EVALUATION OF MAJOR GENES IN THE FREE-RANGING RAIN FOREST (YORUBA) ECOTYPE CHICKENS IN EKITI.

BY

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DECLARATION

I, OLUWADAHUNSI MARY, hereby declare that this project work is entirely my own work and has not been submitted to any other university or higher education institution, or for any other academic award in this university.

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CERTIFICATION

This research project written by OLUWADAHUNSI MARY has been read, approved and adjudged to meet part of the requirements for the award of Bachelor of Agriculture (B. Agric) Degree in Animal production and health of federal university Oye-ekiti, Ekiti, Nigeria.

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DEDICATION

This project is dedicated to Yahweh the covenant keeping God, and to my Parent (Mr and Mrs Oluwadahunsi) and beloved grandmother (Chief Mrs. Rachel Aina Fatimiro), for their moral, financial and prayers support.

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ABSTRACT

This study was carried out on genetic evaluation of the Nigerian Forest (Yoruba)ecotype chicken in three local government of Ekiti State, Nigeria, based on some phenotypic traits and performance traits. A total of Two Hundred (200) of Cocks and Hens, with more of Hens than Cocks, of mature native, forest ecotype chickens were randomly sampled from the study area. The study covered nine (9) settlements (Asin, Ootunja, Igbona, Ilumoba, Aisegba, Agbado, Ifaki, Ido and Aaye) within three local governments (Ikole, Gbonyin and Ido-osi) in Ekiti state. The study was conducted between September and November 2018. Parameters examined included live body weight, eye colour, skin colour, feather colour, feather types, plumage colour, shank colour, beak colour, comb color, comb type, ear-lobe colour, wattle colour, keel bone structure, skeletal variance, presence of major genes, egg shell colour, egg mean weight, number of eggs per clutch, number of chicks per clutch, number of unhatched eggs and post hatch mortality. Mean live body weight of males was significantly ($p<0.05$) heavier than females, In the Occurrence of Skin-colour and percentage by Sex of Chicken, the Creamish skin (60%) were highest of the total population of both Cocks and hens, In the Occurrence of Feather colours and percentage by Sex of chicken, the Black feather mixed with other colors (42%) occurred highest. Most of the chicken in the population surveyed have mixed feather morphology with a percentage of (42.5%), the penciled feathered were more of Cocks with a percentage of 9%, laced feathered were more of Hens with percentage of (24.5%).Data collected on body weight and twenty seven traits from 200 chickens were analysed using SAS statistical package.The result revealed that most of the parameters revealed distinctive variations.

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CHAPTER ONE

1.0 Introduction

Domestic fowl was reported to have originated from the wild ancestor of jungle fowl *Gallus domesticus*from the South-eastern Asia around year (2000-3000 BC). During this period, four species of Jungle fowl foundwere namely, the red Jungle fowl (*gallusgallus*), Ceylon Jungle fowl (*Gallus lafayetti)*, Gray Jungle fowl (*Gallus sonnerati)* and the Black or green Jungle fowl (*Gallus varius*). They are still in existence, till present time(Atteh, 2004).

Chickens play significant socio-cultural and economic roles in African societies. Native chicken production is vital in the livelihood of many house-holds, as resource for rural farmers providing cheap source of nutrition for families (protein), small cash-flow reserve for times of celebrations or need, and contributes to religious ceremonies and recreation (Emuron*et al.*, 2010 and Roberts, 1995). The Nigerian indigenous.chicken is a dual-purpose bird used both for meat and egg production in rural and peri-urban areas of the country. They are found in large numbers and and are distributed across the different ecological zones under traditional family-based scavenging management system (Sonaiya and Olori, 1990).

Indigenous chicken are self-reliant and hardy birds with capacity to adapt and withstand harsh weather conditions, especially in the hot humid environment. They are known to possess qualities such as the ability to hatch own, brood, scavenge for major parts of their food; and possess appreciable immunity against endemic diseases.(Ajayi*et al.*, 2010). Their products, eggs and chicken meat: are preferred by majority of Nigerians because of the pigmentation, taste, leanness and suitability for special dishes (Horst, 1989).

Indigenous poultry species represent valuable resources for livestock development because their extensive genetic diversityallows for rearing of poultry under varied environmental conditions, providing a range of products and functions.(Horst, 1988; Sonaiya*et al.*, 1999). Thus, great genetic resources embedded in the indigenous poultry await full exploitation for information that will provide basis for genetic improvement and diversification, to produce breeds that are adapted to local conditions for the benefit of farmers in developing countries (Horst, 1988; Sonaiya*et al.*, 1999).

Major genes are economically interesting in modern breeding systems as they act as sex marker genes and disease resistant factors (e.g., Avian leucosis). These genes cause a reduction in tropical heat stress by improving breed's ability for convection, resulting in improved feed conversion and better performance.(Ajayi*et al.*, 2010).

In Nigeria, indigenous chickens were characterized along genetic lines of feather and plumage colour (e.gnormal or frizzled feathered), body structure (e.g naked neck, dwarf types and colour variants (e.g black, white, brown, mottled etc.). The frequency distribution of the normal feathered chicken was about 91.8% while that of frizzled and naked neck were 5.2 and 3.0% respectively in Bayelsa State, Nigeria (Ajayi and Agaviezor, 2009).

The Nigerian indigenous chicken represents a large pool of untapped genetic resource. These local chicken ecotypes possess genes and alleles pertinent to their adaptation to particular environments and local breeding goals (Romanov *et al.*, 1996). Local chicken are currently underutilized for development of acceptable, adaptable and improved breeds for the environment. There is need to expand the narrow genetic base on which the world's poultry breeding companies currently operate by including local chicken resources which have been widely reported to be better adapted to local conditions.(Adeleke et al., 2010)

Individuals within classes are distinguished based on external visible traits of their body such as morphological and biometrical traits. Regarding this, indigenous or free-ranging and scavenging chickens have variable plumage, morphological and biometrical traits representing genes of adaptation to their origin. Indigenous free-ranging chickens are classified as gene reservoirs reflecting unique adaptation to their agro-ecological or tropical environments (Horst, 1989).

1.1 Justification for Study

These indigenous birds play essential socio-cultural and economic roles in African households. Naazie and Karbo (2002) reported that local chickens do not only provide for the protein requirement of the family on occasions but also act as the _poor man's bank' and animals for sacrifices, festivities and gifts.

Chickens play very significant socio-cultural and economic roles in African societies. Native chicken production is vital in the livelihood of many house-holds, especially as resources for low-income rural farmers, providing protein nutrition for the family, small cash flow reserve for times of celebrations or need, and contributing to religious ceremonies and recreation (Emuron*et al.,* 2010 and Roberts, 1995).

Over 75 percent of the world's food and agriculture is produced by fewer than 25 domestic plant and animal species (FAO, 2007). The utilization of appropriate animal genetic resources to achieve and maintain sustainable livestock production systems that are capable of responding to human needs is necessary to national and global food security.(Adeleke*et al.,*2010)

Presently, food production is changing from being Producers-driven to consumers-driven. The demand for certified products such as meat and eggs has emerged and the trend keeps increasingthe focus is now on local indigenous breeds or species (Ohwojakpor, *et al.*, 2012).

1.2Statement of research problem

- There is need to study the incidence of major genes within the Rainforest ecotype chicken
- There is inadequate knowledge on the effect of major genes on the performance of Yoruba ecotype chicken, can supply information on breeding strategies for genetic improvement Programme.
- There is currentlydifficulty in selecting major genes in Yoruba ecotype chicken for upgrading and improvement due to their high level of variability.
- There is a need to expand the narrow genetic base on which the world's poultry breeding companies currently operate by utilization of Yoruba ecotype chicken resources in breeding program

1.3 Objectives

- To evaluate incidence of major genes within the Forest(Yoruba) ecotype chicken in Ekiti State.
- To investigate the effect of identified Body weight groups on the performance traits of Forest (Yoruba) ecotype chicken.

1.4Hypotheses of study

H_1 = There are no major genes within the Rain Forest (Yoruba) ecotype chicken.

H_2 =The effect of major genes on performance and phenotypic traits Yoruba ecotype chicken is not significant

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Origin of local chicken

The progenitor of the local fowl is considered to be Red Jungle Fowl (*Gallus ferrugineus*or *bankiva*), though there are three other wild(oriental) species.This species is a native of India, parts of China, the adjacent Islands and the Philippines (FAO, 1998; Dalby, 2003; Anonymous, 2007). The habitats of chickens are divers, as it can be found in lofty forests and in dense thickets, bamboo jungles and cultivated lands. This wild species closely resembles the breed of poultry fanciers, the *Black-breasted Game chickens*, but the crow of the wild cock is not as loud or prolonged as that of the tamed one (MacDonald and Blench, 2000). In Africa, chickens were first discovered in Egypt, where they were reared as foreign pets and game cocks. In 650BC they became common and economically important. They then spread to Sub-Saharan Africa during the first millennium AD (Dalby, 2003).

Characteristics such as naked neck, frizzled feathers, single, pea, rose and walnut combs are common within flocks of local birds (Anonymous, 2007). The naked neck mutation originated in Transylvania, Romania and spread across Europe centuries ago; and the frizzle feathered chicken was first described by Western explorers in Fiji during the seventeenth century (FAO, 2000). The naked neck and frizzle birds were introduced to Africa and the rest of the world by sailors and traders. The modern Local chickens resulted from centuries of cross-breeding with exotic breedsand random breeding within flocks of local birds. As a result, it is not possible to standardize the characteristics and performance of indigenous chickens (FAO, 1998). Indigenous fowls have been variously referred to as the African chicken, local chicken, native chicken, family poultry, village chicken, bush chicken or runner chicken; but, distinct local varieties have been reported in Egypt, Cameroon, Burkina Faso, Morocco and Sudan (Guèye, 1998).

