TITLE PAGE

EFFECT OF BREED, AGE AND SEX ON GROWTH, HAEMATOLOGICAL, SERUM BIOCHEMICAL AND CARCASS CHARACTERISTICS OF TURKEYS (*Meleagris gallopavo*)

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M.Sc/AGRIC/4104/2011-2012

A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES,

AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA

IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE

AWARD OF MASTERS OF SCIENCE IN ANIMAL SCIENCE

DEPARTMENT OF ANIMAL SCIENCE,

FACULTY OF AGRICULTURE,

AHMADU BELLO UNIVERSITY, ZARIA

NIGERIA

AUGUST, 2014

DECLARATION

I declare that the work in the thesis entitle **'EFFECT OF BREED, AGE AND SEX ON GROWTH, HAEMATOLOGICAL, SERUM BIOCHEMICAL AND CARCASS CHARACTERISTICS OF TURKEYS' (*Maleagris gallopavo*)** has been performed by me in the Department of Animal Science, under the supervision of Dr. Mrs. M. Orunmuyi and Dr. M. Kabir.

The information derived from the literature has been acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another higher degree or diploma at any University.

....

Name of student Signature Date

CERTIFICATION

The thesis entitle ‘‘**EFFECT OF BREED, AGE AND SEX ON GROWTH, HAEMATOLOGICAL, SERUM BIOCHEMICAL AND CARCASS CHARACTERISTICS OF TURKEYS**’’ (*Maleagris gallopavo*), by Ibrahim Muhammad Chana meets the regulations governing the award of the degree of Masters of Science (M.Sc) of Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to my dearly –loved Father and Mother Alhaji Ibrahim M. Chana and Hajia Rahmatu Umar Chana in recognition of their love, care, prayers, advice and financial support at all time; to my Brothers and Sisters at home; to my family at large for their prayers and support to the realization of this dream.

ACKNOWLEDGEMENTS

I am ever grateful to Almighty Allah (S.W.T), Most Gracious and Most Merciful, for providing me with this seldom opportunity of going through the hurdle of this research work. My everlasting love and prayer go to our beloved and last Prophet Muhammad bin Abdullah (S.A.W.), his companions and his family.

My everlasting love and appreciation go to my lovely Father, Alhaji Ibrahim M. Chana for the good upbringing, love, care, advice, prayers and financial support which had made everlasting impacts on my life. Special thanks to my sweetest Mother, Hajia Rahmatu Umar who never forgets praying for me. She cared, loved and supported me in all aspects of human endeavours.

My immeasurable humble indebtedness and appreciation are due to my diligent and indefatigable supervisors, Dr. Mrs. M. Orunmuyi and Dr. M. Kabir for their positive contributions, encouragements, support, practical and inspiring guidance throughout this research work. My unreserved gratitude and special thanks also go to them for their patience, tolerance, numerous suggestions as well as critical review of the manuscripts.

I wish to express my sincere appreciations to the Dean, Faculty of Agriculture, Professor G.N. Akpa, Head, Department of Animal Science, Dr. S. Duru, Post graduate co-ordinator Dr. S.B. Abdu, Undergraduate coordinator, Dr. H.M. Rabiu, Seminar co-ordinator, Dr. T.S. Olugbemi, Professor G.S. Bawa, Professor J.J. Omage, Dr. P.A. Onimisi, Dr. S.M. Yashim, my special gratitude goes to my able undergraduate supervisor Dr. Mrs. R. Daudu. The entire academic and non-academic staff of the Department and our great Lecturers from National Animal Production Research Institute, (NAPRI) Shika, Zaria. Professor I.A. Adeyinka, Professor B.I. Nwago and the entire staff of the Institute, I say a big thank you for the cordial and harmonious

relationship and for being there for me through thick and thin. I appreciate the kind cooperation and assistance accorded me by the following farm staff that helped me during data collection; farm manager, Mr. E. Ameh, Maman Tulu, Mrs. Mata, Mrs. Jummai and the entire staff of the farm. Mention must be made of Security Saminu Muhammad for being there for me on the farm and take good care of my birds throughout the period of my experiment.

I sincerely acknowledge the love, care, patience and understanding accorded me by my elder Sisters, Amina Ibrahim Chana and Aisha Ibrahim Chana, Hafsat Ibrahim Chana, Binta Ibrahim Chana and my Brothers Abdullahi Ibrahim Chana, Ibrahim Saidu Chana, Abubakar Ibrahim Chana (Sadiq), Musa Olay, Ibrahim Ibrahim Chana (Salim), Maryam Ibrahim Chana (Salima), Maimunat Ibrahim Chana, Maijidda Ibrahim Chana and Saleh Ibrahim Chana (Na garin Janda) and Hamdar Ibrahim Chana, thank you very much for the support, encouragement and prayers and for not taking 'this' as a rival because of time, resources, energy and money devoted in making it reality from our lovely and unshakable Father Alhaji Ibrahim M. Chana. My immense appreciations to my step Mothers, Hajia Jummai (Mama J.) and Hauwa Dahiru (Aunty Uwani), Bahban Yara, Bahba Hauwa, Bappa Sani, Haji Inus, Kawu Musa (Jet Lee), Bahba Amina, Aunty Talatu (Hauwa Haruna Daya) and my lovely grand Ma Hajia Assama'u (Bahba).

I also appreciate my friends at home, Gambo Shuaibu Saru (Old skull), Adamu Aliyu Firi (Zare), Yakubu Adamu Jajere, Garba Ibrahim Dakasku, Abubakar Muhammad Lamba, Muhammad A. Zakar (Carlos), Abdullahi Lawan (Rabe) and many more of my friends whose names could not be mentioned. Thank you for keeping in contact and prayers while i was committed. Your advice, moral and spiritual support greatly helped in the success of this work.

Indeed many friends and well wishers who stood by me and helped in one way or the other or kept in contact throughout my M.Sc programme, Yakubu Muhammad Abdullahi (Agumasaa), Abdullahi Muhammad Iyad, Abubakar Halilu Gireh, Mustapha Abdullahi (Imam), Abubakar Sani Abdullahi (Class Rep.), Idris Ahmadu Adamu, Usman Abdullahi Eshimutu, Umar Aliyu Umar, Dan Amana Jos, Mallam Sulaiman Abdussalam (Imam), Mustapha Sabo Nalado, Mallam Bukhari Muhammad, Dr. Ibrahim Muhammad Babaiye, Sulaiman Umar (Manu) and Hajia Munirat Atiku Abubakar. I regret however, that exhaustive list of them all is not possible, but to everyone who contributed in one way or the other to the success of this work, I say thank you very much. May Almighty Allah bless and reward you with Al-jannatul firdaus, amen.

TABLE OF CONTENTS

TITLE PAGE i
DECLARATION ii
CERTIFICATION iii
DEDICATION iv
ACKNOWLEDGEMENTS v
TABLE OF CONTENTS viii
ABSTRACT xiii
CHAPTER ONE 1
1.0 INTRODUCTION 1
1.1 Justification 3
1.3 Objectives 4
CHAPTER TWO 5
2.0 LITERATURE REVIEW 5
2.1 Taxonomy and History of Turkey 5
2.2 Domestication of Turkey 6
2.3 Physical Description of Various Breeds of Turkey 6
2.3.2 Bronze white 7
2.4 Turkey Production in Nigeria 8
2.5 Factors Affecting Growth and Performance of Turkey 8
2.5.1 Environmental temperature and management 8
2.5.2 Breed 9
2.5.3 Disease 10
2.5.4 Feed and water consumption 11

2.6 Body Weight....12
2.7. Haematological Parameters....12
2.7.1. Packed cells volume (PCV) 12
2.7.2. Haemoglobin (Hb)....13
2.7.3 Red blood cells (RBCs) 13
2.7.4 White blood cells (WBCs) 14
2.7.5 Serum biochemical parameters 14
2.7.6 Total protein (Tp) 14
2.7.7 Creatinine....15
2.7.8 Aspartate aminotransferase (AST) 16
2.7.9 Alanine aminotransferase (ALT)....16
2.8 Carcass Characteristics 17
2.8.1 Internal organs:....17
CHAPTER THREE....19
3.0 MATERIALS AND METHODS:....19
3.1 Experimental Site 19
3.2 Source of Experimental Birds: 19
3.3 Management of Experimental Birds:....19
3.4 Experimental Design: 20
3.5 Data Collection....20
3.5.1 Body weight (kg):....20
3.5.2 Linear body measurements: 20

3.5.3 Haematology 21

3.5.4 Serum Biochemistry 21

3.5.5 Carcass evaluation: 22

3.6 Statistical Analysis: 24

CHAPTER FOUR 25
4.0 RESULTS 25
4.1 Breed and Sex Effect on Growth, Blood and Carcass Characteristics 25

4.2 Breed and Age Effects on Body Measurement and Blood Profiles 31

4.3 Breed, Sex and Age Effects on Growth and Blood Profiles 36

4.4 Correlation Coefficients 40

CHAPTER FIVE 52
5.0 DISCUSSION 52
5.1 Breed and Sex Effect on Growth, Blood and Carcass Characteristics 52

5.2 Breed and Age Effects on Body Measurement and Blood Profiles 53

5.3 Breed, Sex and Age Effects on Growth and Blood Profiles 54

5.4 Correlation Coefficients 56

CHAPTER SIX 58
6.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS 58
6.1 Summary 58

6.2 Conclusions 59

6.3 Recommendations 59

REFERENCES: 60

LIST OF TABLES

Table 3.1: Compositions of the diet fed.....24

Table 4.1: Breed and sex effects on body weight (kg) and linear body measurement (cm) of Turkeys at 20 weeks of age.....27

Table 4.2: Breed and Sex effect on haematological parameters of Turkey at 16 weeks....28

Table 4.3: Breed and sex effect on Serum biochemical parameters of Turkey at 16 weeks....29

Table 4.4: Breed and sex effects on carcass and organ traits (g) of Turkeys at 20 weeks of age.....31

Table 4.5: Breed effects at various ages on body weight (kg) and linear body measurement (cm) of Turkeys.....34

Table 4.6: Breed effect at various ages on haematological parameters of Turkey.....35

Table 4.7: Breed effect at various ages on Serum biochemical parameters of Turkey.....36

Table 4.8: Breed and sex effects on body weight (kg) linear body measurement (cm) of Turkeys at different ages.....38

Table 4.9: Breed and Sex effect on haematological parameters of Turkey at different ages.....39

Table 4.10: Breed and sex effect on Serum biochemical parameters of Turkey at different ages.....40

Table 4.11: Correlation coefficient of body weight (kg) and linear body measurements (cm) of male Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 12 weeks of age.....45

Table 4.12: Correlation coefficient of body weight (kg) and linear body measurements (cm) of male Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 16 weeks of age.....46

Table 4.13: Correlation coefficient of body weight (kg) and linear body measurements (cm) of male Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 20 weeks of age.....47

Table 4.14: Correlation coefficient of carcass characteristics of male Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 20 weeks of age.....48

Table 4.15: Correlation coefficient of body weight (kg) and linear body measurements (cm) of female Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 12 weeks of age.....49

Table 4.16: Correlation coefficient of body weight (kg) and linear body measurements (cm) of female Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 16 weeks of age.....50

Table 4.17: Correlation coefficient of body weight (kg) and linear body measurements (cm) of female Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 20 weeks of age.....51

Table 4.18: Correlation coefficient of carcass characteristics of female Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 20 weeks of age.....52

