

**EVALUATION OF PHYSICAL BODY TRAITS
AND SOME BLOOD CHARACTERISTICS OF
WEST AFRICAN DWARF GOATS IN
SOUTHWESTERN NIGERIA**

BY




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ABSTARCT



Two hundred West African Dwarf (WAD) goats aged 1-6 years were examined during a 10-months period, from October, 2003 to July, 2004 in randomly selected locations within South Western Zones of Nigeria. Qualitative traits namely coat colour, polled trait, presence or absence of teat, wattle and beard were examined and described in all the experimental animals. Black colour observed in 54% of the animals predominate while brown and mixed colours accounted for 16% and 30% of all the animals respectively. All goats studied irrespective of sex were horned. The goats had a pair of teat each except eight goats with supernumerary teats. Possession of beard was common in all bucks observed but 8.5% of the females had beard. About 36.5% of all the WAD goats examined possessed wattle. The linear body measurements recorded in this study included body length (BL), chest girth (CG), height at girth (HG), height at wither (HW), leg length (LL), shoulder to tail length (STL), nose to shoulder length (NL), tail length (TL) and ear length (EL). There was no sex difference in body weight and linear body measurements with the exception of TL. Location effects were observed for HW, TL and EL while the effect of age was significant ($P < 0.05$) for body weight and linear body measurement apart from CG and NSL. In general, the body weight, linear body measurements (except HE, EL and CG) and blood parameters (except MCV; MCHC and ALB: GLB) were not significantly ($P > 0.05$) influenced by the qualitative traits studied. Correlations among the traits were positive and among all the linear body measurements reported, BL, HW and LL could be used to predict the body weight. Location, sex and age had no significant ($P > 0.05$) effect on the haematological indices studied except RBC and some erythrocyte indices (MCV and MCH). With the exception of ALB: GLB, all serum indices were not significantly influenced by location, sex and age.

CERTIFICATION

It is hereby certified that this was an original research project carried out by Mr. J. O. Adebayo in the Department of Animal Production and Health of the Federal University of Technology Akure in partial fulfilment of the requirement for the award of the M. Tech. Degree.

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DEDICATION

This report is dedicated to my God, the Almighty who is always there for me and to all categories of men struggling hard in life with uncommon determination for a worthy and priceless goal (s). I wish them good success and attainment.



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INTRODUCTION



1.1 GENERAL BACKGROUND

It is well established beyond any reasonable doubt that in the world today, the ever increasing human population exercise continual pressure on food production hence the need for accelerated production of food for the ever-growing population has been a subject of great concern. Using Nigeria as a case study, this problem of low animal protein intake will remain so for sometime if desperate efforts are not made. In view of the increasing demand for protein and its inadequate supply by two major sources of protein (poultry and cattle production) in the country, there is need for urgent and consistent increase in small ruminant production in Nigeria.

It is obvious from the past record that livestock production in sub-Saharan Africa was worth over US \$ 15 billion in 1989 (USDA, 1990). Even then, low estimates of their contribution recognize that they account for a quarter of the value of agricultural production in sub-Saharan Africa (ILCA, 1989; 1990). Small ruminants (sheep and goats) have been reported to enjoy a unique position among other domestic animals reared by man not only as meat suppliers to the teeming population, especially in the rural areas but for their contribution mainly to peasant farmers or household economy in the rural communities (Opasina, 1987; Ologun, 1991). In addition, over 90% of sheep and goats in sub-Saharan Africa which are found in East and West Africa (ILCA, 1989; 1990), provide about 30% of the meat consumed and 16% of the milk produced in this region (ILCA, 1990; Fitzugh *et al.*, 1992). It was also reported that sheep and goats constitute the main and preferred source of meat in the humid zone of West Africa (Odubote and Akinokun, 1994)

Small Ruminant Production in Nigeria

Some information on the household distribution patterns and management system of small ruminants in some areas of the humid south-west and south-eastern Nigeria are available in

literature (Mecha, 1975; Francis, 1987; * Inumorin et al, 1999). As described by these workers, small ruminant management systems in this area are mainly traditional. Animals are neither housed not tethered as they are observed roaming freely in towns and villages. These animals normally graze on roadsides, herbage and on kitchen wastes in village dumps and are rarely provided with water and veterinary care. Ownership per household varies from 2 to 10 for goats and from 2 to 9 for sheep (Mathewman, 1977; Francis, 1987; Ologun, 1991). In a rapid rural appraisal (RRA) study, Ologun (1991) presented information on the characteristics, economic importance and constraints to goat production in the farming systems of Ondo state. Also, livestock census by Resources Management Inventory (RIM, 1991) puts the goat population in Nigeria at 34.5million while a report by FAO (1993) gave the total ruminant animal population in Nigeria as shown in Table 2.1

Table 1.1 Ruminant Animal Population in Nigeria

(1000 / Head)

	1979 – 1981	1991	1992	1993
Cattle	12,066	15,140	15,700	16,316
Sheep	8,022	13,000	13,500	14,000
Goats	11,297	23,500	25,000	24,500

Source -: FAO (1993).

These figures therefore supports the assertion that Nigeria is more self-sufficient in small ruminants than in cattle as reported by Nuru (1985). The ability of small ruminants to tolerate harsh climates, the trait of trypanotolerance in some breeds, suitability for traditional systems on account of small size (Odubote, 1994); short generation interval and ability to thrive on poor quality diets provided by scarce grazing on marginal lands (Johnson et al, 1986) make them strategic in increasing livestock productivity in rural agricultural systems. Compared to other livestock animals which have some culture, religions and traditions prohibiting their consumption

such as pig (by Islam) and beef (by Indians) there is no traditions of such is against eating of goat meat. Despite these advantages, little attention has been paid to the genetic improvement of small ruminants in Nigeria until recently (Odubote et al, 1992; Ebonzoje, 1997).

1.2 RESEARCH JUSTIFICATION

The West African Dwarf (WAD) goat which is the prominent breed in Southern Nigeria has not been fully characterized for qualitative traits, notably coat type and colour, presence of wattle; horn, beard and supernumerary teats (Odubute, 1994).

It is desirable to carry out a study of the inventory and characterization of the WAD goat. This is with a view to achieving conservation and preservation of the genetic resources in this period of indiscriminate crossbreeding. There is also need to study quantitative and qualitative traits as possible indicators of genetic superiority or adaptability.

Phenotypic and genetic indices are useful in selection programmes as the interaction between genotype and environment (phenotype) largely determines the productivity of the animal. These estimates are readily available for cattle, poultry, swine and sheep (Dalton, 1985, Legates and Warwick, 1990).

Investigations of haematological values in apparently normal domestic animals have received increasing attention in recent years. There are reasons for both scientific interest and economics for attempting to establish normal haematological values for tropical animals. Haematological values are of importance in diagnosing many haemoparasitic infections in food animals and the usefulness of normal haematological values in assessing the health status of ruminants has been established (Binta *et al.*, 1996). Also, it has been reported that there is difficulty in assessing the correct health status of an animal without recourse to an examination of its blood because haematological values are of great help to the veterinarian in the diagnosis, prognosis and treatment of many diseases in the tropics. However, there are relatively few reports

on normal blood values for goats in Africa (Oduye, 1976, Aba – Adulugba and Joshua 1990). Ndamukong, (1995) also confirmed the existence of scanty information on the haemoglobin variants in Nigerian sheep and goats.

OBJECTIVES OF THE STUDY

The present project is therefore designed with a view to determining the physical body traits and some blood characteristics of West African Dwarf (WAD) goats.

The specific objectives include:

1. To determine the performance of the WAD goat using physical body measurements
2. To determine the influence of some qualitative trait and non-genetic factors (age, location and sex) on body weights and measurements
3. To determine the haematological values of WAD goats, and the factors affecting them.
4. To establish the existing relationships among body measurements and body weight of WAD goats.
5. To make appropriate recommendations based on the results of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 ORIGIN AND MORPHOLOGY OF GOAT

Goats belong to the Bovidae family of hollow – horned ruminants in the sub order Ruminantia of the Mammalian order of Artiodactyla (French, 1980). The author noted that goats and sheep (*Ovina*) which are closely-related together constitute the tribe of the Caprini and this tribe has been further subdivided into two genera: *Capra* and *Hemitragus*. Archaeological evidence suggests that the goat is one of the oldest of the domesticated farm animals and that it has been associated with man for up to 10,000 years. It is found today over a wider geographical area than any other domesticated animal [Devendra and Mc Leroy, 1992]. It was also observed that goats could survive on bushes, trees, deserts, shrubs and aromatic herbs where sheep and cattle would starve to death (Adalsteinsson, 1990.)

French, (1980) reported the following wild goats as the ancestors of most domestic goats of the present age.

***Capra aegragus:** this is the wild goat of near East Asia. It has scimitar-shaped horn with a sharp anterior keel and a few knobs interrupting it.

***Capra ibex:** the ibex of Alps, Siberia and Nubia have scimitar-shaped horns with flatten front and transversed ridges.

***Capra falcaneri:** The Markhor of central asia has sharp keeled horns that are twisted into open or tight spirals

***Capra prisca:** They have horns with a homonymous spiral which is similar to another another called *Capra dorcas*.

Other species include *Capra pyrenaica* of Spain, *Capra cylindricornis* of Asia; *Capra nireus* of Damascus.

Although the origin of domestic goats has not been conclusively established on the basis of genetic studies, it nevertheless appears from comparative morphological research, supplemented to a limited extent by data from breeding experiments that the wild Bezoar of south west Asia can be considered as the progenitor of most domestic goats. It is probable that the Markhor also contributed with the Bezoar to the generation of certain Indian and near Eastern breeds while the Abyssinian ibex was probably likewise associated with the Bezoar in the ancestry of many goats in North and East Africa (French, 1980).

It was also reported by the same author that although the shape of the horns is subjected to hereditary variation in goat, it should be noted that the sharp anterior keel and the often backward, Scimitar – like curve of domestic goats suggest the Persian wild goat, *Capra hircus* and *aegagus* as the most likely ancestor of most domestic goats. These features are found only in Bezoar wild goats. Domestic goats appear to descend from the Bezoar wild goat and domestication occurred in South West Asia. Archaeological exploration also confirmed that goats entered Africa from Asia.

They may be haired, long-haired, have curled hair, silky or coarse-wooled. They may have wattle on the neck and beards. Some breed (European) have straight noses, others have convex noses. Goats come in almost any colour, solid black, white, red, brown, spotted, two and three-coloured, blended shades, distinct facial stripes, black and white-saddled depending on breeds. Teeth in goats are good guide to age. Six lower incisors are found at birth and a set of 20 milk teeth are complete at 4 weeks consisting of eight incisors in the front of the lower jaw and 12 molars, three on each side in each jaw. Inside of incisors on the upper jaw, there is a dental pad as against the lower incisors bite and cut. The digestive tract of the goat has the typical four stomach consisting of the rumen, the reticulum, the omasum and abomasum. The total blood volume of the goat approximates 1/12 of the body weight; it takes about 14 seconds for goat blood to complete one circulation.



2.2. CLASSIFICATION OF GOAT

Classification of goats has been reported to be based on origin and physical characteristics including those connected with ears and the tails. (Devendra and McLeroy, 1992). The authors noted that this way classification reflects evolutionary trend and relates the breeds to their environment. The four major basis of classification as reported by the same workers include:

- **Ear Shape and Height:** - These parameters are more applicable to sheep than goats. Ear shape and length are not related to function and these are therefore characters of little importance.
- **Function:-** Goats have been classified in terms of their major functions which include meat, milk, fibre or skin production.
- **Body Size:** - This is the mostly widely used in the four methods. Live weight for individual breeds must be available in order to make use of this method. The dwarf goats which occur mainly in Africa can be classified separately on this basis.
- **Height at Wither:** - This method takes account of body size to divide goats into 3 groups which include:
 - **Large Breed** over 65cm, weighing 20-63kg and dual-purpose in function.
 - **Small Breed:** - 51-65cm, weighing 19-37kg and meat or milk producers.
 - **Dwarf Breed:** - Under 50cm, weighing 18-25kg and used mainly for meat production.

Moreover, the distribution of goats specific height characteristics has been studied according to the continent of recent origin (Asia, Africa, The Americas and Oceania). Within continents on a regional basis and within region on a functional basis. (Devendra and burns, 1970; French, 1980)

Tables 2.1, 2.2 and 2.3 show the classification of goats based on continent, Function, height at wither and live weight. The tables are restricted to goat breeds that are indigenous to tropical environments

Table 2.1: The classification of goats on the basis of continent, functions, live weight and height at withers of large breeds (over 65cm)

Continent	Breed	Location	Height at withers (cm)	Mature weight (kg)	Function
Asia	Angora	Turkey			Hair
West Asia	Damascus	Israel, Syria, Cyprus, South, Anatolia	61-65	25-30 55-60	Meat
India, Bangladesh, Pakistan and Sri Lanka	Barbari	North and Central Indian Pakistan	60-76	35-40	Milk
	Jamanapari	North and Central India Pakistan	78-100	65-75	Milk
	Kaghani	India Pakistan	65-75	30-36	Meat and hair
	Kashmiri	Punjan, H. Pradesh, Karshmir, India	65-80	50-60	Pashmina
	Marwari	Jodhur, India	55-65	25-30	Meat and Milk
African	Maradi	Maab, Algeria	70-83	23	Milk
North Africa		Niger	62-72	23-28	Skin and Meat
West Africa	Native Sahel	Zaire	50-60	35-40	Meat
Central Africa		West Africa	70-85	35-60	Meat and milk
	Sudanese	North Sudan	71-80	27	Milk
South Africa	Nubian				
	Shukria	West Ethiopia	70-85	40-60	Milk
		South Africa		36-46	Hair
The America	Angora	Texas, USA	63-65	34	Hair skin
North America	Moxoto	North-East Brazil		31.5	
South America					

(Source: Devendra and Burns, 1970).

