THE PHENOTYPIC CHARACTERIZATION OF NATIVE LESOTHO CHICKENS

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Dedication

To my family

To my lovely and caring husband, for all your love, patience, moral and financial support and for being a friend, father too.

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LIST OF ABBREVIATIONS

Abbreviation	Description
ADG	Average daily gain
AWG	Average weekly gain
FCR	Feed conversion ratio
LES	Lesotho chicken line
NH	New Hampshire chicken line
NN	Naked Neck chicken line
NULFOA	Faculty of Agriculture at the National University of Lesotho at Maseru campus
OVB	Ovambo chicken line
PK	Potchefstroom Koekoek chicken line
RIR	Rhode Island Red chicken line
UFS	University of the Free State
VEN	Lebowa-Venda chicken line
3-day	Chicken body weight measured at 3 day old weight
26-week	Chicken body weight measured at 3 weeks old weight
70-week	Chicken body weight measured at 70 weeks old weight

CHAPTER 1

GENERAL INTRODUCTION

The domestic chicken (*Gallus gallus domesticus*) originated in South-western Asia as a descendent of Red Jungle Fowl and was first introduced into China in about 1400 before the common era (BCE). Chickens are also depicted in Babylonian carvings of about 600 BCE and are mentioned by ancient Greek writers, particularly Aristophanes in 400 BCE (Crawford, 1990). Initially, domesticated fowls were kept for religious and cultural purposes. Cock fighting provided major recreation, especially in America and Europe. A few years later, chickens were kept in small flocks for home consumption until the 20th century when poultry farming became commercialized.

The process of commercialization of poultry farming has accelerated because of intensive selection for production traits and changes in the environment in which poultry are maintained. Industrial societies have fostered intensification of poultry production because of an escalation of land costs, energy and labour. The buffering utilized by individuals and populations in coping with changes in their physical and social environments involve complex behavioural, genetic and physiological responses (Siegel, 1993).

The introduction of the domesticated chicken in Africa is not well documented. However, it is believed that various domesticated chicken breeds were introduced from Europe during the era of colonization, leading to extensive mixing of local and domesticated chicken populations (MacDonald & Edwards, 1993).

In most developing countries the development of poultry industries started in the past 30 years and the major contributing factor to this was the high protein demand of the increasing population. The poultry sector can be divided into commercial and traditional sub-sectors (Mbugua, 1990). Each of them has its own peculiarities that make them special to the national food security. The commercial sub-sector comprises of layers, broilers, parent and grand parent stock. It is confined to the urban and peri-urban areas where the infrastructure necessary for the production and market for produce exists. These industries are interested in a breed with high egg or meat production for commercial enterprises.

In contrast, the traditional sub-sector consists of native/local birds, which has not been classified into breeds, although there are many ecotypes. This sub-sector is very important for the livelihood of most developing nations as it is mainly found in the rural areas (Sonaiya, 1997). It is the major source of readily available protein in the form of eggs and meat as well as cash money for 90% of the rural households (Mbugua, 1990).

Although the importance of increased poultry production was understood decades ago, it seems that the native poultry industry has been neglected in most countries. The native chicken production has not been included in the mainstream agricultural and economic activities of most African countries. There is a paucity of quantitative data to support the importance of the native chicken production systems in household and national economics. There has been more development focused on introducing exotic high yielding breeds than understanding the production potential of native chickens (Rodriguez & Preston, 1997).

The local chicken lines remain prominent in African villages, despite the introduction of high-yielding chicken breeds in the 1920's (Bourzat & Sounders, 1990). This is mainly because farmers are not able to afford the high input requirements of the commercial breeds. In Lesotho 84% of the households in the rural areas live mainly from native chicken production. (Mosoeunyane & Nkebenyane, 2001).

In most developing countries, chickens scavenge within the village boundaries. Their nourishment depends on the feed available in the village and their health on the local disease situation (Aini, 1990). Use and off takes of chickens are also dictated by a number of socio-economic factors prevailing in the village. Because of the role they play in village life, these native chickens are best described as village chickens (Aini, 1990; Kitalyi, 1998; Gueye, 1998). Native fowls (*Gallus domesticus*) are the predominant species in the rural poultry sector in Africa (Andrews, 1990; Jalaludin, 1992). Their production system is popular in most resource-poor countries, as a means of providing supplementary food, extra income and employment for family members and also to capitalize on harvest waste and inferior grains produced on farms (Sonaiya *et al.*, 1999). Native chickens survive under harsh weather conditions in unsheltered places. They are an integral part of the farming system, with short life cycles and quick turnovers. Zulu (1999) reported that native chickens provide the mainstay of the rural economy and contribute to food security and agricultural development. It can be described as low input production systems with output accessible at both inter household and intra household levels. Consequently, it is a means of converting low quality feed into high-quality protein.

Most native chickens have not been selected for particular traits such as meat or egg production. The production level of native hens is generally low (Kitalyi, 1998), with only 40-60 small sized eggs produced per bird per year under small holder management conditions. In general, the native chickens have a small body, different colours of plumage, and are of dual-purpose type. The egg size seldom exceeds 42g and the animals usually reach the market weight of 1.0-1.5 kg at the age of 4 to 5 months (Aini, 1990). They are perceived to have a better taste and proved to have relatively little fat as compared to commercial broilers (Enku-Azahan *et al.*, 1990), thus contributing to their premium price. A review compiled by Joubert (1996) of some identifiable characteristics of native chickens in general, is given in Table 1.1.

According to the results of Dessie and Ogle (1996), the total output of scavenging birds is low, not only because of low egg production, but also due to high chick mortalities. Half of the hatched chickens are used to replace birds that have died. Brooding time of the mother bird is also long in order to compensate for unsuccessful brooding. Smith (1990) estimates that under extensive systems, the reproduction cycle consists of a 10 day laying phase, a 21 day incubation phase and a 56 day brooding phase. This implies a theoretical maximum number of 4.2 clutches per hen per year. In reality the number is probably 2.3. Overall the system is, however, quite productive because of the very low input levels. This is underlined by McArdle (1972), who states that the net output from poultry rearing is higher in scavenging natives as compared to a commercial system, if the input-output relation is the only factor considered.

Table 1.1 Identifiable characteristics of native chickens in Africa

Country	Local name	Identifiable marker	Mature male weight (kg)	Mature female weight (kg)	Other visible traits
Burkina Faso	Cou no.joub-kole	Na:naked neck F: frizzle	1.5	1.2	Thermo-resistancy; resistance to some diseases
Chad	Chickens of Moulkou and Bongor	P: pea comb	1.5	1.0	
Chad	Djided	P: pea comb	1.5-2.0	1.0-1.5	
Ghana	Local Ghanadian	N: naked neck F: frizzle P: pea comb	1.2	1.1	
Swaziland	Inkhukhu	Na: naked neck			
South Africa	Lebowa-Venda	White with black or brown plumage with dark green shades			
South Africa	Ovambo	Predominantly dark coloured plumage			
South Africa	Kaalnekke	Na: naked neck			
Lesotho	Basotho	P: pea comb	1.8	1.6	Resistance to internal parasites

There is great concern globally by organizations such as the UNEP and the FAO over the loss of the biodiversity in domestic animals and plants. Part of the Southern African heritage lies in the genetic diversity of native breeds, which have adapted to the harsh African environment (Zulu, 1999). These are animals that survive on both marginal and high potential grazing and seem to be disease and heat tolerant. Very limited information on these populations concerning genetic diversity exists. Most African native animal populations have not been adequately characterized.

Currently, there is a major global thrust on genetic preservation and biodiversity, which is reflected in efforts on the development of the genome data banks (Crawford & Gavora, 1993). These initiatives have come at an opportune time, because continued crossbreeding and inbreeding practices in village poultry, which do not consider gene preservation aspects, would lead to the erosion of the native germplasm (Bessei, 1989).

Likewise, little has been done on the studies leading to the conservation of the chicken resources genetic pool within Lesotho. More important, is the idea of more food for an increasing population. Unfortunately, like in other developing countries, attention is directed to commercialization, using improved breeds. However, not enough attempts have been made to evaluate their performance under local farming conditions (Lebajoa, 2001).

Aims of the study

Chicken production in Lesotho plays a major role in the provision of household food security (Lebajoa, 2001). Rural families, especially, enjoy the benefit of rearing their own chickens for meat and egg production. These chickens also provide local people with some cash. Native chickens are thought to be adaptive to the production environment. Management costs incurred are very low, since they are free rangers.

Unfortunately, the huge potential of the native chicken has not been realized and utilized in Lesotho possibly because there is little data of their production potential. In the goals and objectives for poultry development in Lesotho, there are no specific objectives and concrete activities for improving the production of the native chickens (Lebajoa 2001).

The object of the study was to phenotypically characterize the production performance of the Lesotho native chicken strains in comparison to other native Southern African chickens, namely the Ovambo, Lebowa-Venda, Potchefstroom Koekoek, and Naked Neck as well as some exotic lines (Rhode Island Red and New Hampshire). This trial was conducted to device a growth curve for the Lesotho native chickens from 3 days old to 70 weeks of age. The study was conducted in two phases, namely a pre-laying and laying phase. Therefore, the study aimed to:

- Determine the performance of the different lines for growth traits in the pre-laying phase.
- Determine the performance of the different lines for growth traits in the laying phase.
- Determine the performance of the different lines for average number of eggs and egg weight.
- Evaluate carcass characteristics for all lines involved.
- Determine mortality rates from 3-day old up to the moulting stage for all lines involved.

This study is based on the hypothesis that native chicken production systems of Lesotho forms the basis for improved native poultry production and can be transformed through breeding from total subsistence to semi-commercial production systems to increase food security and income, especially among the very poor members of the community. This phenotypic characterization of native chickens would be of paramount importance, not only for conservation purposes, but also for the definition of breeding objectives and programmes (Matika *et al.*, 2002).

CHAPTER 2

DESCRIPTION OF CHICKEN LINES

2.1 Phenotypic description of the Lesotho native chickens

The Lesotho native chickens have a very colourful plumage; solid white or black,

Fig 2.1.1 Lesotho chickens - NULFOA Lesotho village farm

brown, red and grey or combination of these. They posses different feather patterns, mostly, barred, pencilled, laced and partridge. Their skin and small almond shaped ear lobes are white in colour. The colour of their egg shell is mainly white or tinted. They are capable of flying and roosting in trees to avoid predators or to shelter themselves at night. Aggressiveness is a normal behaviour in hens to protect her young ones against predators.

The instinct of broodiness ensures their propagation and survival. They can be characterized by relative high egg production and an instinct to broodiness.

Generally, the Lesotho strains could be described by upright, active, alert and sprightly carriage. They possess a moderately long body, fairly wide at the shoulders and narrowing slightly to the root of the tail. They posses a full and round breast with a broad and moderately long back. Their medium long wings are tucked well up; the neck and saddle hackles with medium and full tail cover the bows and tip. The skull is short and fine. The beak is strong and well curved. Eyes are large, bright and prominent. Occasionally, rose combs are found but they mostly possess single and pea combs, which are erect, evenly serrated, of medium size, and following the contour of the skull. The face is smooth and fine in texture. Wattles are of medium length and well rounded at the base. Their necks are of medium length and furnished with long hackle feathers flowing well on the shoulders. The hackle feathers are more pronounced in the males than females. Legs and feet are of medium length, well apart thighs, and course shanks and free of feathers though some are booted.

There are no breed qualifications or any naming of the Lesotho native chickens as yet. Therefore, basing on distinct differences in plumage colour, the Lesotho native chickens could be characterized into three groups as follows:

Brown and Black Red (partridge)

Males exhibit deep mahogany on the neck hackle, dark red and black, often with purple sheen, black breasted and /or black tail. Females are coloured in brown with lighter

Fig 2.1.2 Brown and Black Red (partridge) hen – Thaba-Tseka, Lesotho

hackles striped with black. The breast differs from light brown, deep chestnut red or salmon with golden hackle and a black tail.

Sole coloured

In the black plumage coloured, the surface in both sexes is lustrous green-black or green-brown with the considerable sheen and the slate or light grey under colour. The feather pattern is laced. They have black beaks, shading towards the tip; dark brown eyes; red combs, face, wattles and ear lobes; and black legs and feet. In the white coloured plumage, the surface and under colour are white in both sexes.

Fig 2.1.3 Sole black plumage cockerel – Thaba-Tseka, Lesotho

The dark, red, cuckoo, silver grey spangled.

The cuckoo.

Fig 2.1.4 Blue-white hen with black bars and brown neck - Thaba-Tseka, Lesotho

The plumage in both males and females appears blue-white with bars of black. Shanks are lightly feathered.

The Dark.

Fig 2.1.5 The Dark hen – Mokhotlong, Lesotho

Males possess black hackles (both neck and saddle) with straws more or less striped with brown while various shades of white with black are found at the back. The wing bows are black or mixed with salmon with the grey abdomen. Coverts are black glossed with green. The breast and under parts are jet black with richly black mottling. In females, the neck hackle is brown or white, striped with black extending to the wings forming a brown grey with black lacing. A salmon red colour is found on the breast and each is feather tipped with dark grey. The tail is nearly black and pencilled, while the remainder of the plumage is black.

The red / chestnut.

The male hackles (neck and saddle) are bright glossy red while the back and bow wing are dark red. The remainder of the plumage jets are red. The female hackles appear bright gold, heavily striped with a red colour. The tail and primaries are black or very deep red while the rest of the plumage is red brown.

Fig. 2.1.6 The red / chestnut hen. – Mokhotlong, Lesotho

The Spangled (mottled).

Basically, chickens are white with double lacing.

Fig 2.1.7 The Spangled (mottled) hen – Mokhotlong, Lesotho.

The silver grey (laced).

Fig 2.1.8 The silver grey (laced) cock - Thaba-Tseka, Lesotho

The white colour predominates on the hackles with the grey or black striped wing bays. Males have silver wing bays and females have more lacing on the back.

2.2 Description of the South African Native and exotic lines

The Lebowa-Venda, Ovambo, and Naked neck are regarded as native to South Africa and are adapted to the prevailing harsh conditions in rural areas. The Potchefstroom Koekoek, Rhode Island Red and New Hampshire were bred to be adaptive and to survive under harsh, low input conditions with basic requirements of shelter, feed, water and hygiene. These characteristics form the basis for the phenotypic comparison.