Local chickens in Africa show wide phenotypic differences in feathers, eye, skin, shank, earlobe, comb, feather distribution and body size. They are hardy with high degree of disease resistance and excellent feed conversion rate. The local chickens discover their food via searching round their environment. Both older birds and young chicks scavenge together. They feed on kitchen waste and harvest grain left-overs. These birds are occasionally vaccinated against diseases. They are rarely provided with Laying-nests, which give way for birds to lay their eggs on floors, in bushes and outside in hidden and dark places.

Gondwe (2004) reported that chicken production in Africa is divided into two, namely the commercial (high input and high yield) segment and the rural or village (low input and low yield) segment. While the commercial sector focuses on intensive production of meat and eggs, using high yielding strains developed and supplied by international breeding organizations, the village poultry sector is synonymously called conventional, rural, scavenger, family, local or extensive poultry production (Gondwe, 2004). Horst (1988) described the genetic material base of the local chicken in the tropical areas as rich, and this must form the premise for genetic enhancement and modification to produce a strain adjusted to warmth conditions.

2.2 Potential of Local Chickens

More than 70% of family poultry population in Africa is made up of indigenouschicken type, kept in low-input low-output production systems (Kitalyi, 1998). Family poultry is well integrated into most village farming systems, producing 40 to 70%of national meat and egg supply in most tropical countries (Horst, 1988; FAO, 2000). Indigenous chickens possess unique adaptive traits that permit them to survive; reproduce under harsh climatic, nutritional and management conditions typicallyassociated with low input–output production systems (Mwacharo*et al.*, 2007). Indigenousbirds are kept by rural smallholders, landless farmers and industrial labourers, because of their scavenging adaptability, production ability and low maintenance cost (Kitalyi, 1998).

Local birds are adapted for survival under scavenging free-range conditions due to theirevolvement from the same conditions. However, there are still considerable and largely unexploited potentials for increased production from local birds through improved management (FAO, 2000). According to Horst (1988) products from local poultry stocks are widely preferred because of pigmentation, leanness, and availability for special dishes. He observed that despite the important role played by local poultry, there was paucity of information on its genetic make-up with respect to performance, its comparative evaluation with imported lines under similar management conditions andits adaptability and resistance to local diseases.

Local chickens are beneficial to rural people because they are available, adapted, and inexpensive to keep, and have tasty meat and eggs. Improving the genetic potential of local birds will result in rapid multiplication, increased body weight, improved egg weight and taste. This would also result in more eggs for hatching, sale, consumption, and income (Mburu and Ondwasi, 2005).

2.3 Economic importance of local chicken

- Local chickens have been contributing to increasing food production and income for ruralcommunities.
- Indigenous birds are able to protect themselves and their chicks frompredators because of their alertness and fighting characteristics.
- They thrive wellunder poor and scarce nutrition, poor housing, management and adverse environment with variabletemperature and relative humidity.
- Due to their fewer feathers, they save protein thatmay be used for development of meat tissues (Horst, 1987; Merat, 1990). The reduction in their proteinrequirement results in a reduced incidence of feather pecking and cannibalism (Merat,1990). Akhtar-Uz-Zaman (2002) reported that the reduction in feather coverage of nakedneck birds enabled them to receive more solar radiation, and this could facilitate greatervitamin D synthesis and in turn, contributes to better shell quality.
- Local birds are good gene pools for the genetic improvements of chicken species. They interact well when crossed with other stocks and this resulted in better performing progeny.

2.4Productivity of indigenous chickens

Indigenous chicken productivity is generally is known to be low under the free range system (Gueye, 1998). But their profitability is determined by the relationship between the biomass of the birds populace and the scavengable feed source base.(Kitalyi, 1998).

Indigenous chickens are genetically poor producers of chicken meat and eggs (Busuulwa, 2009). The local chicken takes a long time to achieve sexual development (6-7 months), with little mature carcass weight and produce few eggs each year. Adult hens lay around 2-4 clutches per year, each of around 10-12 eggs (Byarugaba*et al.*, 2002,Ikani and Annatte 2000). According to Mukhergee (1990) local chickens in developing countries are generally small in body size, late maturity (about 36 weeks of age) and have low clutch size/ year (25-45 annually). Ikani and Annatte (2000) stated that the level of fertile egg production by local hen ranges between 20-30 eggs per year i.e. a mean clutch size of 8-9 eggs and 2.5clutches per year. The hens produce small clutch size (2-10 eggs), have long stops between egg-laying of clutches and a common inclination to broodiness. These local chickens have hatchability of 87% and wean 6.3 chicks on average after 2.8 months. (Busuulwa, 2009). Their eggs have high breaking strength, high yolk percentage and low cholesterol content (Mukhergee, 1990). Sonaiya*et al.*, (1999) revealed that the yearly egg production per hen ranges from 20 to 100 eggs with normal egg weight ranging between 34 - 52g.

Adult cocks and hens weighed 2.1kg and 1.4kg (Busuulwa, 2009) and 1.2-3.2kg and 0.7-2.1kg respectively (Gueye, 2000). Sonaiya*et al.*, (1999) found body weights of 1.2kg and 0.8kg were achieved at 32 weeks for normal body size and dwarf breeds of indigenous chickens under extensive system respectively. Kitalyi (1998) reported sexual maturity between 166 to 230days for indigenous chicken breeds of Ethiopia with hatchability and fertility values range 39-44 and 53 – 60% respectively.

2.4.1Mortality under the Scavenging System of Producing Birds

Wirsiy and Fonba (2005) observed that, under the local system disease outbreaks were common and often erased stocks of chicken from an entire household. Abdelqaer*et al.* (2005) reported that 40% of local birds under the indigenous management system were lost before reaching 6 months of age in Cameroon, whilemortalityfrom diseases, predators, parasites, and cold stress for chicks accounted for 49 %, 31.6%, 10 %, and 9.4% of the total loss, respectively. They added that keepers perceived that most frequent disease outbreaks were:Newcastle Disease (51 %), Infectious Bronchitis (21 %), Fowl Typhoid (18 %) andother diseases (10 %); The main predators were foxes (25% of the cases), and wild cats(11.5%).Wirsiy and Fonba (2005) stated that poultry disease epidemics were commonduring transitional periods between end of rainy season and start of dry season. Mortalityfor exotic birds under scavenging conditions were higher than that of local birds thus indicating that, exotic chickens were less adapted to subjected hazards of diseases,parasites and predators under scavenging condition (Samnang, 1998; Demeke, 2003).

2.4.2Egg Production: Local chickens have been observed to have layed eggs throughout the year. Peace Corps (1982) reported that between 30 and 50 eggs are laid per hen per annum. Oluyemi and Oyenuga (1974) reported an annual egg yield of between 40 and 50 eggs Ibadan flocks. Dafwang (1990) in a survey of the Eastern Middle Belt of Nigeria reported 30 eggs per annum. This is similar to the report of Kekeocha (1984).Thus, there exist a wide variability in the egg production capacity and this may be a attributed to genetic and the management system.

2.4.3Clutch Number, Size and Hatchability: Annual egg production is a function of the number of clutches and size of the clutches. Dafwang (1990) reported 2-3 clutches per year and each clutch consisted of an average of 8.75 eggs. Hatchability was found to be in the range of 70%-100%. Atteh (1990)reported 1.84 and 11 eggs as average number of clutches and eggs per clutch for chickens sampled in the Western Middle Belt of Nigeria. Hatchability was reported to be almost 100%. In the Northern part of Nigeria, Hassan et al (1990) and Otchere et al (1990)reported 2.9,10.4 eggs and 83.4%;and 2.6,12.0 eggs and 75% as clutch number, clutch size and hatchability respectively. These estimates were higher than those for the Middle Belt. Eshiett et al (1990) reported 2.13 as clutch number and 8.89 as clutch size for the Owerri flock in South Eastern Nigeria. Sonaiya and Olori (1990),however, reported 2.3 and 9 eggs (range 4-14 eggs)as the clutch number and clutch size respectively, for chickens sampled in South Western Nigeria. Hatchability was reported to be 77%. These values are close to the report for the Middle Belt suggesting closeness or affinity of stocks.

2.4.4Egg Weight: Hill and Mobede (1961) reported an average egg weight of 43.9g. Akinokun (1974) reported that egg weight during first year of lay averaged 33.39g increasing from an average of 28.78g during first month to 40.46g at 10 months in production. Nwosu (1990) reported 38.63g as mean egg weight with total mass of 5.64kg. Individual egg weight and total egg mass of the local chicken were better in the cage than the weight and total egg than in deep litter system. Nwosu and Omeje (1984) reported egg weight of 33.37 $\pm$ 0.849 and total egg mass of 1685 $\pm$46.44g in the cage but 31.61 $\pm$ 0.78g and 1133.26 $\pm$ 31.11g on deep litter for the local hen.

2.5 Major genes

A gene is the unit of heredity which is transferred from apparent to offspring and which determines some characteristic of the offspring. Major gene is a gene with pronounced or significant phenotype expression; it's always evident regardless of how this effect is modified by other genes. Major gene characterizes common expression of oligogenic series, i.e a small number of genes that determine the same trait. Local chicken breeds are often endowed with major genes that confer adaptability and improve performances in tropical conditions. Low frequencies of major genes carriers among local chickens suggest that major genes are on the brink of extinction.(Brown*etal.*, 2017).