ABSTRACT

A study was conducted to assess the effect of breed, sex and age on growth, haematological, serum biochemical and carcass characteristics of Turkey. The data was generated from 100 Turkeys which comprised 50 Norfolk breed and 50 Mammoth breed. The growth traits included biweekly body weight (BW) and linear body measurements: neck length (NL), body length (BL), thigh length (TL), shank length (SL), chest girth (CG) and wing length (WL). Haematological parameters included packed cell volume (PCV), haemoglobin (Hb), pH, red blood cells (RBC) and white blood cells (WBC). Biochemical parameters included total protein (Tp), aspartate transaminase (AST), alanine transaminase (ALT) and creatinine and all the carcass traits (live weight, dressed weight, carcass weight, thigh, breast, wing, back, drumstick and neck). The results obtained for body weight at 20 weeks were 4.15kg and 2.80kg, respectively for male and female Norfolk while for Mammoth were 3.70kg and 3.02kg for male and female, from the result it shows that the male of Norfolk have significantly ($P<0.05$) higher BW than the male of Mammoth but the female of Mammoth have significantly ($P<0.05$) higher BW than the female of Norfolk. For linear body measurements the result shows that the male of Norfolk have the higher values which are significantly ($P<0.05$) different in all the parameters measured than the Mammoth male but no significant ($P>0.05$) difference were observed in all the parameters measured between the females except for BL where the Mammoth female have significantly ($P<0.05$) higher value than that of Norfolk. The result of haematological parameters shows that there were significant ($P<0.05$) difference between the breeds but no significantly ($P>0.05$) difference between sex within breed with Mammoth having the best values in all the parameters measured except for WBC, where the Norfolk have the best values. For biochemical parameters it shows that there were significant ($P<0.05$) difference in Tp and ALT values between the breed but no significant ($P>0.05$) different between sex within breed. AST and Creatinine have no significant ($P>0.05$) difference between and within the breed. The result of carcass shows that there were significant ($P<0.05$) difference in all the traits measured between and within the breed except thigh which has no significance ($P>.05$) difference by the breed and sex. For the organs Norfolk also have the higher values. The result for correlations shows highly positive correlation and high significant ($p<0.01$) between neck and thigh with moderate between drumstick and breast and all other traits that were measured are highly positively correlated in Norfolk while in Mammoth it was moderate to low positive correlations between the traits. In conclusion the Norfolk breed is better because it has high body weight and fast growth, so the farmers should go for Norfolk.

CHAPTER ONE

1.0 INTRODUCTION

Turkey (*Meleagris gallopavo*) is a source of animal protein and one of the world's most demanded poultry. And it's meat consumed in large quantities in Nigeria. Despite the increase in demand for turkey consumption, there are no large scale commercial turkey farms in Nigeria to meet the ever increasing demand (Ogah, 2011). Turkey breeders have selected birds for fast growth and large body size in order to maximize production (Kranis *et al.,* 2008).

Turkey has been found to contribute to the economic and social life of Nigerians in that they are used during festive periods (Smith, 1990). Growth is defined as the increase in the numbers of cell of the body. Growth performance of an animal is the phenotypic expression of the animal genetic makeup (genotype), (Oluyemi and Roberts, 2000). The exact time at which the animal is ready for slaughter can be consider on the basis of body weight and general development (Kabir *et al.,* 2006).

Nowadays with the vast majority of poultry products being marketed in cut-up parts, yield of high value items such as breast and thigh have become critical to processors (Young *et al.,* 2001). Watts and Kennett (1995) reported that demand for high quality parts have driven poultry industry to change their marketing practices to cut-up parts in response to consumer's needs.

Linear body measurements are useful in live weight determination (Gul *et al.,* 2005). The relationships existing among linear body traits provide useful information on performance, productivity and carcass characteristics (Kabir *et al.,* 2010). A number of

external body parts are known to be positively correlated with body weight (Okon *et al.*, 1997). Adeniji and Ayorinde (1990) reported that establishment of relationship between body weight and conformation traits such as shank length, thigh length, breast width, neck length and back length makes the work of breeders easier and faster as efforts can be concentrated on those traits that are easier to be measured. Linear body measurements have also been used to predict live weight in poultry (Gueye, 1998).

Ibe and Ezekwe (1994) reported that body weight and linear body measurements have been documented and found useful in qualifying body size and shape. It has been reported that genetic variation in carcass traits and body shape in turkey has received little attention (Nestor *et al*., 2001). Variation in body weight within a flock can be attributed to genetic variation and environmental factors that impinge on individuals (Ayorinde and Oke, 1995). In comparing between body parts of two strains of Nicholas and hybrid turkey, Barbour and Lilburn (1996) had reported heavier weight of pectoral's major and tibia, plus associated muscles, as well as higher relative weights of pectoral's major in the hybrid toms at 72 and 82 days. Development of muscles and bones were studied by Brenoe and Kolstand (2000) during the period of 4-12 weeks old in two commercial strains of turkeys (BUT-9 and Nicholas) of both sexes. The authors reported that meat proportion increased and bone percentage decreased significantly throughout the experimental period for both strains and sexes. BUT-9 tended to have a higher percentage of meat than Nicholas, while Nicholas strain of turkey showed lower bone percentage than BUT-9. They concluded that BUT-9 males should be preferred, since males gained significantly higher body weight and had higher meat percentage from 8 week of age. Males of late ages should be used in production to satisfy the market for high slaughter weights with large pieces of meat, while females should be

slaughtered at lower live weights because females had a higher meat percentage at young ages compared with males.

Bounous *et al.* (2000) observed that white blood cells and differentials counts, serum albumin, aspartate transaminase (AST) and alanine transaminase (ALT) have not been previously reported for domestic or wild turkeys. Warren, (1995) reported that there are differences between serum chemistry characteristics of different breeds of turkey at different ages from different geographical and agricultural zones of the world. Adejumo *et al.* (2005) reported that serum biochemical values have been established in most domestic mammalian species and limited information is available for domestic avian species and even less has been established for Turkey species.

1.1 Justification

Ogah (2011) reported that body weights of turkey at different ages have to be predicted with reasonable accuracy by taking various body measurements. The most common parameters used for body measurements in turkey are; shank length, breast girth, keel length, body length and thigh length (Ilori *et al*., 2010). Turkey production in Nigeria is not well documented and information on growth pattern of turkey is mostly non-available (Riva *et al*., 2002). There is need for researchers to seek how to improve turkey production in terms of it's growth and carcass characteristics (Lawrence and Fowler, 2002). These can be achieved on the basis of conducting studies on the effects and relationships among breed, age and sex in relation to growth, haematological, serum biochemistry and carcass characteristics of common turkey breeds that are reared in Nigeria. There was limited information on blood available for domestic avian species and even less has been established for turkey species. Breed, sex and feeding also

influence carcass quality which affect market demand. This study was conducted to obtain information on different breeds of turkey (Norfolk black and Mammoth-bronze) with interest on growth, carcass characteristics and blood parameters.

1.2 Hypotheses

Null:

- Breed of turkey (Norfolk-black and Mammoth-bronze) has no effect on Body weight, growth rate and carcass characteristics.
- Sex of the turkey breeds has no effect on weight, growth rate and carcass weight.
- Breed, sex and age have no effect on blood parameters of Turkey.

1.3 Objectives

The objectives of the study were to determine:

1. The effect of breed of turkey (Norfolk-black and Mammoth-bronze) on body weight, growth rate and carcass characteristics.
2. The effect of sex of the birds on body weight, growth rate and carcass characteristics of two breeds of turkey (Norfolk-black and Mammoth-bronze).
3. The effect of breed, sex and age on blood parameters of turkey.
4. The correlation among growth and carcass traits of the two breeds.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Taxonomy and History of Turkey

Kingdom: Animalia

Phylum: Chordata

Class: Aves

Order: Galliformes

Family: Meleagridinea

Genus: Meleagris

Specie: *M. gallopavo*

(Encyclopedia Britannica, 2010)

The modern domesticated turkey descended from one of six subspecies of wild turkey, *Meleagris gallopavo* (Michael, 2008). The Aztecs domesticated the turkey (Mexican Spanish *guajolote*, from Nahuatl *huexolotl*) and used it as a major source of protein (meat and eggs), and also employed its feathers extensively for decorative purposes, as did many other Mesoamerican cultures (Encyclopedia Britannica, 2010). After being introduced to Europe, many distinct turkey breeds were developed (examples include Spanish Black, Royal Palm). In the early 20th century, many advances were made in the breeding of turkeys, resulting in varieties such as the Beltsville Small White (Encyclopedia Britannica, 2010). The 16th-century English navigator William Strickland is generally credited with introducing the turkey into England. (Emett, 2003; Fuller, 2004). His family coat of arms — showing a turkey cock as the family crest — is among the earliest known pictures of a turkey (Peach, 2001). The domestic turkey was sent from England to Jamestown, Virginia in 1607 (James, 1992).

2.2 Domestication of Turkey

Domestication of the common turkey probably started by the Indians of Pre-Columbian Mexico. The birds were first taken to Spain in 1519, where they spread throughout Europe, reaching England in 1541(Encyclopedia Britannica, 2010). When the bird became popular in England, the name turkey cock, formerly used for the guinea fowl of Islamic (or "Turkish") lands, was transferred to it. English colonists then introduced European-bred strains of the turkey to eastern North America in the 17th century. Turkeys were mainly bred for their beautifully coloured plumage until about 1935, after which the breeding emphasis changed to their meat qualities. (Encyclopedia Britannica 2010)

2.3 Physical Description of Various Breeds of Turkey

Adult males have a naked, heavily bumpy head that is normally bright red in colour but turns to white overlaid with bright blue when the birds are excited. Other distinguishing features of the common turkey are a long red fleshy ornament (called a snood) that grows from the forehead over the bill; a fleshy wattle growing from the throat; a tuft of coarse, black, hair like feathers (known as a beard) projecting from the breast; and more or less prominent leg spurs (Encyclopedia Britannica, 2010). The male turkey, or gobbler, or tom, may be 130 cm long and weighs 10 kg, though average weight is less. Female turkeys, or hens, generally weigh only half as much as the males and have less warty heads than do the males. Domesticated strains of the common turkey, developed for their fine-tasting flesh, may be much heavier, (Encyclopedia Britannica, 2010).

2.3.1 Norfolk breed

Black or Black Spanish or Norfolk Black was developed in Europe from the first turkeys brought there from North America by explorers. Despite the names ―Spanish and ―Norfolk‖ (England), birds of this type are to be found in many European nations. Keep in mind that all domestic turkeys have their origins in wild birds taken back to Europe by the Spanish explorers, domesticated there and brought back to the New World by the English colonists. Turkeys were transported to the colonies in the holds of ships as a food supply for the transatlantic crossing from Europe to the New World. The turkeys consumed at the first thanksgiving meal may have actually been from European birds, rather than Wild Turkeys native to the continent. Black turkeys were crossed with the Wild Turkey to help produce varieties such as the Bronze, Narragansett, and Slate. (Encyclopedia Britannica, 2010).

2.3.2 Bronze white

It has white plumage and a deep black beard. The beak is pink to horn colored and the throat and wattles as well as shanks and toes are pinkish-white. The standard eye color is brown. It was commonly used for commercial production in the early 1900s. It was desirable because of its white plumage which reduced the visibility of pinfeathers when plucked. In the 1950s, the breed was crossed with the Broad Breasted Bronze to create the Broad Breasted White. Standard weights are 33 pounds for a tom and 18 for a hen (Encyclopedia Britannica, 2010).