Fig 2.2.1 A Potchestroom Koekoek and two hens – ARC Poultry Unit at Glen.

The Potchefstroom Koekoek was bred from crosses between the Black Australorp and the White Leghorn and is recognized as a locally South African developed breed. It also

resembles the barred Plymouth Rock. It is characterized by relative high egg production and adaptability for household production. The Koekoek is classified as a heavy breed, with an average adult body weight varying from 3-4 kg for cocks and 2.5 - 3.5 kg for hens (Joubert, 1996). The average egg weight is 55.7g and the colour of the eggs is brown (Ramsey *et al.,* 2000). These birds reach sexual maturity at 130 days. They have a characteristic black and white speckled colour pattern, also described as barred, which is present in as many as nine different poultry breeds. The male inherited the bar gene, a sex linked gene and they are easily distinguished, having light grey bars on the feathers, while the females are darker (Van Marle-Köster & Nel 2000).

Fig 2.2.2 A Naked Neck cock and two hens - ARC Poultry Unit at Glen.

The origin of the strange looking Naked Neck chickens is disputed. According to archaeologists, the Naked Neck breed originated in Malaysia; from there it spread all over the world. It is therefore possible that the Dutch East India Company introduced the Naked Neck to South Africa in the 17th century (Ramsey *et al.,* 2000). It is characterized as a dual-purpose breed adaptive to hot climate. They are very colourful – white, red and black feather combinations are found (Joubert, 1996). They reach sexual maturity at 155 days with an average weight of 1.95 kg for males and 1.4 kg for females at 20 weeks of age. These chickens carry the major gene Na- for naked neck, which has autosomal inheritance with incomplete dominance and was mapped on the chromosome of the chicken genome (Pitel *et al.*, 2000). Chickens that are homozygous have a little tuft of feathers on the neck area (Merat, 1996) while the heterozygous has a little tuft of feathers on the lower portion of the neck. The Na-gene is associated with significantly less plumage cover than chickens not carrying the gene.

Fig 2.2.3 A Lebowa-Venda cock and two hens - ARC Poultry Unit at Glen.

The Lebowa-Venda breed was first described by a veterinarian, Dr. Naas Coetzee, who noticed these distinctive chickens in the Venda area of the Limpopo Province. The Lebowa-Venda is characterized by lower egg production, instinct to broodiness and adaptability for household production. These chickens reach sexual maturity at the age of 143 days with an average body weight of 2.1 kg in males and 1.4 kg in females at 20 weeks old. The colour of the eggs is cream and sometimes tinted. The average egg weight is 52.7g. These chickens have white and black or white and brown plumage with shades of dark green on the feather tips (Joubert, 1996).

Fig 2.2.4 Ovambo chickens - ARC Poultry Unit at Glen.

The Ovambo chickens are found in the rura1 areas of Ovamboland and Namibia. They are predominantly dark coloured and are capable of flying and roosting in trees to avoid predators. They are aggressive and will attack and kill mice and small rats. Their broodiness ensures their propagation and survival. These chickens are characterized as layers and survive under harsh conditions. Their average weight at 20 weeks is 2.16 kg for males and 1.54 kg for females. They reach sexual maturity at 143 days and the average egg weight is 52.5g (Joubert, 1996).

Fig 2.2.5 A New Hampshire cock and a hen - ARC Poultry Unit at Glen.

The New Hampshire and Rhode Island Red breeds originated in the United States and they were included in this study, as they are dual-purpose and able to adapt to low-rearing systems in the rural areas. The New Hampshire was bred from the Rhode Island Red and is classified as a heavy breed with an adult body weight varying between 3.9 kg for cocks and 3.0 kg for hens. Plumage colour is a chestnut red with a light salmon colour on the breast areas. Egg colour is light brown.

Fig 2.2.6 Rhode Island Red chickens - NULFOA Lesotho village farm

The Rhode Island Red has a very deep red colour with a brilliant gloss overall. The breed is able to adapt very well to commercial rearing and to tropical conditions. The hen weighs from 2.5 to 3.0 kg while the cock may reach 4.0 kg. The hen is a very good layer of tinted eggs, while the pullets fatten well and the meat is well thought of. The breed does, however, have of a high food conversion ratio.

CHAPTER 3

GROWTH PERFORMANCE

Introduction

Growth involves simultaneous deposition of bones, muscle and fat; each exhibiting an individual pattern of development. When based on the percentage increase over the weight at the end of the pre-laying phase, the most rapid growth or weight gains are made when the chick is young. As the chick grows older, the weekly increments of weight increases become materially less. The heavier the day-old chick, the heavier the pullet at 12 to 18 weeks, but the correlation is less at older ages (Mignon-Grasteaus *et al*, 2001). At 20 to 21 weeks of age, factors other than initial chick weight show their effect on body weight and variations in body weight cannot be associated with day-old weight.

It is generally recognized that the growth of animals from conception to maturity occurs in a sigmoidal response of size over time, usually by plotting live weight against age. This sigmoidal response indicates that growth is self-accelerating during the early growth phase until the inflexion when it becomes self-inhibiting for the final phase approaching maturity (Siegel, 1993). In practice, the middle part of the curve often appears to be linear.

Although animal growth is thought to follow a generalized sigmoidal response, the actual shape of the curve can be affected by numerous factors such as nutrition, environment, health, gender and genotype. If it is assumed that the optimum level of nutrition is provided in a suitable environment and that the health status is high, the genetic potential for growth will have a strong influence on the shape of the growth curve.

Identifying the shape of the growth curve for a given genetic line of chickens is important for several reasons (Van Lumen & Cole, 1998). It allows the geneticists to measure the effects of selection for carcass and other characteristics; it shows the potential growth of the population, which can then be used as a yard stick under commercial conditions and it allows nutritionists to estimate the nutrition requirements of the chickens at various stages of growth.

The efficient utilization of nutrients (feed efficiency) is one of the major concerns in commercial table egg production as feed cost is one of the major components of total cost of production. According to Roberts & Gunaratne, (1992), feed alone may contribute 60 to 70% of the total costs of production in egg type layers. Better utilization of feed and avoiding unnecessary feed wastage could be the leading factors in minimizing total costs of production. A commercial layer requires 25 kg of feed for 1 kg eggs produced (Prawirokusumo, 1988). Kitalyi, (1999) reported a daily feed intake of 102g over a 52 weeks production and 2.27kg feed/dozen eggs laid for layers. Roberts & Gunaratne, (1992) reported a daily feed consumption/layer of 115g.

Feed efficiency measured by feed conversion ratio improves with increasing dietary protein level up to 160g CP/kg after which there is no further improvement (Kingori *et al*, 2003). Feed consumption is a variable phenomenon and is influenced by several factors such as strain of the bird, energy content of the diet, ambient temperature, density of birds in the pen, hygienic conditions and rearing environments. As with any growing pullet, feed conversion is the best when the hen is young, it then gradually decreases with age.

The use of selection within lines to make genetic improvement in the efficiency of feed utilization is a potential means of reducing the costs of livestock production systems, and these selection decisions are generally made for young growing animals (Kingori *et al*, 2003). In the case of commercial poultry this has been achieved through establishing specialized parent and grand parent lines that are utilized in terminal crossbreeding systems.

Materials and methods

Management and Environment

Five hundred and twenty-five day-old chicks (75 from each line) from native Lesotho lines (LES), two exotic lines (New Hampshire (NH) and Rhode Island red (RIR) and four South African native lines namely, Ovambo (OVB), Lebowa-Venda (VEN), Naked Neck (NN) and Potchefstroom Koekoek (PK) were raised in two batches, four weeks apart. The focus of the study was on the Lesotho line while the rest were used for comparison. Eggs for the Lesotho line were sampled from the mountain districts in Lesotho and hatched in Bloemfontein. The study covered the period from 3-days old to moulting stage (70 weeks old). The first 10 and 6 weeks of the study in Batch 1 and Batch 2 were performed at the University of the Free State campus (UFS), Bloemfontein, while the remainder of the Pre-laying phase and the rest of the Laying phase were conducted in Lesotho at the National University of Lesotho, Faculty of Agriculture Maseru campus (NULFOA). Both males and females were raised together.

At the UFS campus, the chickens were kept in a 3m x 4m compartment in a completely randomized block design with a stocking density of 25 chickens per compartment. There were 25 chicks per treatment in Batch 1 while in Batch 2 each treatment was divided into

two replicates of 25 birds per replicate. Feed and water were provided *ad lib*. They were fed commercial broiler starter mash from day old to 4 weeks old when grower mash was introduced and lasted for 6 weeks. From this stage up until the end of laying phase, they were all fed on commercial layers mash (15% CP) for four days in a week and crushed yellow maize for the remaining days and managed under a semi-intensive system in Lesotho. In this system chickens were fed and watered indoors *ad lib* while given freedom to roam about in the adjoining paddocks. At the NULFOA farm, only seven pens were available for all lines. Hence, both batches had to be grouped and raised as one pen per line. Other routine management procedures included vaccination against Mareks (1 day old), Newcastle disease (7 & 21 days old), Gumboro (14 days old) and Fowl pox diseases (60 days old).

Data

Performance data were compiled from 2002 to 2003 at the University of the Free State and the National University of Lesotho. Recorded information on individual weights was used for the analysis of the pre-laying and laying growth traits. The most important traits are 3-day weight, 26 week weight, 70 week weight (moulting), average daily gain (ADG) and feed conversion ratio (FCR). With the exception of FCR, the growth data for these traits included records from 3-days old to 70 weeks old. Feed conversion ratio was calculated as the amount of feed consumed to weight gain ratio. This part of the study was conducted over a period of 35 days due to semi-intensive system followed in Lesotho. This system made it impossible to accurately determine the feed intake of the animals. Males with the highest body weight and average daily gain at 26 weeks of age were selected and kept with the hens at a ratio of 1 cock to 5 hens in each line. Body

weight was recorded weekly. These recordings covered a period of 45 weeks in the laying phase up to 70 weeks of age.

After editing, 133 and 243 records were left for growth curve analysis in the first and second batches, respectively in the pre laying phase while 183 records (149 hens and 34 cocks) were available during the laying phase. Recording ended as the birds showed the signs of moulting accompanied by an individual decrease in body weight

Statistical Analysis

The analysis of variance components for growth traits and feed efficiency was done using the GLM procedure of SAS (1996). Significant differences between the mean treatments (chicken lines) were compared by using Tukey's test for multiple comparisons at a 95% probability level. A linear regression was used to estimate body weight at different points. The following models were fitted:

$Y_{ijm} = \mu + a_i + s_j + l_m + e_{ijm}$ (for 1st batch)

$Y_{ijkm} = \mu + a_i + s_j + b_k + l_m + e_{ijkm}$ (for 2nd batch)

Where:

Y_{ijkm} = an observation of a trait on the i^{th} animal of the j^{th} sex of the k^{th} block of the m^{th} chicken line.

μ = Least square mean

a_i = random effect of the i^{th} chicken

s_j = fixed effect of the j^{th} sex (1-2)

b_k = fixed effect of the k^{th} block (1-2)

l_m = fixed effect of the m^{th} chicken line (1-7)

e_{ijkm} = random error of the environment

Sex: 1- male, 2- female; Chicken lines: 1-Lesotho, 2-Lebowa Venda, 3-Naked Neck, 4-New Hampshire, 5-Ovambo, 6-Potchefstroom Koekoek, 7-Rhode Island Red.

A block effect was included in the model for Batch 2 to account for possible pen effects. Higher number of chickens necessitated more than one raising pens for this batch.

Results and discussion

Average Body Weight

The three stages, which are considered very crucial in the life of the chickens were discussed, namely the 3-day weight, 26-week old and 70 week weight. The 3-day weight is important as the first weight after hatching. The 26-week weight indicates weight at laying hence gives the growth behaviour at the start of laying while the 70-week weight is the period at moulting, which is characterized by decrease in both growth and egg performance.

Body weight at 3 days and 26 weeks old is presented in Table 3.1 and 3.2, respectively. There were significant differences ($p<0.05$) among the lines throughout the growing phase, and the lowest average 3-day weight was obtained for the Lesotho line with 33.8±0.80g and 40.4±0.95g in both Batches 1 and 2, respectively (Table 3.1).

The New Hampshire line was the heaviest with individual weights that ranges between 30.3g and 62.7g, while the weights in the other lines ranged between 25.0g and 57.5g (Table 3.1). The lowest individual weight was found in the Naked Neck (25.0g) while the highest was obtained in the New Hampshire (62.7g). Missohou *et al.* (2002) reported the

average weight of 31.7±5.3g in a Senegal native chicken line at the same age and similar management system.

Table 3.1 Descriptive data for 3-day weight (g) in Batches 1 & 2: number of records (N), means (μ), standard error (SE), coefficient of variation (CV%), minimum (Min), and maximum (Max).

Line	N	μ (g)	SE	CV %	Min (g)	Max (g)	N	μ (g)	SE	CV %	Min (g)	Max (g)
LES	25	33.8^{c}	0.8	11.9	30.0	42.5	48	40.4^{b}	0.9	16.2	29.9	53.5
VEN	25	44.3^{b}	0.7	7.5	39.2	53.6	50	42.7^{ab}	0.8	13.2	29.7	54.8
NN	25	44.3^{b}	0.9	10.4	36.8	52.5	48	42.^{b}	0.8	12.9	25.0	50.1
NH	25	50.3^{a}	0.8	8.2	39.4	56.6	50	46.4^{a}	0.9	13.6	30.3	62.7
OVB	25	42.6^{b}	0.8	9.5	34.2	49.6	50	46.8^{a}	0.7	10.5	36.7	57.5
PK	25	45.4^{b}	0.8	6.2	38.1	57.1	50	45.4^{a}	0.8	12.2	34.2	53.3
RIR	25	42.5^{b}	0.6	7.0	35.5	49.0	50	42.8^{ab}	0.8	12.6	31.0	56.5

Significant difference ($p<0.05$)
Variables in the same column with same superscripts are not significantly different ($P<0.05$).

At 26 weeks old (Table 3.2), the New Hampshire recorded the highest average weight of 1897.2±8.1g and 1376.0±9.1g in Batches 1 and 2, respectively. The Ovambo was the best native performer with an average weight of 1784.4±98.4 and 1409.0±53.0g in Batches 1 and 2, respectively. The average weight of the Lesotho line was 1283.3±45.0g and 917.0±44.2g in Batches 1 and 2 respectively. This is in agreement with the results of Aini, (1990), who reported a mature weight of 1.0 – 1.5kg in a Tswana local chicken line raised under semi-intensive system. Body weight and age of the chickens were positively correlated (r = 0.99 and r = 0.81) in both Batches 1 and 2.