Table 2.2: The classification of goats on the basis of continent, functions, live weight and height at withers of small breeds (51-65cm)

Continent	Breed	Location	Height at withers (cm)	Mature weight (kg)	Function
Asia West Asia India, Bangladesh, Pakistan and Sri Lanka China and Southeast Asia	Anatolian	Turkey	55 - 65	35 - 42	Milk, meat
	Black				Hair
	Angora	Turkey	56 - 60	29	Hair
	Kilis	Turkey	60 - 65	50 - 55	Milk
	Ganjam	Indian	55 - 60	28 - 35	Meat
	Kaghani	Pakistan	56-65	20 - 24	Meat and milk
	Katijang	Malaysia	56 - 65	23	Meat
	Katjang	Indonesia	50- 65	30	Meat
Ma T' ou	Hupeh, China	45- 65	29 -45	Meat and milk	
South China	Central China	50 -55			
Africa North - East and East Africa	Kigezi	Uganda	65	26	Milk
	Somalia	Somali	62	26	Milk
The Americas Central America and the Caribbean S. America	Criollo	West Indies, Latin America	50 - 65	34	Meat
	Moxoto	North - East Brazil	62	31	Meat and milk
Oceania Fiji	Fiji	Fiji	58 - 66	20 - 25	Meat

(Source: Devendra and Burns, 1970)

Table 2.3: The classification of goats on the basis of continent, functions, live weight and height at withers of Dwarf breeds (under 50cm)

Continent	Breed	Location	Height at withers (cm)	Mature weight (kg)	Function	
Asia India, Bangladesh, Pakistan and Sri Lanka	Bengal	East Bengal (Pakistan), North Bangladesh	45-50	9	Meat	
		East Bengal (India)		13-22	Meat	
	South China	Kwantung and Yunnan, China	50	25	Meat	
Africa North - East and East Africa	South Sudan (Yei variety)	Sudan	40-50	11	Meat	
	East African Congo Dwarf	East African	50	25	Meat	
	West Africa	Kosi, West African Dwarf	Upper Nile, Uganda, Zaire	45-50	25-30	Meat
			Cameroon, Ghana Fouta Djallon, Guinea	45-50 40-50	15-21 18-20	Meat Meat Meat Meat

(Source: Devendra and Burns, 1970)

2.3 BREEDS OF GOATS

2.3.1 EXOTIC BREEDS OF GOATS

Domestic goat breeds are many. Swiss breeds are distinguished by milk production and have significantly milk production when compared with others. A few breed kept mostly for meat are the south Africa Boer goats, the Indian brecal, black Bengal, the Latin American Criollo and most of the small goat (WAD goat). Fibre- producing goat breeds are the Angora in Turkey, USA, South Africa, the cashmere in Afghanistan, Iran Australian and China and Dan breed in Russia.

*Anglo – Nubian

The coat colour may be a mixture of roan and white. It has long legs and a curved nose. It is of dual purpose for milk and meat production. It originated in England and of two distinct types: the long pendulous ears and roman nose. The breed yield less than Saanen but the milk has higher butterfat content. It is a large strong goat weighing around 60 – 75kg .

*Saanen

It originated from Switzerland. The Saanen is a small, white or pale fawn, the ears are erect and point forward. It is world-leading milk producer preferred for its odour-free milk. It is usually polled and weighing around 50 – 60kg.

* Jamnapari

It may be white, black or fawn in colour. The ears are large and lopped the female weigh 45 – 60kg. They are horned and may produce some 1.0 – 1.5 litres of milk per day. The breed originated from India .

* Alpine

It may be horned or hornless short tail and strong as the Saanen with usually shades of white into black with white facial stripes on black. They are second in milk production to Saanen and Toggenburg .

* **Toggenburg**

It is brown with white facial ear and leg stripes, straight nosed, horned or hornless. It is mostly short haired, erect eared and reliable milk producer both in temperate and tropical zones.

2.3.2 BREEDS OF GOATS IN NIGERIA

* **Red Sokoto**

It is the otherwise known as Maradi. It is most important breed in the North and is widely distributed in Nigeria. It is up to about 17.3million in Nigeria. It has uniform dark red colour and found in the Sokoto province of Nigeria and also in Niger. The breed is intermediate in size between the long-legged goats and the West African Dwarf goats. The height at wither is 65cm and it is well adopted to the arid zones. Both sexes are horned. The average weight of an adult male is 25kg while that of female is 20kg. The average litter size of the breed in Nigeria is 1.5kg. (Gall, 1996).

* **West African Long Legged**

These goats are long-legged, medium to large size and are found in arid regions in the North of West African, where rainfall is low and sparse vegetation. They do not adopt to humid conditions hence they are referred to as desert goats. The coat is short and the covering hair is fine. It is a Fulani breed kept for milk and meat. Ears are short with horizontal, twisted thin horn. Coat colour ranges from black, tarn, brown and white (Gall, 1996).

2.3.3 West African Dwarf goats

Geographical Distribution of WAD goats: These are found in West and Central African and are believed to be brought from East and North East; particularly Somarlia where similar dwarf are also found. They were indigenous to the forest and derived Savanna Zone of West African and

are well adapted to humid zone. Dwarf goats are present in all humid Africa from the southern Sudan to the West coast.

Conformation of WAD goats : Two types of dwarf goats are recognized: the more common proportionate dwarfing (pituitary hypoplasia) where the head, trunk and legs are all reduced in size and disproportionate dwarfing (achondroplasi)] where the legs are stunted and often bent in relation to the trunk. Both types of dwarfing occur as a result of genetic factors affecting growth and metabolic rate (Devendran and McLeroy,1992) The scientific name of WAD goat is *Capra reversa* and believed to have descended from the ancestral Persia *Capra hircus* which was first introduced into Egypt from Syria.

WAD goats are stocky with short legs and short and wide head. The face is straight or slightly concave. Ears are medium – sized, carried erectly or horizontal. Horns vary; they may be fairly developed, twisted out and backward in the male, but they are more slender in the female. Poled animals occur. Hair is short. Colour varies: The most common is fawn with black face, legs, belling and back stripe but black, red and white animals are frequent as well as pied and multi-coloured ones. There seems to be a tendency for dark or black and white goats to be more common in the forest area while fawn and colours predominate in the savanna area, become lighter toward the Northern dryer area (Gall, 1996).

Strains and Special Features of WAD goats: A breed with average height at withers below or 50cm has been classified as dwarf goat (Gall, 1996) the most important characteristics of WAD goats is their tolerance to trypanosomosis

The (WAD) goats tend to be smaller towards the South and some what taller towards the Northern dryer areas. Strains of WAD goats include Cameroon, Nigeria, Ghana, Liberia Dwarf or the Dwarf Congo, Fouta Djallon, Guinean or Forest Dwarf and Kirdi (Southern Chad).

General Information and Uses of WAD goats: In 15 Countries of the West humid zone, 38 percent of about 38 millions goats are considered to belong to the WAD (Gall, 1996).

Though goats are generally dual purposes animals yielding milk and meat, the West African Dwarf goats (short-legged) are not milk animals. They are raised solely for their much valued meat considered to be of superior quality to that of standard goats, they contribute substantially to meat production and hence to the economy of West Africa. (Kamalu *et al.*, 1988). From literature, it appears that the terms, dwarf goats, pygmy goats and miniature goats are synonymous and interchangeable.

They have the ability to live under the most diverse conditions of natural habitat and flexible integration into dissimilar socio- economic situation. This adaptability is due to certain definite physiological characteristics, which include ability to acclimatize, feed uptake and digestive capacity, fertility and diverse tolerance. Some advantages compared with cattle are: small investment and labour cost per animal ,lower mortality risk , shorter period to maturity while the Disadvantages include higher investment and labour cost per kilogram body weight of animal and a lower dressed carcass weight per kilogram body weight. However, the characteristic of West African Dwarf goats has not been well established and their potential for milk production is low (Gall, 1996;).

2.4 LINEAR BODY MEASUREMENT IN GOAT

In recent times, studies on linear body measurements of livestock have attracted attention (Chineke, 2003). Information on live body measurements on farm animals are available in literature; in cattle (Gilbet *et al.*, 1993), sheep (Sharples and Dumelow, 1990; searle *et al.*,1989 a, b; Taiwo and Odusanya, 2001) pigs (Tegbe and Olorunju, 1986) and poultry (Chambers and fortin, 1984; Monsi, 1992). Ozoje and Herbert (1997) and Otoma *et al.*, (1999) reported on the

linear body measurements of goats. They reported that linear body measurement has been used severally in goat to characterize breed, evaluate breeds performance and predict live weight gain. It has also been used to study the effect of crossbreeding and as a criterion for selecting replacement animals and evaluating breed under controlled environment. These measurements taken on live animals have been used extensively for a variety of reasons in both experimental work and in practice (Lawrence and Fowler, 1997). Chineke (2003) stressed further that the relationships existing among linear body traits provide useful information on performance, productivity and carcass characteristics.

Body weight is subject to short term changes imposed by various natural processes of production such as management system, apart from considering variation in endomorphic, mesomorphic and ectomorphic structures, it is affected by management system, pregnancy and seasonal changes and therefore allows comparison of growth in different parts of the body (Chineke,2003).

Height at wither at any age reflects animal skeletal size while shoulder width, pouch girth and heart girth reflect body condition and are better indicators of live weights and condition score than height at wither (Adebambo, 2000). The scrotal circumference as a measurement of testicular size has been reported to be positively correlated to age, body weight and the right and left scrotal lengths in red sokoto goats. The same author also confirmed that the letter size, sex and parity has no significant influence on kid body measurement at birth but they were significantly affected at 3 months, heart girth and body length of singles were significantly affected and were bigger and longer than those of triplets. It has been reported that WAD goats weighing between 15 -20kg was 45- 50cm high at withers , while Jamnapari goat weighing between 65-75kg was 78-100cm high at withers (Devendra and,McLeroy,1992). This also agrees with the earlier report of some workers.(Devendra and Burns;1970.).

2.5 ECONOMICS TRAITS IN GOATS.

It has been confirmed that selection based on the economic traits of WAD goat has not been done because of small herd size, poor management system practiced by most WAD goat farmers, lack of adequate recorded and empirical data (Odule, 1976). However, there are few reports from authors on some economic traits of WAD goats (Sponenberg *et al.*, 1988, ; Adu *et al.* 1979 Odubote, and Akinokun, 1994). The coat colour and the polled traits appear to be the most studied of the qualitative traits. The genetic basis of some of these traits have been enunciated for the temperature breeds and species (Odubote, 1994).

2.5.1 Coat Type and Colour

The coat type is thought to have effect on thermo – regulation while coat colour is likely to influence radiant heat lost (Osinowo *et al.*, 1988). This point to the fact that coat type and colour may likely exert influence on body weight. Thus, it could be concluded from literature that factors such as specie, breed, geographical location and coat type do exert influence on performance.

The absorption of heat is directly related to the degree of pigmentation. The coloured animals are likely to predisposed to higher heat load. This excess heat load must be eliminated for the animal to be in a thermal balance state and this will involve energy which could have been toward production (Odubote, 1994). Osinowo *et al.*, (1988) also reported a tendency for weaning weight to increase with the degree of colouration in Yankasa lamb. They also reported that weaning and yearling weight decrease with degree of colouration. He stressed that the preponderant coat colour, black in WAD goat may be an adaptation to the humid tropics in contrast with the brown and white predominantly found in Red Sokoto and Sahel goats respectively of the arid zones. However, the black coat colour predisposes goat to high heat load probably high metabolic rate and increased thyroid activities.

Odubote (1994) studied the influence of coat colour on body weight in WAD goats and reported that body weight increases with decrease in the degree of pigmentation. In WAD goat, the hair type is necessary and advantageous as it permits conventional heat loss from the animal surface in hot environment. (Odubote, 1994). He also noted that suppression of pigmentation led to an increase in wool growth rate. When heat loss is difficult, it is not surprising to observe that animals of small stature are found in warm humid zones. All the goats examined by Odubote (1994) have short and straight hair coat type. The hair according to him, was however longer in the breeding males extending from the mare to the trail region along the longitudinal line at the back. He recorded in his study that body hair ranged from 2.0 to 4.5cm with a mean of 2.9 ± 0.8 cm ($n=15$). The ruff on basket of male is between 7.0 and 16.0cm in length with a mean of 10.9 ± 3.3 cm ($n=10$).

Some authors reported variation in coat colour and stressed that the coat colour was very variable, includes white, black, brown, pied and mixed colours while some animals were found to be spotted and other were speckled (Osinowo *et al.*, 1988, Odubote, 1994). It was also reported that there were no sex difference found for coat pigmentation (Odubote, 1994).

Ryder (1980) in his own study had earlier reviewed coat colour in sheep and concluded that four loci are involved, namely A, B, S and E loci with the C locus as pigmentation inhibitors. The different shades and colours were also attributed to variations in the size, density and distribution of the pigment granules. Adalstiensson (1990) recently described 11 gene loci, some interacting while some with multiple alleles that affect coat colour in sheep. Odubote (1994) also reported that further grouping of goat colour into the three major colours viz basic black white and brown (specified by Ryder, 1980) gave proportions of 53.3%, 6.8% and 39.9% respectively. He stressed that the predominant colour was black, which might due to the humid tropics in contrast with the brown and white predominantly found in the Red Sokoto and Sahel goats respectively of the arid sahel zone.

Moreover, the mode of inheritance of coat colour is very complex as have been noted by Ryder (1980) and Osinowo *et al.*, (1988). Odubote (1994) stressed further that attempts at fitting data into a two or three allele single locus genic model were not successful.