2.4 Turkey Production in Nigeria

The growth of turkey industry in Nigeria is very fast. This fast growth was made possible by intensification of production and development of large breeds with standard weights ranging from 15-17 kg for male and 8-10kg for female, (Ogundipe and Dafwang, 1986; Ojewola, 1993). Turkey production in Nigeria has largely remained at the small holder level due to various reasons ranging from management problems to lack of incentives by Government. (Udokainyang, 2001). There is obvious lack of information on specific requirements for turkey production in Nigeria, which may be attributed to low level of researchninto turkey production in Nigeria. More so, the lack of interest on turkey production was mainly due to the government policy that liberalized turkey importation since 1977. According to Thear and Fraser (1986) imported turkey formed about 60% of the total turkey in Nigeria market, while the rest is supplied by other sources including soldiers. Nigerians consume about 8.6g animal protein per head with turkey accounting for about 1.5g despite its great potentials in the supply of good quality animal protein and high rate of turnover of investment (Ojewola 1993; Ojewola *et al*., 2000).

2.5 Factors Affecting Growth and Performance of Turkey

2.5.1 Environmental temperature and management

Environmental extremes have deleterious effects on the productive performance and well-being of all domestic animals (Ilori *et al*., 2010). This condition affects the feed intake and growth rate and has negative effect on feed efficiency in growing birds (Ilori *et al.*,2009) When turkey feed is deficient of required nutrients, it could lead to health problems thereby causing weight loss. Hot ambient temperatures, above the zone of thermoneutrality for domestic poultry, typically the summer season in the greater

poultry producing area especially in tropical regions and these affect performance and overall adaptation to the climatic region (Ilori *et al*., 2009). According to Reece and Lott (1983), these conditions reduce feed intake and growth rate and negatively affect feed efficiency in growing birds. Prolonged periods of stress caused by elevated ambient temperature increase the time to reach market weight and increase in mortality rate (Deaton *et al.*, 1978).

According to Smith (1992) young turkey (poults) are very difficult to rear thus poults should be transferred to brooder house as soon as they are hatched and brooded at 35^0C or even higher, such as 37.8^0C for white poults, for the 1^{st} two weeks but reduce by about 2^0C every week until room temperature is reached. Solaja (1986), reported that during brooding of the poults, there should be a proper temperature of not less than 32.2^0C initially and gradually reduced to18.3^0C – 21.1^0C by the 6th week of age. The principal brooding system involves the use of either solid or wire floor. Floor brooding on a litter of wood shavings or peat moss requires a large floor area which must be maintained in a dry condition to minimize the risk of parasites (Sainsbury, 1992). Cole and Ronning (1994) reported that young poults should be reared in exactly the same way as chicken but are more delicate and it is even more important to protect them from drought and cold in the first week of life.

2.5.2 Breed

The genetic code passed from parent to offspring determines how fast animals reach their maturity size. Potential growth is the maximum possible growth rate genotype can achieve when given perfect nutritional and husbandry condition (Gous, 1997). Genetic selection for increased growth rate has consequence on nutritional and environmental requirements of turkey.

2.5.3 Disease

Genetic increases in body weight (BW) of turkeys are associated with a increase in resistance to some diseases (Saif *et al.* (1984)). In chickens, there is evidence of a relationship between increased BW and decreased disease resistance. Han and Smyth (1972, 1973) found that high growth lines had higher mortality and a higher percentage of birds with lesions in the dorsal root ganglia, gonads, liver, and spleen than corresponding low-growth lines when exposed to Marek's disease. Mauldin *et al.* (1978) observed that mortality plus survivors with heart lesions following challenge with *Escherichia coli (E. Coli)* were greater for a high weight line than a low-weight line and greater for normal than for dwarf birds in a generation where there was a previous outbreak of *E. necatrix*.

In another generation with no history of disease, the low-weight line appeared to be more susceptible to *E. coli* challenge with no difference in resistance between normal and dwarf birds. Maatman *et al.* (1993) found that a commercial broiler stock was more susceptible to *E. coli* inoculation than was a commercial leghorn stock. Conversely, genetic increases in antibody production have been associated with decreased BW (Martin *et al.*, 1990; Parmentier *et al.*, 1998). Boa-Amponsem *et al.* (1991) suggested that demands for fast growth, whether genetically induced or imposed by nutritional manipulations, result in deprivation of resources to systems that determine general fitness. This hypothesis of changes in resource allocation for growth at the expense of fitness in growth selected chickens was discussed in detail by Dunnington and Siegel (1996). Turkeys may suffer from coccidiosis, air sacculitis and blackhead, which are caused by organisms specific to each disease. Isolation ensures that these organisms do not come into contact with these birds. Blackhead, a disease more common to the

chickens may not harm the chickens but is fatal to turkeys (Olatoye, 2010). Although turkeys are resistant to various disease but the veterinary care is required at initial stages and for vaccinations, but the turkeys are completely resistant to Marek's and affected by bronchitis, fowl pox and coccidiosis. Some of the commonly encountered diseases in turkey are fowl cholera, erysipelas, hemorrhagic enteritis and avian influenza. The turkeys are protected from fowl cholera and erysipelas by vaccination

2.5.4 Feed and water consumption

Turkeys had measured feed conversion ratio as 2.5 at 12 weeks, and 3.0 at 16 weeks, respectively (Gansel and Neubauer, 1974). Feed intake of turkeys was 2.97-3.58 kg/kg body weight and highest profit was obtained by slaughtering at 14 weeks old (Kucka, 1989), and daily food consumption for turkeys averaged 10.2 to 10.7 g at first 2 weeks; 32.5 to 33.7 g over the 12 week period and food conversion for turkeys (g feed/g gain) 3.00 to 2.89 over the 12-week period (Jagbir Singh *et al.,* 1991), and with consumption varying from 2.77 to 4.38 kg/kg weight gain for turkey (Kucka, 1991). Heat production is affected by body weight, species and breed, level of production, level of feed intake, feed quality and, to a lesser extent, by the amount of activity and exercise. This implies that the birds increase water consumption to compensate for water loss and to increase the heat dissipation capacity. However, water retention is reduced due to the increased electrolyte excretion in urine and faeces (Belay *et al*., 1992; Belay and Teeter, 1996). At this point, if the amount of water lost is not completely compensated, dehydration and increased body temperature will occur. To overcome this problem, birds consume markedly more water (Tanveer *et al*., 2005), causing plasma expansion, reduced plasma osmolarity and whole blood viscosity (Zhou *et al*., 1999). Although birds consume more water to overcome these consequences, water retention is reduced due to increased

electrolyte excretion (Belay *et al*., 1992) and due to continuous loss of water through panting.

2.6 Body Weight

Gansel and Neubauer, (1974) reported the values of body weight of Beltswille White and Broad Breasted White turkeys as 4150 and 3650 g of at 12 weeks and also 5700 and 5000 g at 16 weeks. Popescu-Vifor and Puscatu, (1979) reported 4710 to 5320 g for Beltswille White turkeys at 13 weeks. Turkoglu *et al.,* (1990) reported 4420.0, 5309.0, 6104,6 g of Betina turkeys at 16, 18, 20 weeks respectively and also 4870.0, 5818.4, 6682.0g for Bronze X Betina turkeys, respectively. Sarica *et al.,* (1991a) reported 4416.9, 4799.4, 5547.0 g for Bronze turkeys at 16, 18, 20 weeks. Testik and Celen, (1993) reported 3225.5-2359.7, 5323.5-3816.7 g for Bronze turkeys for males-females at 14, 18 weeks respectively. Celen and Testik, (1995) reported 5860.0-5200.0 g for Canadian Hybrid Turkeys at 14 weeks and 7020.0-6025.0 g at 18 weeks. Aksoy, (1996) reported 10575 and 6877 g for males and females for Bronze turkeys at 24 weeks. Isguzar and Testik, (2001) reported 5170.3-3927.8 g, 7282.7-5022.4 g for Bronze turkeys for males-females at 16, 20 weeks. Sengul, (2001) reported 3348.3-3064.2 g for Bronze turkeys at 16 weeks.

2.7. Haematological Parameters

2.7.1. Packed cells volume (PCV)

PCV is a measure of the proportion of blood volume that is occupied by red blood cells. Mary and Gamothy (2008) reported that the PCV of turkey ascended with age from 0-3 weeks and reached the peak value of 54.39 per cent at 18-26 weeks and then decreased gradually to a lower value at above 50 weeks age group, the highest values were observed in both sexes at 18- 26 weeks. Hodges (1977), Suchy *et al.* (1995) and

Strakova *et al.* (1996) had reported that PCV increased with age in turkeys. Lisano and Quay (1977) observed that PCV values increased with age in the first nine months and gradually declined over the next 4 months in turkeys. Ferguson *et al.* (1964) observed that PCV values increased with age in male turkeys from 3 days to 13 months. Hunsaker (1969) reported that PCV values were higher in male turkeys than in females. Hodges (1977) reported significant difference between PCV values of male and female turkeys. Lisano and Quay (1977) had reported higher mean PCV values in males than in female turkeys.

2.7.2. Haemoglobin (Hb)

Haemoglobin is the iron-containing oxygen-transport metalloprotein in the red blood cells of all vertebrates. Hb in the blood carries oxygen from the respiratory organs to the rest of the body (i.e tissues) where it releases the oxygen to burn nutrients to provide energy to power the functions of the organism in the process called metabolism (Wikipedia 2007). Mary and Gamothy (2008) reported that Hb concentration increased with age in turkeys from 0-3 weeks to 26-34 weeks age group to reach the highest value of 10.47 g/dl and then decreased gradually. Strakova *et al.* (1996) reported that Hb value ranged between 8.44 to 10.67 g/dl in 94 days old turkeys. Ferguson *et al.* (1964) and Suchy *et al.* (1995) reported that Hb increased with age in turkeys. Lisano and Quay (1977) observed that Hb values increased with age for the first nine months and then decreased gradually in turkeys and they also reported higher Hb values in males than females.

2.7.3 Red blood cells (RBCs)

Red Blood (RBC) these cells carry oxygen throughout the body tissues via the blood flow through circulatory system. Too many RBCs (or platelets) in the bloodstream may

cause slow blood flow and compromise circulation. A low RBC may signify anaemia, a shortage of red blood cells, or haemoglobin the oxygen- carrying part of the RBC; this usually reflects underproduction or premature destruction of the cells (Encyclopedia Britannica, 2010).

2.7.4 White blood cells (WBCs)

White Blood Cell (WBC) is the count of white blood cells called leukocytes. WBCs defend the body against infection and make up part of the immune system. Like other blood cells they are produced in the bone marrow. A high WBC means fighting an infection, or the immune system has been activated. A low WBC might mean there is a problem with production in the bone marrow, which could be the result of various chronic diseases (Encyclopedia Britannica, 2010).

2.7.5 Serum biochemical parameters

Serum biochemical values are useful in determining the health and general condition of birds. A review of the literature on the composition of turkey blood and some studies were reported with a small number of birds and gave no details concerning the age, sex, state of reproduction, or other conditions (Kirshner *et al*., 1951). Also, clinical chemistries can be a useful adjunct in the development of a diagnosis and prognosis in avian species (Lewandowski *et al*., 1986) and may provide useful information about the physical condition of individuals.