Table 3.2 Descriptive data for 26-week weight (g) in Batches 1 & 2: number of records (N), means (μ), standard error (SE), coefficient of variation (CV%), minimum (Min), and maximum (Max).

Line	N	μ (g)	SE	CV %	Min (g)	Max (g)	N	μ (g)	SE	CV %	Min (g)	Max (g)
LES	9	1283.3^{c}	75.0	17.5	850.0	1600.0	21	917.6.0^{c}	48.2	24.1	450.0	1400.0
VEN	22	1527.3^{bc}	72.0	22.2	800.0	2000.0	27	1111.0^{bc}	45.5	21.3	490.0	1760.0
NN	19	1531.6^{bc}	81.0	20.6	1100.0	2300.0	36	1234.0^{ab}	47.4	23.1	690.0	1960.0
NH	18	1897.2^{a}	83.7	18.7	1400.0	2500.0	38	1376.0^{a}	64.7	29.0	830.0	2500.0
OVB	20	1784.4^{ab}	98.4	21.1	1350.0	2600.0	38	1409.0^{a}	53.0	23.2	800.0	2360.0
PK	23	1700.3^{ab}	74.7	21.1	1350.0	2600.0	43	1170.0^{b}	39.6	22.2	750.0	2000.0
RIR	22	1795.5^{ab}	64.6	16.9	1400.0	2500.0	40	1192.0^{ab}	46.9	24.9	640.0	1750.0

Significant difference *(p <0.05)*
Variables in the same column with same superscripts are not significantly different (*P*<0.05).

The lower performance of all the breeds in Batch 2 could be because of the lower level of nutrition (growers mash 3 weeks in comparison to 6 weeks in Batch 1) prevailing in this batch.

The average weight of cocks' (g) and hens at 26 weeks and 70 weeks old are given in Table 3.3. Sex was not significantly different (p>0.05) during the first three weeks of the chickens' growth (Fig 3.1 to 3.7). However, significant differences (p<0.05) were observed in sex during the 26-week weight. Similar results were obtained by Aganga *et al.*, (2000) in his study on local Tswana chickens. Missohou *et al.* (2002) further, showed that both sexes exhibit a similar pattern of growth up to 10 weeks of age but thereafter, males grow faster and attain higher mature body weight than female birds.

Significant differences in weight ($P<0.05$) were observed among the cocks in all the lines at the 26th week. Though the differences were not significant ($P>0.05$) between the Lesotho and Naked Neck lines, the Lesotho was the worst performers. At the 70th week, there were no significant differences ($P>0.05$) among the lines except the New Hampshire, which showed the biggest weight increase. However, compared with the findings by Gunaratne *et al.* (1993) on the mature weight of the Nigerian village cocks reared under semi-intensive (1227.0±17.0g), the Lesotho cocks performed relatively well (1325.0 ± 25.0g).

Table 3.3 Average weight of cocks' (g) and hens at 26 weeks old and 70 weeks old (Average of both batches)

Line	Average weight of cocks (g)		Average weight of hens (g)	
	Weight at 26 weeks old	Weight at 70 weeks old	Weight at 26 weeks old	Weight at 70 weeks old
LES	$1325.0^{b} \pm 25.0$	$2350.0^{bc} \pm 50.0$	$1113.8^{b} \pm 71.6$	$2047.5^{ab} \pm 65.6$
VEN	$1612.5^{a} \pm 165.0$	$2735.0^{bc} \pm 190.1$	$1320.8^{a} \pm 60.0$	$1940.0^{b} \pm 71.8$
NN	$1488.3^{b} \pm 149.5$	$2360.0^{bc} \pm 239.2$	$1154.3^{ab} \pm 45.2$	$1965.5^{b} \pm 74.0$
NH	$2080.0^{a} \pm 106.1$	$3572.9^{a} \pm 4.1$	$1326.3^{a} \pm 44.6$	$2328.0^{a} \pm 14.3$
OVB	$2025.0^{a} \pm 96.8$	$3122.5^{ab} \pm 112.7$	$1363.9^{a} \pm 50.4$	$1818.3^{b} \pm 26.1$
PK	1700.0a ± 109.1	$3284.3^{ab} \pm 151.3$	$1228.3^{ab} \pm 47.3$	$2132.2^{ab} \pm 63.2$
RIR	$1980.0^{a} \pm 25.5$	$2962.0^{abc} \pm 49.0$	$1198.4^{b} \pm 52.8$	$1778.3^{b} \pm 29.3$

Significant difference ($P< 0.05$); Mean (±SE)
Variables in the same column with same superscripts are not significantly different ($P<0.05$).

Significant differences ($P<0.05$) were observed between the average weights of hens of the different lines at the onset of laying. An average body weight of 1113.8 ± 71.6g (range of 830.0g-1300.0g) was recorded for the Lesotho hens at the onset of laying (26

weeks) (Table 3.3). The Ovambo had the highest (1363.9±50.4g) body weight of the other lines while the Naked Neck was the lightest (1154.3±45.2g).

At the 70th week (Table 3.3), significant differences ($p<0.05$) existed for hen weights between the lines. Of importance, is the observation that there were no significant differences for the 70-week weight between the Lesotho and other lines, including the New Hampshire.

Detailed tests of Choprakarn *et al*. (1998) have shown that practically, all individual chickens have periods of weight gain followed by intervals when they gain no weight. According to Missohou *et al.* (2002), on an individual bird basis, an increase in body weight occurs during the two or three weeks prior to and one week after the production of her first egg. During the following 10-12 weeks, the young pullet gains weight very slowly. In fact, many birds lose weight. The similar trend was observed in this study.

Average body gain

Average daily gain (ADG) in the pre-laying growth stage is outlined in Table 3.4 while Figures 3.1 to 3.7 show the average weekly gain (AWG) growth curve predictions from the 1st to the 70th week. Average daily gain was found to differ significantly ($p<0.05$) throughout the pre-laying growth phase with the exception of the Lebowa-Venda and Naked Neck.

Table 3.4 Average daily gain (g/day) in Batches 1 & 2 in the pre-laying phase

	Batch 1						Batch 2					
Line	N	μ (g)	SE	CV %	Min (g)	Max (g)	n	μ (g)	SE	CV %	Min (g)	Max (g)
LES	25	6.6^{c}	0.2	18.2	4.3	8.3	48	4.6^{c}	0.2	25.4	2.1	7.2
VEN	25	7.9^{c}	0.4	22.9	4.0	10.4	50	5.7^{bc}	0.2	22.1	2.4	9.1
NN	25	7.9^{bc}	0.3	21.3	5.5	11.9	49	6.3^{ab}	0.2	23.9	3.4	10.9
NH	25	9.8^{a}	0.4	19.2	7.1	12.9	50	7.0^{a}	0.3	26.9	4.2	13.0
OVB	25	9.5^{ab}	0.5	24.4	6.1	13.0	50	7.2^{a}	0.2	24.1	4.0	12.2
PK	25	8.9^{ab}	0.4	21.3	6.9	13.5	50	5.9^{b}	0.2	23.2	3.7	10.4
RIR	25	9.2^{ab}	0.3	17.5	7.2	13.0	50	6.1^{ab}	0.2	25.8	3.1	9.1

Significant difference ($p>0.05$)
Variables in the same column with same superscripts are not significantly different ($P<0.05$).

The Lesotho's average daily gain (Table 3.4) was the lowest (6.6±1.2g/day and 4.6±1.2g/day) followed by the Lebowa-Venda (7.9±1.8g/day and 5.7±1.3g/day) in the pre-laying phase while the Ovambo had the highest average daily gain amongst the natives.

Figures 3.1 to 3.7 show the weekly gain from 3-day old to 70 weeks old. Though both linear and polynomial regressions were fitted (Table 3.5), only the linear regression is discussed since there is very little difference between the R^2 of the two trends.

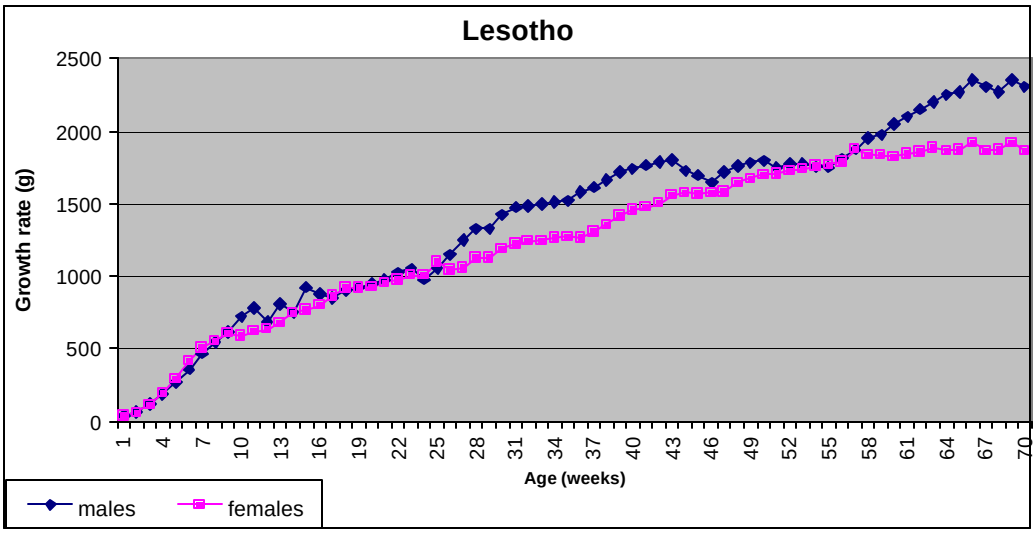

Fig 3.1 Growth predictions in the Lesotho line (g/week)

There were no significant differences (p>0.05) between the cocks' (29.9g/week) and hens' (25.6g/week) weight gains throughout the growth period. The males only showed a dramatic increase above the females in the last 15 weeks of the trial.

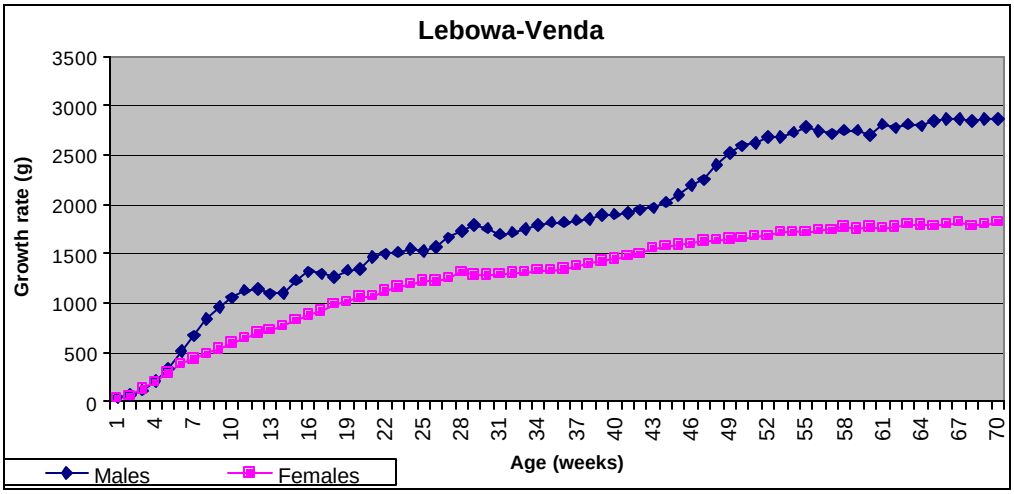

Fig 3.2 Growth predictions in the Lebowa-Venda (g/week)

Significant differences (p<0.05) were observed between the gain in cocks (38.1g/week) and hens (23.5g/week) in the Lebowa-Venda.

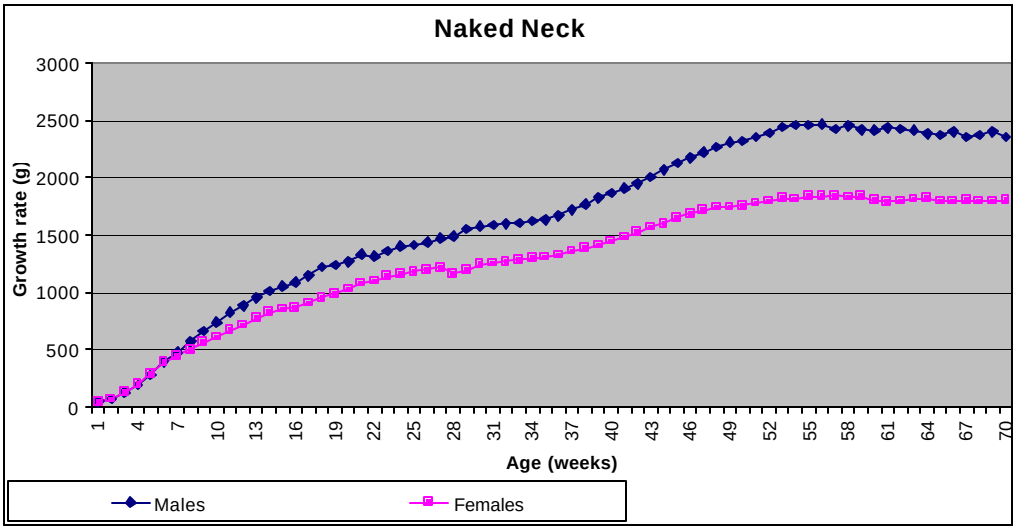

Fig 3.3 Growth predictions in the Naked Neck (g/week)

Cocks and hens in the Naked Neck gained by 34.0g/week and 24.5g/ week, respectively. Significant differences (p<0.05) in gain were observed between males and females.