2.5.1.2 POLLED TRAIT AND BEARDEDNESS.

Recordcau (1981) reported that polled trait is caused by an autosomal dominant gene that has a marked difference in expressivity between sexes. However, most of the WAD goats examined by many authors were horned irrespective of the sex (Wilson, 1991, Odubote, 1994). They reported that horns curled outwards and backwards in males while they were sharp, upwards and backward pointing in the females. Beard has been observed as a common phenomenon with adult breeding bucks (Odubote, 1994). The author reported that 80% of the males in his study exhibited the characteristic. He affirmed that possession of beard is a secondary sexual characteristic and is under male hormones. The beard has threshold levels of androgenic hormones. The beard observed in his study measure between 5.0cm and 10.0cm with a mean of $7.4\text{cm} \pm 3.2\text{ cm}$ (n=8) in the females while it was between 8.0 and 14.0cm with a mean of $9.2 \pm 2.7\text{cm}$ (n=12) in the males. Legates and Warwick (1990) reported that the gene for polledness in some breeds of goats is associated with a form of inter-sexuality and cryptorchidism.

2.5.1.3 WATTLES AND TEATS

Wilson (1991) and Odubote (1994) reported that the colour of the wattle is usually the predominant coat colour, about two third of the WAD goats under observation possess the wattle and expression of the trait could be bilateral or unilateral (on the left or right side of the ear). They also reported that the ear appendage varied from a length of 1.5cm to 4.5cm. The unilateral expression was about 6.2% which was much lower than bilateral expression (Odubote, 1994). He added that there was no sex difference in the incidence of wattle. However, he suggested that the

mode of inheritance of wattles in goats is simply single locus with complete or incomplete dominance as earlier reported by Casu *et al.* (1970) and Osinowo *et al.* (1988). He observed that there might be additional modifying gene locus that is epistatic or it might be a case of multiple alleles at a single locus. Shongjia *et al.* (1992) reported that litter size and milk yield of wattled Sannen does were significantly higher than for non-wattled does.

Most of the female goats studied by some author (Mason, 1984, and Odubote, 1994) had a pair of teats each. However, there are very few goats with 3 (supernumerary teats in the flock). Due to the low level of incidence it was suggested that it might be due to mutation.

2.6 MORPHOLOGY AND BIOFUNCTION OF BLOOD IN CAPRINE

Blood is the specialized connective tissue within the vascular systems of animals which transports oxygen, heat, nutrients, waste products of metabolism, hormones, enzymes and immune bodies within the body (Baker and silverton, 1982). It also helps in the maintenance of a constant concentration of water and electrolytes in the cells, regulation of the body's hydrogen ion concentration and defends against microbial invasion (Bxeazile *et al.*, 1971). Essentially blood consists of plasma (a mixture of serum and fibrinogen), a fluid medium in which are suspended erythrocytes, leukocytes and thrombocytes. Plasma is a complete solution of proteins, salts and numerous metabolites.

2.6.1 BLOOD CELL

Blood cells are essentially of three distinct types -erythrocytes, leucocytes and thrombocytes. They are classified according to biogenesis, sundry morphological characteristics (such as colour, size, shape) and biological functions. It has been well postulated that primitive undifferentiated. Pluripotent stem cells in the bone marrow give rise to unipotent cells, each committed to the formation of the blood cell series (Baker and Silverton, 1982). Erythrocytes or red cells derive their red colour from the presence of haemoglobin (the haemo containing oxygen-

carrying pigment attached to erythrocytes). They are non nucleated, pale greenish yellow biconcave discs under the microscope.

Goats have been shown to have the smallest red blood cells among the domestic animals (Schalm *et al.*, 1975). They stressed that erythropoietin (EP) hormone induces erythroid stem cells to develop into erythroblasts and eventually into erythrocytes. Atmospheric or anaemic hypoxia increases erythropoiesis by increasing EP production and hyperoxia decreases it in a reverse manner.

Leukocytes includes all white blood cells and their precursors. They are nucleated, some of which are capable of amoeboid movement and are present in blood in smaller numbers than red blood cells. Remanowsky staining differentiates Leukocytes into granulocytes and agranulocytes of a constant concentration of water and electrolytes in the cells, granulocytes consists of neutrophils, eosinophils and basophils while agranulocytes are made up of lymphocytes and monocytes. Each granulocyte type is formed independently precursor - wise, as have been shown through early identification of granule structure (Dellman 1971). The lymphocytes are functionally grouped into thymus - dependent or T - cells concerned with cellular immunity and bursa - equivalent or B - cells concerned with humoral antibody formation. In addition, lymphocytes possess on their surface histocompatibility antigens and receptors for complements (Schalm *et al.*, 1975).

Furthermore, lymphocytes may be involved in the production of plasma protein and the globulins of blood plasma particularly gamma - and beta - globulins which are derived, in part from lymphocyte. Monocytes are now known to be derived chiefly if not solely from stem cells in the marrow and migrate into tissues to become macrophages. They are the largest white blood cells in the bone marrow and migrate into tissues to become macrophages. They are the largest white blood cells and have the ability to ingest bacteria and other particulate matter, thereby acting as scavenger cells at the site of infection (Baker and Silverton, 1982). The thrombocytes (or

platelets) appear as small, non-nucleated oval or rough surface helping to form a physical barrier, preventing bleeding and subsequently releasing blood-clotting factors.

2.6.2 BLOOD PROTEINS

There are very many types of blood proteins, which are of varying concentrations and functional importance. A few of the most important ones are briefly reviewed.

2.6.2.1 PREALBUMIN AND RETINOL -BINDING PROTEIN

Prealbumin (PA) M.W. 54000 and retinal-binding protein (RBP) M.W.21000 are both synthesized by the liver (Silverman *et al.*, 1986). Measurement of their serum levels may provide a more timely and sensitive assessment of albumin. Both PA and RBP are transport proteins. PA binds thyroxine and triiodothyronine, the latter to a lesser extent. RBP in the form of a 1:1 complex with PA transports vitamin A (retinol). Decreases or increases of their levels are associated with disease conditions ranging from malignant conditions to liver disease and protein malnutrition (Sternbery, 1977).

2.6.2.2 ALBUMIN

Albumin is the most abundant plasma protein (Schalm *et al.*, 1975). Its molecular weight of 66000 helps its retention by the capillaries. Its chief biological functions are to regulate the partition of water between intra to extra vascular components, determine the colloidal osmotic pressure of the blood (Duke, 1970), transport and store a wide range of ligands and act as a source of endogenous amino acids (Silverman *et al.*, 1986). Among the substances transported are free fatty acids bilirubin, porphyrins, ketosteroids, drugs such as penicillin, aspirin and the barbiturates, histamine and cations such as zinc, copper and calcium.

2.6.2.3 GLYCOPROTEINS

These are proteins conjugated with carbohydrates. All the electrophoretic fractions of serum except album contain carbohydrates. These include gamma-globulin, ceruloplasmin, haptoglobin, 2-microglobulin and *d1 - acid mucoprotein or seromucoid and transferrin. They possess diverse functions, for instance ceruloplasmin from *d2 - globulin fraction is the principal copper transporting protein binding 90 - 95% of the blood copper (Frieden, 1981).

2.6.2.4 LIPOPROTEINS

The d* - and B -lipoprotein fractions function in the transport of glycerides cholesterol and its esters. Phospholipids and other fat soluble materials in the blood (Schalm et; 1975).

2.6.2.5 IMMUNOGLOBULINS

Immunoglobulins (Igs) are unique in their heterogeneity in their sites of synthesis and the fact that their synthesis is an adaptive response to antigenic stimulation, they represent the antigenic history of the animal (Silverman et al ., 1975). IgE, IgA and IgM are further subdivided based on the structure, configuration and function of the heavy and light chains of the immunoglobulin molecules

2.6.2.5 HAEMOGLOBIN

Haemoglobin is a spheroidal protein with m.w. of 64456. It is a conjugated protein with pairs of identical subunits; each is the site of oxygen uptake and release (Schalm et al ., 1975). It was expanded further that each of the polypeptide chain is controlled by a distinct genetic locus. Mutations in these are reflected in the haemoglobin. The quantity and type of globin polypeptide chain synthesized appears to be influenced by genetics, non-genetic and environmental factors.

Investigation of the electrophoretic mobility of haemoglobin and finger printing of polypeptide chains have led to the elucidation of the chemical and steric structure of the globin molecules. Differences in the amino acid and sequence of the globin molecules are responsible for phylogenetic and intra species differences in adult hemoglobin, differences between embryonic, foetal and adult forms within a species and heterogeneity within an individual (Kitchen, 1969).

2.7.9 FACTORS AFFECTING BLOOD COMPONENTS IN FARM ANIMALS PARTICULARLY IN GOATS.

The haematology of the goat is generally similar to what obtains in sheep and cattle, with the main exception of the size of the erythrocytes. Several factors affecting blood values especially in the goat are discussed in the following subsections.

2.7.9.1 BREED

Variations in blood values can be due to between and within breed effects in animals (Oduye, 1976, Aba-Adulugba and Joshua, 1990). These authors explained that the difficulty in studying breed differences in blood composition is due to variation from herd to herd or flock to flock; so that identical conditions are necessary for proper evaluation to avoid interactions of these factors. Aba - Adulugba and Joshua (1990), reported somewhat lower blood values for WAD goats among five breeds studied and they found no significant breed differences. Somvanshi *et al* . (1987) in attempting to explain the lower blood values in Indian goats as compared to European and American breeds, attributed them to breed difference. Furthermore, Uanian and Felincians - Silva (1984) also reported highly significant breed effects for blood zinc and copper in several Brazilian goat breeds. Studies on inherited blood disorders in blood composition in sheep and in cattle suggest overwhelming evidence for breed differences in blood traits in farm animals.


2.7.9.2 AGE

Results of studies on effects of age on blood traits have not been consistent. Aba – Adulugba and Joshua (1990) reported significantly lower blood values due to age in five Nigerian goat breeds earlier on, rapid increase after birth for mean erythrocyte counts and then stability, at about 3 year of age had been observed in goats (Holman and dew , 1964,). Also, Hoversland *et al* .. (1974) reported a steady rise in serum protein level as the age of pygmy goats (similar to WAD) rose from 2 to 22 weeks . However, in Nigerian goats, Oduye and Adadevoh (1976) and Akerejola (1977) did not find any age differences for some blood traits. Similarly , Somvanshi *et al* .. (1987) reported a lack of age difference in Pashmina goats of India. This was further confirmed in Ethiopian highland sheep by Otesile and Kasali (1992) that age generally had no effect on some blood traits except that young sheep of less than four months had significantly lower total blood protein and immunoglobulin concentration than other age groups.

2.7.9.3 SEX

Validya *et al* .. (1970) observed significantly greater values of both erythrocyte count and hamoglobin in male than female goats in India. Also, it was earlier reported that after three months of age, males goats had higher erythrocyte counts than females although packed cell volume and haemoglobin concentration remained the same because of the smaller size of the male erythrocytes(Holman and Dew, 1966). However, the general consensus of more recent work is that sex effect is not significant (Akerejola, 1977, Somvanshi *et al* .. 1987. Aba- Adulugba and Joshua, 1990; Otesile and Kasali (1992).

2.7.9.4 ENVIRONMENT AND MANAGEMENT



Haematological values have been reported to depend on the locality and environmental conditions of animals (Oyewale and Olowokorun, 1986). This agrees with the report of Olusanya (1977) that PCV, Hb concentration and erythrocyte counts were higher in White Fulani cattle during the relative dry months of the year than the wet month. This was attributed to changes in the water content of serum since body water content would decrease with decrease in water intake during the dry months resulting in haemo concentration. However, it was observed that haematological parameters did not change remarkably between normal and deprived Yankassa sheep in the hot dry weather of Northern Nigeria (Igbokwe and Abodunrin, 1990). The effects of climatic variation on blood values in farm animals have been studied. However, some authors confirmed variation in haematological values of farm animals with different environments (Oyewale & Olowokorun, 1986). Also, Oyewale and Olowokorun (1986) emphasise how greatly the blood picture of goats alters with different families and with environments. They reported differences in Haematological values of West African Dwarf goats due to diurnal variation.

Management as expressed by handling leading to excitation, apprehension and exercise are known to increase values for total red blood count, PCV and Hb content. This has been attributed to the effect of specific contraction and release of erythrocytes into the peripheral circulation (Cole 1974).

2.7.9.5 PATHOLOGICAL STATUS

Disease and infections increase or decrease blood values. These abnormal conditions include generalized infections, localized infections, intoxications including those caused by metabolic disturbances, chemicals, drugs and venoms, associations with rapidly-growing neoplasms, acute haemorrhage, sudden haemolysis of red cells, leukaemia and trauma (Coles, 1974).

Haemoparasites exert the most detrimental effect on blood values as they affect the blood-forming system. The most significant include *Trypanosoma* spp, *Eperythrozoon* spp, *Schistosoma* spp, *Babesia* Spp, And *Anapalsma* spp (Jagon et al., 1984) Opasina, 1987). Gastro- intestinal worms of importance include *Strongyloids* spp, *Haemonchus* spp; *Ostergia circuncinta* and *Oesophagostomium columbianum* (Jensen and Brinton, 1982. Opasina, 1987). Ogunsusi (1978) reported that both acute and chronic helminthiases in sheep caused decline in PCV, Hb, conc. and red blood cell values. This confirmed the earlier report of Sykes and Coops(1974) that *Haemonchus contortus* causes blood loss through the piercing of the mucosal wall with its lancet, leading to anaemia.

In trypanosomiasis infection, which is one of the most prevalent and most studied disease of ruminants, a vast array of blood changes has been documented. Anaemia elevated plasma volumes in sheep and goats, Lymphopenia in sheep and monocytosis in sheep and goats (Anosa and Isoun, 1980). Other blood changes due trypanosomiasis are increased total serum protein levels in goats .