Yakubu reported that abnormal looking birds are deliberately removed from flocks as they are **frown upon** by society and have no market values. Certain Major genes have been found **potentially** useful to the tropical production environment either because of their direct effect on production or because of their indirect effect on quantitative trait loci. Among these major genes with indirect effects are feather distribution and feather morphology and these have been associated with increased heat resistance (Horst 1998).Psenti et al(1999) described some mutant developmental defects in chicken that include Polydactly and ptylopody had better body weight and egg production. These major genes which exist in populations of Nigerian local chicken, could therefore be exploited to broaden the production base of rural poultry (Fayeye*et al., 2006*)

Brown*etal.*, (2017), **reported that** half of the studied population of local chicken carried at least one major gene, but **the contributions** of single genes to local chicken resources were relatively low. However; **Major genes** were more common among the female chickens (57.8%), while **66.2% of the male chickens exhibited** none of the adaptive genes ($p<0.001$). the occurrence of **the crested head, rose comb** and pea comb was significantly different between male and **femalechickens($p<0.001$)**.About one quarter (22.6%) of major gene carriers exhibited more than **one phenotype. The highest** overall proportions were observed for crested head, pea comb,silky feathers,**frizzled feathers** and **naked** neck.Ptilopody was the least frequently found phenotype among local chicken. Hagan et al did not find any effect of feather distribution (naked neck) and Feather morphology(Frizzled gene) on body weight and other growth traits in indigenous chicken.

2.6Mutant Genes in Chickens

According to FAO (1998), seven mutants have been identified to be common among local birds in thetropics and are found to be potentially useful. They include Na - naked neck; Dw - dwarf;

K -slow feathering; Fa - Fayoumi; F - frizzle ; H - silky; and Fm - fibro-melanosis. Theuse of these genes to improve productivity in small holder poultry breeding programmeshas been undertaken in various tropical countries, Indonesia, Malaysia,Thailand, Bangladesh, Bolivia, India, Cameroon and.Nigeria (Horst, 1988; Mukherjee,1990; Barrio *et al.*, 1991; Mathur, 2003; FAO, 1998; Njenga, 2005; Cahaner, 2007).It was reported that, the use of single or combined dominant genes for featherrestriction (Na) featherings structure (F), and sex-linked recessive gene forreduced body size (dw), gave positive effect on productivity of birds in the tropics (Horst,1989; Haaren-Kiso*et al.*, 1995). Research into the effects of these genes on economicfactors has been undertaken in some African and Asian countries (Khadijah, 1988;Mathur and Horst, 1989).

2.6.1The Naked Neck Gene and its Effects on the Performance of Chickens

The naked neck phenotype in chickens is caused by an autosomal gene which exhibitsincomplete dominance (Davenport, 1914; Warren, 1933). The naked neck gene wasassigned the symbol *Na* by Hertwig (1933). It is incompletely dominant with theheterozygous (Nana) birds showing an isolated tuft of feathers on the ventral side of theneck above the crop, while the homozygous (NaNa) birds either lack this tuft or it isreduced to just a few pinfeathers or small feathers (Crawford, 1976). The resulting bareskin becomes reddish, particularly in males as they approach sexual maturity (Hutt,1949; Somes 1990). The apteria of birds (the featherless portion of the skin of birds) carry scattered-down and semiplume feathersbut that of the naked neck birds contains no feathers. The feather tracts themselves areeither absent or reduced in area so that birds have greatly reduced feather cover (Horst,1982; 1987; Merat, 1990). Anonymous (2005) stated that naked neck birds could bekept on free range, or be confined in runs, and arenot known to being good fliers,they however need protection during extremely cold temperatures because of their lack offeathers but can cope remarkably well in very hot climates.

Plate 1: Naked neck chicken

According to Bordas*et al.* (1978), the feather coverage of naked neck birds is reducedby 20 - 30% and 30 - 40% in the heterozygote (*Nana*) and homozygote(*NaNa*). This reduction in feather coverage facilitates better heat dissipation and improves thermoregulation resulting in better relative heat tolerance in hot climates. At temperatures of 30°C or higher, homozygous or heterozygous naked neck birds wereheavier than their normal feathered counterparts and their feed efficiency were at leastequal (Merat, 1986). In studies involving fast growing naked neck and normalfeathered birds, a higher growth rate and meat yield were exhibited by the naked neckbirds compared to their normally feathered counterparts when reared at high ormoderate ambient temperatures (Merat, 1986; Cahaner*et al.*, 1993; Eberhart andWashburn, 1993). Mahrous*et al.* (2008) reported that under moderate temperature, thenaked neck (*Nanaff*) and naked neck frizzled (*NanaFf*) genotypes had significantlyheavier body weight compared to their normal feathered (*nanaff*) counterparts. Theyadded that, the presence of the *Na* gene in a single state or interacted with *F* gene,significantly improved feed conversion ratio compared to their *nanaff*sibs.

Under constant heat stress the heterozygous naked neck (Nana) layers have significantly higher egg number, egg weight, egg mass, body weight and productivity index than the normal feathered (Somes, 1988; Hareen-Kiso, 1991; Mathur, 2003). However,according to Mathur (2003) under natural conditions there were large differences in theperformance of naked neck birds in terms of egg number, egg weight, egg mass, bodyweight and productivity index at different locations (Turkey, Egypt, Cuba, Burundi,Bolivia and Malaysia).

The reduction of plumage (20 - 40%) gives 1.5 - 3.0% more carcass yields to the nakedneck genotypes than their normal feathered counterparts regardless of the temperature.Due to the higher proportion of muscle in the pectoral region of naked neck birds, thereis 1.8-7.1% more meat in them than normally feathered birds when their carcasseswere dressed (Merat 1986). Fathi*et al.* (2008) reported that the naked neck genotypes(*NaNa*or *Nana*) exhibited higher relative dressed carcass weight, drumstick andbreast muscles compared to normally feathered individuals (*nana*); and that theproportion of abdominal fat was decreased in both naked neck genotypes comparedwith normally feathered ones. Intramuscular and subcutaneous fat in naked neck birds was low due to the utilization of a larger fraction of energy for thermoregulation (Merat,1990). N'Dri*et al.* (2005) observed that slow growing homozygous and heterozygous Na birds matured fasterthan normally feathered birds and that carcass yield of *Na* birds was higherthan that of normally feathered birds (81.6 % vs. 80.0 %). Singh *et al.* (1996) reportedthat heterozygous naked neck broilers gained about 3% more weight than their normallyfeathered counterparts under commercial conditions during the spring and summermonths, and that this advantage was almost tripled at high ambient temperature of about32°C.

Rauen*et al.* (1986) reported that egg numbers were not significantly affected by thenaked neck gene at moderate temperatures; however, naked neck hens had a betterlaying rate at high temperatures. Adult body weight of naked neck hens was slightlyhigher than full plumage ones at temperatures above 30°C, nevertheless, the situationwere reversed at temperatures below 20°C. They added that, although the ratio of eggweight to body weight was increased by the *Na* gene at any temperature, the increase ofmean egg weight in *NaNa*and *Nana* genotypes compared with *nana* was lower atmoderate temperature than at high temperature, where it reaches 3 - 4g for the nakedneck homozygote.

In a study under temperate and subtropical conditions in Taiwan andFrance, Chen *et al.* (2008) reported that the naked neck genotype had a negative effecton body weight and a positive effect on feed intake, feed efficiency, clutch length andegg weight. Above 30°C feed efficiency was superior for naked neck females comparedto their normal feathered counterparts. Fraga and Lam (1987) found better egg shellstrength for the *Na/na*genotype. Rauen*et al.* (1986) observed that the advantage of the*Na* gene at high temperature for egg production mainly involved persistency of laying,and was more marked in medium-sized than in light strains.

An increase of embryonic mortality (up to 10% in pure strains) was associated with the*NaNa*and *Nana* genotypes (Crawford, 1977, 1978; Horst, 1982; Rauen, 1985 andMerat, 1986). Post embryonic chick mortality was not different for naked neck and fullyfeathered chicks except when exposed to heat stress above 40°C, in which case themortality of fully feathered chicks was slightly higher than their naked neckcounterparts (Merat, 1990). Adult mortality did not differ between the naked neck andnormal feathered birds at 20°C; however, at 30°C or more, mortality for heterozygousnaked neck layers was lower than their fully feathered counterparts (Rauen*et al.*, 1986).There was less frequent cannibalism among naked neck birds and this may be related to survival rate (Barrio *et al.*, 1987).And abundance access to sun rays for vitamin D.

Naked neck birds are superior to normal feathered birds for growth, feed efficiency,carcass traits, viability, immunocompetence, blood biochemical parameters andmortality (Barrio *et al.*, 1991).It was concluded that naked neck gene in a single state or incombination with the frizzle gene significantly increased immune response of chickensunder moderate temperature; therefore, introduction of the naked neck (*Na*) gene into chickens during improvement andselection programs for disease-resistance was recommended, particularly in unfavorableenvironments.

The naked neck gene has higher resistance to coccidiosis-causing protozoa; *E. tanellaand E. necatrix*(Barrio *et al.*, 1991; BangaMboko, 1996). Naked neck broilers aresuperior to their normal feathered counterparts in both winter and summer in terms ofgrowth rate, feed efficiency, dressing percentage and liveability, but the differenceis higher in summer than in winter (Singh *et al.*, 1998). According to Sharifi (2006), theuse of the naked neck gene (*Na*) in the homozygous form under high temperaturesresulted in distinct improvement of survival ratio of hens, growth and components ofreproduction like number of eggs, egg weight, shell quality, proportion of settable eggs,fertility, number of chicks hatched and chick weight as compared to their normallyfeathered counterparts.

The annual egg production of indigenous naked neck birds is 50 - 55 eggs per hen(Akhtar-Uz-Zaman, 2002). InKenya (naked neck, frizzle, dwarf and normal feathered) the naked neck was superior inbody weight, egg weight, eggshell thickness, growth rate up to 5 weeks andsurvivabilty (low mortality, Njenga (2005). However, fertility was lowest for naked neck. Moreki andMasupu (2003) reported that under scavenging conditions the naked neck genotype wassuperior in egg production and hatchability.

Desai *et al.* (1961) reported 106, 68 and 86eggs/ bird/ year for Bare-neck (naked neck), large Baladi and Betwilrespectively among indigenouschickens in Sudan. However, Mohammed *et al.* (2005) did not find anysignificant difference in hen-day egg production, hen-housed egg production and eggshell thickness among the three phenotypes Sudan genotypes. The naked neckwas only superior in live weight. Studies by Singh *et al.* (1996) in Indiadid not show any significant difference between the indigenous naked neck and otherecotypes in terms of age at sexual maturity, 40-week body weight, annual eggproduction, clutch size, fertility and hatchability except in egg size, which wassignificantly heavier within the naked neck ecotype compared to other ecotypes.