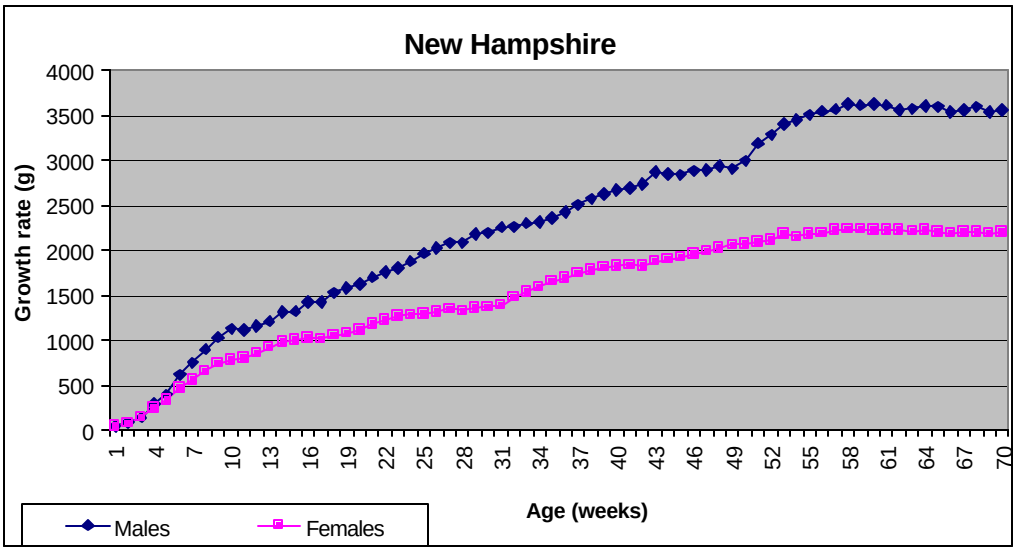

Fig 3.4 Growth predictions in the New Hampshire (g/week)

The New Hampshire cocks gained weight at 50.8g/week while the gain in hens was 30.1g/week. There were significant differences (p<0.05) between both sexes.

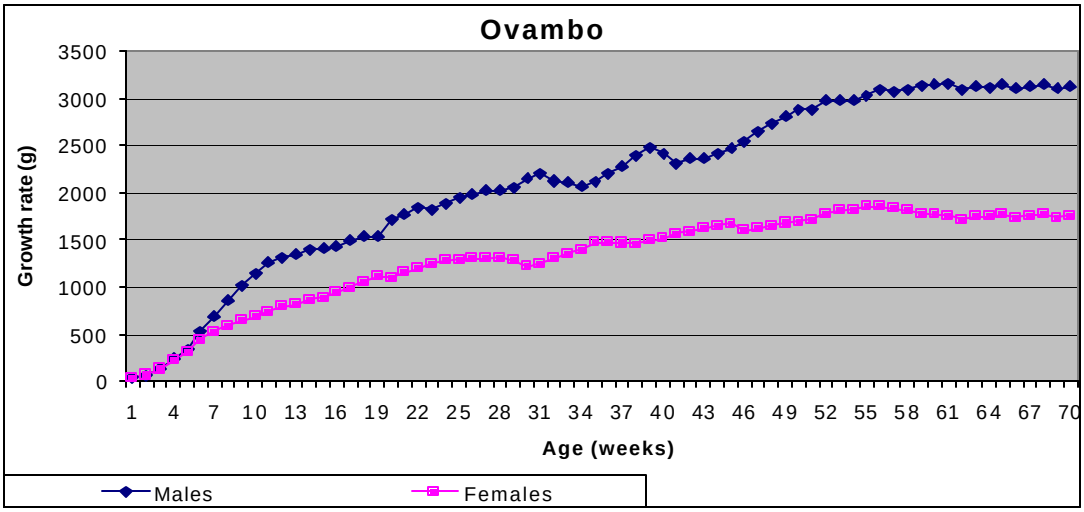

Fig 3.5 Growth predictions in the Ovambo (g/week)

Weekly weight gain in the Ovambo cocks and hens were 41.7g and 22.4g, respectively. Gain in the cocks was significantly different ($p<0.05$) from the hens' gain.

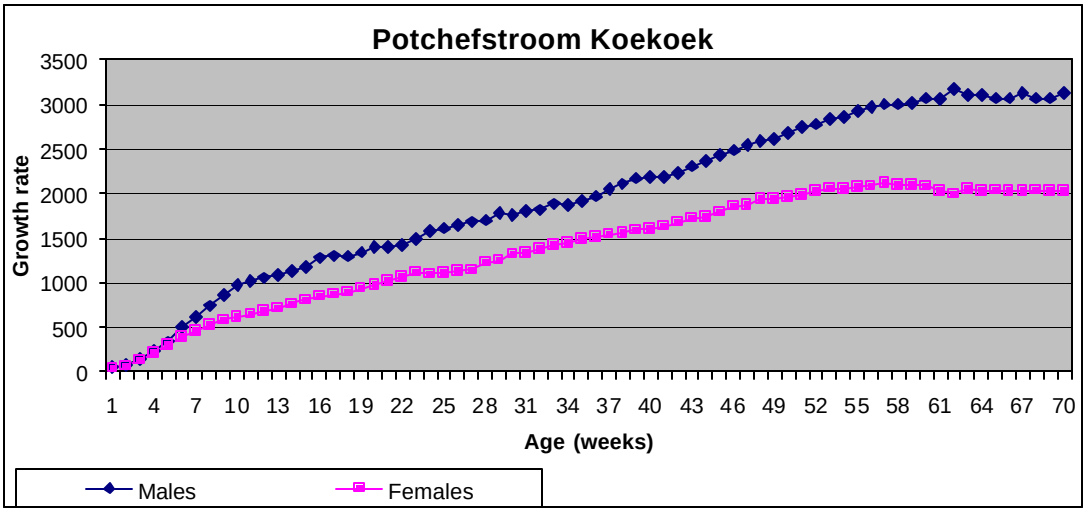

Fig 3.6 Growth predictions in the Potchefstroom Koekoek (g/week)

The Potchefstroom Koekoek cocks and hens' body gains during the period of study were 43.6g/week and 29.5g/week, respectively. There were significant differences ($p<0.05$) in weight gain between cocks and hens.

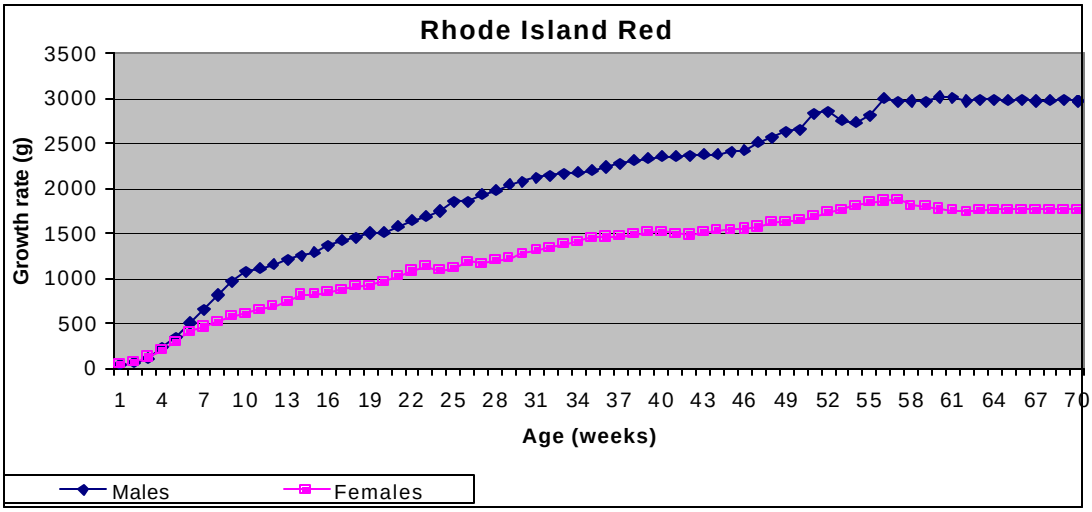

Fig 3.7 Growth predictions in the Rhode Island Red (g/week)

Weekly weight gain in the Rhode Island Red cocks was 40.3g/week. Significant differences ($p<0.05$) were observed between the cocks' gain and the hens' (23.8g/week).

For comparison, both linear and polynomial equations for each line with their respective R^2 are also outlined in Table 3.5.

Table 3.5 Prediction equations and R^2 for each sex per line

Line	Sex	Prediction Equations		R^2	
		Linear	Polynomial	Linear	Polynomial
LES	Cock	Y=29.9x + 334.1	Y= -0.23x^2 + 48.0x + 116.7	0.95	0.99
	Hen	Y=25.5x + 339.9	Y= -0.28x^2 + 44.5x + 112.0	0.96	0.99
VEN	Cock	Y=38.1x + 487.6	Y= -0.28x^2 + 57.9x + 249.8	0.95	0.96
	Hen	Y=23.5x + 431.4	Y= -0.44x^2 + 51.8x + 91.9	0.90	0.99
NN	Cock	Y=34.0x +433.8	Y= -0.46x^2 + 66.7x + 41.7	0.93	0.98
	Hen	Y=24.5x + 408.9	Y= -0.38x^2 + 51.7x + 82.3	0.91	0.98
NH	Cock	Y=50.8x + 52.3	Y= -0.47x^2 + 59.0x + 108.0	0.96	0.99
	Hen	Y=30.3x + 452.7	Y= -0.53x^2+ 59.0x + 108.0	0.93	0.99
OVB	Cock	Y=41.7x + 639.7	Y= - 0.53x^2+ 79.5x + 186.2	0.93	0.97
	Hen	Y=22.4x + 513.6	Y= -0.46x^2 + 55.1x + 120.7	0.86	0.98
PK	Cock	Y=43.6x + 410.1	Y= -0.31x^2 + 65.4x + 148.2	0.97	0.99
	Hen	Y=29.6x + 334.8	Y= -0.37x^2 + 55.6x + 21.8	0.94	0.99
RIR	Cock	Y=40.3x + 598.1	Y= -0.50x^2 + 80.4x + 117.4	0.93	0.99
	Hen	Y=23.8x + 418.1	Y= -0.40x^2 + 52.9x + 68.6	0.90	0.99

The Lesotho cocks were the worst performers in weight gain (29.9g per week) throughout the rearing period. This gain is similar to the Potchefstroom Koekoek's and New Hampshire's hens (30.3 and 29.6g/week, respectively). The highest gain in cocks was observed in the New Hampshire (61.7g per week). However, there were no significant differences (P>0.05) between the weight gain in hens with the exception of the New Hampshire and Potchefstroom Koekoek.

Feed Conversion Ratio

The best feed conversion ratio was observed (Table 3.6) for the New Hampshire line (3.2±0.4 & 3.3±0.1) in Batches 1 and 2. These differences however, were not significant. The lowest feed conversion was found in the Lesotho line (3.7±0.6 & 4.2±0.4) in Batches 1 and 2. There were no marked differences in feed conversion ratio among all the lines ($p>0.05$). A rapid increase in the feed conversion ratio (FC deterioration) was observed at the age of five weeks.

Table 3.6 Feed Conversion Ratio in Batches 1 & 2 in the first 5 growing weeks in the pre-laying phase

	Batch 1							Batch 2						
Line	N	μ	SE	CV %	Min	Max	Sign	N	μ	SE	CV %	Min	Max	Sign
LES	25	3.7	0.2	29.4	2.5	5.5	ns	48	4.2	0.1	21.5	2.9	5.4	ns
VEN	25	3.7	0.2	30.5	2.5	5.4	ns	50	4.1	0.2	31.1	2.4	5.7	ns
NN	25	3.9	0.2	30.4	3.0	5.9	ns	49	3.8	0.2	28.8	2.2	5.0	ns
NH	25	3.2	0.4	60.7	1.8	6.6	ns	50	3.3	0.1	21.9	2.6	4.1	ns
OVB	25	3.6	0.3	41.4	2.4	5.9	ns	50	3.5	0.1	25.2	2.1	4.2	ns
PK	25	3.6	0.3	38.9	2.4	5.9	ns	50	3.9	0.2	30.2	2.4	5.0	ns
RIR	25	3.5	0.3	35.6	2.8	5.7	ns	50	3.7	0.1	27.1	2.3	4.7	ns

Sign: Significant level.

Generally, the means of the Lesotho line were significantly different ($p<0.05$) from others in all growth traits measured except for the FCR. The fastest growth rate among the native lines was recorded in the Ovambo line. With the exception of the Lesotho and Rhode Island Red lines, which were not tested, Van Marle-Köster & Webb, (2000), obtained similar results.

Conclusions

The Lesotho line appeared to be the poorest performer in the pre-laying growth traits compared with South African Natives and exotic lines. Feed conversion ratio was high in all the lines. This shows that they are economically expensive to raise to maturity under commercial production conditions.

The Lesotho hens compared fairly well with the other lines in terms of growth up to 70 weeks of age. Only the New Hampshire and Potchefstroom Koekoek grew faster. The fact that there were no significant differences between the Lesotho hens and the other lines at 70-week weight and average body gain per week is an indication that with proper selection and management this line could be established as a dual purpose breed for extensive environments. The Lesotho hen, like the New Hampshire and Potchefstroom Koekoek was able to maintain a high body weight at the end of laying. Therefore the breed has an advantage of fetching higher market price by that time.

Secondly, the breed can be slaughtered in good condition at the end of laying, hence presenting an advantage for food security at household level. The Lesotho cocks had a lower body weight gain hence the reason for low weight gains in the mixed population (both sexes). However, the higher percentage of variation could provide a better chance for selection progress in the traits studied.

Though the differences between the lines may be genetically based, further research is required to confirm this. Moreover, due to a lack of literature, the current study could be considered as an initiative to shed more light on the conservation of the genetic pool in this line.

CHAPTER 4

EGG PRODUCTION PERFORMANCE

Introduction

Native chickens are still very common in the areas of most rural people in most developing countries (Sonaiya, 1997). The native chicken has evolved in a way that allows it to survive and reproduce in a marginal environment. More important, the supply of eggs for home consumption has made this chicken unique (Kitalyi, 1998). To date, the native chicken remains an important source of high-quality protein food. Through selling of their eggs, there is some additional income for many rural dwellers (Smith, 1990). Furthermore, it performs other socio-economic and cultural roles as a form of savings and insurance and allowing low-income farmers to meet their social and cultural obligations (Sonaiya *et al.*, 1999).

Concern over food security and health issues has resulted in a shift from scavenging system to semi-intensive management. However, wide variation in the performance of native chickens in egg production is a constraint to its utilization on a larger scale.