2.7.9.6 NUTRITION

Igbokwe and Abodunrin(1990) reported that PCV, Hb concentrations and total blood protein were depressed during mid and final periods of low and medium planes of nutrition compared to high plane of nutrition in Zebu bulls. Similarly it was observed by them that PCV and Hb concentration were also reduced with low protein in the diet of Yankasa sheep. This they attributed to protein deficiency depriving haematopoietic organs of amino acids necessary for cell formation and haemoglobin production.

2.8 HAEMATOLOGICAL STUDIES IN GOATS

Some reports in the literature dealt with the haematological parameters of normal goat in the temperate climates (Binta *et al.*, 1996). They compared the values of some breeds while some authors reported on haematological values of WAD goat (Aba-Adulugba and Joshua, 1990; Ndamukong, 1995, Binta *et al.* 1996). In more recent studies some worker reported on haematological values of Nigerian goats (Aba-Adulugba and Joshua, 1990; Ndamukong, 1995; Binta *et al.*, 1996; Imumorin *et al.*, 1999). They reported that Nigerian goats had higher WBC counts than the breeds in temperate climate. The report in table 2.5 shows the mean values of Hb, PCV, WBC, RBC and erythrocytic indices of five Nigerian breeds as observed by Aba-Adulugba and Joshua (1990).

The results confirmed that the haematological indices of Nigerian breeds were similar and highest WBC counts were observed in WAD goats than other Nigerian breeds. This report agreed with observations of other workers (Oduye, 1976; Imumorin *et al.*, 1999). The hemoglobin values of Nigerian goats were considerably lower than those reported in temperate regions of the world. Imumorin *et al.*, (1999) in their study observed that haemoglobin value of WAD and Red Sokoto breeds were lower than Spanish goat breeds and confirmed higher values of haemoglobin concentration for WAD goats than that of Red Sokoto breed.

Table 2.4: Haematological studies in five indigenous breeds of goats in Nigeria

Breeds of goats	Number of blood samples examined	PCV (%)	Hb(mg/dl)	WBC (10^3)	RBC (10^6)	MCV(fl)	MCH (pg)	MCHC (g/dl)
Sokoto Red	124	28.14 ± 5.48	9.95 ^b ± 1.56	9.21 ^f g ± 4.56	1.17 ^d ± 1.73	35.77 ^e ± 7.18	11.75 ^f ± 1.98	32.55 ^e ± 5.16
Kano Brown	45	28.86 ^a ± 4.25	9.68 ^b ± 1.73	10.6 ^f g ± 4.56	8.79 ^d ± 1.73	33.26 ^e ± 7.18	10.77 ^f ± 1.98	33.39 ^e ± 3.99
Salla	28	29.31 ^a ± 4.8	9.21 ^b ± 1.41	8.4 ^f 1g ± 3.06	8.01 ^d ± 1.72	38.38 ^e ± 6.18	11.63 ^f	31.31 ^e ± 4.92
Bororo White	7	28.33 ^a ± 4.56	9.23 ^b ± 1.68	6.99 ^f g ± 2.4	7.72 ^d ± 1.8	36.37 ^e ± 6.37	12.17 ^f ± 2.69	32.33 ^e ± 3.37
West African Dwarf(WAD)	6	23.67 ^a ± 5.8	7.73 ^b ± 1.88	13.48 ^f g ± 6.37	7.09 ^d ± 2.06	34.33 ^e ± 5.88	11.0 ^f ± 2.3	32.67 ^e ± 3.25

Figure with the same superscript indicate no statistically significantly difference: i.e. $p > 0.05$

Source: *Aba - Adulugba and Jacob (1990)*

CHAPTER THREE

MATERIAL AND METHOD

3.1 ANIMALS AND THEIR MANAGEMENT

A total number of two hundred West African Dwarf goats (32 males and 168 females) with age ranging between 1 to 6 years were used in this study. The experimental animals were selected randomly from six towns of South-Western Nigeria.

The management system in the selected area of study was mainly traditional whereby goats were allowed to graze on roadsides, herbage and kitchen wastes in village dump and rarely provided with supplementary feed and water. Some of the farmers provided shelters for their animals in the late evening, while others allowed them to return to the household in the evening and spent the night on the pavements, around kitchens or on platforms. About 60% of the available goats population were sampled in each location.

3.2 STUDY AREA

The study was carried out at 6 towns within four states (Ekiti, Ondo, Osun, Oyo) located in the humid zone of southwestern Nigeria. The towns include Igbara-Odo ($7^{\circ} 22' N, 5^{\circ} 10' E$) and Ogotun-Ekiti ($7^{\circ} 24' N, 5^{\circ} 12' E$) in Ekiti State; Akure ($7^{\circ} 15' N, 5^{\circ} 15' E$) in Ondo State; Ejigbo ($7^{\circ} 50' N, 4^{\circ} 17' E$) and Ede ($7^{\circ} 40' N, 4^{\circ} 24' E$) in Osun State; and Ibadan ($7^{\circ} 22' N, 3^{\circ} 8' E$) in Oyo State.

The study areas are characterized by heavy rainfall between March and October followed by a dry season from November to February. They are largely made up of a rainforest with rainfall ranging between 1200 and 1350mm annually. A warm humid climate prevails with relative humidity between 70% and 90% and temperature ranging between $27^{\circ}C$ and $32^{\circ}C$ for most of the year.

3.3 DATA COLLECTION S

3.3.1 Body Measurements

Individual animal body weight was taking using weighing balance while the linear body measurements of each goat were taken using tailor tape rule. The linear body measurements recorded in this study included body length (BL), chest girth (CG), height at girth (HG), height at wither (HW), leg length (LL), shoulder to tail length (STL), nose to shoulder length (NL), tail length (TL) and ear length (EL).

The description of the measurements were as follows:

Body length :- the distance from the external occipital protuberance to the base of the tail.

Chest girth :- measured as the circumference of the chest behind the fore legs.

Height at wither :- measured on the dorsal midline at the highest point on the withers

Leg length :- the distance from the tip of the hoof to the hip

Shoulder to tail length :- The distance from the point of shoulder to pin bone or to the end of occygeal vertebrae.

Nose to shoulder length :- Measured the distance from the nose to the tip of the shoulder.

Tail length :-The distance from the base of the attachment of the tail to the end of occygeal vertebrae.

Ear length :- The distance from the base of the attachment of the ear to the head of the ear.

3.3.2 QUALITATIVE TRAITS

Each goat was described for coat type and pigmentation presence or absence of horns, beard, wattles and teat number. The descriptor list for goats as compiled by FAO (1993) was adopted after necessary modification for the coat type and pigmentation. The wattles were either absent or

present, while horns were also treated for presence and absence. Teats were checked for supernumerary teats.

3.3.3 BLOOD SAMPLES

Each goat was bled from the jugular vein and blood was collected in two sample bottles and one of the bottles contained EDTA (Ethylene diamine tetra acetic) as anti coagulants with a concentration of 1mg per ml of blood. The second bottle contained no anticoagulant from which serum was separated and stored at -20°C until assay. Blood sample of about 10 – 15ml per individual animal was collected and preserved by refrigeration until laboratory analyses.

3.4.1

LABORATORY ANALYSES

3.4.1 PACKED CELL VOLUME DETERMINATION

Blood samples are filled into capillary tubes by capillary action to about 75% of its length and the outside of the tubes dried using cotton wool. One end of the capillary tube was sealed with special clay material and then the tube was placed in a haematocrit microcentrifuge and spun for five minutes at 12,000 r.p.m. The spun micro – haematocrit tube was then placed on the micro – haematocrit tube reader to determine the packed cell volume in a percentage (%) of the total volume of blood.

3.4.2 Haemoglobin Determination:

Sahilis acid haematic method (Kelly, 1979; Baker and Silverton, 1982) was used to estimate the haemoglobin concentration. 0.02ml of blood was added to the dilution tube containing freshly prepared 0.1 MHCL up to mark 20 calibration on the tube, then rinsed for up

three times in the solution, following which the solution was thoroughly mixed. The tube was allowed to stand for five to ten minutes to allow for colour intensity to develop. Distilled water was added in drops with mixing at each dilution until the colour matched that of the standard. The readings were taken with haemoglobinometre and calculation is made with the correction factors considered for the instrument. The instrument has 100% equivalent of 14gm per 100ml of blood, and the formular used was:-

$$M\% = \frac{M(14)\text{gm}}{100 \text{ haemoglobin/ per } 100\text{ml of blood}}$$

where M represents value read from calibration.

3.4.3 Total Erythrocyte Counts:

The enumeration of total erythrocyte was done by haematocytometry method described by Lamb (1981). The count is performed with the aid of improved Neubauer counting chamber, Red cell pipette (bulb type), Red cell diluting fluid containing 3.0g of sodium citrate, 1.0ml of formaldehyde and 100ml of distilled water. The blood samples were diluted with the diluting fluid in ratio of 1:200.

After dilution, the chamber was filled with the diluted blood sample, which was then allowed to stand for one minute prior to counting under x40 of a microscope. The number of cells per area blood was calculated by multiplying the number of cells counted by those correction factors. These factors took into consideration the area of the slide counted, the depth of the dilution and the level of dilution of the blood. The area counted was 0.2sq cm, while the depth of the dilution and the degrees of blood dilution were 0.1mm and 1:200 respectively. The cell/mm³ was calculated thus:

$$\text{Number of cell counted} \times \frac{5}{\text{Xi}} \times \frac{10}{\text{Xii}} \times \frac{200}{\text{Xiii}} = \text{cells/mm}^3$$

3.4.4 Erythrocyte indices:

These values are obtained by calculation described by Schalm (1975). The packed cell volume of the haematocrit, the number of the erythrocytes of blood, and the haemoglobin concentration in g/dl are the basic data used for the calculation.

3.4.4.1 Mean Corpuscular Volume (MCV):

MCV was obtained by dividing the volume of packed red cell by 100ml of blood by the total red cell count in millions per microlitre. The unit is expressed in fesolitres (fl)

$$\text{i.e } \text{MCV} = \frac{\text{PCV} \times 10}{\text{RBC}} = \text{"X"} \text{ FL}$$

3.4.4.2 Mean Corpuscular Haemoglobin (MCH)

Haemoglobin concentration in grams per 100ml is divided by the total erythrocyte count in millions per microlitre. The unit is expressed in pictogram (pg)

$$\text{i.e } \text{MCH} = \frac{\text{Hb} \times 10}{\text{RBC}} = \text{"W"} \text{ pg}$$

3.4.4.3 Mean Corpuscular Haemoglobin Concentration (MCHC):

Haemoglobin concentration in grams per 10.00 (dl) of blood is divided by the volume of PCV per 100ml of blood. The unit is expressed in grams per deciliter (g/dl)

$$\text{i.e } \text{MCHC} = \frac{\text{Hb} \times 100}{\text{PCV}} = \text{"Z"} \text{ gm/dl}$$

3.4.5 Total Leucocyte Counts:

The same method was used as in red cell count except that the fluid contained 3ml acetic acid, 0.3ml of 0.5% crystal violet and 97ml of distilled water. The dilution is in the ratio of 1:20. After the dilution, the counting was made and calculation was done using the formular

$$\text{Number of cells counted} \times \frac{0.25}{a} \times \frac{10}{b} \times \frac{20}{c} = \text{cell mm}^3$$

where a = correction factor as 4.sq.mm area was counted

b = correction factor as depth = 0.1mm

c = correction factor as blood dilution = 1:20

3.4.6 ASSAYS FOR TOTAL SERUM PROTEIN AND SERUM ALBUMIN/ GLOBULIN

Serum analyses which included estimation of total protein, albumin and globulin was conducted using standard method described by Lamb (1981)

3.4.6.1 Assay for Total Serum Protein.

The stock biuret solution was prepared by dissolving 45g of sodium potassium tartrate in 400ml of 0.2M NaOH, 15g of CuSO₄ was added and the whole mixture made up to 1 litre with 0.2M NaOH. Biuret test reagent was prepared by diluting 10 ml of stock biuret reagent to 50 ml with 0.2 M NaOH containing 0.5% potassium iodide. Standard protein solution was prepared by dissolving 0.1 g of bovine albumin in 100ml of isotonic NaCl (0.9%w/v).

Method: To the tubes marked "test" and the three others marked 'blank' (liver blank and serum blank) and 'standard' the following were added. To the test tubes marked 'test', 2.95 ml of the saline was added, followed by 0.05 ml of serum a liver homogenate, 3 ml of biuret solution were added respectively. And the tube marked 'standard' contained 3 ml of the standard protein solution and 3ml of the biuret solution. The saline serum, liver homogenate and biuret solution were dispensed using micropipettes.

All the tubes were placed in a water bath at 37°C for 10 minutes. The tubes were removed at the expiration of the time allowed to cool before reading the absorbance at 550nm using a spectrophotometer.

Grams of protein per 100ml of serum or liver homogenate were calculated using the formula:

$$\frac{\text{Test} - \text{Blank reading}}{\text{Standard} - \text{Blank reading}} \times 6 \text{ (g/100ml)}$$

3.4.6.2 Assay for Serum Albumin/Globulin

1 M sodium citrate (anhydrous) and 1 M citric acid were prepared. 0.01% Bromocresol green were prepared by 9.8 ml of 0.1 M NaOH to 0.698 g of bromocresol green which then dissolved and later made up to 100 ml with water. To prepare the buffered green, 17.3 of sodium citrate.

Method: To test tubes marked 'test', 4 ml of the buffered bromocresol green and 0.2 ml of the serum or liver homogenate was added, 4ml of bromocresol green and 0.2 ml of water was added to the blank. 4 ml of bromocresol and 0.2 ml of the standard albumin solution was added to the test tube marked standard. The content of the test tubes were mixed using microshaker and allowed to stand at room temperature for 5 minutes.