2.6.2The frizzle (*F*) gene

The Frizzle gene is a mutant in the chicken. It is characterized byfeathers growth such that they curve outward, instead of lying smoothly along the bird's body (Hutt, 1949). Frizzling is caused by a single incompletely dominant autosomal gene, known as *F*, restricted by an autosomal recessive modifier, *mf* (Landauer and Dunn, 1930). According to Somes (1990), the frizzle was first suggested to be a dominant gene,after it had been described by Aldrovandi in 1600. Landauer (1933) described an autosomal recessive modifier gene which greatly restricted the effect of *F*. He stated that the shafts of all feathers in the homozygotes are extremely recurved and the barbs are curled. He added that in the heterozygote, only the contour feathers are recurved and that these birds are not able to fly, while the feathers look bare.

Plate 2: Frizzled feathered chicken

The modifying genes make the extent of curling less extreme and in unmodified homozygous frizzled chickens, the rachises of all feathers are extremely recurved (Landauer, 1933; Landauer and Dunn, 1930). The frizzle (*F*) gene which is positioned on chromosome 6 causes the outline feathers to curve outward away from the body (Somes, 1990). He further explained that the modifying gene lessens the extreme aspects of the homozygote so that they appear less wooly. The frizzle gene (*F*) has a feather curling effect and causes feather mass reduction

2.6.1Effect of the frizzle (*F*) gene on egg production

Studies have shown that birds with the frizzle gene perform well under hot humid conditions (Gondwe and Fairfull, 1995). Horst and Mathur (1992) observed that when reared under high tamperatures, the frizzling feathered layers performed better in terms of egg production as compared to their normally feathered groups. Adedeji*et al.* (2006) ascribed the better performance of the frizzle birds to their feather structure which enhances heat dissipation.

The frizzle gene reduces the insulating properties of the feather cover (reduce feather weight) and makes it easier for the bird to radiate heat from the body more efficiently (Horst, 1989).It was also found that air passes over the exposed body surface to reduce internal heat of the birds. This condition grants the birds the ability to feed more compared to those stressed by heat and hence theimproved laying performance. Adomako (2009) reported that higher hatchability values of frizzle birds than eggs in naked neck birds was due to the modification of their plumage structure (curled feathers). He further stated that hatchability under natural incubation is influenced to a large extent by the hens'ability to cover all the eggs-set. The frizzle feathers extend outward and away from the body and therefore as the hens sit (incubate) the eggs, the protruding feathers give better cover to a larger number of eggs, thereby a higher percentage of eggs hatch successfully.

2.6.2Effect of the frizzle (*F*) gene on sexual maturity, growth traits and mortality.

The Frizzle genotype is a fast growing indigenous chicken which could be utilized in breeding and development of native foundation stock for production of meat type chicken in the humid tropics (Oke, 2011). The frizzle and naked neck genes positively increased egg weights by 8.62 and 29.62 per cent over the normal feathered gene. However, egg shape index significantly ($p<0.05$) favoured the local chicken. Similarly, shell thickness was significantly ($p<0.05$) higher in the *FF* and *Na* birds than in the *na*. Consequently, the modifier genes of frizzling and naked neck are relevant in the development of a layer breed for the local environment.

2.6.3Frequency of frizzle and naked neck genotypes in the population.

In Ghana, Hagan (2010) reported very low gene frequencies for frizzle (0.03) and naked-neck (0.05) compared to the normally feathered counterparts (0.95). He explained that the lower than expected gene frequencies for the dominant genes might be attributed to the naked neck and frizzled birds being used for rituals; and for which normally feathered birds would not be used for sacrificial purposes.

A survey conducted by Adomako (2009) to assess the percentage of naked neck (*Nana*), frizzle (*Ff*) and normal feathered (*nana/ff*) birds within the population of indigenous birds in Ghana showed that a high percentage of indigenous chickens were normal feathered (78.33%) compared to naked neck (13.33%) and frizzle (8.33%) phenotypes. This means that the naked neck and frizzle genes were present within the randomly-mating indigenous chicken population but their combined frequency within the population was low.

2.6.5Silky gene

The silky chicken (*Gallus gallus var. domesticus*) is a small unique breed of poultry aptly named for its fluffy plumage, which is said to feel like silk. These birds are well known for their calm and friendly temperament. Silky-feathered chickens originated from India and were later established in China and Japan (Roberts, 1997). The silky bird was first mentioned by Marco Polo in his Asian travelogues in 1298 as chickens with hair like cats that lay the best of eggs (Haw, 2006). Silky gene (h) is an autosomal recessive gene which causes the barbs of the feathers to be highly modified giving the silky and a woolly appearance. Silky chickens are mostly white and black coloured feathers along with several other colours. Phenotypically, Silky birds are easily identified among other chicken breed populations. Silky feather is located on chromosome-3.

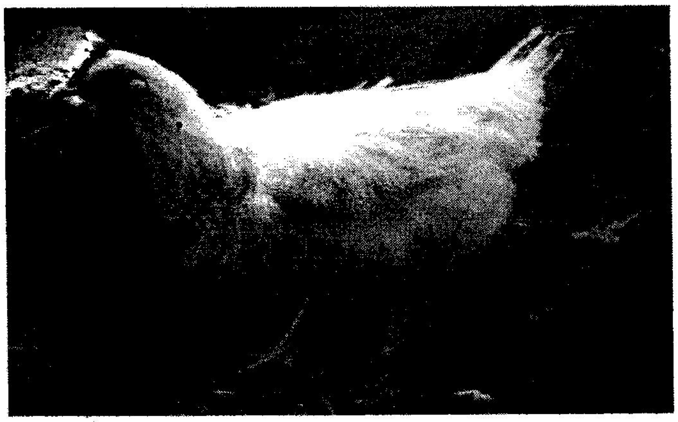

Plate 3: Silky feathered chicken

These birds are known for their nutritive and medicinal value (Li *et al.*, 2003). Silky chicken meat has been credited with health promoting benefits and medicinal properties..Toyosaki and

Koketsu (2004) noticedthat, the eggs and meat of white Silky chickens are well known for their high amount of unsaturated fatty acids, vitamins, calcium and potassium compared to other breeds of chicken. It is known to have very low fat, more collagen, vitamin A, iron and DHA. The egg yolk to whole eggweight ratio of Silky chicken is significantly larger than that of egg yolk of layer egg as reported by Rowshan (2013).The amount of cholesterol in Silky chicken egg is significantly ($P < 0.01$) less than that of other Layer hen eggs. The amount of vitamins (B2, B6, D and E), calcium and potassium in Silky chicken eggs are significantly higher than those of Layers eggs. Unsaturated fatty acidsarachidonic acid) in Silky chicken eggs are 62.5% among total fatty acids, where the unsaturated fatty acids of other hen eggs are 53.9%.

Silky hens are excellent brooders and are able to make good mothers. According to Ekarius (2007) the silky feathered birds are used to incubate and raise the offspring of other chickens and waterfowls like ducks, geese, and game birds such as quail and pheasants. The hybrid strain can lay 120 eggs in a year and reaches slaughter weight at 12 weeks of age. The males and females weigh 1.8kg and 1.36kg respectively (Graham, 2006). Sexual maturity for males and females is about five months. Silky fowls can produce 40-50 eggs per year (Rowshan, 2013). Nirasawa*et al.,* (1997) reported that the rate of egg production is very low for silky chicken because of its strong broodiness.Broodiness is a phylogenic trait controlled by some numbers of autosomal genes.

2.6.6Crest feathered gene

A feather crested head is a prominent feature exhibited by several wild fowl species, and varieties of several domesticated birds (Bartels, 2003). In chicken, crest (Cr) is an autosomal incompletely dominant gene that causes a tuft of elongated feathers to sprout from the head, with homozygous individuals often exhibiting a more developed crest than heterozygotes. Homozygosity for crest has been associated with cerebral hernia that causes a malformation of the cranium (Frahm and Rehkamper, 1998).

Plate 4: Crested chicken

2.6.7 Polydactyl (five toed chicken) gene

Polydactyly in chicken occurs whenthe fifth toe develops on top of the first toe and is longer than the first toe. William Bateson one of the founders of classical gene (1861– 1926), gave a description of polydactylism in birds including chickens developing five and even six toes (Bateson, 1894). Polydactyl gene is a complex gene influenced by modifier and suppressor genes. According to Crawford (1990) polydactyl genes are autosomal genes (Po) and the basic mode of its inheritance is incomplete dominance.

Plate 5: Five toed chicken

Initial study on complex genetic nature of the polydactyl chicken conditions was reported by Huang *et al.,*(2006) and this has lately been supplemented with molecular studies showing the involvement of more than one gene in the polydactyl manifestation. Landauer (1948) noticed that, the five-toed trait expression in chickens was also influenced by environmental factors. Columella (1977) described chickens with five toes among the most fertile and prolific birds, and hence do not have transverse spurs sticking out from their legs.

2.6.8Ptilopody (feathered shank) gene

Ptilopody is an autosomal dominant mutation controlled by two different genes. They are not allelic but belong to different loci of the chromosome. When both genes are present, heavy feathering appeared, but if only one is present the feathering is weak. Hutt (1949) phenotypically described shank feathering as a condition in which the hock, the tarso-metatasus, and the outer toe of the chicken is feathered.Ikeobi*et al.*, (1997) reported that chickens with feathered feet had better meat characters compared with their recessive counterparts which had significantly higher egg production and hatchability advantage. They further stated that the additional feathers appearing on the shank hinder the effort of the birds to release excess body heat, thereby adversely affecting their general performance, survival, and adaptation.