2.7.6 Total protein (Tp)

The plasma proteins serve a number of important functions including maintenance of normal blood volume and water content in the tissues, and maintaining normal acid-base balance in the blood. Mary and Gomothy (2008) reported that total serum protein

increased from 2.71 g/dl in 0-3 weeks to 4.68 g/dl in 26-34 weeks and then declined to a lower value of 2.32 g/ dl in above 50 weeks in poultry. The overall value of 3.10 g/dl irrespective of age was in agreement with the value of 3.50 g/dl reported by Clarkson (1966) and 3.44 g/dl by Turk (1968) in turkeys. Bierer (1969) observed that the total protein in turkeys ranged between 3.00-3.60 g/dl. Lisano and Quay (1977) reported higher mean total protein value in females than in male turkeys. Kundu *et al.* (1993) also had reported higher protein values in females than in male guinea fowls at 5 and 8 months of age and suggested that age had greater influence on females than males. Darshan *et al.* (1987) observed that the protein values were higher in females than in male broiler parents and suggested that the increased protein level in females was due to oestradiol effect and advancement of age. Ogundu *et al.* (2013) reported that there are breed effects on Total protein values of turkeys at 12 weeks of age, the blacks had the values of 4.8 g/dl and white had the values of 6.38 g/dl. The authors also reported that there were age effects on Tp values of turkeys at 6 and 12 weeks of age, the authors gave the values as 6.22 g/dl at 6 weeks and 4.90 g/dl at 12 weeks and also reported that there were sex effects on Tp values of turkeys and they gave the values as 5.66 g/dl for males and 5.53 g/dl for females.

2.7.7 Creatinine

Creatinine is a waste product, a measure of kidney function as well as skeletal muscle buildup and breakdown in body maintenance. Increases indicate muscle breakdown, often to supply amino acids to the body when protein digestion is impaired. Decreases indicate low protein intake or impaired protein digestion. Ibrahim *et al.* (2012) reported that the values of creatinine in poults (4 to 8 weeks) as 0.63 mg/dl, for growers (12 to 20

weeks) as 0.55 mg/dl and that of adult (20 weeks and above) was 0.98 mg/dl in turkeys reared in Semi-Arid environment of Nigeria.

2.7.8 Aspartate aminotransferase (AST)

AST can also reflect gonadal function and shows the amount of oxygen available at membranes. Aside from liver/heart/muscle damage, elevations in AST can indicate a deficiency of hormones and Vitamin E. Decreases indicate a deficiency in the gonad itself. Aspartate aminotransferase (AST) values are age-dependent to varying degrees among different species and the cause of this age-dependent increase activity has not been defined (Hochleithner, 1994). Moreover, fluctuations in serum levels of AST are difficult to interpret because of the wide distribution of this enzyme in avian tissue (Amand, 1986). Ibrahim *et al.* (2012) reported that the values of AST in poults (4 to 8 weeks) was 18.17 iu/L, for growers (12 to 20 weeks) as 24.17 iu/L and that of adult (20 weeks and above) as 42.67 iu/L in turkeys reared in semi-arid environment of Nigeria. Ogundu *et al.* (2013) reported that there were breed effect on AST values of turkeys at 12 weeks of age, the blacks had the values of 76.91 iu/L and white had the values of 72.79 iu/L. The authors also reported that there were age effects on AST values of turkeys at 6 and 12 weeks of age and gave the values as 78.95 iu/L at 6 weeks and 70.87 iu/L at 12 weeks. Sex effect on AST values of turkeys was reported and values of 73.36 iu/L for males and 70.63 iu/L for females were reported by same authors.

2.7.9 Alanine aminotransferase (ALT)

ALT also reflects liver function and increases can mean problems with this organ as well as possible heart damage. Ibrahim *et al.* (2012) reported that the values of ALT in poults (4 to 8 weeks) was 15.50 iu/L, for growers (12 to 20 weeks) was 35.17 iu/L and

that of adult (20 weeks and above) as 37.33 iu/L in turkeys reared in semi-arid environment of Nigeria. Ogundu *et al.* (2013) reported that there were breed effect on ALT values of turkeys at 12 weeks of age, the blacks had the values of 18.42 iu/L and white had the values of 17.30 iu/L. The authors also reported that there were age effects on ALT values of turkeys at 6 and 12 weeks of age, with values as 17.89 iu/L at 6 weeks and 17.82 iu/L at 12 weeks. They also reported that there were sex effects on ALT values of turkeys with the values of 15.09 iu/L for males and 16.47 iu/L for females.

2.8 Carcass Characteristics

A turkey's skeleton comprises about 5% of its total body weight with strong well developed muscles running the length of the leg (Stu Keck, 2004). Strain, sex and feeding strategies may influence carcass quality and composition, which in turn may be utilized to meet different market demands (Brenoe and Kolstad, 2000). Nestor *et al.* (2001) observed that genetic variation in carcass traits and body shape in turkey had received little attention.

2.8.1 Internal organs:

Nestor *et al.* (1995) reported that with an increasing body weight of turkeys, the weight of internal organs was also increasing, yet not proportionally. As a consequence, the percentage share of those organs in body weight is decreasing in the successive generations of birds. Sarica *et al.* (2009), who compared the total percentage contribution of internal organs in body weight, between slow-growing Bronze turkeys, fast-growing Hybrid turkeys and their hybrids, demonstrated the highest percentage of heart, live rand gizzard in Bronze turkeys (4.2% in toms and 4.7% in hens), followed by hybrids (3.0% in toms and 3.9% in hens), and the lowest one in hybrids (2.9% in toms

and 3.0% in hens). Moran *et al.* (1970) reported that the average carcass percentage of Large White turkeys for males at 27 weeks was 81.2 % and 79.5 % for females at 24 weeks. Sarica *et al.* (1991a) reported 73.4 and 72.5 % for Bronze turkeys at 20 weeks. Sarica *et al.* (1991b)

CHAPTER THREE

3.0 MATERIALS AND METHODS:

3.1 Experimental Site

This research was carried out at the Poultry Unit of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria. Zaria is Located within the Northern Guinea Savannah Zone of Nigeria, on the latitude $11^0$9' 45" N and longitude 7^0 38' 8" E, at an altitude of 610m above sea level (Ovimaps, 2012).

3.2 Source of Experimental Birds:

Day old Poults of two breeds of Turkey were purchased from ZARTECH Farms Ltd, Ibadan, Oyo State of Nigeria. A total of 100 day old poults comprising 50 Norfolk-black and 50 Mammoth-bronze was used for this study. The Norfolk have black plumage while Mammoth have white plumage and their eye colour is brown

3.3 Management of Experimental Birds:

Before the arrival of the poults, the brooding room was cleaned, disinfected and fumigated. On arrival, the birds were brooded with the aid of kerosene stoves and electric bulbs as sources of heat. The birds were allowed *ad libitum* access to feed and water, they were fed with starter diets made up of 28% crude protein (CP) and 2800 kcal/kg metabolizable energy (ME) from day old to four weeks (1-4), from 4 weeks to 8 weeks the birds were fed with diets containing 26% CP and 2900 kcal/kg ME. The diet fed from 8 weeks to 12 weeks consisted of 22% CP and 3000 kcal/kg ME, from 12 weeks to 16 weeks 19% CP and 3100 kcal/kg ME and from 16 weeks to 20 weeks 17% CP and 3351kcal/kg ME (Waldroup, 2001). Vaccines, antibiotics and anticoccidiosis were administered to the birds at appropriate time to protect them from diseases. The experiment lasted for 20 weeks from May to September 2013.

3.4 Experimental Design:

The study was a 3-way factorial arrangement with breed, sex and age in 2 × 2 × 3 factorial in Completely Randomized Design (CRD). Each breed was repeated five times with ten birds per repetition.

3.5 Data Collection

3.5.1 Body weight (kg):

The body weight of an individual bird was taken with a weighing scale in the morning before feeding at an interval of two weeks (i.e. day 1, 2 weeks, 4 weeks, 6weeks, 8 weeks, 10weeks, 12 weeks, 14 weeks, 16weeks, 18 weeks and 20 weeks) respectively. All birds were weighed and the mean body weight was calculated for each breed.

3.5.2 Linear body measurements:

Linear body measurements were taken at interval of two weeks (i.e. day 1, 2, 4, 6, 8, 10, 12, 14, 16, 18 and 20 weeks, respectively) and they included shank length (cm), back length (cm), chest girth (cm), neck length (cm), thigh length, and wing length. All measurements were taken by the same person and were done with a tailor's tape rule calibrated in centimetre.

Shank length (SH): The bones of tarso- metatarsus were measured from hock joint to the base of three toes that make the shank (cm).

Back length (BL): The back was measured from the base of the neck to the uropygial gland at the base of the tail (cm).

Chest girth (CG): The measurement were across the keel bone from left armpit to the right armpit (cm).

Thigh length (TL): The measurement was taken from the hock joint to the hinge joint (cm).

Neck length (NL): The neck was gently straightened out and the length was measured (cm).

Wing length (WL): The wing was measured from the shoulder joint to the extremity of terminal phalanges (cm).

3.5.3 Haematology

A total of forty (40) birds were randomly selected which comprised of twenty (20) birds from each breed in which ten (10) males and ten (10) females of each breed were used at 4, 8, 12 and 16 weeks of age. Two (2) mls of blood sample was collected from each bird through their wing vein with a sterile syringe and each blood sample was transferred immediately to a test tube containing EDTA (ethylene diamine tetraacetic acid) each bottle contained 2 mls of EDTA in order not to coagulate. Thin smears on glass slides were made immediately after the blood collection to avoid any interference on cell structure. Total red blood cell (RBC) and total white blood cell (WBC) counts were performed by a manual method using blood diluted on 0.01% toluidine blue stain (Zinkl, 1986). The haemoglobin concentration was measured by cyanmethemoglobin method. The Packed Cell Volume (PCV) was determined by the microhematocrit method in capillary tubes and centrifuged for 5 minutes.

3.5.4 Serum Biochemistry

A total of twenty (20) birds were randomly selected which comprised of ten (10) birds from each breed in which five (5) males and five (5) females of each breed were used at 8 and 16 weeks. Three (3) mls of blood sample was collected from each bird through their wing vein with a sterile syringe and emptied into a collecting tube without

anticoagulant (plain parameters). Serum was obtained by centrifugation and the serum samples were stored until analyzed. Total protein was determined by Kjedahl method as described by Kohn and Allen (1995), albumin by the method of Doumas *et al*., (1971), Creatinin was determined by the methodology of Harrison (1947). The liver functions were also determined: the levels of Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT) were determined using spectrophotometric method as described by Holder and Rej (1983) and Rej and Holder (1983).

3.5.5 Carcass evaluation:

At the end of twenty (20) weeks, 6 birds were selected from each breed which comprised of 3 males and 3 females on the basis of average weight and were weighed, slaughtered and eviscerated for carcass evaluation. The birds were fasted for 12 hours before slaughtering, bled and slaughtered weight was taken in kg. The birds were defeathered manually using hot water and eviscerated. The live weight and carcass weight were recorded. The dressing percentage was calculated. Organ weights and the major primal carcass parts were expressed as the percentages of the dressed weight.

Table 3.1: Compositions of the diet fed.

	1-4 weeks	4-8 weeks	8-12 weeks	12-16 weeks	16-20 weeks
Maize	42	47	55	56	60
SBM	20	18	19	8	8
GNC	25	26	18	20	15
Maize bran	3.23	3.23	3	9.25	7.3
Fish meal	7	3	0	0	0
Bone meal	1	1	1	1	1.5
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.12	0.12	0.12	0.12	0.12
Methionine	0.15	0.15	0.15	0.15	0.15
Palm oil	0	0	3	4	6
Lime stone	1	1	1	1	1
Total	100	100	100	100	100
Cal.Analysis					
Energy	2806.68	2835.50	3082.28	3116.94	3254.15
CP	27.68	25.86	22.04	18.93	16.81
CF	3.12	3.18	3.06	3.48	3.19
Ca	1.12	0.99	0.84	0.85	1.20
P	0.73	0.62	0.51	0.47	0.55
Lysine	1.63	1.41	1.19	0.89	0.81
Methionine	0.65	0.57	0.48	0.43	0.41

SBM=soybean meal, GNC=groundnut cake, Cal. Analysis=calculated analysis, CP=crude protein, CF=crude fibre, Ca=calcium and P=phosphurus

3.6 Statistical Analysis:

The data generated were subjected to Generalized Linear Model (GLM) procedure of SAS (2002). Difference among the breeds in terms of body weight, linear body measurements and carcass traits were compared using Duncan Multiple Range Test (DMRT) Duncan, (1955).