The values were read at 640nm in a spectrophotometer. Grams of serum or liver albumin per 100ml of serum or liver homogenate was worked out by the formula below:

$$\frac{\text{Test} - \text{Blank reading}}{\text{Standard} - \text{Blank reading}} \times 5 \text{ (g/100ml)}$$

The Globulin concentration was obtained by subtracting albumin from the total protein result i.e. Total serum protein – albumin = globulin.

However, the albumin / globulin ratio was obtained by dividing the calculated albumin value by the calculated globulin value.

3.5 STATISTICAL ANALYSES

The data collected on physical body measurements and blood analyses were classified according to location, age, sex, body weight and qualitative traits for statistical analysis. The effect of the factors mentioned above on the physical body measurements and blood parameters was estimated from least-squares procedures using Statistical Analysis System (SAS, 1999), where significant differences were observed, differences between means were tested using Duncan's multiple range test outlined in the SAS (1999) statistical package.

Correlation and regression analysis were computed to determine relationships among the linear measurements and live body weight.

$$Y = a + bx \dots\dots\dots (1) \text{ Linear}$$

$$Y_1 = a + ie + bx \dots\dots\dots (2) \text{ Exponential}$$

$$Y_2 = a + bx + cx^2 \dots\dots\dots (3) \text{ Quadratic}$$

where Y, Y₁, Y₂ are dependent variables (live weight) and X represents the independent variables (BL, HW, HG, CG, NSL and STL) and b and c represent regression coefficients associated with the independent variables when the independent is zero. The coefficient of determination (R²) was used to compare the accuracy of prediction.

The following models were used

a. For body measurements

$$Y_{KLmn} = U + P_k + S_l + R_n + E_{KLmn}$$

where

Y_{KLmn} - observation of the independent variable on the Mrth goat of the Kth sex, of the ith age, of nth location.

U = overall mean of all observations

P_k = Effect of the kth sex (K = 1,2).

S_l = effect of the lth age (l = 1,2,3,4)

R_n = effect of the nth location (n = 1,2,3,4)

E_{KLMn} random error normally and independently distributed with zero mean and variance $\delta^2 e$.

2. For qualitative traits

$$Y_{ijklm} = U + B_i + G_j + P_k + S_l + R_n + E_{ijklm}$$

Y_{ijklm} = Observation of independent variable on the M^{th} goat of the coat colour, of the j^{th} Wattle, of the K^{th} beard, of the i^{th} polled trait, of the n^{th} teat

U = overall mean of all observation

B_i = effect of the i^{th} coat colour of goat ($i = 1, 2, 3$)

G_j = effect of the j^{th} wattle ($j = 1, 2$)

P_k = effect of the beard ($k = 1, 2$)

S_l = effect of l^{th} horn ($l = 1, 2$)

R_n = effect of n^{th} teat ($n = 1, 2$)

E_{ijklm} = Random error normally and independently distributed with zero mean and variance $\delta^2 e$.



CHAPTER FOUR

RESULTS

4.1 INCIDENCE OF QUALITATIVE TRAITS.

Table 4.1 shows the incidence of Qualitative traits in WAD goats as observed in the study.

The coats colour was very variable and included black, brown, white, pied, mixed colour and in the same manner, some animals were specked or with patches. The patterns of pigmentation were very irregular and in general, coat colours were grouped into three basic groups viz black, brown and mixed in the proportions of 54%, 16% and 30% respectively. All the WAD goats examined in this study were horned irrespective of sex. The horns curl outwards and backwards in male, while they were sharp, upward and backward pointing in the females. About 36.5% of all the WAD goats examined possessed wattle. The colour of the wattles was usually the predominant coat colour. 95% of all the female goats studied had a pair of teats each while supernumerary teats were observed in only eight of them. Beard was exhibited by eighty-two percent of the males in this study and few females (8.3% of the females) were also reported to show the trait.

Table 4.1 Incidence of qualitative traits in WAD goats

Traits	Total number of animal examined	Class	Number of animal that possessed the trait	Percentage of animal that possessed the trait
Coat Colour	200	Black	108	54
		Brown	32	16
		Mixed	60	30
Polled Trait	200	Horned	200	100
		Polled	0	0
Treat in Female animal	168	Normal	160	95
		Supernumerary	8	5
Wattle	200	Present	73	36.5
		Absent	127	63.5
Beard in all animals	200	Present	42	21
		Absent	158	79
Beard in male animal (Bucks)	32	Present	26	81
		Absent	6	19
Beard in female animal (Does)	168	Present	16	9.5
		Absent	152	90.5

4.2 BODY WEIGHT AND LINEAR MEASUREMENTS

The estimated least-squares means for body weight and linear measurements of WAD goats in various locations is presented in table 4.2. The total population of goats in Ekiti, Ondo,

oyo and Osun State were 58%, 11.5%, 25% and 5.5% respectively. The body weight of WAD goats was not significantly ($P>0.05$) different for the locations with the exception in Oyo State where goats were significantly ($p<0.05$) smaller in body weight than others. The effect of location was significant ($P>0.05$) For LL, HW, TL, EL and STL, but not for BL, CG, NSL and HG. Highest values ($62.00 \pm 8.88\text{cm}$, $12.36 \pm 2.73\text{cm}$, $55.91 \pm 9.55\text{cm}$, $27.18 \pm 6.15\text{cm}$) of CG, TL, STL and NSL were recorded for Osun State respectively. While 70.00 ± 5.43 , 37.35 ± 3.63 , 50.39 ± 3.88 , 43.48 ± 4.96 were the highest values reported in Ondo State for BL, LL, HW and HG respectively. Height at withers ($46.48 \pm 5.56\text{cm}$) of goats examined in Ekiti State was not significantly different from other locations except Ondo State ($50.39 \pm 3.88\text{cm}$).

The overall means for BW, BL, LL, HW, CG, TL, STL, EL, NSL, HG were $14.67 \pm 4.33\text{kg}$, $68.48 \pm 10.50\text{cm}$, $34.38 \pm 4.58\text{cm}$, $47.39 \pm 5.52\text{cm}$, $60.31 \pm 8.25\text{cm}$, 10.37 ± 1.34 , $50.71 \pm 7.38\text{cm}$, $9.70 \pm 0.87\text{cm}$, $25.22 \pm 5.94\text{cm}$ and $41.21 \pm 5.12\text{cm}$ respectively.

Table 4.3 shows the estimated least-square means for body weight and linear measurements in WAD bucks and does as examined in this study. The total populations of female and male goats investigated in this study were 84% and 16% respectively. The WAD bucks estimated body weight of $14.71 \pm 3.99\text{kg}$ was not significantly ($p>0.05$) different from that of does ($14.45 \pm 4.40\text{kg}$). Likewise, there was no sex difference in all linear measurements, but the tails of does ($10.44 \pm 1.20\text{cm}$) was significantly ($p>0.05$) longer than that of buck ($10.01 \pm 1.90\text{cm}$).

TABLE 4.2: Least square means for body weight and linear measurements of WAD goats by locations

Location	Number of Animals	BW	BL	LL	HW	CG	TL	STL	NSL	EL	HG
Ekiti State	116	15.06 ^a ± 4.43	69.05 ± 8.92	34.61 ^{bc} ± 4.34	46.48 ^b ± 5.56	59.68 ± 7.42	10.05 ^c ± 1.23	50.78 ^b ± 7.06	25.15 ± 0.80	9.60 ^{bc} ± 0.89	40.58 ± 5.40
Ondo State	23	15.35 ^a ± 5.43	70.00 ± 5.43	37.35 ^a ± 3.63	50.39 ^a ± 3.88	60.22 ± 13.00	10.17 ^c ± 10.93	51.37 ^b ± 6.44	25.83 ± 3.96	9.26 ^c ± 0.81	43.48 ± 4.96
Osun State	50	13.04 ^b ± 2.80	66.98 ± 11.08	32.19 ^c ± 4.80	48.35 ^{ab} ± 5.69	61.48 ± 7.15	10.76 ^b ± 0.67	49.04 ^b ± 7.62	24.67 ± 8.62	10.01 ^{ab} ± 0.59	41.17 ± 4.45
Oyo State	11	16.27 ^a ± 4.90	65.91 ± 19.72	35.27 ^{ab} ± 3.66	46.27 ^b ± 4.82	62.00 ± 8.88	12.36 ^a ± 2.73	55.91 ^a ± 9.55	27.18 ± 6.15	10.32 ^a ± 1.15	43.00 ± 3.85
Overall Means	200	14.67 ± 4.33	68.48 ± 10.50	34.38 ± 4.58	47.39 ± 5.52	60.31 ± 8.25	10.37 ± 1.34	50.71 ± 7.38	25.22 ± 5.94	9.70 ± 0.87	41.21 ± 5.12

Means with different superscripts in the same column are significantly different ($p < 0.05$)

KEY

BW = Body Weight, BL = Body Length, LL = Leg Length, HW = Height at Withers, CG = Chest Girth, TL = Tail Length

STL = Shoulder to Tail Length, NSL = Nose to Shoulder Length, EL = Ear Length, Hg = Height at Girths

Table 4.3: Least-squares means for body weight and linear measurements of WAD bucks and does

SEX	Number of Animals	BW	BL	LL	HW	CG	TL	STL	NSL	EL	HG
Buck	32	15.71 ±3.99	68.67 ±10.84	35.10 ±4.55	46.55 ±5.01	58.68 ±8.18	10.01 ^b ±1.90	50.07 ±7.98	23.96 ±3.47	9.46 ±0.82	41.39 ±4.62
Doe	168	14.45 ±4.45	67.45 ±8.55	34.24 ±4.59	47.55 ±5.61	60.73 ±8.22	10.44 ^a ±1.20	50.83 ±7.28	25.46 ±6.28	9.75 ±0.87	41.7 ±5.22

Means with different superscripts in the same column are significantly different ($p < 0.05$)

Key

BW = Body Weight, BL = Body Length, LL = Leg Length, HW = Height at Withers, CG = Chest Girth, TL = Tail Length
STL = Shoulder to Tail Length, NSL = Nose to Shoulder Length, EL = Ear Length, Hg = Height at Girths

The estimated least-square means for body weight and linear measurements of WAD goats in various age ranges are presented in table 4.4. The total population of animals as examined in this study in the age group of 1-2, 2-3, 3-4 and 4-6 years was 46.5%, 30.0%, 11.0% and 12.5% respectively. WAD goats within age ranges of 1-2 years were significantly smaller ($p < 0.05$) smaller in body weight than other goats in this study. Although goats that were between 3-4 years of age were heavier than others, they were not significantly ($P > 0.05$) different from them. Linear measurements by age of all animals were significantly ($p < 0.05$) different except CG and NSL. Goats that were between 1-2 years of age were significantly ($p < 0.05$) lower than other goats, but the best performance in term of all linear measurements were recorded for goats between 3 to 4 years of age.

Table 4.5 shows the estimated least-squares means for body weight and linear measurement by the incidence of Qualitative Traits in WAD goats. The effect of coat colour was not significant ($P < 0.05$) for the body weight in all experimental animal. Linear measurements (except HG and CG) were not significantly ($p > 0.05$) influenced by coat colour and goats with brown coat colour had highest values ($42.97 \pm 5.38\text{cm}$) for HG and CG among other goats. The body weight and linear measurements were not significantly ($P > 0.05$) influenced by the presence or absence of beard except HG. In general and with the exception of BL and STL, goats with beard had higher values of body weight and linear measurements than those without beard

The presence or absence of wattles had no significant ($P > 0.05$) effect on the body weight and linear measurements of goats in this study; but values of body weight and all linear measurements were higher in animals that exhibited the trait than others except EL and AG.

In the same manner, and apart from EL body weight and linear measurements were not significantly ($P > 0.05$) influenced by the number of teats possessed by female goats in this study.

TABLE 4.4: Least square means for body weight and linear measurements of WAD goats by age

Age (year)	Number of Animals	BW	BL	LL	HW	CG	TL	STL	NSL	EL	HG
1-2	93	11.98 ^b ±2.39	64.19 ^c ±0.95	33.44 ^b ±4.83	45.97 ^b ±5.25	56.94 ±7.80	9.99 ^c ±1.25	47.88 ^c ±4.40	24.28 ±4.61	9.55 ^b ±0.91	40.12 ^{bb} ±4.69
2-3	60	17.08 ^a ±2.37	70.57 ^b ±1.35	34.75 ^{ab} ±4.70	48.68 ^{ab} ±6.13	63.65 ±7.89	10.52 ^b ±0.94	51.93 ^a ±6.87	26.08 ±8.15	9.78 ^{ab} ±0.76	42.58 ^{ab} ±5.09
3-4	22	17.33 ^a ±3.87	75.89 ^a ±1.59	36.39 ^a ±3.13	49.61 ^a ±3.50	64.72 ±6.05	11.44 ^a ±2.20	49.11 ^b ±7.39	25.00 ±3.83	10.06 ^a ±0.76	43.94 ^a ±3.13
4-6	25	16.97 ^a ±5.33	74.46 ^{ab} ±2.07	35.52 ^{ab} ±2.38	47.96 ^{ab} ±4.96	61.68 ±7.20	10.63 ^a ±1.16	53.00 ^a ±7.04	26.84 ±4.88	9.81 ^{ab} ±0.97	40.04 ^b ±6.47

Mean with different superscripts in the same column are significantly different ($p < 0.05$)

Key

BW = Body Weight, BL = Body Length, LL = Leg Length, HW = Height at Withers, CG = Chest Girth, TL = Tail Length
STL = Shoulder to Tail Length, NSL = Nose to Shoulder Length, EL = Ear Length, Hg = Height at Girth

TABLE 4:5: Least square means for body weight and linear measurements by incidence of qualitative traits in WAD goats.