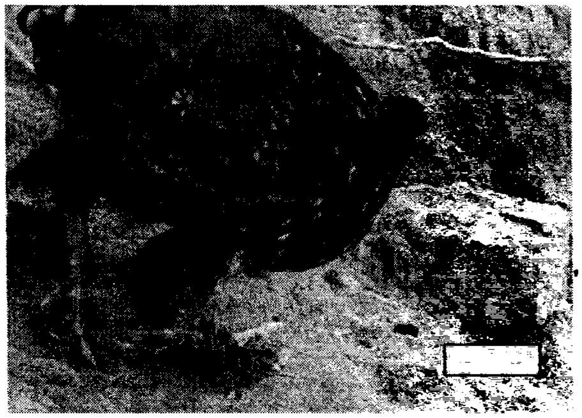

Plate 6: feathered shank

2.6.9Dwarfism gene

Dwarfism in chicken is an inherited trait found in chickens. It consists of significant delayed growth, and result in adult individuals with a distinctive small body size compared to normal chickens of the same breed. Birds with dwarfism gene do not show any signs at the early weeks of life. Dwarfism in chickens can be identified at 8-10 weeks of age, but classification is more precise when the chicks are five months old or more (Hutt, 1949). Poultry breeders use short shanks and small body size to separate dwarf birds from normal counterparts (Leenstra and Pit, 1984). Dwarfism in chickens has been found to be controlled by multiple alleles. The two types of dwarf genes are autosomal dwarf (adw) which is accompanied either by semi-lethality (cp) and poor hatchability (adw)on very poor viability and hatchability (Cole, 1966) and sex-linked dwarf gene (dw) which are located on the sex chromosome.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study locations: The study was conducted in Ekiti State. Three local government areas namely; Ikole-Ekiti, Gbonyin-Ekiti, Ido-osiEkiti were conveniently selected for the survey. Three villages/towns were selected based on convenience from each local government except Ikole-Ekiti. This includes; Ikole-Ekiti (7.7983^{0}N, 5.5145°E, Elevation; 508m), Gbonyin-Ekiti; IlumobaEkiti (7.6375^{0}N, 5.4196^{0}E, Elevation: 500m), AgbadoEkiti (7.5885N, 5.5229°E, Elevation; 508) and AisegbaEkiti (7.6065^{0}N, 5.4989°E, Elevation: 508.7m), Ido-osinEkiti; IfakiEkiti (7.7894^{0}N, 5.2423°E, Elevation: 457m),ido-ekiti (7.8431^{0}N, 5.1871°E, Elevation: 457m) and AayeEkiti (7.800^{0}N, 5.217^{0}N, 5.217°E, Elevation: 508m).

The area is underlain by metamorphic rocks and has undulating surface. The state enjoys a tropical climate with two distinct seasons: Rainy season (April to October) and dry season (November to march).

Mean Temperature ranges from 21° c to 28°c, South-west and north-east trade winds blow during the rainy and dry seasons, respectively. Tropical forests exist in the southern part of the state, while Guinea Savannah occupies the northern peripheries.

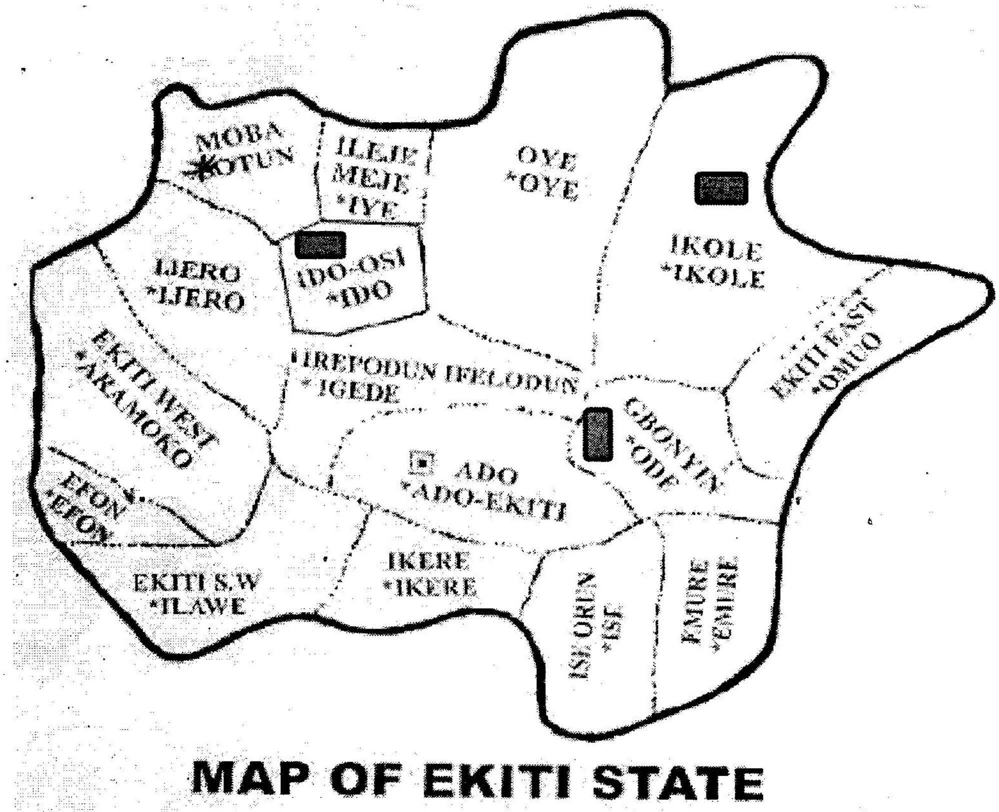

Fig1: Map of Ekiti state showing Local Government Areas.

3.2 Management of the Rain Forest (Yoruba) Ecotype chicken

The forest ecotype chickens evaluated in this study were managed under extensive system of Animal Husbandry where they were partially housed against predators at night and normally released in the morning to scavenge, with supplementary feed in the morning, Kitchen waste and crop residues constituted their major feed resources. The use of ethno-veterinary drugs was normally adopted to combat health challenges of the chickens with occasional interference of Animal scientist and Veterinary personnel.

3.3 Sampling and sampling procedures

Two hundred (200) Forest ecotype chickens (male and female) between the ages of 5 to 6 months and above (i. e. 20 to 24 weeks) weresampled in three (3) local government areas of Ekiti State. The first stage of sampling involve a sampling of three Local Government Areas from sixteen (16) local Local Government Areas of ofEkiti state, These were Ikole, Gbonyin, and Ido-osi.The second stage involved random selection of three communities from each local government areas respectively, making a total nine(9) communities. Namely Ikole (Asin, Ootunja, Igbona), Gbonyin (Ilumoba, Aisegba, Agbado), and Ido-osi(Ifaki, Ido,Aaye). The third and final stage involves the sampling of 67 chickens from Ikole, 67 chickens from Gbonyin and 66 from Ido-osi local governments respectively, making a total of 200 chickens sampled in all.

3.4 Data collection

Data were collected to satisfy the first objective of study, data were collected on some traits on the Rain forest. ecotype chicken (YEC), within the nine settlements in the three local government Area of Ekiti state. And these are:

- Skin colour, Drumstick colour, Feather distribution, Feather morphology, Plumage pattern, Shank colour, Comb type, Shank type, Earlobe colour, Comb colour,Eye color, Digit color, Number of digits, Beak color, Wattle color, Drumstick color, Presence or absence of roach back, Keel bone structure, Skeletal variation.

To satisfy the second objectives, performance indicators were measured and they are;

- Body weight, Number of eggs per clutch, Unhatched eggs (%), Post mortality (%) of chicks at four weeks, Eggshell color andNumber of chicks per clutch.

Data were recorded for a total of 200 indigenous chickens of both sexes following the FAO descriptors for chicken genetic resources (FAO, 1986).Descriptions of comb types were based on illustrations presented by Somes (1990). Digital electronic hanging scale (WH-AO8, made in china) was used to measure the respective body weight of individual chickens and bulk egg weight in the field.

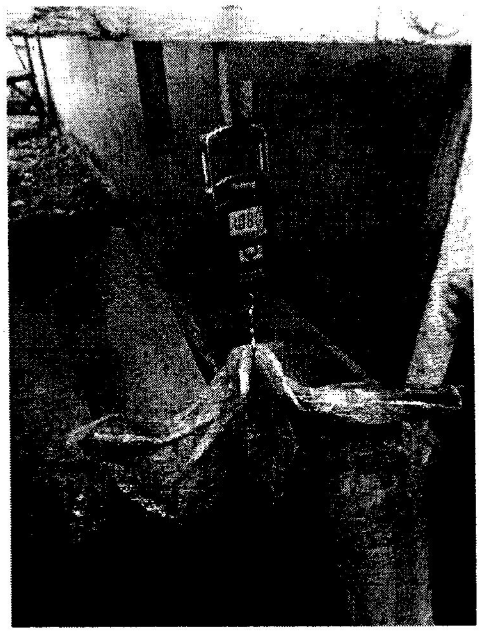

Plate 7:Digital Hanging scale(WH-AO8)

3.5 Data Analysis

Data were entered into Statistical Analytical Systems (SAS) version 8.0 for window, (1999). Qualitative and Quantitative data were entered into Microsft EXCEL spread sheet. The data was subjected to simple descriptive analysis. Interaction between Performance Traits and weight groups of Henswereanalysed using Analysis of Variance technique carried out with SAS at 5% significant level, and the mean separationwas done using Tukey's Honestly Significance difference

CHAPTER FOUR

Results

4.0 Cephalic Traits

Table 1 reveals the frequency and percentage of beak colour by sex of Yoruba ecotype chicken (YEC). Eight different beak colors were observed. Brown coloured beak was 48% of the sampled population, followed by yellow beak (21%). The Black and Cream coloured beaks were predominant in hens (10.5 and 4.0 %) than in cocks (6.5 and 1.0 %). The chi-square value is the probability that there was no association between beak colour and sex in YEC (X^2=0.129) value shows that there was no association between Beak colour and sex of chicken of the Rainforest ecotype chicken.