As in most other Sub-Saharan countries (Sonaiya, 1997), the largest proportion of the feed of the native chicken in Lesotho is based on scavenging system, constituting materials from the surrounding environment, by-products from harvesting and processing of grains and cultivated and wild vegetation, which are frequently supplemented by household wastes. However, Bayley & Phororo, (1992) indicated that supplementation of native chickens with protein and energy nutrients give significant improvement in egg production.

Similarly, native chickens have been raised by most of the population of Lesotho and it represents an important source of eggs (Mosoeunyane & Nkebenyane, 2001). Although consumed by families on most occasions, native chickens are not able to provide consumption on a daily basis due to its relative low production. The chicken does play a very important role in the cash flow of rural people provided that it does not suffer from diseases such as Newcastle disease. The Lesotho native chicken does not have specific characteristics and vary in performance (Lebajoa, 2001).

Materials and methods

Management and Environment

Once the first eggs were observed among the lines, only 5% of the cocks per line with the highest body weight and average daily gain were selected and kept with the hens at a ratio of one cock to five hens for 45 weeks. They were reared under a semi-intensive production system. General management is discussed under growth performance (Chapter 3). Eggs were collected thrice in a day and kept under normal room temperature.

Data

The recording of egg number and weight was done daily and it covered a period of 45 weeks in the laying phase up to 70 weeks of age. Recording ended as the birds showed signs of moulting, which were accompanied by very low egg production. After editing, 149 records on egg production were available.

Statistical analysis

A General Linear Model (GLM) procedure of Statistical Analysis System (SAS, 1996) was applied for the analysis of egg performance traits. Age at first lay, egg production per

hen per week and average egg weight were studied under egg performance traits. Means for each variable effect were compared using the Least Squares Analysis of Variance and Tukey's test at the 95% probability level. The following model was fitted:

$Y_{ij} = \mu + a_i + l_j + e_{ij}$

Where:

Y_{ij} = an observation of a trait on the i^{th} animal of the j^{th} chicken line.

μ = Least square mean

a_i = random effect of the i^{th} chicken

l_j = fixed effect of the j^{th} chicken line (1-7)

e_{ij} = random error of the environment

Sex: 1- male, 2- female; Chicken lines: 1-Lesotho, 2-Lebowa Venda, 3-Naked Neck, 4-New Hampshire, 5-Ovambo, 6-Potchefstroom Koekoek, 7-Rhode Island Red.

Results and Discussion

Egg laying commenced when chickens were between 25 and 26 weeks old. There were no significant differences ($P>0.05$) between the lines for age at first lay. According to some literature on sexual maturity in native chickens, the lines tested were delayed in reaching maturity. This could possibly be ascribed to stress imposed by the change in the environment (from the Free State University to Lesotho). Horst (1997) indicated that native fowls were found to reach sexual maturity between 23 weeks (Nigerian local chicken) and 24 weeks of age (Korean native fowl). Aganga *et al.*, (2003) reported sexual maturity of 23 weeks old also in Tswana chickens. Gunaratne *et al.*, (1993) reported a greater delay (28 weeks) in sexual maturity in Sri Lankan chickens.

The performance of hens in all the lines in egg production traits is outlined in Table 4.1. Egg production differed significantly ($P<0.05$) among the different lines.

Table 4.1 Least square means of egg production\hen and their respective average egg weight (g) for 45 weeks in laying (at 70 weeks old).

Line	No. of hens at 26 weeks old	No. of hens at 45 weeks old	*Egg production	
			Hen prod /45 weeks	Avg. Egg weight (g)
LES	19	8	$64^{b} \pm 2.1$	$48.5^{b} \pm 2.1$
VEN	25	13	$65^{b} \pm 3.4$	$46.6^{c} \pm 1.1$
NN	32	28	$43^{c} \pm 4.1$	$50.6^{b} \pm 1.1$
NH	35	30	$85^{a} \pm 8.1$	$52.0^{a} \pm 1.0$
OVB	26	21	$65^{b} \pm 4.9$	$51.5^{a} \pm 0.9$
PK	27	22	$86^{a} \pm 6.3$	$50.8^{b} \pm 1.3$
RIR	25	21	$66^{b} \pm 2.3$	$52.2^{a} \pm 0.9$

*Measured as number of eggs laid per hen per week and average egg weight during production of 45 weeks.
Variables in the same column with same superscripts are not significantly different ($P<0.05$).
Mean (±SE)

The Potchefstroom Koekoek was the best performer in egg production followed by the New Hampshire (86±6.3; 85±8.1 hen production per 45 weeks), respectively though the difference was not significant (P>0.05). The Naked Neck was the worst performer in egg production (43±4.1).

Significant differences were observed among the lines in average egg weight. The exotic lines gave high egg weights (52.2±0.9 and 52.0±1.0) while the Lebowa-Venda had the lowest egg weight (46.6±1.1). The Lebowa-Venda and Ovambo were the first to show

signs of moulting while the Potchefstroom Koekoek, Rhode Island Red and New Hampshire were the last.

Figures 4.1 to 4.7 show the weekly gain in egg number and weight from the 26th week (point-of-lay) to the 45th week in production (moulting). Linear regressions were fitted (Table 4.2).

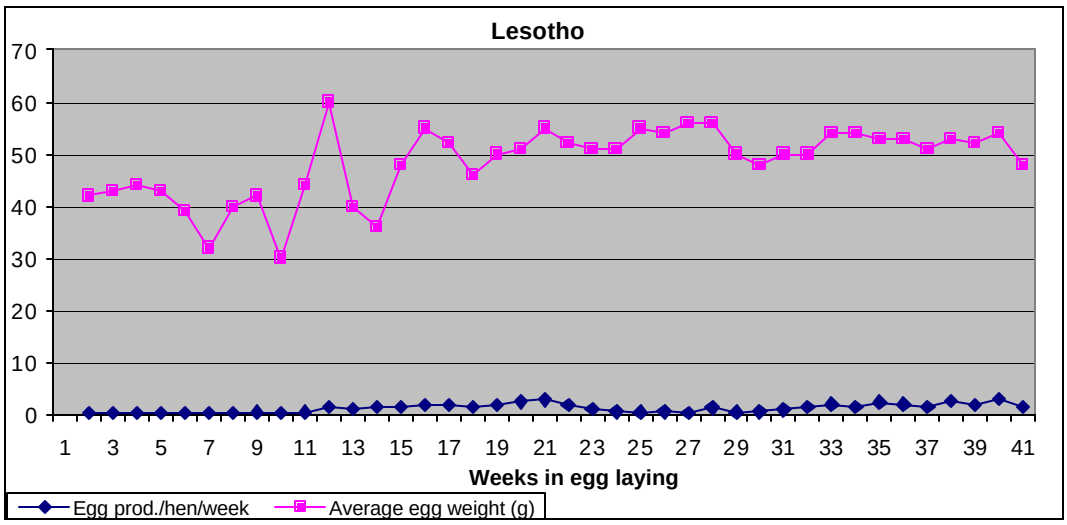

Fig 4.1 Predictions in increase in egg number/week and egg weight (g/week) in the Lesotho.

Egg number and weight in the Lesotho increased by 0.04/week and 0.35g per week, respectively. There was a gradual increase in egg weight during the first three weeks thereafter a drastic drop followed. This too, was also followed by high fluctuations, which lasted for 20 weeks. During this time the weights range from 30.0g to 56.7g. However, at the 28th week up to the end of laying fewer fluctuations were experienced. The highest egg weights were obtained between the 14th and 27th week. The line reached peak production from the 11th to 20th week.

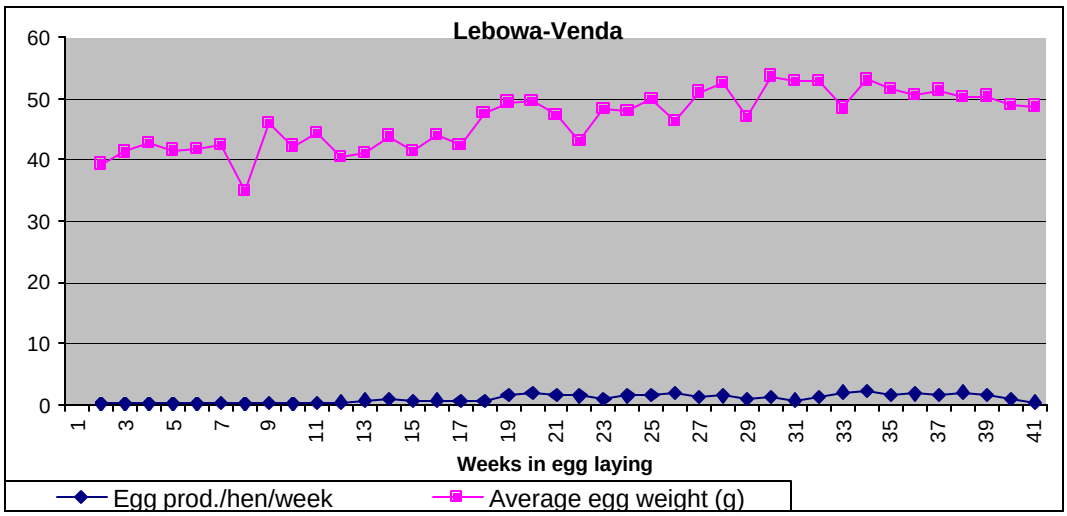

Fig 4.2 Predictions in increase in egg number/week and egg weight (g/week) in the Lebowa-Venda.

Increases in egg number and weight per week in the Lebowa-Venda were 0.04 and 0.32g, respectively. Changes in egg weight were relatively less with ranges of 34.9g and 53.7g. There was a steady increase in egg number up to the ninth week. This was followed by high fluctuations, which ended up with a decline in egg number towards the end of laying. Peak production was observed between the 18^{th} and 26^{th} week.

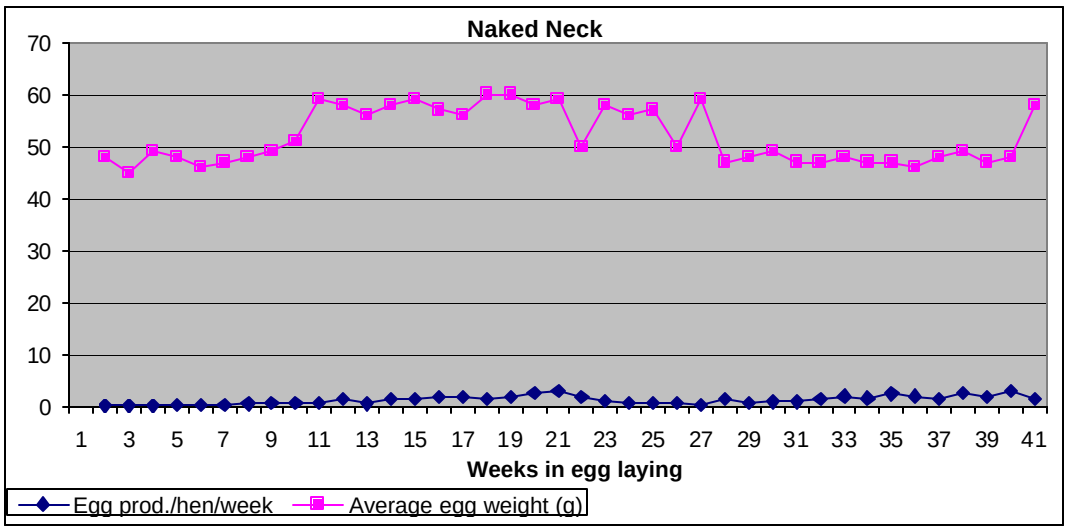

Fig 4.3 Predictions in increase in egg number/week and egg weight (g/week) in the Naked Neck.

Gains in egg number and weight per week in the Naked Neck were 0.04 and 0.06g. There were high variations in egg weight ranging between 46g and 60g. Peak production was reached on the 14th week and lasted for ten weeks.

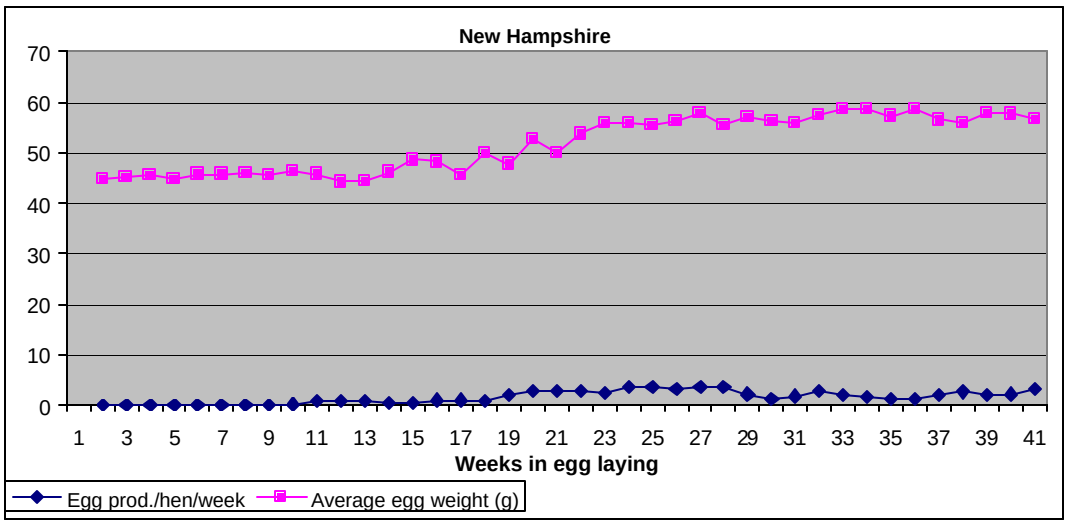

Fig 4.4 Predictions in increase in egg number/week and egg weight (g/week) in the New Hampshire.

Slight changes in egg weight were experienced throughout the laying phase (0.42g/week). Fluctuations in egg number were very high and peak production was observed during the 18^{th} and 28^{th} week period. However, after that drop, production started to rise. Egg number increased by 0.07/week.

