samee, A.M. and Ibrahim, H., (1997). Winter and summer effects and their amelioration on lactating Friesian and Holstein cows maintained under Egyptian conditions. *International Conference on Animal, Poultry and Rabbit Production and Health*, (Institute of Efficient Productivity, Zagazig University, Zagazig, Egypt), 305-312.

Mason, I.L, (1981). Breeds. Chapter 3, Goat Production. Ed. C. Gall. Academic Press: London, New York, Toronto, Sydney, San Francisco.

Melvin J. Swenson, (1993), the composition and functions of blood, Dukes' Physiology edited by Melvin J. Swenson and William O. Reece.

Naude, R.T and Hofmeyr, H.S. (1981). Meat production. Chapter 9: Production. Ed. C. Gall. Academic Press: London, New York, Toronto, Sydney, San Francisco.

Othman, A.M, Jesse F.F.A, Adza- Rina, M.N, Ilyasu, Y, Samri-Saad, M, Wahid, A.H, Saharee, A.A, and Mohd, Azmi. M.L,(2014) Heamtological, Biochemical and Serus Electrolyte Changes in Non-Pregnant Boer Does inoculated with Corynebacterium Pseudotuberculosis Via Various Routes, Journal of Agriculture and Veterinary Science, Vol7, Issue10, pp 05-08.

Owen, J.E, Norman, G.A., Philbrooks, C.A. and Jones, N.S.D. (1978). Studies on the meat production characteristics of Botswana goats and sheep. 3. Carcass tissue composition and distribution. Meat Science. 2, 59.

Pegler, H.SH. (1886). The Book of the Goat. London. Bazzaar, Exchange and Mart, 3rd Edition.

Popoola,M.A. Bolarinwa,M.O. Yahaya,M.O. Adebisi,G.L Saka,A.A.(2014). Thermal comfort effect on physiological adaptation and growth performance of west African dwarf goats raised in nigeria. European scientific journal. Vol (3).275-281.

Ribeiro , R.D.X, Oliveira, R.L, Aly Agy, M.S.F, Ribeiro, M.D, Ribeiro, C.V.M, and Silva, T.M, (27-30 December 2009) thermal comfort index and physiological parameters of cross-bread Boer goats fed sunflower pie, world congress on oil and fats and 28th ISF congress.

Schreiner, S.C.C., 1898. The Angora Goat. Longmans Green and Co, London

Smith, M.C. and Sherman, D.M. (1994). Blood, lymph, and immune system. In: Goat

Medicine. pp 194-205. Lea and Febiger, Philadelphia.

Snyman, M.A. (2014), South African goat breeds: Boer goat. Info pack ref. 2014/002. Grootfontein Agricultural Development Institute.

Solaiman, S.G (2010). Goat science and production, 1st Edition, Wiley Black-Well. USA

Solaiman, S.G. (2010). Feeds and Feeding Management, Goat Science and Production, pp 193, 1st edition, Wiley Black-Well. USA.

Solaiman, S.G. and Devendra, C. (2010), Perspectives on Goats and Animal Production, Goat Science and Production, pp 4, 1st edition, Wiley Black-Well. USA.

Swenson, M.J.(1993). Physiological properties and cellular and chemical constituents of

blood. In: Duke's. Physiology of Domestic Animals.pp 22 – 46. 11th edition. (Edited by

Swenson, M.J. and Reece, W. O.). Cornell University Press, Ithaca and London.

Williams, M.R. and Bunch, K.J. (1981).Variation among cows in the ability of their blood polymorphonuclear leukocytes to kill Escherichia coli and Staphylococcus aurious. Res. Vet. Sci. 30: 298-302.

Appendix (1)

Female lactating Boer goat

Appendix (2)

Male adult Boer goat