Table 2 shows the frequency and percentage of Comb colour by sex of Yoruba ecotype chicken (YEC).The Red comb colour (98.5%), Brown comb colour (1%) and pink comb colour (0.50%). pale red was observed more in the Hens (52%) than the Cocks (42%). The chi square value (x^2=0.54) is the probability that there was no association between Comb color and sex of chicken.

Table 3 reveals four comb types; single comb (96%) which occurred highest in Cocks and Hens. Pea combs (2.5%), which were found only in the Hens. Rose comb (2.5%) and Buttercup (0.5%) occurred lowest in the total population of both Cocks and Hens. The chi square value (x^2=0.30) is the probability that there was no association between Comb color and sex of chicken.

Table1: Occurrence of Beak color and percentage by Sex of Chicken

Beak Color	Yellow	Yellowish black	White	Cream	Gray	Brown	Dark brown	Black	Total
Cock	18(9.00)	1(0.50)	0(0.00)	2(1.00)	0(0.00)	45(22.50)	7(3.50)	13(6.50)	86(43.00)
Hen	24(12.00)	1(0.50)	1(0.50)	8(4.00)	2(1.00)	51(25.50)	6(3.00)	21(10.50)	114(57.00)
Total	**42(21.00)**	**2(1.00)**	**1(0.50)**	**10(5.00)**	**2(1.00)**	**96(48.00)**	**13(6.50)**	**34(17.00)**	**200(100)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.129

Table2: Occurrence of Comb colour and percentage by Sex of Chicken

Comb Colour	Red	Pale	Brown	Pink	Total
Cock	2(1.00)	84(42.00)	0(0.00)	0(0.00)	86(43.00)
Hen	6(3.00)	105(52.50)	2(1.00)	1(0.00)	114(57.00)
Total	**8(4.00)**	**189(94.50)**	**2(1.00)**	**1(0.50)**	**200(100.00)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.54

Table 3: Occurrence of Comb type and percentage by Sex of Chicken

Comb Type	Buttercup	Pea	Rose	Single	Total
Cock	1(0.50)	1(0.50)	1(0.50)	83(41.50)	86(43.00)
Hen	0(0.00)	4(2.00)	1(0.50)	109(54.50)	114(57.00)
Total	**1(0.50)**	**5(2.50)**	**2(1.00)**	**192(96.00)**	**200(100.00)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.30

Table 4 shows the frequency and percentage of Earlobe colour by sex of Yoruba ecotype chicken (YEC). Red earlobe colour in the total population was (52%), Reddish white (35%), white (11%), Grey (1%), Whitish pink (0.50%), Brown (0.50%).Reddish white earlobe occurred more in Hens (21%) than Cocks (14%). The chi-sqaure value (x^2=0.32) is the probability shows no relationship between Earlobe colour and sex of chicken.

Table 5 indicates the frequency and percentage of Eye colour by sex of Yoruba ecotype chicken (YEC). Orange eye color has the highest frequency (95%), Red color (4.5%) occurred most in the cocks (4%) and in Hens (0.50%) and Brown eye colour (0.50%) was found in hens. The chi square value (x^2=0.01) is the probablity that there is a relationship between Eye color of chickens and sex of chicken.

Table4: Occurrence of Earlobe colour and percentage by Sex of Chicken

Earlobe Colour	Red	Reddish white	White	Whitish Pink	Brown	Gray	Total
Cock	48(24.00)	28(14.00)	9(4.50)	0(0.00)	0(0.00)	1(0.50)	86(43.00)
Hen	56(28.00)	42(21.00)	13(6.50)	1(0.50)	1(0.50)	1(0.50)	114(57.00)
Total	**104(52.00)**	**70(35.00)**	**22(11.00)**	**1(0.50)**	**1(0.50)**	**2(1.00)**	**200(100.0)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.32

Table5: Occurrence of Eye colour and percentage by Sex of Chicken

Eye colour	Brown	Orange	Red	Total
Cock	0(0.00)	78(39.00)	8(4.00)	86(43.00)
Hen	1(0.50)	112(56.00)	1(0.50)	114(57.00)
Total	**1(0.50)**	**190(95.00)**	**9(4.50)**	**200(100.00)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.01

4.1 The Body Traits

Table 6 shows the frequency and percentage of Skin colour by sex of Yoruba ecotype chicken (YEC). The Creamish skin (60%) was found the highest of the total population of both Cocks and hens, followed by Whitish skin colour (20.5%) and Yellowish skin (19.5%) was the lowest occurring in the population. The chi square value (x^2=0.58) is the probability that there is no relationship between Eye color of chickens and sex of chicken.

Table 7 shows the frequency and percentage of Drumstick colour by sex of Yoruba ecotype chicken (YEC). The Creamish Drumstick colour (59%) was found the highest of the total population of both Cocks and hens, followed by Yellowish Drumstick colour (23.5%) and Whitish Drumstick color (17.5%) was the lowest occurring in the population. The yellowish drumstick color and creamish drumstick was prevalent in the Hen (14%, 35%) than in cocks (95%, 24%), while the Whitish drumstick colour occurred in Cocks (9.5%) than the Hens (8%).The chi square value (x^2=0.03) is the probability that Plumage pattern has association with sex of chicken.

Table 8 shows the frequency and percentage of Keel bone structure by sex of Yoruba ecotype chicken (YEC). The tables showed that 81.5% 0f the examined chickens have normal keel bone structure, followed by crooked keel bone structure (11.5%) which was more in hens (7.5%) than in cocks (4.5%), Dented(5%) and Concave keel structure(2%). The chi square value (x^2=0.25) is the probability that there is no relationship between Eye color of chickens and sex of chicken

Table 6: Occurrence of Skin-colour and percentage by Sex of Chicken

Skin colour	*Yellow*	Yellowish-pink	Cream	Creamish-pink	White	Whitish-pink	Total
Cock	5(2.50)	11(5.50)	14(7.00)	35(17.50)	12(6.00)	9(4.50)	86(43.00)
Hen	7(3.50)	16(8.00)	30(15.00)	41(20.50)	11(5.50)	9(4.50)	114(57.00
Total	**12(6.00)**	**27(13.50)**	**44(22.0)**	**76(38.00)**	**23(11.50)**	**18(9.00)**	**200(100)**

NOTE: Values in *bracket* are in percentage of Total frequency

Chi-square Probability 0.58

Table7: Occurrence of Drumstick colour and percentage by Sex of Chicken

Drumstick Colour	Yellow	Yellowish-pink	Cream	Creamish-pink	White	Whitish-pink	Total
Cock	6(3.00)	13(6.50)	25(12.50)	23(11.50)	13(6.50)	6(3.00)	86(43.00)
Hen	12(6.00)	16(8.00)	49(24.50)	21(10.50)	16(8.00)	0(0.00)	114(57.00)
Total	**18(9.00)**	**29(14.50)**	**74(37.00)**	**44(22.00)**	**29(14.50)**	**6(3.00)**	**200(100)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.03

Table 8: Occurrence of Keel bone structure and percentage by Sex of Chicken

Keel bone Structure	Concave	Crooked	Dented	Normal	Total
Cock	0(0.00)	8(4.00)	4(2.00)	74(37.00)	86(43.00)
Hen	4(2.00)	15(7.50)	6(3.00)	89(44.50)	114(57.00)
Total	**4(2.00)**	**23(11.50)**	**10(5.00)**	**163(81.50)**	**200(100.00)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability

Table 9 reveals the frequency and percentage of Skeletal variation by sex of Yoruba ecotype chicken (YEC). Most of the birds are normal (93%). Dwarfism gene occurred more amidst the Hens (3%) than the cocks (2%). Polydactyly occurred more in the Hen with a percentage of(2%) and Cocks(0%), while multiple spurs occur in the Cocks (0.5%) and (0%) in Hens. %). The chi square value (x^2=0.17) is the probability that there is no relationship between skeletal variation of chickens and sex of chicken

Table9: Occurrence of Skeletal variation and percentage by Sex of Chicken

Skeletal Variant	Normal	Dwarf	Polydactly	Murtiple Spurs	Absence of spurs	Total
Cock	83(41.50)	2(1.00)	0(0.00)	1(0.50)	0(0.00)	86(43.00)
Hen	103(51.50)	6(3.00)	4(2.00)	0(0.00)	1(0.50)	114(57.00)
Total	**186 (93.00**	**8(4.00)**	**4(2.00)**	**1(0.50)**	**1(0.50)**	**200(100.00)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.17

4.2 The Feather and Plumage Traits

Table 10 shows the frequency and percentage of Feather Colours by sex of Yoruba ecotype chicken (YEC) Black feather mixed with other colors (42%) occurred highest, followed by Brown mixed with other colors (28.5%), Black (7.5%), White(6.5%),White with other colours (2.5%) and Maroon (2%) occurring least in the Cocks and hens of the surveyed population. The chi square value (x^2=0.001) the probability that the Eye colour of chicken is highly affected by sex

Table 11 shows the frequency and percentage of Feather distributon by sex of Yoruba ecotype chicken (YEC). The result shows that most of the chicken in the population surveyed have normal feather distribution with a percentage of (98.5%), and with other observed feather distributions which were frizzled feather (1%) and Silky Feathered (0.50%) of the total population.. The chi square value (x^2=0.10) is the probability that Feathered of chicken is highly affected by sex.

Table 12 shows the frequency and percentage of Feather morphology by sex of Yoruba ecotype chicken (YEC)., the result shows that most of the chicken in the population surveyed have mixed feather morphology with a percentage of (42.5%), the penciled feathered were more of Cocks (9%,) and Hens (25%). laced feathered were more of Hens with percentage of (24.5%) and cocks (1.5%) and mottled feathered also occurred more in the Hens with a percentage of (10%) and Cocks (3.5%).The chi square value (x^2=0.01) is the probability that Feathered of chicken is affected by sex of chicken.