Qualitative Traits	Number of Animal	BW	BL	LL	HW	CG	TL	STL	NSL	EL	HG
Coat Colour		14.57	67.44	34.02	47.09	59.03 ^b	10.19±0.	49.73	24.79	9.63	40.54 ^b
1 Black	108	±4.34	±10.73	±4.85	±5.55	±8.31	94	±4.40	±4.71	±0.92	±5.08
2 Brown	32	15.47	69.81	34.61	47.42	63.61 ^a	10.27	51.45	24.45	9.64	42.97 ^a
		±4.92	±12.65	±5.09	±6.04	±8.46	±1.92	±7.45	±4.71	±0.88	±5.38
3. Mixed	60	14.43	69.64	34.02	47.90	60.88 ^{ab}	10.44	52.09	26.41	9.86	41.46 ^{ab}
		±4.01	±8.68	±4.15	±5.21	±7.57	±1.54	±7.30	±7.85	±0.75	±4.81
Beard Incidence		14.88	66.31	34.43	47.46	60.67	10.84	50.37	25.17	9.74	43.00 ^a
Present	42	±4.19	±12.95	±4.91	±5.46	±7.66	±1.77	±8.00	±6.23	±0.89	±4.75
Absent	153	14.63	69.16	34.41	47.38	59.21	10.24	50.84	25.17	9.69	40.76 ^{ab}
		±4.38	±9.66	±4.47	±5.57	±10.12	±1.27	±6.65	±6.23	±0.87	±4.75
Wattle Incidence	73	15.26	69.60	34.64	47.56	60.35	10.52	51.87	25.65	9.68	41.25
Present	127	±4.54	±10.00	±4.17	±6.40	±7.82	±1.27	±6.65	±4.84	±0.87	±3.28
Absent	160	14.00	67.79	34.22	47.30	60.28	10.28	50.00	24.96	9.71	43.94
		±4.20	±10.80	±4.83	±5.62	±8.55	±1.37	±7.75	±6.63	±0.87	±2.84
Teat: Normal	160	14.67	68.57	34.34	47.25	60.14	10.35	50.85	25.13	9.67 ^a	41.13
		±4.31	±9.83	±4.62	±5.53	±8.27	±1.36	±7.04	±5.92	±0.86	±5.12
Supernumerary	8	14.56	66.38	35.25	50.63	64.38	10.81	47.38	27.50	10.32 ^b	42.88
		±5.15	±22.07	±3.69	±4.27	±6.89	±0.53	±7.59	±6.44	±0.58	±5.19

Means with different superscripts in the same column are significantly different ($p < 0.05$)

Key

BW = Body Weight, BL = Body Length, LL = Leg Length, HW = Height at Withers, CG = Chest Girth, TL = Tail Length
STL = Shoulder to Tail Length, NSL = Nose to Shoulder Length, EL = Ear Length, Hg = Height at Girth

4.4 WEIGHT – LINEAR MEASUREMENTS

The Pearson Correlation of body weight and linear measurement is shown in table 4.6. Generally, the correlation coefficient of body weight and all linear measurements in the study were positive. The strongest relationship ($r = 0.603$) existed between CG and BL while the weakest relationship ($r = 0.142$) existed between NSL and HW. BL and HW ($r = 0.525, 0.512$) had the strongest relationship with the body weight and NSL ($r = 0.172$) had the weakest relationship with it.

Table 4.7 and 4.8 show equations, estimates of parameters and coefficients of determination for the fitted functions namely simple and multiple linear, exponential and quadratic functions. While some linear body measurements and weight had significant ($p < 0.05$) and strong inter relationships between them, others were not significant ($p > 0.05$). The coefficient of determination (R^2) from the models varied from 1.00 to 88.00. The R^2 obtained by using linear, exponential and quadratic functions ranged from 1.00 to 48.60 and from 1.00 to 88.00 and from 1.00 to 48.00 respectively. The regression coefficients for body weight weights on linear measurements were either positive or negative.

On the basis of R^2 , body weights- linear measurement relationships were fitted best for simple, exponential followed by linear and quadratic functions.. There was either good or poor fit obtained for any of the three models in weight – linear measurements. There were very poor fit for nearly all the functions of body weight to BL, LL, HG, CG, STL and NSL (Table 4.7 and 4.8). Hence, among the body measurements, accuracy of prediction was only fair with HW ($R^2 = 48.60, 38.00, 48.00$ in Table 4.7). Multiple linear, exponential and quadratic functions were used to determine the best predictions of body weights from linear measurements (table 4.8). The linear measurements did not predict body weights effectively except BL and HW that predict body weight fairly by the three functions (58.60, 40.51 and 57.10 in table 4.8). The multiple linear functions gave the best prediction followed by quadratic and exponential functions.

Table 4.6: The pearson correlation of body weight and linear measurements.

	BW	BL	LL	HW	CG	EL	TL	STL	NSL
BW									
BL	0.525*								
LL	0.489*	0.437*							
HW	0.512*	0.418*	0.483*						
CG	0.410*	0.603*	0.272	0.490*					
EL	0.277	0.280	0.132	0.321*	0.398*				
TL	0.292	0.304	0.055	0.235	0.315*	0.410*			
STL	0.443*	0.536*	0.374*	0.355*	0.591*	0.257	0.365*		
NSL	0.172	0.254	0.257	0.142	0.280	0.287	0.217	0.153	
HG	0.415*	0.359*	0.184	0.428*	0.499*	0.353*	0.289	0.361	0.176

* = Significant (P<0.01)

* = Significant (P<0.05)

Key

BW = Body Weight, BL = Body Length, LL = Leg Length, HW = Height at Withers, CG = Chest Girth, EL = Ear Length
 TL = Tail Length, STL = Shoulder to Tail Length, NSL = Nose to Shoulder Length, HG = Height at Girth

Table 4.7: Estimate of parameters in Simple Linear, Exponential and Quadratic Functions fitted for weight – linear measurements Relationship for WAD goats.

Linear Measurement	Functions	S. E.	R ² %	Significant
Body length (BL)	$Y = 36.12 + 0.91x$	0.23	13.10	**
	$Y_1 = 3.743e + 0.013x_1$	0.005	7.50	**
	$Y_2 = -89.99 + 8.56x - 0.11x^2$	0.04	8.90	**
Height at Withers (HW)	$Y = -21.40 + 0.78x$	0.08	48.60	***
	$Y_1 = 3.43e + 0.013x$	0.002	38.00	***
	$Y_2 = 25.879 + 0.59x + 0.012x^2$	0.004	48.00	***
Leg Length (LL)	$Y = 32.75 + 0.73x$	0.18	44.10	***
	$Y_1 = 3.677e + 0.011x$	0.004	88.00	***
	$Y_2 = -25.480 + 2.265x + 0.127x^2$	0.027	14.50	***
Height at Girth (HG)	$Y = 69.404 - 1.034x$	0.099	1.00	NS
	$Y_1 = 4.236e - 0.023x$	0.021	1.20	NS
	$Y_2 = 66.697 + 2.262x - 0.0754x^2$	1.156	1.08	NS
Chest Girth (CG)	$Y = 55.737 + 1.211x$	1.285	1.00	NS
	$Y_1 = 4.094 + 0.010x$	0.024	1.00	NS
	$Y_2 = 71.885 + 2.179x - 0.0176x^2$	1.109	1.00	NS
Nose to Shoulder Length (NSL)	$Y = 45.617 + 0.541x$	0.616	14.00	NS
	$Y_1 = 3.805e + 0.009x$	0.013	12.80	NS
	$Y_2 = 53.031 - 0.033x + 0.009x^2$	0.007	15.50	NS
STL Shoulder to Tail Length (NSL)	$Y = 61.421 + 0.237x$	0.162	1.00	NS
	$Y_1 = 4.138 + 0.002x$	0.003	1.00	NS
	$Y_2 = 58.478 + 0.409x - 0.002x^2$	0.006	2.00	NS

NS = Non Significant

*** = Significant (P<0.01)

** = Significant (P<0.05)

Key

BW = Body Weight, BL = Body Length, LL = Leg Length, HW = Height at Withers, CG = Chest Girth, EL = Ear Length
TL = Tail Length, STL = Shoulder to Tail Length, NSL = Nose to Shoulder Length, HG = Height at Girth

Table 4.8: Estimate of parameters in multiple linear, Exponential and Quadratic Functions fitted for weight – linear measurements Relationship for WAD goats.

Linear Measurement	Function	S. E.	R ² %	Significant
Body length (x ₁)	Y = 37.587 + 0.882x ₁ - 0.814x ₂	0.241 1.043	13.28	** NS
Height at Girth (x ₂)	Y ₁ = 3.787e + 0.013x ₁ - 0.015x ₂ Y ₂ = -97.903 + 8.744x ₁ - 0.118x ₁ ² + 3.375x ₂ - 0.863x ₂ ²	0.004 0.002 0.044 1.443	40.50 19.39	** ** ** NS
Body length (x ₁)	Y = -1.913 + 0.733x ₁ + 0.746x ₂	0.171 0.077	58.60	** **
Height at Wither (x ₂)	Y ₁ = 3.114e + 0.0102x ₁ + 0.0123x ₂ Y ₂ = -45.212 + 2.848x ₁ - 0.031x ₁ ² + 1.069x ₂ - 0.063x ₂ ²	0.004 0.002 0.036 0.004	40.51 57.10	** ** NS ***
Body length (x ₁)	Y = 23.942 + 0.571x ₁ + 0.5002x ₂	0.272 0.210	17.90	** **
Leg Length (x ₂)	Y ₁ = 3.556e + 0.008x ₁ + 0.0008x ₂ Y ₂ = -41.251 + 8.423x ₁ - 0.115x ₁ ² - 2.289x ₂ + 0.029x ₂ ²	0.05 0.004 0.046 0.029	10.80 23.10	NS ** ** NS
Height at Girth (x ₁)	Y = 23.411 + 1.270x ₁ + 0.785x ₂	0.793 0.083	48.90	NS **
Height at Wither (x ₂)	Y ₁ = 3.479e + 0.027x ₁ + 0.013x ₂ Y ₂ = 31.265 + 5.287x ₁ + 0.921x ₁ ² + 0.586x ₂ - 0.002x ₂ ²	0.17 0.002 1.153 0.004	37.70 49.40	NS ** NS NS
Height at Girth (x ₁)	Y = 34.120 - 1.447x ₁ - 0.754x ₂	1.22 0.182	15.90	NS **
Leg Length (x ₂)	Y ₁ = 3.704 - 0.029x ₁ + 0.011x ₂ Y ₂ = 3.559 - 4.073x ₁ + 0.604x ₁ ² + 2.162x ₂ - 0.015x ₂ ²	1.23 0.019 1.488 0.027	10.80 16.00	NS ** NS NS
Leg Length (x ₁)	Y = 11.379 + 0.284x ₁ + 0.271x ₂	1.151 0.088	49.44	** **
Height at Wither (x ₂)	Y ₁ = 3.318 + 0.003x ₁ + 0.012x ₂ Y ₂ = 5.723 + 0.301x ₁ + 0.012x ₁ ² + 0.910x ₂ - 0.002x ₂ ²	0.03 0.001 0.021 0.004	36.70 49.60	NS ** NS NS

NS = Non Significant

*** = Significant (P<0.01)

** = Significant (P<0.05)

Key

BW = Body Weight, BL = Body Length, LL = Leg Length, HW = Height at Withers, CG = Chest Girth, EL = Ear Length
TL = Tail Length, STL = Shoulder to Tail Length, NSL = Nose to Shoulder Length, HG = Height at Girth

4.4 HAEMATOLOGICAL INDICES.

The estimated Least-squares means for haematological indices of WAD goats by location is presented in table 4.9. The effect of location was significant ($P < 0.05$) for RBC, MCV and MCH. All other haematological indices were not significantly ($P > 0.05$) influenced by location. Highest values ($10.03 \pm 0.69 \times 10^3$ cc, 41.05 ± 1.78 FL, 13.88 ± 3.25 Pg) for RBC, MCV and MCH were recorded in Oyo, Ondo and Oyo State respectively. The overall mean values for PCV, Hb, WBC, RBC, MCV, MCH; MCHC were $31.83 \pm 5.62\%$, 11.35 ± 0.63 mg/dl, $9.37 \pm 1.27 \times 10^3$ cc, $8.56 \pm 1.72 \times 10^3$ cc, 43.45 ± 1.88 Fl, 12.32 ± 3.21 Pg and 35.07 ± 1.56 g/dl.

Table 4.10 shows the estimated least-square means for haematological indices of WAD bucks and does. Sex had no significant ($P > 0.05$) effect on haematological indices except MCV and MCH. The values (50.42 ± 6.49 Fl, 137.71 ± 6.46 Pg) of MCV and MCH for bucks were significantly ($P < 0.05$) higher than the values (42.15 ± 1.36 FL, 120.46 ± 3.98 Pg) recorded for does. In general, the values of other haematological indices (PCV, Hb, WBC, RBC and MCHC) in does were higher than the values recorded for bucks.

The estimated least-square means for haematological indices of WAD goats by age is presented in table 4.11. All the haematological indices observed with exception of some erythrocytic indices (MCV and MCH) were not significantly ($P > 0.05$) influenced by age. The values (57.4 ± 3.02 Fl) of MCV reported for goats between 3 and 4 years were higher than others, while the least value of same parameter were observed for goats between 2 and 3 years. The highest and least value for MCH were observed for goats between 1 and 2 years and 4 and 6 years respectively.