Model for the experiment:

$$Y_{ijkl} = \mu + B_i + A_j + S_k + (B \times A)_{ij} + (B \times S)_{ik} + (B \times S \times A)_{ijk} + e_{ijkl}$$

Where:

Y_{ijkl} = Observations

μ = Overall population mean

B_i = the effect of i^{th} breed (i = Norfolk-black, Mammoth-bronze)

A_j = the effect of j^{th} age (j= 12, 16, 20)

S_k = the effect of k^{th} sex (k= male, female)

$B \times A_{ij}$ = interaction of breed and age

$B \times S_{ik}$ = interaction of breed and sex

$B \times S \times A_{ijk}$ = interaction of breed, sex and age

e_{ijkl} = random error term

CHAPTER FOUR

4.0 RESULTS

4.1 Breed and Sex Effect on Growth, Blood and Carcass Characteristics

The interaction effect of breed and sex on body weight and linear body measurements, haematological and biochemical of Turkeys at 20 weeks of age are shown on Tables 4.1, 4.2 and 4.3 respectively. There was significant differences ($p<0.05$) in body weight of both sexes across breeds, the male of Norfolk had an average body weight of 4.15kg and Mammoth had 3.70kg while the female of Mammoth have an average of 3.02kg and Norfolk has 2.80kg at 20 weeks of age which showed that the male of Norfolk were heavier than male of Mammoth but this was reversed in the females as Mammoth were heavier than that of Norfolk (Table 4.1). For linear body measurements all the parameters measured were significantly affected by sex with male of Norfolk having the superior values except in CG and WL of female across the breed that shows no significant difference.

In table 4.2 there was significant difference ($p<0.05$) of sex across the breed for haematological prameters at 16 weeks of age. For serum biochemical parameters of Turkey at 16 weeks (Table 4.3), the result shows that there was significant effect ($p<0.05$) of sex across the breed on Tp and ALT with Mammoth having the best Tp values and Norfolk has the best of ALT values.

Table 4.1: Breed and sex effects on body weight (kg) and linear body measurement (cm) of Turkeys at 20 weeks of age.

		NORFOLK		MAMMOTH		
Traits	Male	Female	Male	Female	SEM	LOS
BW	4.15[a]	2.80[d]	3.70[b]	3.02[c]	0.04	*
NL	29.59[a]	26.49[c]	26.98[b]	25.90[d]	0.10	*
BL	33.38[a]	29.68[d]	32.56[b]	30.20[c]	0.13	*
TL	20.31[a]	16.96[c]	20.29[a]	17.50[b]	0.13	*
SL	16.60[a]	14.33[c]	16.07[b]	13.69[d]	0.13	*
CG	47.57[a]	41.72[c]	43.62[b]	41.68[c]	0.21	*
WL	33.29[a]	29.80[c]	31.67[b]	30.00[c]	0.13	*

abcd means with different superscripts on the same row are significantly different ($p<0.05$). BW=Body weight, NL=Neck length, BL=Back length, TL=Thigh length, SL= Shank length, CG= Chest girth, WL= Wing length, SEM= standard error of mean, LOS=level of significant, NS=not significant, * $p<0.05$,

Table 4.2: Breed and Sex effect on haematological parameters of Turkey at 16 weeks.

	NORFOLK		MAMMOTH			
Parameters	Male	Female	Male	Female	SEM	LOS
PCV (%)	35.81^{b}	35.95^{b}	37.01^{a}	37.75^{a}	0.73	*
Hb (g/dl)	11.88^{b}	11.96^{b}	12.43^{a}	12.55^{a}	0.23	*
pH	7.29^{b}	7.21^{b}	7.89^{a}	7.75^{a}	0.10	*
RBC ($\times 10^{12}$/l)	6.12^{b}	6.20^{b}	6.16^{a}	6.29^{a}	0.11	*
WBC ($\times 10^{9}$/l)	8.36^{a}	8.21^{a}	7.46^{b}	7.64^{b}	0.18	*

ab means with different superscripts on the same row are significantly different ($p<0.05$). PCV = packed cell volume, Hb = haemoglobin, RBC = red blood cells and WBC = white blood cells, SEM= standard error of mean, LOS=level of significant, NS=not significant, * $p<0.05$

Table 4.3: Breed and sex effect on Serum biochemical parameters of Turkey at 16 weeks.

	NORFOLK		MAMMOTH			
Parameters	Male	Female	Male	Female	SEM	LOS
Tp (g/dl)	3.19[b]	3.36[b]	4.08[a]	3.80[a]	0.31	*
AST (iu/l)	17.70	15.20	14.30	15.00	1.78	NS
ALT (iu/l)	8.60[a]	9.30[a]	4.40[b]	4.70[b]	1.78	*
Crt (mg/dl)	73.90	67.90	67.60	70.50	8.28	NS

ab means with different superscripts on the same row are significantly different ($p<0.05$). Tp = total protein, AST = aspartate transaminase, ALT = alanine transaminase and Crt = creatinine, SEM= standard error of mean, LOS=level of significant, NS=not significant, * $p<0.05$

The interaction effect of breed and sex on carcass traits of Turkey at 20 weeks of age, the result shows that the live weight, dress weight, carcass weight, breast, wing, back, drumstick and neck were significantly affected ($p<0.05$) by sex across breed except the thigh which has not significantly affected ($p>0.05$) by sex across the breed (Table 4.4). The male of Norfolk had the best carcass traits followed by male of Mammoth and there females. Table also shows that the small intestine, legs and kidneys were significantly affected ($p<0.05$) by sex across the breed while the heart, gizzard, liver, large intestine, head, lungs and spleen were not significantly affected ($p>0.05$) by the sex at 20 weeks of age.

Table 4.4: Breed and sex effects on carcass and organ parameters (g) of Turkeys at 20 weeks of age.

	NORFOLK		MAMMOTH			
Variables (g)	Male	Female	Male	Female	SEM	LOS
LVWT	4533.33[a]	2800.00[c]	3800.00[b]	3066.67[cd]	121.34	*
DRSWT	3900.00[a]	2500.00[c]	3233.33[b]	2466.67[cd]	114.26	*
CACWT	3133.33[a]	2033.33[cd]	2716.67[b]	2200.00[c]	90.14	*
THIGH WT	371.00	321.00	335.00	354.33	30.21	NS
BREAST WT	576.33[a]	522.67[a]	551.33[a]	435.00[b]	48.80	*
WING WT	340.00[a]	284.33[b]	356.67[a]	251.33[b]	29.09	*
BACK WT	442.67[a]	339.00[b]	443.33[a]	361.00[b]	36.58	*
DRMSTC WT	392.00[a]	295.33[b]	374.00[a]	280.67[b]	26.37	*
NECK WT	258.67[a]	180.33[b]	236.67[a]	181.67[b]	20.67	*
Heart WT	0.50	0.58	0.57	0.53	0.04	NS
Gizzard WT	4.36	4.93	4.17	4.48	0.29	NS
Liver WT	2.24	1.99	2.22	2.31	0.22	NS
SI WT	5.42[b]	5.90[a]	4.89[b]	6.33[a]	0.45	*
LI WT	1.11	1.42	1.40	1.51	0.07	NS
Head WT	3.60	3.89	3.27	3.38	0.23	NS
Leg WT	4.53[a]	3.74[b]	4.49[a]	3.85[b]	0.18	*
Lungs WT	0.82	0.72	0.85	0.80	0.14	NS
Kidneys WT	0.59[a]	0.46[b]	0.61[a]	0.61[a]	0.04	*
Spleen WT	0.12	0.17	0.17	0.11	0.03	NS

abcd means with different superscripts on the same row are significantly different ($p<0.05$). LVWT = live weight, DRSWT =dressed weight and CACWT = carcass weight, SEM= standard error of mean, LOS=level of significant, NS=not significant, * $p<0.05$, WT=weight SI = small intestine and LI = large intestine.

4.2 Breed and Age Effects on Body Measurement and Blood Profiles

The interaction effects of breed and age on body weight and linear body measurements, haematological and biochemical of turkeys at different ages are shown on Tables 4.5, 4.6 and 4.7 respectively. There was significant effect ($p<0.05$) of breed on body weight at 12 weeks of age with Norfolk having an average values of 1.96kg. For linear body measurements all the parameters that were measured at 12 weeks of age were significantly affected by breed with Norfolk having the superior values except in body length (BL) that shows no significant difference ($p>0.05$). There was significant effect ($p<0.05$) of breed on body weight at 16 weeks of age, Norfolk had higher average value of 2.64kg. For linear body measurements, all the parameters that were measured at 16 weeks of age were significantly affected by breed with Norfolk having the superior values except in SL and WL that shows no significant difference ($p>0.05$). There was significant effect ($p<0.05$) of breed on body weight at 20 weeks of age with Norfolk had higher average value of 3.49kg. For linear body measurements all the parameters that were measured at 20 weeks of age were significantly affected by breed with Norfolk having the superior values except in TL and SL that shows no significant difference ($p>0.05$) (Table 4.5)

The interaction effects of breed and age on haematological parameters of Turkey at 8 weeks of age, from the table it shows that there was significant affect ($p<0.05$) of breed on PCV and pH but no significant differences ($p>0.05$) on other parameters measured where Norfolk had the higher PCV values and Mammoth having the highest pH values. At 16 weeks it shows that there was significant difference ($p<0.05$) of breed on PCV and Hb but no significant differences ($p>0.05$) on other parameters measured which in include pH, RBC and WBC with Mammoth having the highest PCV and Hb values (Table 4.6).

The interaction effect of breed and age on serum biochemical parameters of Turkey at different ages, there was no significant effect ($p>0.05$) of breed on all parameters measured at 8 weeks. The same pattern was followed at 16 weeks on all parameters measured except on ALT which has the significant effect ($p<0.05$) with Norfolk having the better values (Table 4.7).

Table 4.5: Breed effects at various ages on body weight (kg) and linear body measurement (cm) of Turkeys.

Age	Traits	Norfolk	Mammoth	SEM	LOS
12	BW	1.96[a]	1.75[b]	0.04	*
	NL	23.70[a]	21.65[b]	0.19	*
	BL	28.40	28.76	0.25	NS
	TL	17.16[a]	16.60[b]	0.26	*
	SL	14.28[a]	12.48[b]	0.25	*
	CG	36.60[a]	31.94[b]	0.40	*
	WL	28.85[a]	27.32[b]	0.26	*
16	BW	2.64[a]	2.55[b]	0.04	*
	NL	28.50[a]	26.85[b]	0.19	*
	BL	31.80[a]	31.07[b]	0.25	*
	TL	18.68[a]	19.29[b]	0.26	*
	SL	15.84	15.48	0.25	NS
	CG	44.10[a]	43.00[b]	0.40	*
	WL	31.45	31.05	0.26	NS
20	BW	3.49[a]	3.36[b]	0.04	*
	NL	31.48[a]	30.44[b]	0.19	*
	BL	35.75[a]	34.95[b]	0.25	*
	TL	20.28	20.63	0.26	NS
	SL	17.30	17.04	0.25	NS
	CG	52.03[a]	51.13[b]	0.40	*
	WL	34.90[a]	33.83[b]	0.26	*

BW=Body weight, NL=Neck length, BL=Back length, TL=Thigh length, SL= Shank length, CG= Chest girth, WL= Wing length, SEM= standard error of mean, LOS=level of significant, NS=not significant,

Table 4.6: Breed effect at various ages on haematological parameters of Turkey.