Table10: Occurrence of Feather-colour and percentage by Sex of Chicken

Feather Colour	Black	Black with Other colours	Brown	Brown with Other colours	White	White with other colours	Maroon with other colours	Total
Cock	2(1.00)	45(22.50)	1(0.50)	23(11.50)	7(3.50)	4(2.00)	4(2.00)	86(43.00)
Hen	13(6.50)	41(20.50)	7(3.50)	46(23.00)	6(3.00)	1(0.50)	0(0.00)	114(57.0)
Total	**15(7.50)**	**86(43.00)**	**8(4.00)**	**69(34.50)**	**13(6.50)**	**5(2.50)**	**4(2.00)**	**200(100)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.001

Table11: Occurrence of Feather distribution and percentage by Sex of Chicken

Feather Distribution	Normal	Frizzled	Silky	Total
Cock	85(42.50)	0(0.00)	1(0.50)	86(43.00)
Hen	112(65.50)	2(1.00)	0(0.00)	114(57.00)
Total	**197(98.50)**	**2(1.00)**	**1(0.50)**	**200(100.00)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.10

Table12: Occurrence of Feather morphology and percentage by Sex of Chicken

Feather Morphology	Penciled	Barred	Laced	Double laced	Edged	Mottled	Frizzled	Mixed	Total
Cock	18(9.00)	1(0.50)	3(1.50)	0(0.00)	2(1.00)	7(3.50)	1(0.50)	53(26.50)	86(43.C
Hen	4(2.00)	4(2.00)	49(24.50)	1(0.50)	0(0.00)	20(10.00)	1(0.50)	30(15.00)	114(57.
Total	**26(13.00)**	**5(2.50)**	**52(26.00)**	**1(0.05)**	**2(1.00)**	**27(12.50)**	**2(1.00)**	**83(42.50)**	**200(10**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.0001

Table 13 shows the frequency and percentage of Plumage pattern by sex of Yoruba ecotype chicken (YEC). the result shows that most of the chicken in the population surveyed have mixed plumage pattern with a percentage of (39%), the Wheaten plumage patterned were more of Hens with a percentage of 21.5% and Cocks (3.5%), Solid plumage were more of Hens with percentage of (11%) and Cocks (6%), mottled plumage also occurred more in the Hens with a percentage of (11%) and Cocks (3.50%). The chi square value (x^2=0.0001) is the probability that Plumage pattern has high association with sex of chicken.

Table13: Occurrence of Plumage pattern and percentage by Sex of Chicken

Plumage Pattern	Wheaten	Columbian	Solid	Barred	Mottled	Frizzled	Non-descript	Total
Cock	7(3.50)	0(0.00)	12(6.00)	0(0.00)	7(3.50)	1(0.50)	58(29.00)	86(43.00)
Hen	43(21.50)	4(2.00)	23(11.00)	4(2.00)	22(11.00)	1(0.50)	20(10.00)	114(57.00)
Total	**50(25.00)**	**4(2.00)**	**35(14.50)**	**4(2.00)**	**29(14.50)**	**2(1.00)**	**78(39.00)**	**200(100)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.0001

4.3 Leg (Phalanges) Traits

Table 14 shows the frequency and percentage of Digit colour by sex of Yoruba ecotype chicken (YEC). The Yellow digit colour (51.5%) was found the highest of the total population of both Cocks and hens, Cream digit colour (12%) and Gray digit colour (19.5%) was the lowest occurring in the population. The green digit colour occurred more in the Hens (5%) than the Cocks (0.5%), while the brown digit colour occurred more in the Cocks (7%) than Hen (3.5%).The chi square value (x^2=0.07) is the probability that Plumage pattern has no association with sex of chicken

Table14: Occurrence of Digit colour and percentage by Sex of Chicken

Digit Color	Black	Brown	Green	Cream	Yellow	Yellowish green	Yellowish brown	Golden yellow	Gray	White	Total
Cock	0(0.00)	14(7.00)	1(0.50)	11(5.50)	45(22.50)	1(0.50)	2(1.00)	1(0.50)	8(4.00)	1(0.50)	86(43.00)
Hen	1(0.0)	7(3.50)	10(5.00)	13(6.50)	58(29.00)	9(4.50)	4(2.00)	0(0.00)	9(4.50)	1(0.50)	114(57.0)
Total	**1(0.50)**	**21(10.5)**	**11(5.00)**	**24(12.0)**	**103(51.5)**	**10(5.00)**	**6(3.00)**	**1(0.50)**	**17(9.5)**	**2(1.00)**	**200(100)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.07

4.4 Interaction between Reproduction of traits and Body weights groups in Hens

Table 15 shows the frequency and percentage of Matured weight by sex of Yoruba ecotype chicken (YEC). Percentage of Matured weight Groups amidst the cocks surveyed were 0.51-1.00kg (9%), 1.01-1.50Kg (25%), 1.51-2.00Kg (4.50) and 2.01-2.50Kg (4.%), while the Hens belong more to the lower weight groups 0.51-1.00kg (38%), 1.01-1.50Kg (16%), 1.51-2.00Kg (2%) and 2.01-2.50Kg(1%). The chi square value (x^2=0.15) is the probability that Plumage pattern has no association with sex of chicken

Table 16 shows significant difference between Hens of different weight groups. There were significant difference ($p<0.05$) among weight groups of the Hens in the population for matured weight, and no significant difference for egg weight, number of eggs/ clutch, number of eggs hatched, number of chicks, unhatched eggs and number of chicks that died at four weeks old.

Table15: Mature weight range and percentage by Sex of Chicken

Mature Weight	0.51-1.00kg	1.01-1.50kg	1.51-2.00kg	2.01-2.50kg	Total
Cock	18(9.00)	51(25.50)	9(4.50)	8(4.00)	86(43.00)
Hen	76(38.00)	32(16.00)	4(2.00)	2(1.00)	114(57.00)
Otal	**94(47.00)**	**83(42.00)**	**13(6.50)**	**10(5.00)**	**200(100.00)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.15

Table 16: Interaction between Reproduction of traits and Body weights groups in Hens

Traits	0.51-1.00	1.01-1.50	1.51-2.00	Avg	LOS
Matured weight(Kg)	0.84[c]	1.16[b]	1.95[a]	1.109	<0.0001
Egg weight(g)	33.14	36.75	-	34.59	0.189
Eggs/clutch	9.79	9.44	-	9.68	0.605
Chicks/clutch	8.00	7.33	-	7.8	0.277
Unhatched eggs	0.88	0.92	0.00	1.35	0.163
Mortality of chicks at 4wks (%)	1.27	1.68	0.00	1.36	0.454

LOS= level of significance

DISCUSSION

5.1 Cephalic Traits

Beak colour

Eight different beak colors were observed. Brown coloured beak was 48% of the sampled population, followed by yellow beak (21%). The Black and Cream coloured beaks were predominant in hens (10.5 and 4.0 %) than in cocks (6.5 and 1.0 %). The frequency of beak colors varies with different levels of pigmentation in the beak and this also might have been affected by presence of xanthophyll in the feed stuffs available for chickens in respective settlements.

Comb colour

Three comb colours (Red, Brown and Pink) were observed in this study with a difference between sexes. The Red comb colour (98.5%), Brown comb colour (1%) and pink comb colour (0.50%). Pale red was observed more in the Hens (52%) than the Cocks (42%) And it agrees with Farouque et al (2010), it also agrees with Guhl and Ortman (1953) who repoted that comb colour in male and female Chickens are influenced by the levels of sex hormones.

Comb type

Four comb types were examined in the study. Single comb (96%) occurred highest in Cocks and Hens. Pea combs (2.5%), which were found only in the Hens. Rose comb (2.5%) and Buttercup (0.5%) occurred lowest in the total population of both Cocks and Hens. The gene frequencies of the comb types in this study failed to conform to the 9: 3: 3:1 Mendelian mode of inheriting this character. The failure of this might be due to possible interactions between the major genes which themselves may be pleitropic to quantitative traits. Pleitropic traits are capable of exerting threshold effects on other genes, preventing latter from expressing their effects. Otherwise, it could also be the involvement of comb and wattle in heat loss thus granting better adaptive features for the largest comb type (single comb) which will enhance more heat loss. This was in tandem to the reports of Oluyemi and Roberts (2000) and sonaiya (2000). The gene frequencies for rose, buttercup and pea obtained in this study were far lower thus showing that these comb types are already endangered.

Earlobe colour

In this study, Red earlobe colour in the total population was (52%), Reddish white (35%), white (11%), Grey (1%), Whitish pink (0.50%), Brown (0.50%).Reddish white earlobe occurred more in Hens (21%) than Cocks (14%). Variations in earlobe colour have been reported from other studies (Cabarles 2012). Chanseng *et al.*, 2016 reported that the variation in chicken earlobe colour may be caused by Ancestral lineages or and mutations, as well as the adaptability to local conditions.

He further reported that the presence of white earlobes is due to purine base deposition and the formation of other colors is attributed to mixture of different pigments including melanin or carotenoid and also the red color could reflect the health of the birds with the degree of redness which shows blood flow. Since 52% of the birds in this study, have red earlobes, then it can be said that most the chickens are healthy.

Eye colour

Orange-eyed chicken were more frequent in the observed population, and it was more frequent in Hens than in Cocks. This is tandem to the work of (Guni 2013).The orange color of the eyes could be due to lack of colour pigment in the eyes, hence what is seen could be blood circulating the blood vessels of the eye and this depend on the pigmentation (carotenoid pigments and blood supply) of a number of structures within the eye (Crawford 1990). The high occurrence of orange eye has also been reported by Cambodia (FAO 2009).