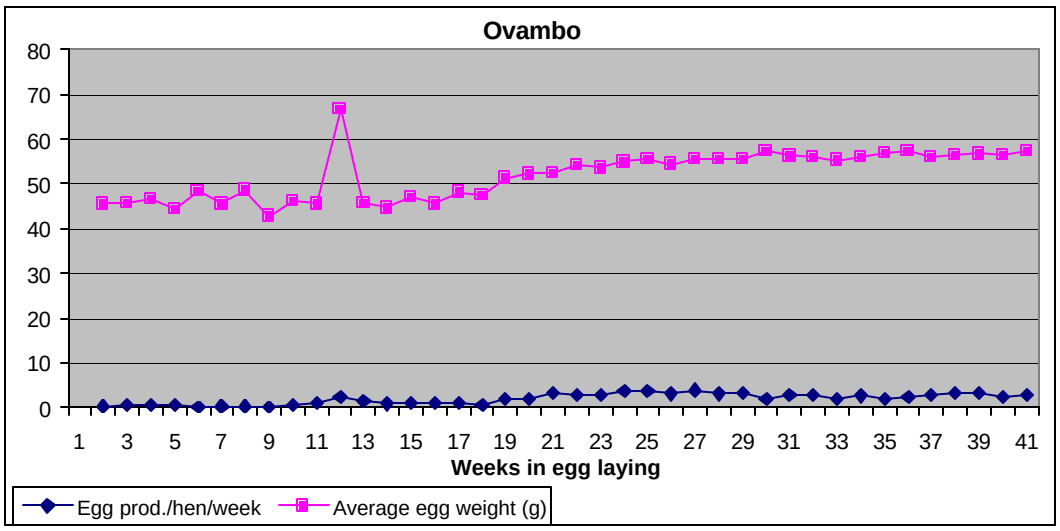

Fig 4.5 Predictions in increase in egg number/week and egg weight (g\week) in the Ovambo.

Weekly gains in egg number and egg weight were 0.07/week and 0.38g/week, respectively. There has been less variation in egg weight (0.38g/week) in the Ovambo throughout the laying period. Though peak period was reached on the 19th week and lasted for ten weeks, less variation was observed in egg number.

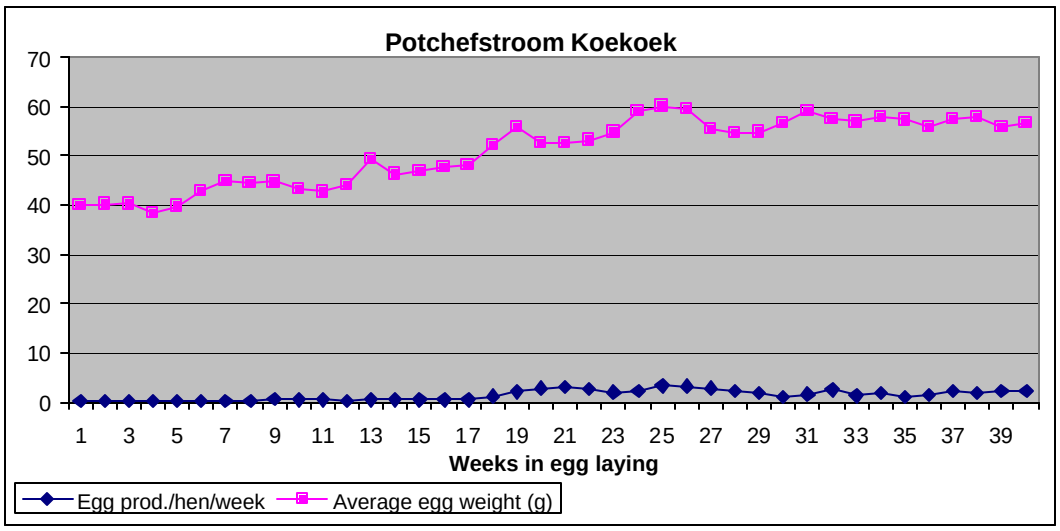

Fig 4.6 Predictions in increase in egg number/week and egg weight (g/week) in the Potchefstroom Koekoek.

Slight variations were observed in the Potchefstroom Koekoek in egg weight (0.54g\week). A steady increase was observed in egg number from the 1st week to the 16th week. This was followed by a rapid increase, which led to the peak between the 18th to the 26th week. Egg number increased by 0.06/week.

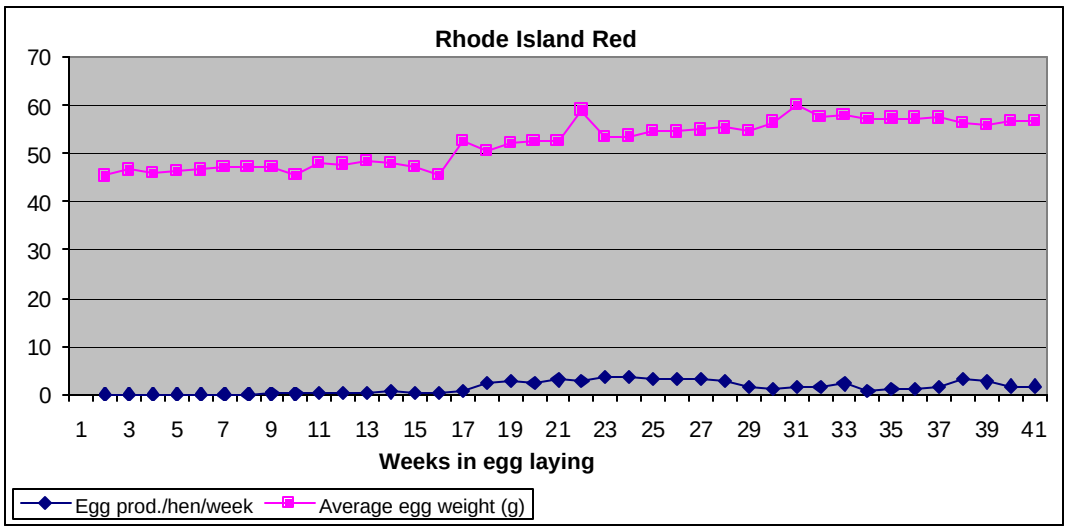

Fig 4.7 Predictions in increase in egg number/week and egg weight (g/week) in the Rhode Island Red.

Egg weight and number increased by 0.36g/week and 0.06/week, respectively. A slight gain in egg number was observed from the 1st week to the 16th. Peak production was reached between the 18th and the 28th though production increased after a drop that lasted for 9 weeks.

Table 4.2 outlines both linear and polynomial regressions for increase of egg number/hen/week and egg weight per line

Table 4.2 Linear and polynomial regressions and R^2 for egg weight and increase in egg production per week per line.

Line	Egg Variable	Prediction Equations		R^2	
		Linear	Polynomial	Linear	Polynomial
LES	Weight	Y=0.37x + 40.5	Y=-0.12x^2+1.06x+35.3	0.67	0.47
	Number	Y=0.04x + 1.04	Y=-0.01x^2+ 0.06x + 0.22	0.55	0.33
VEN	Weight	Y=0.32x + 39.6	Y=-0.01x^2+ 0.6x + 37.7	0.85	0.69
	Number	Y=0.06x + 0.03	Y=-0.002x^2+ 0.12x + 0.5	0.49	0.65
NN	Weight	Y=-0.48x + 53.3	Y= -0.02x^2 + 0.90x + 45.6	0.20	0.26
	Number	Y=0.040x +0.34	Y= -0.00x^2 + 0.008x + 1.2	0.37	0.39
NH	Weight	Y=0.42x + 42.4	Y=-0.003x^2+ 0.57x + 41.4	0.85	0.85
	Number	Y=0.79x + 1.01	Y=-0.004x^2+ 0.23x -1.2	0.49	0.62
OVB	Weight	Y=0.35x + 44.5	Y= -0.003x^2+ 0.49x + 43	0.57	0.58
	Number	Y=0.7x + 0.09	Y=-0.003x^2+ 0.19x + 0.74	0.59	0.67
PK	Weight	Y=0.53x + 40.1	Y=-0.02x^2+ 0.90x + 45.6	0.85	0.89
	Number	Y=0.06x + 0.15	Y=-0.009x^2+0.008x+ 0.90	0.46	0.54
RIR	Weight	Y=0.36x + 44.5	Y=-0.005x^2+ 0.56x + 42.8	0.83	0.85
	Number	Y=0.06x + 0.19	Y -0.005x^2+ 0.26x + 1.28	0.36	0.55

Though the Naked Neck had the lowest egg number (43±4.1), the gain in egg number was similar to gain in Lesotho and Lebowa-Venda (0.04/week) and has the advantage of higher egg weight gain (0.48g/week) with the exception of the Potchefstroom Koekoek (0.54g/week).

The Lesotho hen performed fairly well (0.35g/week; 0.04/week). There were no significant differences (P>0.05) between the different lines with the exception of the New Hampshire and Potchefstroom Koekoek, which produced more eggs and the Naked neck which produced less.

Research on egg production traits indicates an egg weight of 34.5±0.7g for Nigerian chickens (Adenokun & Sonaiya, 2001) reared under semi-intensive systems, which is about 29% lower than that of the Lesotho line. Gunaratne *et al.,* (1993) reported an average egg weight of 48.0±0.03g in Sri Lankan chickens while Aganga, *et al.,* (2003) reported a range of 44.5g in Tswana chickens. However, the lowest egg weight range of (30.0-40.0g) was reported by Bourzat and Sounders (1990) in Burkina Faso chickens while Missohou *et al.* (2002) reported the lowest average weight of 37.5±2.9g in Senegalese chickens.

According to Gueye (1998), annual egg production per village hen ranges from 20–100 eggs with an average weight ranging from about 30.0–50.0g. Van Marle-Köster & Webb (2001) reported a high average egg number/hen/week of 2.1±0.2 for the Ovambo and 4.0±0.2 for the Potchefstroom Koekoek reared under an intensive system. Egg weight for other lines ranged from 50.6±0.9g to 52.2±0.7g. These results are in agreement with those of Kumer *et al.,* (2002) on the range with egg weight of indigenous chickens at 50.6±1.7 to 53.6±1.3 in slow and fast feathering indigenous lines. According to Van Marle-Köster & Webb (2001), the Ovambo has the smallest egg weight in a battery cage system.

Conclusions

With the exception of the New Hampshire and Potchefstroom Koekoek, the Lesotho hen performed well with the weekly gain of 0.35g and 0.04 eggs/week compared to the other lines in this study for egg production traits. The line has the added advantage of delayed moulting, which implies that the Lesotho hen can stay longer in production. This proves that there is a chance for even better performance if selection and a planned breeding program are introduced.

In conclusion, the phenotypic variations observed amongst these different populations indicate that the Lesotho native line is not inferior to other native lines and demonstrates the worthiness for it to be preserved in the fowls of Africa.

CHAPTER 5

CARCASS EVALUATION

Introduction

The species *Gallus gallus* was first documented more than 8000 years ago for cock fighting and religious sacrifices. Its use for food and breeding expanded in Roman times. Today, we have two types of commercial chickens, the broiler strain, which has been selected for meat production and the layer strain, which has been selected for egg production. Broilers are selected for superior or maximum body mass, pectoral muscle mass and growth rate. As a result, when compared to native chickens, where selection has never been done, the broiler averages more than twice their body weights (Gunaratne, 1999).

Native chickens have a lower feeding rate than broilers (Kitalyi, 1999). Some organs of the broiler's gut are relatively larger in size. Increased intestinal nutrient transport is also the result of artificial selection since it is the process directly responsible for absorbing the nutrients required to fuel rapid growth (Prawirokusumo, 1988).

However, layer chicks exhibit lower growth rates, smaller pectoral muscles and relatively lighter and shorter intestines than native fowls. According to Kitalyi (1999), native fowls possess sophisticated and well-developed sensory organs in order to escape predators as to ensure their survival. Similarly, bones of the native fowls are long and strong.

Materials and Methods

Pre-slaughtering data

At the 70th week old (moulting) stage, eight chickens were randomly selected from the seven different chicken lines for slaughtering. Birds were separated and placed out of the flock for approximately 12 hours before processing to allow for the emptying of the digestive tract to avoid food contamination during processing. Only water was given to them to prevent dehydration. Just prior to slaughtering, the live weight of each chicken was taken.

Slaughter and carcass measurements

The birds were killed by the use of the *outside cut*. To kill and bleed the birds, each bird was held with the head facing down. With the left hand, the head was slightly rolled to the left, exerting a slight upward pressure. A clear cut was made on the jugular vein just below the ear lobe until a gush of blood came out. Bleeding took about three minutes. Blood was collected into the measuring cylinder.

After scalding and plucking, the visceral parts were pushed through the incision on the abdominal muscles into the cavity by loosening the upper end of the digestive tract including the bronchial tube. The digestive tract was removed by grabbing the gizzard and slowly pulling out the entrails through the cut leaving the respiratory organs in the cavity. It was then weighed. Reproductive organs and connective tissues were removed and discarded. The gall bladder was carefully cut at the neck of the bile duct. The digestive tract was trimmed and the gizzard was split, the feed materials inside were washed away and the yellow tough lining was peeled off. After processing, the giblets (heart, liver and gizzard and intestines) were weighed. Thereafter, weights of the dressed

carcass, head and feet were taken. Finally each chicken was deboned manually and the weight of bones were recorded.

Statistical analysis

Differences in carcass parameters between different chicken lines were determined by using the general linear model (GLM) procedure of the statistical analysis system SAS (1996). Least squares analysis of variance and Tukey's test ($\propto$=0.05) were used to identify differences between treatment means.

Results and discussion

As indicated in Table 5.1, significant differences were observed in the dressed weight among the native lines (p<0.05). Due to their significantly higher average live weight, the New Hampshire, Potchefstroom Koekoek and Ovambo (2337.5±242.0; 2012.5±187.5 and 1930.0±245.0) had a significantly higher dressed weight than the other lines. However, dressing percentage was high in all the lines and no significant differences were observed amongst the lines. These findings are in agreement with those of Van Marle-Köster & Webb, (2000).

Table 5.1 Least square means of 70 weeks old native and exotic chicken lines for dressed carcass (g), blood (g), head (g), feet (g), giblets (g) and bone (g).