Age(week)	Parameters	Norfolk	Mammoth	SEM	LOS
8	PCV (%)	36.05^{a}	35.95^{b}	0.04	*
	Hb (g/dl)	11.96	12.03	0.33	NS
	pH	5.60^{b}	7.57^{a}	0.14	*
	RBC ($\times 10^{12}$/l)	6.19	6.14	0.15	NS
	WBC ($\times 10^{9}$/l)	8.84	9.09	0.27	NS
16	PCV (%)	34.35^{b}	36.00^{a}	0.04	*
	Hb (g/dl)	11.41^{b}	12.23^{a}	0.33	*
	pH	8.31	8.57	0.14	NS
	RBC ($\times 10^{12}$/l)	6.00	6.04	0.15	NS
	WBC ($\times 10^{9}$/l)	7.83	7.84	0.27	NS

ab means with different superscripts on the same row are significantly different ($p<0.05$). PCV = packed cell volume, Hb = haemoglobin, RBC = red blood cells and WBC = white blood cells, SEM= standard error of mean, LOS=level of significant, NS=not significant, * $p<0.05$.

Table 4.7: Breed effect at various ages on Serum biochemical parameters of Turkey.

Age	Parameters	Norfolk	Mammoth	SEM	LOS
8 weeks	Tp (g/dl)	3.24	3.82	0.31	NS
	AST (iu/l)	19.20	16.00	1.78	NS
	ALT (iu/l)	8.40	5.00	1.74	NS
	Crt (mg/dl)	73.40	78.50	8.28	NS
16 weeks	Tp (g/dl)	3.31	4.06	0.31	NS
	AST (iu/l)	13.70	13.30	1.78	NS
	ALT (iu/l)	9.50^{a}	5.10^{b}	1.74	*
	Crt (mg/dl)	68.40	59.6	8.28	NS

ab means with different superscripts on the same row are significantly different ($p<0.05$). Tp = total protein, AST = aspartate transaminase, ALT = alanine transaminase and Crt = creatinine, SEM= standard error of mean, LOS=level of significant, NS=not significant, * $p<0.05$.

4.3 Breed, Sex and Age Effects on Growth and Blood Profiles

The interaction effect of breed and sex on body weight and linear body measurements, haematological and biochemical parameters of Turkey at different ages are shown on Tables 4.8, 4.9 and 4.10. There were significant differences ($p<0.05$) in body weight of both sexes across the breeds. The male of Norfolk had an average body weight of 2.21kg and Mammoth has 1.88kg while the weight of the female across the breed were not significantly different ($p>0.05$) at 12 weeks of age which showed that the male of Norfolk were heavier than that of Mammoth but the female were the same. For linear body measurements all the parameters that were measured at 12 weeks of age were significantly affected by sex and breed with males of Norfolk having the higher values. The same pattern were observed at 16 weeks of age but at 20 weeks there were significant differences ($p<0.05$) in body weight between the females across the breed with the female of Mammoth having higher body weight than that of Norfolk. For linear body measurements all the parameters measured were significantly affected ($p<0.05$) by sex and breed at 20 weeks (Table 4.8).

In Table 4.9, there was significant difference ($p<0.05$) of sex across the breed on all the parameters measured. The males and females of Mammoth had higher values but in WBC the male and female of Norfolk had higher values at 8 weeks of age. The same pattern was followed at 16 weeks except that there were no significant differences ($p>0.05$) within and across the breed on pH and WBC. For serum biochemical parameters of Turkey at 8 and 16 weeks (Table 4.10), the result shows that there was significant ($p<0.05$) effect of sex across the breed on Tp and ALT with Mammoth having the best Tp values and Norfolk had the best of ALT values

Table 4.8: Breed and sex effects on body weight (kg) linear body measurement (cm) of Turkeys at different ages.

		NORFOLK		MAMMOTH			
Age	Parameters	Male	Female	Male	Female	SEM	LOS
12	BW	2.21[a]	1.70[c]	1.88[b]	1.62[c]	0.04	*
	NL	24.15[a]	23.25[b]	22.50[c]	20.81[d]	0.23	*
	BL	30.20[a]	26.60[b]	30.76[a]	26.79[b]	0.28	*
	TL	17.93[a]	16.40[b]	17.59[a]	15.73[c]	0.29	*
	SL	15.55[a]	13.00[b]	13.00[b]	11.96[c]	0.28	*
	CG	37.80[a]	35.50[b]	33.12[c]	30.77[d]	0.46	*
	WL	29.80[a]	27.90[b]	27.94[b]	26.69[c]	0.29	*
16	BW	3.06[a]	2.22[c]	2.77[b]	2.34[c]	0.04	*
	NL	30.60[a]	26.40[c]	27.24[b]	26.46[c]	0.23	*
	BL	33.40[a]	30.20[c]	31.77[b]	30.38[c]	0.28	*
	TL	21.05[a]	18.30[c]	20.56[b]	18.00[c]	0.29	*
	SL	17.08[a]	14.60[c]	17.12[a]	13.85[d]	0.28	*
	CG	47.60[a]	40.60[d]	43.47[b]	42.54[c]	0.46	*
	WL	33.80[a]	29.80[d]	32.53[b]	30.54[c]	0.29	*
20	BW	4.15[a]	2.80[d]	3.70[b]	3.02[c]	0.04	*
	NL	33.05[a]	29.90[c]	31.41[b]	29.46[c]	0.23	*
	BL	38.01[a]	33.40[c]	36.06[b]	33.85[c]	0.28	*
	TL	22.55[a]	18.00[c]	22.65[a]	18.62[b]	0.29	*
	SL	18.00[a]	16.60[c]	18.77[b]	15.31[d]	0.28	*
	CG	56.05[a]	48.00[c]	53.41[b]	48.85[c]	0.46	*
	WL	36.80[a]	33.00[c]	35.06[b]	32.62[d]	0.29	*

abcd means with different superscripts on the same row are significantly different ($p<0.05$). BW=Body weight, NL=Neck length, BL=Back length, TL=Thigh length, SL= Shank length, CG= Chest girth, WL= Wing length, SEM= standard error of mean, LOS=level of significant, NS=not significant, * $p<0.05$.

Table 4.9: Breed and Sex effect on haematological parameters of Turkey at different ages.

		NORFOL		MAMMOTH			
Age	Parameters	Male	Female	Male	Female	SEM	LOS
8	PCV (%)	35.40^{b}	$35.70B^{b}$	37.80^{a}	37.10^{a}	0.46	*
	Hb (g/dl)	11.06^{b}	11.86^{b}	12.57^{a}	12.49^{a}	0.46	*
	pH	5.83^{b}	5.37^{b}	6.46^{a}	6.92^{a}	0.19	*
	RBC ($\times10^{12}$/l)	6.12	6.27	6.00	6.27	0.21	NS
	WBC ($\times10^{9}$/l)	9.64^{a}	9.04^{a}	8.71^{b}	8.47^{b}	0.38	*
16	PCV (%)	35.20^{b}	35.50^{b}	37.10^{a}	37.90^{ca}	0.46	*
	Hb (g/dl)	11.03^{b}	11.79^{b}	12.87^{a}	12.59^{b}	0.46	*
	pH	8.22	8.39	8.40	8.27	0.19	NS
	RBC ($\times10^{12}$/l)	5.86^{a}	5.12^{b}	6.27^{a}	6.81^{a}	0.21	*
	WBC ($\times10^{9}$/l)	7.70	7.96	7.51	8.16	0.38	NS

ab means with different superscripts on the same row are significantly different ($p<0.05$). PCV = packed cell volume, Hb = haemoglobin, RBC = red blood cells and WBC = white blood cells, SEM= standard error of mean, LOS=level of significant, NS=not significant, * $p<0.05$.

Table 4.10: Breed and sex effect on Serum biochemical parameters of Turkey at different ages.

		NORFOLK		MAMMOTH			
Age	Parameters	Male	Female	Male	Female	SEM	LOS
8	Tp (g/dl)	3.24^{b}	3.24^{b}	4.16^{a}	4.48^{a}	0.44	*
	AST (iu/l)	20.40	18.00	17.00	16.00	2.51	NS
	ALT (iu/l)	7.80^{a}	9.00^{a}	4.40^{b}	3.60^{b}	2.48	*
	Crt (mg/dl)	81.20	65.60	78.00	79.00	11.70	NS
16	Tp (g/dl)	3.14^{b}	3.48^{b}	4.00^{a}	4.12^{a}	0.44	*
	AST (iu/l)	15.00	12.00	11.60	15.00	2.51	NS
	ALT (iu/l)	9.40^{a}	9.60^{a}	4.40^{b}	5.8^{b}	2.48	*
	Crt (mg/dl)	66.60	70.20	57.20	62.00	11.70	NS

ab means with different superscripts on the same row are significantly different ($p<0.05$). Tp = total protein, AST = aspartate transaminase, ALT = alanine transaminase and Crt = creatinine, SEM= standard error of mean, LOS=level of significant, NS=not significant, * $p<0.05$.

4.4 Correlation Coefficients

The correlation coefficient of body weight (kg) and linear body measurement (cm) of male Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 12, 16 and 20 weeks of age are shown on Table 4.11, 4.12, 2.13 and 4.14 respectively. Estimates of positive correlation range from 0.06 (SL and NL) to 0.88 (WL and BL). There were significantly ($p<0.001$) high positive and high correlation between WL and BL, BL and NL, TL and BL, CG and TL, WL and CG and WL and TL. There were significantly ($p<0.01$) high positive and high correlation between CG and BL, TL and NL and CG and SL. Moderate but positive relationship which were significant ($p<0.05$) existed between BL and BW and TL and BW, all others were positive but moderately related with the exception of SL and BW, SL and NL and SL and BL which had the lowest positive correlation in Norfolk male. Above diagonal there were significantly ($p<0.001$) high positive and high correlation between WL and CG, SL and CG, NL and CG, SL and WL. There were significantly ($p<0.01$) high positive and high correlation between BL and SL, NL and SL, BL and CG, BL and CG, TL and CG, NL and WL and NL and BL. Moderate but positive relationship which were significant ($p<0.05$) existed between BL and TL, all others were positive moderate related with the exception of SL and BW, BW and BL, TL and BW, CG and BW and WL and BW which had the lowest positive correlation in Mammoth male (Table 4.11).

In table 4.12, estimates of positive correlation ranges from 0.09 (WL and SL) to 0.88 (BL and NL), there were significantly ($p<0.001$) high positive and highly correlation between BL and NL, BL and BW, CG and NL, CG and BL, WL and NL, WL and BL, WL and CG, there were significantly ($p<0.01$) high positive and high correlation between NL and BW, CG and BW, WL and BW, CG and TL, moderate positive relationship which were significant ($p<0.05$) existed between TL and NL, WL and TL.