5.2 The Body Traits

Skin color

Yellowish skin in the observed population is low (19.5%). And these might be due to the fact that majority of chickens used for commercial egg and meat production and local chicken have different ancestral lineage (Hutt 1949). These commercial chickens are homozygous for yellow skin allele unlike local chickens and the expression of the yellow gene is aided by presence of carotenoids and Xanthophyll's in the feed given to the birds (Eriksson et al., 2008). And also the low frequency of yellow skin gene might also be due to the fact that most of the local chickens might be due to different feed stuffs available for chickens in respective settlements. The differences could also be due to different genetic determination. Even if the chickens were exposed to carotenoids, some birds may be unable to deposit the pigment under the skin.

Drumstick Colour

The Creamish Drumstick colour (59%) was found the highest of the total population of both Cocks and hens, followed by Yellowish Drumstick colour (23.5%) and Whitish Drumstick color (17.5%) was the lowest occurring in the population. The yellowish drumstick color and creamish drumstick was prevalent in the Hen (14%, 35%) than in cocks (95%, 24%), while the Whitish drumstick colour occurred in Cocks (9.5%) than the Hens.it was observed during the study that the chicken drumstick are more darker than the normal skin colour except some other cases, whereby it is the same. This can be due to pigment in the bone marrow which can colour the surrounding tissue and make the bones themselves look very dark.

Keel bone structure

Keel bone is the extension of the sternum (Breast bone) which runs axially along the midline of the sternum and extends outward, perpendicular to the plane of the ribs. Damaged keel bone occurs more in the laying Hen as shown in (Table8). On the field most birds with these defects could be as a result of falls and crashes or low calcium in diet. This agrees with the work of (Davies 2019).

Skeletal Variation

Table 8 reveals that polydactyl, multiple spurs, dwarfism which are major genes are low in the observed population which might be due to the fact that these genes are going into extinction. And it agrees with Brown *et al.*, 2017 that reported that the Low frequencies of major genes carriers among local chickens suggest that major genes are on the brink of extinction, these might be caused due to usage of these birds used for rituals, sacrifices in the community. And also owner of such chickens prefer to hide them because it is believed such birds are fetish, it agrees with Yakubu findings as per respondent's declaration, abnormal looking birds are deliberately removed from flocks as they are frown upon by society and have no market values.

5.3 The Feather and Plumage Traits

Feather colour and plumage pattern

Diverse Feather color and plumage pattern were observed in the chicken examined especially with different coloration in the male chicken intended to attract females, while hen have more subtle colors to camouflage (Ayeni, 1980) against predators which is more evident in this study revealed by the low Occurrence of solid colors.

Feather distribution

The Study shows that chicken in the population surveyed have normal feather distribution with a percentage of (98.5%), and with other observed feather distributions which were frizzled feather (1%), Silky Feathered (0.50%) and Naked neck (0%) of the total population. The frequencies of frizzled, silky and naked neck were low in this study. And this agrees with Hagan (2010) who reported very low gene frequencies for frizzle (0.03) and naked-neck (0.05) compared to the normally feathered counterparts (0.95). He explained that the lower than expected gene frequencies for the dominant genes might be attributed to the naked neck and frizzled birds being used for rituals; and for which normally feathered birds would not be used for sacrificial purposes.

Feather morphology

The study shows that most of the chicken in the population surveyed have mixed feather morphology with a percentage of 42.5%, the penciled feathered birds were more in Cocks (9%) than Hens (2%). Laced feathered birds were more in Hens with percentage of 24.5% than cocks 1.5% and mottled feathered birds also occurred more in the Hens with a percentage of 10% and

Cocks 3.5%. The difference in feather morphology observed in the study might be due to the difference in Sex. In the study the penciled feathers were more of cocks while laced feathers were more of hens

5.4 Leg (Phalanges) Traits

Digit Colour

In this study, various digit colours were observed. The Yellow digit colour (51.5%) was found to be the highest, Cream digit colour (12%) and Gray digit colour (19.5%) was the lowest occurring in the population. The green digit colour occurred more in the Hens (5%) than the Cocks (0.5%), while the brown digit colour occurred more in the Cocks (7%) than Hen (3.5%). Out of the total population of both Cocks and Hens, yellow digit has the highest frequency. This agrees with the work of oluyemi and Roberts (2000) who reported that common digit colors were yellow. pigmentation which is a function of nutrition and had been reported to depend on combination of pigments in the upper layers of the skin that are associated with the absence of melanin pigments in the dermis and epidermis of the skin (Duguma, 2006). It can be deduced that feed resources i.e green plants available for the chickens during scavenging contained carotenoid pigment and xanthophyll that support the yellow pigmentation in the skin.

5.5 Interaction between Reproduction of traits and Body weights groups in Hens

Body weight

Percentage of Matured weight Groups amidst the cocks surveyed were 0.51-1.00kg (9%), 1.01-1.50Kg (25%), 1.51-2.00Kg (4.5%) and 2.01-2.50Kg (4.%), while the Hens belong more to the lower weight groups 0.51-1.00kg (38%), 1.01-1.50Kg (16%), 1.51-2.00Kg (2%) and 2.01-2.50Kg(1%). Adult cocks and hens was reported by Busuulwa (2009) as 2.1kg and 1.4kg. Gueye (2000) also reported 1.2-3.2 kg and 0.7-2.1kg for Cocks and Hens respectively. The study further showed that the male chickens were a little bit superior to female chickens in the Body weight. The reason for the body weight superiority could be due to endocrinal differences that exist between male and female, and it could also be as a result of production pressure on the female chicken as reported by Fayeye (2006) and Prado-Gonzalez (2003).

Egg Weight

In this study, the mean egg weight measured was 33.14 and 36.75 for bodyweights of 0.51-1.0kg and 1.01-1.5kg respectively. Akinokun (1974) reported that egg weight during first year of lay averaged 33.39g increasing from an average of 28.78g during first month to 40.46g. Nwosu (1990) reported 38.63g as mean egg weight. Nwosu and Omeje (1984) reported egg weight of 33.37 $\pm$ 0.849. It was observed that as the bird grows and increases in body weight, the egg weight increases during first year of lay.

Eggs per clutch

In this study, averages of 10 eggs were observed per clutch. Atteh (1990) reported 11 eggs as average number of clutches and eggs per clutch for chickens sampled in the Western Middle Belt of Nigeria. Hassan et al (1990) and Otchere et al (1990) reported 10.4 eggs and 12.0 eggs.

Chicks per clutch

81.7% and 77.7% of eggs for bodyweights of 0.51-1.0kg and 1.01-1.5kg respectively were hatched in the survey. Dafwang (1990) reported hatchability of 70%-100%. Atteh (1990) reported hatchability to be almost 100%.

Unhatched eggs

In the study, 18.3% and 22.3% of eggs for bodyweights of 0.51-1.0kg and 1.01-1.5kg respectively were not hatched. The reasons for this might be due to nutritional deficiencies, chick deformities and failure in embryo development.

Mortality of Chicks

Mortality of chicks in the study was about 1.27% and 1.68% for bodyweights of 0.51-1.0kg and 1.01-1.5kg respectively. The total chicks' loss could be due to diseases, predators, parasites, and cold stress in raining season. The main predators were hawks, cats and snakes. Mortality for exotic birds under scavenging conditions were higher than that of local birds thus indicating that, local chickens were more adapted to subjected hazards of diseases, parasites and predators under scavenging condition (Samnang, 1998; Demeke, 2003).

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATION

6.1 Conclusion

It could be concluded that there were variations in the phenotypic traits of Yoruba ecotype chickens examined. The occurrences of major genes - naked neck, frizzle, silky, crest, and polydactyl were low within the Yoruba ecotype chicken population in the three local government of Ekiti State. The study also shows that the performance traits were not affected by the Weight groups except for the mature weight.

6.2 Recommendations

1. It is recommended that polydactyl, naked neck and silky phenotypes must be preserved for future breeding programs in order to prevent the total extinction of these important genes.

2. More public education should be organized at the village level and market centers by extension agents to change the negative social bias against these mutant traits found within the local chicken population.

3. Local poultry farmers should incorporate these major genes into meat and egg type chickens for improved productivity and adaptability to the humid tropical conditions in Ekiti state.

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APPENDICES

Occurrence of Roach back and percentage by Sex of Chicken

Roach back	Present	Absent	Total
Cock	0(0.00)	86(43.00)	86(43.00)
Hen	0(0.00)	114(57.00)	114(57.00)
Total	**0(0.00)**	**200(100)**	**200(100)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.0

Occurrence of Shank type and percentage by Sex of Chicken

Comb Type	Present	Absent	Total
Cock	0(0.00)	86(43.00)	86(43.00)
Hen	0(0.00)	114(57.00)	114(57.00)
Total	**0(0.00)**	**200(100.00)**	**200(100.00)**

NOTE: Values in bracket are in percentage of Total frequency

Chi-square Probability 0.81

Occurrence of Breast blisters and percentage by Sex of Chicken

Breast blisters	Present	Absent	Total
Cock	0(0.00)	86(43.00)	86(43.00)
Hen	0(0.00)	114(57.00)	114(57.00)
Total	**0(0.00)**	**200(100.00)**	**200(100.00)**

NOTE: Values in bracket are in percentage of Total frequency

Occurrence of Shank colour and percentage by Sex of Chicken

[illegible]	Golden yellow	Yellowish green	Yellowish Brown	Green	Brown	Cream	Gray	Black	White	Total
[illegible]	1(0.50)	0(0.00)	1(0.50)	2(1.0)	12(6.0)	12(6.0)	5(2.50)	1(0.50)	1(0.50)	86(43.00)
[illegible]	0(0.00)	7(3.50)	2(1.00)	13(6.5)	7(3.50)	18(9.00)	11(5.50)	1(0.50)	1(0.50)	114(57.0)
[illegible]	1(0.50)	7(3.50)	3(1.50)	15(7.5)	19(9.5)	30(15.00)	14(7.0)	2(1.00)	2(1.00)	200(100)

[illegible]: Values in bracket are in percentage of Total frequency

[illegible] Probability 0.48