Line	Live wt. (g)	Dressed wt. (g)	Dressed %	Blood (g)	Head (g)	Feet (g)	Giblets (g)	Viscera (g)	Bone (g)
LES	2187.5^{b}	1460.0^{b}	66.7^{a}	68.2^{c}	96.8^{a}	50.6^{b}	182.5^{ab}	241.9^{c}	452.6^{a}
	(66.6)	(65.9)	(0.7)	(4.4)	(9.7)	(3.5)	(11.8)	(12.5)	(13.6)
VEN	2337.5^{b}	1554.4^{b}	66.5^{a}	74.8^{c}	122.2^{a}	51.4^{b}	194.0^{ab}	264.1^{c}	508.3^{a}
	152.2)	(115.7)	(1.2)	(6.6)	(11.1)	(5.4)	(9.2)	(11.2)	(14.8)
NN	2162.8^{b}	1297.7^{b}	60.0^{a}	77.9^{abc}	125.4^{a}	54.1^{b}	211.9^{a}	292.0^{bc}	415.3^{a}
	(176.4)	(133.0)	(1.3)	(8.0)	(57.1)	(8.6)	(3.9)	(8.3)	(9.7)
NH	2950.5^{a}	1903.0^{a}	64.5^{a}	106.2^{a}	129.8^{a}	76.7^{a}	230.1^{a}	395.4^{a}	608.9^{a}
	(242.0)	(190.8)	(1.9)	(11.5)	(16.0)	(7.3)	(7.1)	(16.1)	(11.2)
OVB	2470.4^{ab}	1672.5^{ab}	67.7^{a}	98.8^{ab}	121.0^{a}	64.2^{ab}	212.5^{ab}	313.7^{bc}	551.9^{a}
	(245.0)	(182.4)	(1.8)	(10.9)	(20.6)	(10.6)	(9.1)	(15.9)	(12.6)
PK	2708.3^{ab}	1792.9^{a}	66.2^{a}	97.5^{abc}	145.6^{a}	65.0^{ab}	219.4^{ab}	333.1^{ab}	548.6^{a}
	(187.5)	(146.4)	(1.5)	(7.6)	(13.9)	(7.7)	(11.2)	(14.2)	(14.7)
RIR	2370.2^{b}	1583.3^{b}	66.8^{a}	80.6^{bc}	118.5^{a}	59.3^{b}	196.7^{c}	265.5^{c}	508.2^{a}
	(205.3)	(157.6)	(1.6)	(6.3)	(16.1)	(7.8)	(8.2)	(11.4)	(12.0)

Means with different superscripts differ significantly.
Standard errors of the means are given in parentheses. ($p>0.05$)

No significant differences ($p>0.05$) for weight of the blood, feet and giblets were observed among the Lesotho, Lebowa-Venda, Naked Neck and Rhode Island Red lines. Bone and head weights were not significantly different ($p>0.05$) among the lines. Results of bone percentages too, are in agreement with those of Van Marle-Köster & Webb (2000).

Conclusions

The results revealed no significant differences in head, feet and bone weight amongst the lines.

The Lesotho, Lebowa-Venda and Naked Neck lines had the lowest live weight, which ultimately resulted in less weight in most carcass parameters measured. Considering the weight of the visceral organs being correlated to feeding intake, the Lesotho line would therefore be disadvantaged due to low weight of the viscera, which implies lower capacity. However, having low feeding intake and small capacity could be an advantage in egg production performance.

Although the Lesotho line appears to have lower carcass yield, the difference is not significant from other lines except for the New Hampshire and Potchefstroom Koekoek, which were significantly heavier. These results give an indication that with selection, the line can perform on par with most native lines used in this study.

CHAPTER 6

MORTALITY

Introduction

Native fowl production has been in existence in Lesotho since unmemorable times. These native fowls outnumbered commercial chicken by 10 to 1 during 1970 and 1990 but were severely thinned down by outbreaks of Newcastle disease. According to Awan (1993), the number of rural poultry was estimated to be 1.6 million. There are a large number of rural families whose only assets are the few chickens they own.

However, native chickens are faced with two problems namely, high mortality that can lead to their extinction and the loss of their genetic pool due to ongoing inbreeding and crossbreeding which resulted from the importation of dual-purpose breeds. The most common mixed strains are crosses of the natives with the Barred Plymouth Rock, Potchefstroom Koekoek and Lebowa-Venda. Improving the native fowl could be a worthwhile enterprise in the country severely ravaged by poverty, especially since the breed has managed to survive in many rural areas.

Materials and methods

Five hundred and twenty-five day-old chicks from native Lesotho lines (LES), two exotic lines (New Hampshire (NH) and Rhode Island red (RIR) and four South African native lines namely, Ovambo (OVB), Lebowa-Venda (VEN), Naked Neck (NN) and Potchefstroom Koekoek (PK) were raised as discussed in Chapter 3.

The eggs for the Lesotho line were sampled from different areas in the mountainous areas in Lesotho and hatched in Bloemfontein, South Africa. The chicks were transferred to

Maseru, a lowland district in Lesotho, where the study was conducted. The highlands and lowlands are very diverse environments, especially in winter (Temperature range: Thaba-Tseka -15°C to 10°C; Low lands –5°C to 22°C). Mortality rate was monitored daily up to moulting (70 weeks old). The Chi-square Test was used for the analysis of the mortality rate.

Results and Discussion

Fig.6.1 & 6.2 show the mortalities of all the lines in the pre-laying phase. Significant differences ($p<0.05$) were observed between the Lesotho line and all other lines. These mortalities could mainly be attributed mainly to infectious coryza disease.

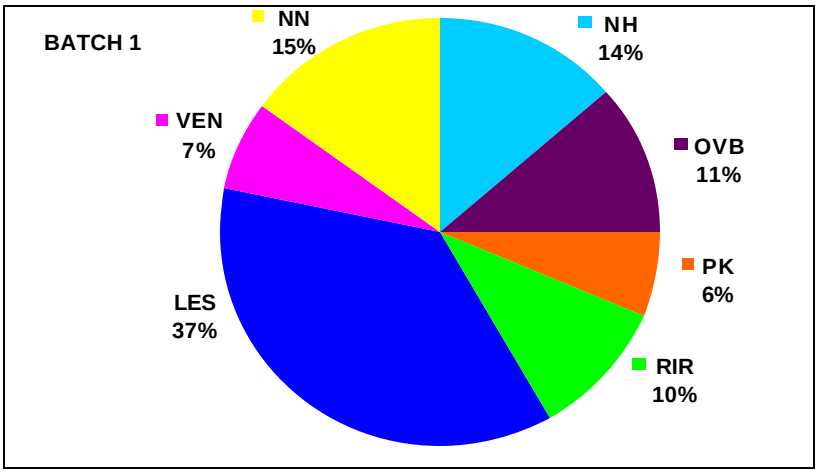

Figure 6.1 Mortality rates of all lines at the 26th week (Batch 1)

In Batch 1 (Fig 6.1), the mortality rate was highest in the Lesotho line (37%). This was more than double that of the second highest breed (New Hampshire with 15%), while the Potchefstroom Koekoek had the lowest mortality (6%).

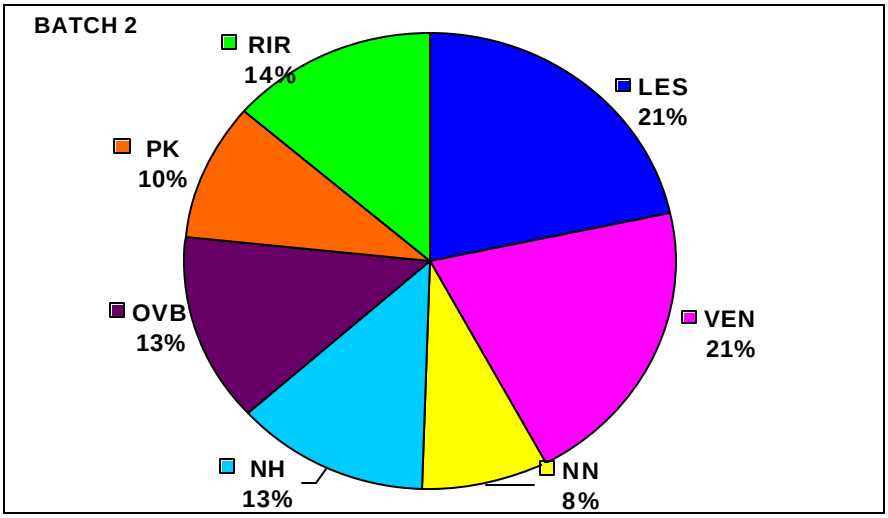

Fig 6.2 Mortality rates of all lines at the 26th week (Batch 2)

In Batch 2 (Fig 6.2), the highest mortalities were exhibited by the Lesotho and Lebowa-Venda lines (21%) while the Naked had the lowest (8%).

Generally, the Pre-laying mortality rates were highest in the Lesotho line in both batches (37% & 21%) followed by the Lebowa-Venda (7% & 21%) and New Hampshire (14% & 13%) with no marked differences between the Ovambo and Rhode Island Red in both batches. The Potchefstroom Koekoek had the least losses (8% & 6%).

The mortalities of all the lines in the Laying phase are shown in Fig.6.3 while the overall mortalities are shown in Fig 6.3 (pre-laying and laying phases). Significant differences ($p<0.05$) were observed between the Lesotho line and all other lines.

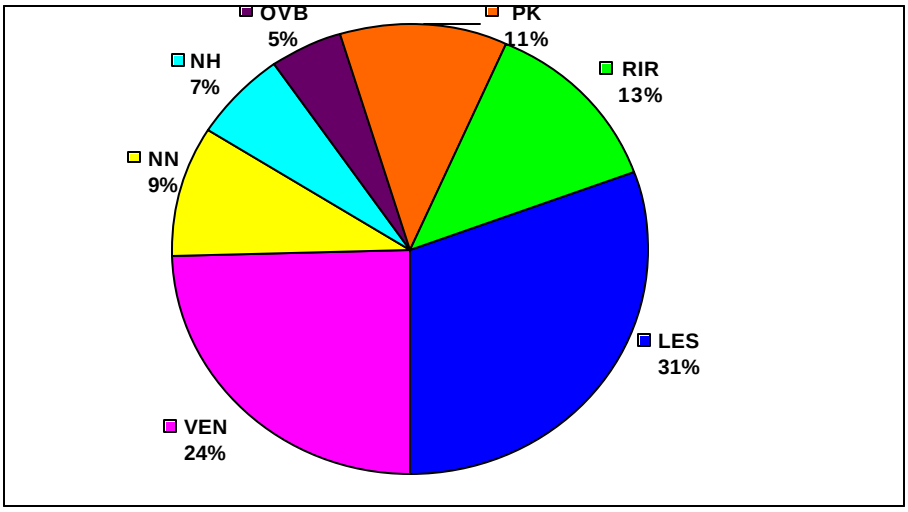

Fig 6.3 Mortality rate (%) in the laying phase

The highest mortality (Fig 6.2) was found in the Lesotho line (31%). Second was the Lebowa-Venda (24%), while the least was obtained in the Ovambo (5.0%).

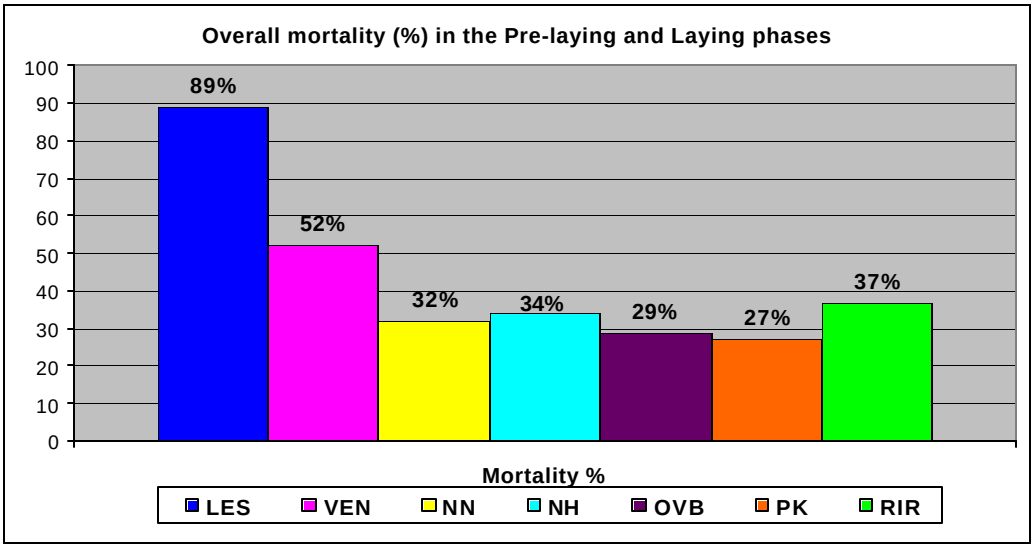

Fig 6.4 Overall mortality (%)

There were no significant differences ($p > 0.05$) between the mortalities in the pre-laying and laying phases. No significant differences ($p > 0.05$) in mortality rate were observed

between the New Hampshire, Naked Neck, Ovambo and Rhode Island Red. As depicted in Fig.6.4, the Lesotho line had the highest mortality rate (89%). Although the New Hampshire performed best in growth, carcass and egg traits, it had the second highest mortality rates (52%). The lowest mortality rate was experienced in the Potchefstroom Koekoek (27%).

These results, of high mortality rates in the native lines, are in agreement with the results of Ajuyah (1998) on high mortality in the early growing phase. The cause of the high mortality is similar to that obtained by Kelly *et al.* (1994), who found that mortality due to infectious coryza was equally important to Newcastle disease in village chickens.

Lebajoa (2001) also reported high mortality in Lesotho native chickens though the cause was Newcastle disease. According to studies by Shakir *et al* (1999) and Farooq *et al* (2002), the line indigenous to the country happens to be more adaptive; however, this was not reflected in the results in this study. Like the Lebowa–Venda, which according to previous studies was the poorest growth performer in South Africa (Van Marle-Köster & Nel, 2000), their lighter weights and weight gain are assumed to play a role in their survival. Apparently, there could be a positive correlation between body weight and survival in native chickens.

This higher mortality percentage could also be ascribed as a function of poor quality chicks (Farooq *et al*, 2002) since feed and management practices were similar for all lines. Choprakarn *at al.* (1998) reported a mortality in Thai indigenous chickens of 28.2%, which is relatively low, compared with the Lesotho line.

In many cases, mortality is associated with seasonal changes in temperature or certain periods that may coincide with feed changes or increases in competition within pens (Maes *et al.*, 2001). Generally, higher death rates could be due to substandard health measures and management practices, poor chick quality and accidental deaths (Dessie & Ogle, 1996). Mortality rate due to diseases is one of the important factors associated with the limited expansion of the number of native chickens in the rural areas (Pederson, 2002). Thus, disease remains to be a great threat to these chickens.