Table 4.9: Estimated Least-squares means for Haematological indices of WAD goats by location

Location	Number of Animals	PCV (%)	Hb (mg/dl)	WBC ($\times 10^3$)	RBC ($\times 10^6$)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Ekiti State	116	31.85 \pm 5.22	10.77 \pm 2.11	9.87 \pm 9.43	8.34 ^b \pm 1.67	39.40 ^{ab} \pm 1.31	13.36 ^b \pm 4.38	36.24 \pm 2.57
Ondo State	23	30.91 \pm 4.83	10.32 \pm 1.60	8.97 \pm 1.20	7.59 ^b \pm 0.95	41.05 ^a \pm 1.78	12.05 ^a \pm 5.94	33.30 \pm 0.06
Osun State	50	32.27 \pm 4.94	13.39 \pm 17.43	8.86 \pm 1.77	10.03 ^a \pm 0.69	33.08 ^c \pm 0.99	13.88 ^b \pm 3.25	33.41 \pm 0.84
Oyo State	11	31.55 \pm 2.94	10.59 \pm 1.03	8.17 \pm 1.40	8.26 ^b \pm 0.69	38.77 ^b \pm 8.48	13.76 ^b \pm 1.69	35.60 \pm 0.26
Overall Mean	200	31.83 \pm 5.61	11.35 \pm 0.63	9.37 \pm 7.27	8.66 \pm 1.72	43.45 \pm 1.88	12.32 \pm 3.21	35.07 \pm 1.56

Mean with different superscripts in the same column are significantly different ($p < 0.05$)

Key

PCV = Packed Cell Volume, Hb = Haemoglobin, WBC = White Blood Cell, RBC = Red Blood Cell
 MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin,
 MCHC = Mean Corpuscular Haemoglobin Concentration.

Unit: (%) – Percent (mg/dl) - Milligram per deciliter (fl) – Fesolitre (pg) Pictogram (g/dl) Gram per deciliter

Table 4.10: Least-squares means for Haematological indices of WAD bucks and does

SEX	Number of Animals	PCV (%)	Hb (mg/dl)	WBC ($\times 10^3$)	RBC ($\times 10^6$)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Bucks	32	33.61 \pm 5.86	11.30 \pm 1.92	9.07 \pm 1.52	8.45 \pm 1.92	50.42 ^b \pm 6.49	137.72 ^a \pm 6.46	33.57 \pm 0.40
Does	168	31.49 \pm 5.53	11.36 \pm 2.56	9.43 \pm 7.89	8.70 \pm 1.68	42.15 ^a \pm 1.86	120.46 ^b \pm 3.98	35.35 \pm 2.37

Mean with different superscripts in the same column are significantly different ($p < 0.05$)

Key

PCV = Packed Cell Volume, Hb = Haemoglobin, WBC = White Blood Cell, RBC = Red Blood Cell
 MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin,
 MCHC = Mean Corpuscular Haemoglobin Concentration.

Unit: (%) – Percent (mg/dl) – Milligram perdecilitre (fl) – Fesolitre (pg) Pictogram (g/dl) Gram perdecilitre

Table 4.11: Least-squares means for Haematological indices of WAD goats by age

Age	Number of Animals	PCV (%)	Hb (mg/dl)	WBC ($\times 10^3$)	RBC ($\times 10^6$)	MCV (fl)	MCH (pg)	MCHC (g/dl)
1-2	93	32.52 ± 5.44	12.20 ± 2.59	8.96 ± 1.64	8.67 ± 1.70	41.40 ^c ± 2.22	12.76 ^a ± 4.66	33.43 ± 1.14
2-3	60	30.80 ± 1.76	10.37 ± 1.76	10.73 ± 12.85	7.91 ± 1.93	41.35 ^c ± 3.55	11.86 ^{ab} ± 5.79	38.81 ± 2.93
3-4	22	30.00 ± 4.23	13.06 ± 1.44	8.15 ± 1.64	8.53 ± 10.58	57.41 ^a ± 3.02	10.17 ^b ± 3.17	33.37 ± 0.56
4-6	25	33.04 ± 7.42	11.45 ± 2.55	8.55 ± 1.80	8.15 ± 1.78	44.28 ^b ± 4.01	8.33 ^c ± 8.50	33.41 ± 0.27

Means with different superscripts in the same column are significantly different ($p < 0.05$)

Key

PCV = Packed Cell Volume, Hb = Haemoglobin, WBC = White Blood Cell, RBC = Red Blood Cell
 MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin,
 MCHC = Mean Corpuscular Haemoglobin Concentration.

Unit: (%) – Percent (mg/dl) - Milligram perdecililitre (fl) – Fesolitre (pg) Pictogram (g/dl) Gram perdecililitre

Table 4.12 shows the estimated least-squares means for haematological indices by incidence of Qualitative trait in WAD goats. The effect of coat colour was significant ($P < 0.05$) for only MCV and MCHC but not for other haematological indices. Brown goats had highest values of MCHC among other animals, while animals with mixed colours recorded highest values for MCH. Black coat coloured animal had significantly ($P < 0.05$) lower values (36.09 ± 0.34 FI) of MCV and MCHC than animals with other coat colours. All haematological indices of goats that possessed beard were not significantly ($P > 0.05$) different from animals that lacked the trait. Also, effects of wattle and teat were not significant ($P > 0.05$) for all haematological indices in this study.

Table 4.12: Least-squares means for haematological indices by incidence of qualitative traits in WAD goats

Qualitative Traits	Number of Animals	PCV (%)	Hb (mg/dl)	WBC ($\times 10^3$)	RBC ($\times 10^6$)	MCV (fl)	MCH (pg)	MCHC (g/dl)
Coat Colour:	108	31.48 \pm 5.91	11.82 \pm 1.87	9.75 \pm 9.80	8.90 \pm 1.55	36.09 ^c \pm 0.34	12.13 \pm 2.97	12.30 ^c \pm 1.27
	Black							
	32	31.90 \pm 4.69	10.69 \pm 1.56	8.82 \pm 1.14	8.33 \pm 2.17	48.43 ^b \pm 4.87	12.97 \pm 10.21	43.38 ^a \pm 5.47
Brown	60	32.41 \pm 5.56	10.84 \pm 1.87	8.98 \pm 1.58	8.41 \pm 1.70	54.07 ^a \pm 5.18	12.32 \pm 7.57	33.45 ^b \pm 0.51
Mixed								
Beard:	42	32.02 \pm 4.91	13.53 \pm 1.87	8.87 \pm 1.57	8.28 \pm 1.47	59.47 \pm 6.66	11.82 \pm 5.10	33.25 \pm 1.70
	Present	158	31.69 \pm 5.73	10.72 \pm 1.94	4.49 \pm 8.18	8.78 \pm 1.76	38.82 \pm 1.37	12.38 \pm 4.09
Absent								
Wattle:	73	31.76 \pm 5.73	10.83 \pm 1.94	10.54 \pm 1.18	8.28 \pm 1.44	42.78 \pm 3.07	13.01 \pm 4.29	33.36 \pm 1.32
	Present	127	31.76 \pm 5.48	11.65 \pm 1.48	8.70 \pm 1.59	8.85 \pm 1.79	44.00 \pm 2.40	11.95 \pm 4.42
Absent								
Teat: Normal	160	31.78 \pm 2.55	11.36 \pm 2.03	9.36 \pm 7.41	8.65 \pm 1.71	43.15 \pm 1.86	12.37 \pm 3.29	35.13 \pm 1.62
	Supernumerary	8	33.00 \pm 7.43	11.09 \pm 2.46	9.71 \pm 1.53	9.04 \pm 2.03	50.58 \pm 1.50	11.14 \pm 1.47

Means with different superscripts in the same column are significantly different ($p < 0.05$)

Key

PCV = Packed Cell Volume, Hb = Haemoglobin, WBC = White Blood Cell, RBC = Red Blood Cell

MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin,

MCHC = Mean Corpuscular Haemoglobin Concentration.

Unit: (%) – Percent (mg/dl) - Milligram perdecililitre (fl) – Fesolitre (pg) Pictogram (g/dl) Gram perdecililitre

4.6 SERIUM INDICES

The least-squares means for Serum Indices of WAD goats in various locations are presented in table 4.13. The effect of location was not significant ($P>0.05$) for serum indices except for the ratio of albumin and globulin. The value (1.85 ± 0.54) for ALB:GLB for goats examined in Osun State was higher than values recorded for animals in the other locations.

Table 4.14 shows the estimated least -squares means for Serum indices of WAD bucks and does. The results of this study showed that sex had no significant ($P>0.05$) effect on serum indices studied except for the ratio of albumin and globulin.

The least-squares means for Serum Indices of WAD goats by age ranges are presented in table 4.15 and the result showed that age had no significant influence on serum indices of Wad goats examined.

Table 4.16 shows the least-squares means for Serum Indices by incidence of qualitative traits in WAD goats and results showed that the qualitative traits with the exception of coat colour and number of teat had no significant ($P>0.05$) effect on serum indices of WAD goats in this study. Brown goats had significantly ($P< 0.05$) higher value (2.21 ± 0.88) of ALB: GLB than goats with black and mixed coat colour. Significantly, ($p<0.05$) higher value (2.38 ± 0.98) of the same parameter was reported for goats with 2 (normal) teats. The overall means of TSP, ALB, GLB, ALB: GLB were 5.59 ± 0.10 gm/100ml, 4.39 ± 1.63 gm/ 100ml , 2.08 ± 0.81 gm/ 100ml and 1.91 ± 0.70 respectively.

Table 4.13: Least-squares means for serum indices of WAD goats in various locations

Location	Number of Animals	TSP (gm /100ml)	ALB (gm/100ml)	GLB (gm /100ml)	ALB: GLB
Ekiti State	116	5.52±1.02	3.29±2.98	2.06±0.65	1.87 ^b ±0.73 ^a
Ondo State	23	5.35±0.84	3.44±0.68	1.98±0.56	1.85 ^b ±0.54 ^b
Osun State	50	5.83±0.93	3.76±1.80	2.22±1.19	1.93 ^b ±0.58 ^a
Oyo State	11	5.64±1.28	3.81±1.07	1.84±1.68	2.28 ^a ±1.05 ^a
Overall Mean	200	5.59±1.02	3.62±1.63	2.08±0.81	1.91±0.70

Means with different superscripts in the same column are significantly different ($p < 0.05$)

Key

TSP - Total Serum Protein, ALB - Albumin, GLB - Globulin, ALB: GLB - Albumin/Globulin

Unit: g /100ml = gram per 100mililitre

Table 4.14: Least-squares means for serum indices of WAD Bucks and Does

Sex	Number of Animals	TSP (gm /100ml)	ALB (gm/100ml)	GLB (gm/100ml)	ALB: GLB
Buck	32	5.41±0.94	3.65±5.72	2.00±0.60	1.83 ^b ±0.65
Does	168	5.62±1.01	3.61±0.80	2.09±0.84	1.92 ^a ±0.71

Means with different superscripts in the same column are significantly different ($p < 0.05$)

Key

TSP – Total Serum Protein, ALB – Albumin, GLB – Globulin, ALB: GLB – Albumin/Globulin

Unit: g /100ml = gram per 100millilitre



Table 4.15: Least-squares means for serum indices of WAD goats by age

Age	Number of Animals	TSP (gm/100ml)	ALB (gm/100ml)	GLB (gm/100ml)	ALB: GLB
1-2	93	5.58±0.92	7.30±3.02	2.09±0.98	1.95 ^a ±0.7
2-3	60	5.63±0.95	3.57±0.77	2.06±0.56	1.88 ^{ab} ±0.64
3-4	22	5.26±1.21	1.97±0.95	1.97±0.75	1.88 ^a ±0.74
4-6	25	5.26±1.18	2.16±0.85	1.16±0.65	1.81 ^b ±0.77

Means with different superscripts in the same column are significantly different ($p < 0.05$)

Key
 TSP – Total Serum Protein, ALB – Albumin, GLB – Globulin, ALB: GLB – Albumin/Globulin
 Unit: g/100ml = gram per 100millilitre

Table 4.16: Least-squares means for serum indices for the incidence of qualitative traits in WAD goats

Qualitative Traits	Number of Animals	TSP (gm/100ml)	ALB (gm/100ml)	GLB (gm/100ml)	ALB: GLB
Coat Colour: Black	108	5.62±1.03	6.56±3.09	2.09±3.09	1.85±0.65 ^b
Brown	32	5.64±1.05	6.74±0.81	1.91±0.81	2.21±0.88 ^a
Mixed	60	5.49±0.92	3.51±0.70	2.51±0.70	1.84±0.61 ^b
Beard Incidence Present	42	5.52±1.01	3.53±0.79	2.03±0.79	2.89±0.73
Absent	158	5.61±1.00	5.67±2.58	2.09±2.58	1.91±0.69
Wattle Incidence Present	73	5.58±0.95	5.50±1.64	2.11±1.69	1.85±0.77
Absent	27	5.60±1.00	6.21±1.02	2.06±1.02	1.95±0.65
Test: Normal	160	5.55±0.99	5.23±1.69	2.08±1.69	1.88 ^b ±0.68
Supernumerary	8	5.31±0.85	5.36±1.02	1.95±1.02	2.38 ^a ±0.92

Means with different superscripts in the same column are significantly different ($p < 0.05$)

Key
 TSP – Total Serum Protein, ALB – Albumin, GLB – Globulin, ALB: GLB – Albumin/Globulin
 Unit: g/100ml = gram per 100millilitre

CHAPTER 5

DISCUSSION

5.1 INCIDENCE OF QUALITATIVE TRAITS.

The large variation in coat colours observed in this study is indicative of the fact that WAD goats in South Western Nigeria are yet to undergo ample and conscious selection efforts towards the improvement of coat colour; Unlike in developed countries of the world, where different breed of goat are known for their peculiar pattern of pigmentation. The irregular pattern of pigmentation observed in this study has been reported by some workers (Ryder, 1980; Osinowo *et al.*, 1988; Odubote, 1994).