There were lowest positive correlation in TL and BW, SL and BW, WL and SL, SL and NL, SL and BL in Norfolk. Above diagonal there were significantly ($p<0.01$) high positive and high correlation between CG and WL, moderate positive relationship which were significant ($p<0.05$) existed between BL and CG, NL and BL. All others were lowest positively correlated with the exception of BW and NL, BW and BL which were moderately positive correlated in Mammoth. In table 4.13, estimates of positive correlation ranges from 0.10 (SL and CG) to 0.93 (WL and NL), there were significantly ($p<0.001$) high positive and highly correlation between all the traits measured including body weight in Norfolk. Above diagonal there were significantly ($p<0.01$) high positive and high correlation between all the traits measured with exception of NL and BL, TL and CG, BL and WL which were significantly ($p<0.001$) high positive and highly correlated but in BW and CG, NL and SL, BL and SL, SL and WL are moderately correlated in Mammoth.

In table 4.14, there were highly positive correlation and high significant ($p<0.01$) between neck and thigh with moderate between drumstick and breast and all other traits that were measured are highly positively correlated in Norfolk. Above diagonal there were highly positive correlations between all the traits measured with the exceptions of thigh and live weight, wing and live weight, drumstick and live weight, back and dress weight, back and carcass weight which have low positive correlations and other were moderately positive correlated in Mammoth.

The correlation coefficient of body weight (kg) and linear body measurement (cm) of female Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 12 , 16 and 20 weeks of age are shown in Table 4.15, 4.16, 4.17 and 4.18 respectively, estimates of positive correlation ranges from 0.50 (SL and NL) to 0.88 (CG and BL), there were significantly ($p<0.001$) high positive and highly correlation between CG and

BL, WL and CG, WL and SL. There were significantly ($p<0.01$) high positive and high correlation between CG and TL, WL and SL, WL and BL, CG and BW, TL and BW, TL and BL, BL and NL. Moderate but positive relationship which were significant ($p<0.05$) existed between TL and NL, SL and BL, CG and NL, BL and BW, all others were positive moderate related in Norfolk female. Above diagonal there were significantly ($p<0.01$) high positive and high correlation between BW and SL, BL and CG, BL and WL, TL and WL. High positive relationship which were significant ($p<0.05$) existed between BL and TL, SL and WL, BL and SL, all others were positive moderate related with the exception of BW and TL, BW and CG, NL and BL, NL and TL which had the lowest positive correlation in Mammoth female (4.15).

In table 4.16, estimates of positive correlation ranges from 0.10 (WL and SL) to 0.83 (CG and BW), there were significantly ($p<0.01$) high positive and high correlation between CG and BW, WL and CG with moderate in CG and BL, moderate positive relationship which were significant ($p<0.05$) existed between WL and BW, CG and TL and all others were positively moderate correlated with the exception of SL and BW, WL and SL which were lowest positively correlated in Norfolk. Above diagonal there were significantly ($p<0.01$) high positive and high correlation between TL and WL, all others were positively moderate correlated with the exception of CG and WL, SL and CG, SL and WL, TL and CG, NL and TL, NL and SL, BW and WL which were lowest positively correlated in Mammoth.

In table 4.17, estimates of positive correlation ranges from 0.02 (SL and BW) to 0.77 (WL and NL), there were significantly ($p<0.01$) high positive and high correlation between CG and BW, there were moderate positive correlation between SL and BW, CG and NL, SL and BL, WL and TL and other traits were lowest positive correlated in Norfolk. Above diagonal there were significantly ($p<0.01$) high positive and high

correlation between CG and NL, all other traits were moderate positively correlated with the exception of BL and TL, BL and SL, TL and BW, SL and BW, BL and WL, SL and WL, CG and WL which were lowest positively correlated in Mammoth.

In table 4.18, there were highly positive significant ($p<0.01$) correlations between carcass weight and thigh, carcass weight and breast, back and live weight, all other traits were highly positively correlated in Norfolk. Above diagonal there were highly positive significant ($p<0.01$) correlations between live weight and wing, live weight and back, dress weight and back, all other traits were highly positively correlated in Mammoth.

Table 4.11: Correlation coefficient of body weight (kg) and linear body measurements (cm) of male Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 12 weeks of age.

Traits	BW	NL	BL	TL	SL	CG	WL
BW		0.57	0.13	0.06	0.03	0.06	0.06
NL	0.32		0.61**	0.42	0.77**	0.83***	0.72**
BL	0.52*	0.86***		0.48*	0.77**	0.72**	0.65**
TL	0.48*	0.69**	0.82***		0.72**	0.42	0.53**
SL	0.06	0.05	0.17	0.44*		0.85***	0.83***
CG	0.33	0.43	0.73**	0.80***	0.61**		0.94***
WL	0.42	0.65	0.88***	0.77***	0.43	0.79***	

BW=Body weight, NL=Neck length, BL=Back length, TL=Thigh length, SL= Shank length, CG= Chest girth, WL= Wing length, SEM= standard error of mean, LOS=level of significant, NS=not significant, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 4.12: Correlation coefficient of body weight (kg) and linear body measurements (cm) of male Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 16 weeks of age.

Traits	BW	NL	BL	TL	SL	CG	WL
BW		0.44	0.35	0.02	0.03	0.13	0.28
NL	0.72**		0.54*	0.01	0.06	0.11	0.06
BL	0.80***	0.95***		0.21	0.18	0.52*	0.41
TL	0.06	0.44*	0.33		0.09	0.24	0.27
SL	0.10	0.12	0.03	0.49*		0.01	0.10
CG	0.64**	0.94***	0.90***	0.57**	0.19*		0.69**
WL	0.66**	0.94***	0.89***	0.49*	0.09	0.93***	

BW=Body weight, NL=Neck length, BL=Back length, TL=Thigh length, SL= Shank length, CG= Chest girth, WL= Wing length, SEM= standard error of mean, LOS=level of significant, NS=not significant, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 4.13: Correlation coefficient of body weight (kg) and linear body measurements (cm) of male Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 20 weeks of age.

Traits	BW	NL	BL	TL	SL	CG	WL
BW		0.67**	0.65**	0.65**	0.58**	0.44	0.53**
NL	0.57***		0.88***	0.75**	0.28	0.64**	0.79**
BL	0.71**	0.88***		0.86***	0.37	0.80**	0.83***
TL	0.84***	0.80***	0.85***		0.55**	0.83***	0.78**
SL	0.65***	0.82***	0.74***	0.74***		0.31**	0.35
CG	0.77***	0.81***	0.74***	0.77***	0.78***		0.76**
WL	0.56**	0.93***	0.82***	0.82***	0.81***	0.86***	

BW=Body weight, NL=Neck length, BL=Back length, TL=Thigh length, SL= Shank length, CG= Chest girth, WL= Wing length, SEM= standard error of mean, LOS=level of significant, NS=not significant, * p<0.05, ** p<0.01, *** p<0.001

Table 4.14: Correlation coefficient of carcass characteristics of male Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 20 weeks of age.

Parameters	LV	DRS	CAC	THI	BREAS	WIN	BACK	DRMST	NECK
LV		0.96	0.96	0.19	0.54	0.03	0.29	0.05	0.33
DRS	0.99		0.98	0.45	0.28	0.30	0.02	0.28	0.58
CAC	0.99	0.98		0.45	0.28	0.30	0.02	0.28	0.58
THI	0.91	0.95	0.88		0.72	0.99	0.88	0.98	0.99
BREAS	0.95	0.98	0.93	0.99		0.83	0.96	0.84	0.64
WIN	0.84	0.89	0.79	0.99	0.96		0.95	0.99	0.95
BACK	0.53	0.63	0.47	0.83	0.76	0.91		0.96	0.81
DRMST	0.93	0.96	0.89	0.99	0.99*	0.98	0.81		0.94
NECK	0.91	0.95	0.87	0.99**	0.99	0.99	0.84	0.99	

LV = live weight, DRS =dressed weight and CAC = carcass weight, THI = thigh, BREAS= breast, BAC = back, DRMST = drumstick, * $p<0.05$, ** $p<0.01$

Table 4.15: Correlation coefficient of body weight (kg) and linear body measurements (cm) of female Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 12 weeks of age.

Traits	BW	NL	BL	TL	SL	CG	WL
BW		0.36	0.46	0.16	0.66**	0.03	0.50
NL	0.60		0.09	0.12	0.39	0.30	0.37
BL	0.66*	0.78**		0.64*	0.61*	0.67**	0.71**
TL	0.78**	0.72*	0.79**		0.64*	0.27	0.33**
SL	0.58	0.50	0.63*	0.55		0.39	0.61*
CG	0.82**	0.74*	0.93***	0.88**	0.69*		0.44
WL	0.63*	0.78**	0.89**	0.78**	0.82***	0.88***	

BW=Body weight, NL=Neck length, BL=Back length, TL=Thigh length, SL= Shank length, CG= Chest girth, WL= Wing length, SEM= standard error of mean, LOS=level of significant, NS=not significant, * p<0.05, ** p<0.01, *** p<0.001

Table 4.16: Correlation coefficient of body weight (kg) and linear body measurements (cm) of female Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 16 weeks of age.

Traits	BW	NL	BL	TL	SL	CG	WL
BW		0.24	0.45	0.25	0.29	0.29	0.01
NL	0.54		0.54	0.02	0.03	0.32	0.24
BL	0.41	0.41		0.34	0.34	0.25	0.41
TL	0.50	0.36	0.22		0.31	0.03	0.68**
SL	0.02	0.25	0.07	0.09		0.02	0.03
CG	0.83**	0.44	0.38**	0.67*	0.17		0.23
WL	0.69*	0.41	0.58	0.33	0.10	0.77**	

BW=Body weight, NL=Neck length, BL=Back length, TL=Thigh length, SL= Shank length, CG= Chest girth, WL= Wing length, SEM= standard error of mean, LOS=level of significant, NS=not significant, * p<0.05, ** p<0.01, *** p<0.001

Table 4.17: Correlation coefficient of body weight (kg) and linear body measurements (cm) of female Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 20 weeks of age.

Traits	BW	NL	BL	TL	SL	CG	WL
BW		0.43	0.46	0.19	0.14	0.39	0.41
NL	0.23		0.39	0.41	0.29	0.79**	0.09
BL	0.02	0.27		0.05	0.10	0.35	0.16
TL	0.07	0.21	0.31		0.40	0.25	0.30
SL	0.58	0.17	0.36	0.08		0.27	0.05
CG	0.77**	0.43	0.26	0.23	0.53		0.05
WL	0.51	0.07	0.17	0.40	0.07	0.07	

BW=Body weight, NL=Neck length, BL=Back length, TL=Thigh length, SL= Shank length, CG= Chest girth, WL= Wing length, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 4.18: Correlation coefficient of carcass characteristics of female Norfolk (below diagonal) and Mammoth (above diagonal) breed of Turkey at 20 weeks of age.

Parameters	LV	DRS	CAC	THI	BRE	WIN	BAC	DRM	NEC
LV		0.99	0.99	0.89	0.98	0.99**	0.99*	0.99	0.99*
DRS	0.99		0.99	0.89	0.98	0.99**	0.99	0.99	0.99
CAC	0.98	0.98		0.94	0.99	0.99	0.98	0.97	0.99
THI	0.99	0.99	0.99*		0.97	0.89	0.87	0.82	0.88
BREAS	0.97	0.97	0.99*	0.99		0.98	0.97	0.94	0.97
WING	0.94	0.94	0.99	0.97	0.99		0.99	0.99	0.99
BAC	0.99*	0.99	0.99	0.99	0.98	0.95		0.99	0.99
DRMSTC	0.47	0.47	0.63	0.58	0.66	0.75	0.49		0.99
NECK	0.99	0.99	0.99	0.99	0.99	0.96	0.99	0.52	

LV = live weight, DRS =dressed weight and CAC = carcass weight, THI = thigh, BRE= breast, BAC = back, DRM = drumstick, NEC=neck * $p<0.05$, ** $p<0.01$

CHAPTER FIVE

5.0 DISCUSSION

5.1 Breed and Sex Effect on Growth, Blood and Carcass Characteristics

Sexual dimorphisms in body weight and linear body measurement, as observed in this study is in agreement with the finding of Ogah (2011) who reported that the body weight and linear body measurements of the indigenous turkey by sex were significantly affected by sex. The values of respective traitsreported in this study were however, lower than those reported by Kodinetz (1940) and Muzic (1990) from Zagorje turkey at 20 weeks of age (Table 4.1).

Variation in haematological parameters among breed of Turkey agreed with the result of Sturkie (1986), Uko and Ataja (1996), Mushi *et al.* (1999) and Iheukwumere *et al.,* (2006). Reports from these authors indicated variability in haematological profiles among different breeds. The significant differences which may be attributed to breed differences are consistent with strengthening the argument for inherent genetic differences as reported by Islam *et al.* (2004) and Chineke *et al.* (2006) (Table 4.2).

The Tp values obtained were within the normal range given by (Cambell 2004) who reported the normal values for Tp as ranging from 2.5 – 4.5g/dl. Darshan *et al.,* (1987) observed that the protein values were higher in females than in male broiler parents and suggested that the increased protein level in females was due to oestradiol effect and advancement of age. The values of AST obtained in the present study were lower than the values obtained by Ogundu *et al.,* (2013). The authors reported that there were sex effects on AST values of turkeys and gave the values as 73.36 iu/L for males and 70.63 iu/L for females. The values of ALT obtained in the present study were lower than the values reported by Ogundu *et al.,* (2013). They reported sex effects on ALT values of

turkeys and gave the values as 15.09 iu/L for males and 16.47 iu/L for females. These differences could be attributed to breed and physiological status of birds.

The male of Norfolk had higher carcass traits followed by male of Mammoth and then their females. This is in line with Karima and Fathy (2005) who reported significant breed differences in live body weight and other carcass parameters of broiler chickens. This is also in agreement with the findings of Musa *et al*. (2006) who found Males compared to females to have shown higher live weight and carcass weight. The superior average male performance among the more economically important traits is as a result of sexual dimorphism.

5.2 Breed and Age Effects on Body Measurement and Blood Profiles

The result of body weight and linear body measurements as affected by breed and age suggests that the Norfolk was superior to Mammoth with respect to body weight and linear body measurement. Norfolk therefore possesses gene for faster growth than the Mammoth breed (Table 4.5). This result is in line with reports of Sonaiya *et al*. (1986) that age is a major determinant of growth and physiological development. Omeje and Nwosu (1986) opined that these relationships could be utilized in the genetic improvement of growth through selection. Giordani *et al*. (1993) also reported significant difference in the growth performance of different strains of birds.

In general haematological parameters are affected by diurnal fluctuations or changes in daily physical and metabolic activities (Sanni *et al.,* 2000; Piccione *et al.*,2001, 2005). The mean haematological values RBC, Hb, WBC and PCV of birds vary among breeds, other factors which affect these parameters include sex and nutrition supplied to the bird (Sturkie, 1965). PCV, Hb concentration and RBC count had been reported to increase with age in chickens (Islam *et al.,* 2004) Table 4.6.

Aspartate aminotransferase (AST) values are age-dependent to varying degrees among different species and the cause of this age-dependent increase activity has not been defined (Hochleithner, 1994). Ogundu *et al.,* (2013) reported that there are age effects on ALT values of turkeys at 6 and 12 weeks of age. Ibrahim *et al.*,(2012) reported that the values of creatinine in poult (4 to 8 weeks) as 0.63 mg/dl, for growers (12 to 20 weeks) as 0.55 mg/dl and that of adult (20 weeks and above) as 0.98 mg/dl in turkeys reared in Semi-Arid environment of Nigeria. The values for this study was not the same (Table 7) with what was obtained by the above authors but the difference may be due to the time or age at which the blood was collected, breed effect and environment where these birds were raised.

5.3 Breed, Sex and Age Effects on Growth and Blood Profiles

Okon *et. al.,* (1997) reported that body weight of birds differed with breed. Essien and Adeyemi (1999) also reported that body weight differed with genotype or breed as age advances in birds. They also reported breed differences in body parameters of birds at different ages. Adedeji *et al.,* (2008) recorded increase in body length, wing length, shank length, breast and chest girth as age progresses. Essien and Adeyemi (1999) reported that shank length increased with age and differed among the breeds. The increasing trend in this study for body weight and linear body measurements (Table 8) as the birds advanced in age across breed of both sexes are in support of these previous reports and also those of Pingel *et al.,* (1990), Essien and Adeyemi (1999) and Adedeji *et al.,* (2008). This suggests that age is a major determinant of growth (increases in body weight and body lengths) and physiological development.

Olayemi and Ojo (2007), reported that in Nigerian local turkeys there were no significant sex variation in RBC count, PCV, Hb concentration and WBC up to 20

weeks of age. The present study had a similar trend. The mean haematological values RBC, Hb, WBC and PCV of birds vary among breeds. Other factors which affect these parameters include sex and nutrition of the bird (Sturkie, 1965). PCV, Hb concentration and RBC count had been reported to increase with age in chickens (Islam *et al.*, (2004); Uko and Ataja (1996) and Ikhimioya *et al.,* (2000)) compared the blood parameters of different breeds of poultry and similarly concluded that there were significant variations in the haematological parameters of different breeds of poultry. Oyewale and Ajibade (1990) reported a higher RBC, PCV and Hb values in the adult male turkeys than in the females, higher values were also reported in these parameters in adult male than in the females in the domestic chicken (Oyewale and Durotoye, 1988).

The serum biochemical values obtained in this study were in line with the observations of Oluyemi (1998) who reported significant differences in serum biochemical values for chicken and duck due to breed and species. Mary and Gomothy (2008) reported that total serum protein increased from 2.71 g/dl in 0-3 weeks to 4.68 g/dl in 26-34 weeks and then declined to a lower value of 2.32 g/ dl in above 50 weeks. Lisano and Quay (1977) reported higher mean Tp value in females than in male turkeys. Kundu *et al.,* (1993) also had reported higher Tp values in females than in male guinea fowls at 5 and 8 months of age and concluded that age had greater influence on females than males. The values of AST obtained in the present study were lower than the values obtained by Ogundu *et al.,* (2013) reported that there are sex effects on AST values of turkeys and they gave the values as 73.36 iu/L for males and 70.63 iu/L for females. The values of ALT obtained in the present study were lower than the values obtained by Ogundu *et al.,* (2013) reported that there are sex effects on ALT values of turkeys and they gave the values as 15.09 iu/L for males and 16.47 iu/L for females. These differences could

be attributed to higher temperature fluctuations in the tropics which have effect on the blood biochemical parameters and subsequently on production.

5.4 Correlation Coefficients

The relationships between live weight and body measurements were determined with correlation analyses. Correlation analysis gave a chance to define the relationship between traits measured. Tables 4.11 to 4.18 show the correlation coefficients of linear body measurements at different ages and carcass characteristics of Turkey respectively, these result agreed with the result of Ogah (2011) who reported that in male turkeys all the linear body traits highly correlated with body weight, ranging from 0.41 for keel length to 0.97 for the shank length. Bachev and Lalev (1990) recorded similar trend between body weight and principal body measurements in turkey, which means selection for body weight may lead to increase in other body measurements given that majority of genes influencing the body weight and body measurements of turkey are of common action.

This means that as the body weight was increasing, a corresponding increase was expressed in other body measurements. These results also indicated pleiotropic effects, suggesting that the traits were controlled by the same set of genes. Correlation coefficients obtained in this study ranged from low to high. Medium to high correlation coefficient between body weight and other linear body parameters implies that selection for body weight will bring about selection for the other body parameters.

The result of the correlation study between carcass traits and organ weight this study agreed with the result of Isidahomen *et al.*, (2012) who reported that the correlation coefficients among carcass traits and organ weights showed that correlations between parameters studied were generally positive and mostly very highly significant ($P<0.01$). The authors also reported that there were strong associations between most parameters

with *r* ranging from 0.00 between kidney and all of the cut parts to 0.89 between abdominal fat and slaughter weight. Strong and positive correlations among most parameters demonstrate inter-relationship among these parameters of carcass traits. All the carcass traits and majority of the associations between these traits were positive, some have high and positive significant ($P<0.01$) direct relationship with each other which means that for all these traits there existed increase in a linear measurement as live weight increases in these set of birds. Any of the traits could be used as indicator of live weight. These are in accordance with other findings especially in other chicken strains like broiler chicken where they reported positive and significant correlations between live weight, carcass weight, breast weight and organs (Musa *et al.*, (2006); Ojedapo *et al.*, (2008); Zerehdraran, (2005)). According to Muhiuddin (1993), if the positive phenotypic correlations translate into positive genetic correlations then, selection for one will improve the other as a correlated response.

CHAPTER SIX

6.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

This study was conducted to assess the effect of breed, sex and age on growth, haematological parameters, biochemical parameters and carcass characteristics of turkey. The data generated from 100 Turkeys which comprised of 50 Norfolk breed and 50 Mammoth breed were used. The body weight, linear body measurements, haematological and biochemical parameters values were obtained and the data generated were analysed using SAS (2002). The result obtained for body weight at 20 weeks were 4.15kg and 2.80kg for male and female Norfolk, respectively while for Mammoth, 3.70kg and 3.02kg were obtained for male and female, respectively. The result further showed that the male of Norfolk have significantly ($P<0.05$) higher body weight than the male of Mammoth, while the female of Mammoth have significantly ($P<0.05$) higher body weight than the female of Norfolk.

For linear body measurements the result showed that the males of Norfolk had higher values which are significantly ($P<0.05$) different in all the parameters measured than the values for Mammoth males. However, no significant ($P>0.05$) difference was observed in all the parameters measured between the females except in body length where the Mammoth females have higher value which was significant ($P<0.05$) different from that of Norfolk females. The result of haematological parameters showed that there were significant ($P<0.05$) difference between breed but no significant ($P>0.05$) difference between the sex with Mammoth having better values in all the parameters measured except in WBC where the Norfolk have better values. For biochemical parameters, the results showed that there were significant ($P<0.05$) difference in Tp and ALT values between the breed but no significant ($P>0.05$) difference were found between the sex,

AST and Creatinine between the breed. The result of carcass showed that there were significant ($P<0.05$) difference in all the traits measured between the breed except thigh weight which has no significant ($P>0.05$) difference by breed and sex. The result for correlations shows positive and highly significant correlation ($P<0.01$) between neck and thigh with moderate coefficient between drumstick and breast weight. All other traits that were measured were positive and highly significant ($P<0.05$) in Norfolk while in Mammoth was high to low positive correlations between the traits.

6.2 Conclusions

- In conclusion, from the result obtained in this study, the significant effect ($P<0.05$) of breed and sex at different ages on body weight and linear body measurements showed the Norfolk breed demonstrate higher body weight than the Mammoth breed.
- For marketing purposes, the farmers need to know which breed can grow fast and give highest carcass weight, dressed weight and other primal cuts, in this study Norfolk was better.
- The positive correlation and high significant ($p<0.01$) between traits measured showed that Norfolk was better.

6.3 Recommendations

- The Norfolk breed was better because it had high body weight, fast growth, high carcass weight and hardy.
- Further research should be carried out on blood parameters of these birds at adult stage.
- For breeding purpose the male of Norfolk and female of Mammoth and vice versa may be crossed to monitor the growth of offspring.

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