The predominant black colour observed in this study may be an adaptation to the humid tropics in contrast to the brown and white colours predominantly found in the Red Sokoto and Sahel goats respectively of the arid Sahel zones. In the same manner, the black coat colour may predispose the goat to high heat load, high metabolic rate and increased thyroid activity as reported by Odubote (1994).

Over 63% of all animals examined in this study did not possessed wattles. This, expression of the trait could be termed to be occasional as reported by Wilson (1991). However, this observation contrary to the report of some studies (Odubote, 1994). He noted that the expression of wattles is a common phenomenon in the flock of goats. Although the functions of the wattles is not yet fully understood, it was suggested that it might be involved in heat regulation (body metabolism) as an adaptive feature (Odubote, 1994). All the WAD goats examined were horned irrespective of the sex. This was similar to the observations of Mason (1984), Wilson (1991) and Odubote (1994). In the same manner, the polled goat that was not observed in this study suggested that the gene for polledness in some breeds of goats was associated with a form of intersexuality and to cryptorchidism as reported by Warwick and Legates (1979).

The expression of beard trait among the male goats was predominant in this study because it is a secondary sexual characteristic under male hormonal control. Also, few females that were reported to exhibit this trait shows that they possess threshold levels of androgenic hormone. Nonetheless, the beard in females has been reported to be sparse or scattered just as it is in young bucks (Odubote, 1994). The normal number of teats observed among all female animals in this study was two; but the low incidence of supernumerary teats might be due to mutation.

5.2 BODY WEIGHT AND LINEAR MEASUREMENT

The overall mean body weight (14.67 ± 4.33 kg) reported in this experiment showed that WAD goats observed in the area of study are very small in size. The small body size recorded agreed with the reports of many workers. (Devendra and Burn, 1970; Gill and Dev, 1972; French, 1980; Devendra and McLeroy: 1992; Odubote and Akinokun, 1992; Odubote, 1994). The overall mean body weight of was smaller than the value reported for exotic breeds (Devendra and Burn, 1970; Gill and Dev 1972, French; 1980; Devendra and McLeroy, 1992). The WAD goats in this study were classified as dwarf goat weighing 18 – 25kg by Devendra and McLeroy (1992). This report agreed with works of French (1980) and Odubote (1994). The small body size could be described as an adaptive feature to humid environment aimed at reducing the surface area and thus the heat load coupled with hair coat type. (Odubote, 1994).

The overall mean height at withers of 47.39 ± 5.52 cm reported indicates that goats in the South Western Nigeria are predominantly dwarf goats that stand less than 50cm high at the wither as classified by French (1980) and Devendra and McLeroy (1992). The overall mean recorded for all linear measurements were smaller than those reported for exotic breeds (Devendra and Burn, 1970; Gills and Dev, 1972; French, 1980). The smaller body size and linear measurement

recorded for WAD goats than the exotic breeds in this study could also be as a result of poor diet due to poor management system adopted by farmers in the area of study.

The lower values of body weight and linear measurements recorded for goats between 1 – 2 years of age shows the significant effect of age on performance of goat. In general, each measurement studied increased with increase in age. This report agreed with the work of Ozoje and Herbert (1997). He observed that these increases, calculated as a percentage of their values at birth, were at different rate. The height at wither at any given age reflects the animal's skeletal size, while shoulder width, pouch girth and heart girth reflect body conditions (Jeffery and Berg, 1972).

The result showed that sex was not an important source of variation for body measurements in goat considered in this study. Similar result have been reported (Devendra and McLeroy, 1992). The females having bigger and longer body than the males in most measurements taken could be as a result of various physiological functions and processes that take place in does like other female animals most often than bucks. Also observation revealed that farmers tend to feed female animals than males due to some peculiar cares given them because of their roles in reproduction. This corroborated the findings of French (1980) and Devendra and McLeroy (1992). The brown coat colour, possession of beard and wattle by WAD goats favoured better performance in term of physical body measurements as observed in this study.

The brown coat colour, possession of beard and wattle by WAD goats favour better performance in term of physical body measurements as observed in this study

5.3 WEIGHTS – LINEAR MEASUREMENTS

The result of Pearson Correlation analysis showed that any increase one of the body traits was as a result of an increase in an other. Positive relationships between body traits in goat had been reported, (Eboje and Herbert, 1977; Akan, 2000).

The results of the study clearly showed that neither simple nor multiple linear, exponential, nor quadratic functions could be used efficiently in describing the weight – linear measurements relationship in goats. It is necessary that efforts should be made by other workers to establish the existing relationships among body weight and linear measurements in goat by using various models and functions. The properties of the model and the data should be examined and the appropriate model chosen (Oni et al, 2001).

The results of this study revealed that among the body measurements, BL, HW and LL could be better used to predict the body weight of goats. Therefore, the observation of positive values for regression coefficient could indicate that live weight gain increases with increase in body dimensions (BL, HW and LL). That is any increase in body weight was as a result of an increase in the linear measurements. Similar positive relationships between liveweight and body dimensions had been reported in sheep (Searle, et al, 1989); goat (Ebozoje and Herbert; 1997; Akpan, 2000); Cattle (Orheruata and Olutogun, 1994; Omeje; et al; 2001). Poultry (Cason and ware, 1990; Oni et al 2001a,b) and rabbit (Chineke, 2000).

On the other hand, regression coefficients in the relationships between live weight and some linear measurements were negative. Reporting negative coefficients for regression values, Dilwah (1948) concluded that growth decreased with increase in age.

5.4 HAEMATOLOGICAL STUDIES

The present investigation examined the effects of age, sex, location and some qualitative traits on haematological values of WAD goats in South Western Nigeria.

The overall mean PCV of $31.83 \pm 5.62\%$ in the present study was not significantly different from those reported in goats by other Oduye (1976) reported average value of $28.66 \pm 4.58\%$, Oyewale and Olowookorun (1986) observed 29.75 ± 33.39 while Aba-Adulugba and Joshua (1990) reported 31.25 ± 5.65 for the PCV in their studies

The erythrocytic values obtained for the goats in this study were similar to those found for tropical goats (Oduye, 1976, Amakiri, 1981; Aba – Adulugba and Joshua, 1990). The similarity between the results of this study and those recorded for tropical goats as showed above is an indication that most of the goats evaluated by these scholars were poorly managed by traditional farmers with inadequacies in term of feeding and health. The difference between the means of haematological indices (except MCV and MCH) reported for bucks and does in this study was not significant ($P > 0.05$). Similarly, Age did not produce any significant difference ($P > 0.05$) between the means of RBC, counts, WBC counts, Hb and MCHC. The reason was as a result of the fact that quality of blood did not change as its quantity increases with age.

The results of this study have shown that age and sex have not significant effect on Hb conc, WBC counts, RBC counts of WAD goats in Nigeria. This agrees with the studies of some workers (Amakiri, 1981; Aba – Adulugba and Joshua, 1990). However, the slight decrease in RBC values with advancing age in goats (from 3 – 4 years upward) in this study agrees with the report of some studies (Holman and Dew, 1963; Nfi, 1991). The decrease in RBC due to increase in age could be as a result of body weakness at old age that weaken the cells responsible for the production of erthrocyte thereby causing its reduction in the body system. Also age effects on some blood traits in small ruminants have been reported by Akerejola (1991), Ofesile and Kasali (1992). In other reports, significant sex effects on some blood characteristics in animals have been repoted (Valdya et al, 1970; Kamalu et al., 1988).

The values of RBC counts and PCV in this study were different from those of the temperate breeds (Lewis, 1976; Lang, 1980). The lower values of RBC, PCV and plasma protein

of WAD goats than the temperate breeds of goats could be as a result of poor management system adopted by the farmers in the area of study. The inadequacies in term of feeding and health management could also be considered as reasonable contributory factors. Similarly, the haemoglobin values of goats in this study were lower than those reported by Milson *et al.*, (1960). This corroborates the report of some workers (Oyewale and Olowookorun, 1986; Aba – Adulugba and Joshua, 1990; Nfi, 1991).

The higher Hb values observed in females agrees with some studies (Immumorin *et al.*, 1999). However, the present investigation showed that WAD goats had a mean WBC counts similar to those reported in temperate climate (Holman and Dew, 1963; Milson *et al.*, 1960). Holman and Dew observed a mean total white blood of 8.08×10^3 whilst *et al* reported 9.00×10^3 . The results reported in this study is contrary to higher WBC counts of WAD goats (14.54×10^3 ; $12.59 \pm 2.71 \times 10^3$) reported by Edward *et al* (1955) and Aba- Adulugba and Joshua (1991) respectively. Nevertheless, the values of WBC counts in the present investigation corroborate those reported by Oyewale and Olowookrun (1986). They observed value of $9.23 \pm 1.71 \times 10^3$ for WBC count of WAD goats in their studies.

The haematological indices (PCV, HBC, WBC counts) reported in this study were not significantly ($P > 0.05$) influenced by location. Even, RBC counts were reported to be significantly ($P > 0.05$) higher only in one location than other locations in this study. Further work on the effect of location on haematological indices in WAD goats might be very illuminating. Despite the result of this study on the effect of location on haematological indices, it worth's to note that few studies had earlier reported the positive influence of environment and management on the blood characteristics of small ruminants (Coles, 1974; Blanca and Kunz, 1978, Oyewale and Olowookoun, 1986).

Almost all haematological indices reported in this study were not influenced by all the qualitative traits under observation. Only MCV and MCH were influenced significantly ($P >$

0.005) by coat colour and beard while wattle and teats had no effect on all haematological indices under observation. However, further investigations are required in this aspect to establish the influence of qualitative traits on haematological indices of goats.

5.5 SERUM INDICES

The result of this study on serum parameters revealed that location, sex and age had no significant ($P > 0.05$) effect on serum indices. Only one of the location recorded higher value of GLB/ALB ratio, which was significantly ($P < 0.05$) different from values observed on other locations. Contrary to this report, some studies have shown significant sex and age effect on serum protein (Validya *et al.*, 1970, Kamalu *et al.*, 1988; Otesile and Kasali, 1992, Imumorin *et al.*, 1999). The TSP values in this study were lower than those reported for WAD goat by Imumorin *et al.*, (1999). They observed TSP of $6.4 \pm 0.7\text{g}/100\text{ml}$ for Red Sokoto and $6.5 \pm 0.5\text{g}/100\text{ml}$ for WAD goat and higher values of TSP in females recorded in this study could probably be as a result of high feed consumption by the female than male as a result of cares given to them by farmers due to various physiological functions (pregnancy & lactation) they perform. This was in agreement with Kamalu *et al.*, (1988) and Imumorin *et al.*, (1999). But this result disagreed with the works of Akerejola (1977) and Otesile and Kasali (1992). Coat colour and teats were the only qualitative traits reported to have significant ($P > 0.05$) effect on serum indices. Goats with brown colours and females with supernumerary traits were observed to have high values of serum indices than other animals. However, further work is still required to consolidate the results of this study in this aspect.

Serum parameters are important in the maintenance of the proper osmotic pressure between the circulating fluid and the fluid in the tissue spaces, so that exchange of materials between blood and the cells was maintenance of normal blood pressure and pH. These importance were better obtained in older animals as evidenced in the present study. Serum protein, albumin

and globulin studies are undertaken to uncover the nature of the health status of domestic animals. The serum proteins which are most easily obtainable in the animal's body are of value to the veterinarians in diagnosis, treatment and determination of prognosis of many diseases.



CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

There was an irregular pattern of pigmentation among all WAD goats observed in this study but the prevailing coat colour was black. The values of body weight, linear body measurements and haematological indices reported in this study were lower than the values of the same parameters observed for temperature goats. The body weight and height at withers of the examined animals, range between 10.34 and 19.00kg and between 41.87 and 52.91cm respectively. The results showed that WAD goats in south western Nigeria are predominally dwarf. Location effect was observed for some linear measurements (LL, HW, TL and EL) but sex had no significant ($P>0.05$) effect on body weight and linear measurements with the exception of tail length. The effect of age was significant ($P>0.05$) for the body weight and all the body measurements (except CG and NSL) studied.

In general, the body weight, linear body measurements (except HG and CG) and blood parameters (except MCV, MCHC and ALB: GLB) were not significantly ($P>0.05$) influenced by all qualitative traits considered in this study. Correlation between all pairs of traits in all groups were positive and among all the linear body measurements reported in this study, BL, HW and LL could be better used to predict the body weight. With the exception of RBC with other erythrocytic indices (MCV, MCH, MCHC) and ALB: GBL, it could be generally concluded from the results of this study that location sex and age had no significant effect on haematological and serum indices of WAD goats. However, further research works are required in this aspect to consolidate the results of this study.

6.2 RECOMMENDATIONS

Within the limitations and results of this study and based on physical body traits of WAD goats observed, the following suggestions and observations are hereby recommended:

- ❖ WAD goats between 3 and 4 years of age are recommended as the best based on the productive performance using physical body measurements than other age ranges when there is need to purchase goats and slaughter them for carcass quality.
- ❖ WAD goats that possessed wattles and beard have the potential of performing better than the animals that lacked the traits.
- ❖ WAD goats with brown coat colour have the potential of performing better than goats with other coat colours.
- ❖ Female WAD goats could be suggested to be better than their male counterparts in term of physical body performance. Due to the higher values of body weight and recorded linear measurement in the study than the male.
- ❖ HW, BW and LL are body linear measurements that could be directly used to determine body weight of WAD goats.
- ❖ Improvement of management system of WAD goats in the area of study would definitely enhance productivity and performance of the experimental animals.
- ❖ More scholars and research workers should carry out more works on the characterization of WAD goats based on qualitative traits and establish their relationship with body weight.

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