It is not very common for Basotho people to offer a chicken to a visitor. Therefore, it could be deduced that although egg sampling was done in different areas in the mountains, inbreeding within this population could be high because virtually no exchange of genetic material between villages normally took place. The villages in the mountains are also very isolated and virtually no new genetic material is introduced.

Lesotho chickens are also kept for several years or, as long as they remain productive and broody. The mating is also indiscriminate with a few sires wondering around within the village. Unlike other populations, selection within the Lesotho lines has never been done. This suggests that inbreeding has been going on and could be the cause of the loss of vigour within the Lesotho line hence the reasons for higher susceptibility to diseases and therefore higher mortality.

Conclusions

In all the lines, the highest rate of mortality was experienced in the pre-laying growth stage. However, Batch 1 had the relatively higher mortality rate in most lines compared to Batch 2.

It could be deduced that despite the intensive management that was ensured during the growing stage, the highest mortality was experienced then. It could therefore be probable that the cause of the mortality in this study was not mainly a function of management but a genetic factor, or the chickens are not adapted to the confined area in which the trials were conducted.

However, for conservation of this genetic pool within the Lesotho line, which had the highest mortality rate, emphasis should de directed towards improvement of the survival traits. Since the study was conducted under a different environment from the place where chickens naturally survive, it is advisable to conduct a similar study to determine its mortality behaviour.

CHAPTER 7

GENERAL CONCLUSIONS AND RECOMMENDATIONS

The Lesotho line is the product of natural selection and has survived in its harsh environment for many generations. It is able to survive and give some produce on a very meagre of food supply and has good instinctive ability to protect itself from predators. The productivity of the Lesotho native chicken compares fairly well with other native lines as well as with some of the exotic lines tested in this study as well some results found in the literature. However, the high mortality and low growth performance in the pre-laying phase are of concern. This could be ascribed to indiscriminate and uncontrolled breeding, which has been taking place within the line.

Productivity may be increased by a conservation effort in which a structured breeding programme is followed. The large population in the sampled area, short generation interval and large variation within the population could facilitate fast genetic progress.

It can be concluded that the Lesotho chickens, which are mostly raised by the majority of households in the different villages in Lesotho, have the potential to increase income and generate employment, as well as contributing to the national supply of meat and eggs. The constraint is their low productivity in some phases of the production chain.

It is recommended that a similar study be conducted in the environment in which the eggs were sampled as to evaluate the effect of the environment in the production performance of the Lesotho line. In this study much more emphasis should be placed on the mortality rate. It should determine whether the high mortality rate is a result of inbreeding or a

natural lower resistance to diseases. Secondly, studies on DNA should be done to determine the heteroxygosity levels of the Lesotho line.

Lastly, owing to a lack of information and literature, the current study could be considered as an initiative to shed more light on the use and production potential of the Lesotho native chicken.

SUMMARY

Studies were made on growth, carcass and egg performance as well as mortality of the Lesotho native chickens compared to the South African native (Potchefstroom Koekoek, Ovambo, Lebowa-Venda and Naked Neck) and two exotic lines, namely the New Hampshire and Rhode Island Red from 3-days old to 70 weeks old (moulting).

Chickens were raised in two batches with an interval of four weeks between the two batches: from 3-day old to ten and six in Batches 1 and 2, respectively. Chickens were reared in Bloemfontein (UFS) under confinement, fed *ad libitum* with broiler starter mash for the first four weeks where after grower mash was fed to the chickens up to the age of ten weeks old. From this stage until the end of the laying phase, they were all fed yellow maize and managed semi-intensively in Lesotho at the NULFOA. The study was done in two phases, namely the pre-laying and laying phases.

With the exception of feed conversion ratio (FCR), which was conducted in the first 35 days of the study, all measurements of growth and egg performance traits were recorded weekly while mortality was recorded daily. Carcass yield analysis was done at 70 weeks of age. Presentation of the growth data was done in three stages, namely 3-day, 26-week and 70-week weights, which are considered crucial in a chicken's life span.

The means of the Lesotho line were significantly different ($p<0.05$) from other lines in all growth traits, namely 3-day weight, 26-week weight, average daily gain (ADG) and average weekly gain (AWG) except for the FCR and hen weight at 70 weeks old. With the exception of the New Hampshire and Potchefstroom Koekoek, no significant

differences ($p>0.05$) were observed between the Lesotho hen weight and other lines. The Ovambo had the highest body weight and average daily gain of all the native populations at 26-weeks old, while the Potchefstroom Koekoek had the highest 70-week weight. Feed conversion ratios ranged between 3.2±1.9 for the New Hampshire to 3.9±1.2 for Naked Necks in Batch 1, and 3.3±1.2 for New Hampshire to 4.2±0.9 for the Lesotho line in Batch 2. All differences between the lines for FCR were highly significant ($p<0.01$).

All the lines commenced their egg production between the 25th to 26th weeks of age and there were no significant differences ($p> 0.05$) between the ages at first lay among all the lines. Egg production was found to differ significantly ($p<0.05$) among the different lines. The average number of eggs laid per week per hen and egg weight of the Lesotho hens was 1.2 and 48.5g, respectively. The New Hampshire had a significantly ($p<0.05$) higher dressed weight than other lines (1903.0±190.8g) while the Naked Neck had the lowest (1297.7±133.0g). Bone and head weight were not significantly different ($p>0.05$) among the different lines. The Lesotho line had the highest overall mortality (89%) of all the lines. The lowest mortality (27%) was found in the Potchefstroom Koekoek. A probable reason for high mortalities in the Lesotho could be ascribed to the result of inbreeding within the line.

Although the Lesotho hens exhibited the lowest growth at the onset of laying (1113.8±71.6g), they eventually compensated and ended being large (2047.5±65.6g) at 70-weeks old. The Lesotho hen, like the New Hampshire and Potchefstroom Koekoek showed potential for being a good dual-purpose breed, since it was able to maintain a high body weight at the end of laying. Therefore the breed has an advantage of fetching a

higher market price at the end of laying. The constraint is that of their low growth in the earlier part of their life span. This can be improved through the implementation of planned breeding programs.

OPSOMMING

Vergelykende studies is gedoen t.o.v. groei, karkas- en eierprestasie, sowel as mortaliteit by die Lesotho inheemse hoenders teenoor die Suid-Afrikaanse inheemse rasse (Potchefstroom Koekoek, Ovambo, Lebowa Venda en Kaalnek) en twee eksotiese lyne, nl. die New Hampshire en Rhode Island Red vanaf drie dae tot 70-weke ouderdom (verveertyd).

Kuikens is op hok gehou in twee afsonderlike groepe, met ‘n tussenpose van vier weke tussen die twee groepe: Groep 1 vanaf drie dae tot 10 weke oud en Groep 2 vanaf 3 dae tot 6 weke. Die grootmaakproses het by die UV te Bloemfontein geskied waar slaghoenderbeginmeel gedurende die eerste vier weke *ad libitum* aan die kuikens gevoer is, waarna slaghoendermeel gevoer is tot op ouderdom tien en ses weke in Groepe 1 en 2 onderskeidelik. Vanaf hierdie stadium tot aan die einde van die lê-fase is almal geelmielies gevoer onder semi-intensiewe bestuur by NULFOA in Lesotho. Die studie is in twee fases gedoen, nl. die voor-lê- en lê-fase.

Met die uitsondering van voeromsetverhouding (FCR) wat in die eerste 35 dae van die studie onderneem is, is alle metings van groei en eierprestasie-eienskappe weekliks aangeteken , terwyl mortaliteit daagliks aangeteken is. Karkasopbrengsontleding is op ouderdom 70-weke gedoen. Aanbieding van die groeidata is in drie fases gedoen, nl. 3-dae, 26-weke en 70-weke gewigte, wat as deurslaggewend in ‘n hoender se lewensduur beskou word.

Die gemiddelde van die Lesotho-lyn het betekenisvol verskil ($p<0.05$) van alle ander lyne t.o.v. alle groei-eienskappe, nl. 3-dae gewig, 62-weke gewig, gemiddelde daaglikse toename (ADG) en gemiddelde weeklikse toename (AWG), behalwe vir FCR en hengewig op 70-weke ouderdom. Met die uitsondering van die New Hampshire en Potchefstroom Koekoek, is geen betekenisvolle verskille ($p>0.05$) waargeneem tussen die gewig van die Lesotho-hen en dié van ander lyne nie. Die Ovambo het die hoogste liggaamsgewig en gemiddelde daaglikse toename van al die inheemse populasies op 26-weke ouderdom gehad, terwyl die Potchefstroom Koekoek die hoogste 70-weke gewig gehad het. Voeromsetverhoudings het tussen 3.2 ± 1.9 vir die New Hampshire en 3.9±1.2 vir Kaalnekke in Groep 1 gevarieer, en tussen 3.3 ± 1.2 vir new Hampshire en 4.2±0.9 vir die Lesotho-lyn in Groep 2. Alle verskille tussen die lyne vir FCR was hoogs betekenisvol ($p<0.01$).

Al die lyne het hul eierproduksie tussen 25 tot 26 weke ouderdom begin en daar was geen betekenisvolle verskille ($p>0.05$) tussen die ouderdom van aanvang van lê by al die lyne nie. Eierproduksie het wel betekenisvol ($p<0.05$) tussen die verskillende lyne verskil. Die gemiddelde aantal eiers gelê per hen per week en eiergewig van die Lesotho-henne was 1.23 en 48.50g, onderskeidelik. Die New Hampshire het ‘n betekenisvolle ($p<0.05$) groter uitslaggewig as ander lyne gehad (1903.0±190.80g) , terwyl die Kaalnek die laagste (1297.7±133.0g). Been- en kopgewig was nie betekenisvol verskillend ($p> 0.05$) tussen die verskillende lyne nie. Die Lesotho-lyn het die hoogste algehele mortaliteit (89%) van al die lyne gehad. Die laagste mortaliteit (27%) is by die Potchefstroom Koekoek gevind. Die hoë mortaliteit by die Lesotho kan moontlik aan inteling binne die lyn toegeskryf word.

Alhoewel die Lesotho-henne die laagste groei met die aanvang van lê getoon het, (1113.8±71.6g), het hulle uiteindelik gekompenseer en groot geëindig (2047.5±65.6g) op 70-weke ouderdom. Die Lesotho-hen, soos die new Hampshire en Potchefstroom Koekoek het potensiaal getoon as ‘n goeie dubbeldoelras, aangesien dit ‘n hoë liggaamsgewig aan die einde van die lê-periode kon handhaaf. Die ras het dus die voordeel dat dit ‘n hoër markprys na lê-tyd kan behaal. ‘n Beperking is die lae groei vroeër in hul lewensduur. Dit kan verbeter word deur die implementering van beplande teelprogramme.

REFERENCES

Adenokun, S D. & Sonaiya, E. B., 2001. Comparison of the performance of Nigerian chickens from three agro-ecological Zones. *Livestock Research for rural Development.* 13: 2.

Aganga, A A., Omphile, U. J., Malope, P., Chabanga, C. H., Motsamai, G. M. & **Motsumi, L. G., 2000.** Traditional poultry production and commercial broiler alternatives for small-holder farmers in Botswana. *Livestock Research for Development.* 12: 4.

Aganga, A. A., Tsoenyane, S. O. & **Molefhe, L., 2003.** Influence of Feed Type on Egg Production of Laying Chicken. *International Journal of Animal Science.* 2: 4 256-258.

Aini, I., 1990. Indigenous chicken population in South-East Asia. *World's Poultry Science Journal.* 46: 51-57.

Ajuyah, A.O., 1998. AG 273: Livestock production 4 – Course Book 2. Published by University Extension. The University of South Pacific, P.O. Box 1168, Suva, Fiji.

Andrews, P. 1990. Rural Poultry Development in the Gambia. – CTA – *Seminar Proceedings on Smallholder Rural poultry production* 9 – 13 October 1990, Thessaloniki, Greece. 2: 81 – 85.

Awan, M.A., 1993. The Epidemiology of Newcastle disease in rural poultry. University of Reading. UK. (M.Sc. thesis).

Bayley, B. & Phororo., H., 1992. An Analysis of egg marketing in: *Lesotho; Implications of Liberization.* Institute of South African Studies. National University of Lesotho. Roma.

Bessei, W., 1989. Preservation of local poultry stocks. In *Genotype x environment interaction in poultry production*. Report of a meeting. Jouy-en-Josas, France, 9-11 May 1989. Colloquis de LINRA, No. 50, P.175-188.

Bourzat, D. & Sounders, M., 1990. Improvement of traditional methods of poultry production in Burkina Faso. In: *Proceedings, CTA Seminar, 3rd International Symposium on Poultry Production in Hot Climates*, Hameln, Germany, 12 June 1987.

Bureau of Statistics Lesotho, 2001. Statistical Report. Lesotho.

Choprakarn, K., Salangam, I. & Tanaka, K., 1998. Laying performance, Egg characteristics and Egg composition in Thai Indigenous Hens. *Journal for. Naionalt Research. Council*. 30: 1-2.

Crawford, R.D., 1990. Origin and history of poultry species. Chapter 1. In*: Poultry Breeding and Genetics. Ed.* By R.D. Crawford. Elsevier, Amsterdam.

Crawford, R.D. & Gavora, J.S., 1993. Gene resources: Global view of inventory and conservation In: *Proceedings, 10th International Symposium on current problems of Avian Genetics*. Nitra, Slovakia, 7-10 June 1993, P. 131-136.

Dessie, T. & Ogle, B., 1996. Studies on Village poultry production in the Central Highlands of Ethiopia. *In*: *Proceedings, Intergrated Farming in Human Development.* Ethiopia.

Enku-Azahan, E.A., Yeong, S.W. & Noroziah, M., 1990. Intensive rearing of Kampung chickens for meat production. *In*: *Proceedings, 2nd Congress Veterinarian Association. Malaysia.* 108-110.

Farooq M., Gul N., Chand N, Durrani, FR., Khurshid. A., Armed, J., Asghar, A. & Zahir-ud-Din, 2002. Production performance of backyard chicken under the care

of women in Charsadda, Pakistan. *Livestock Research for Rural Development*. 14: 1

Gueye, E. F., 1998. Village egg and fowl meat production in Africa. *World's Poultry. Science. J.*, 54: 73-85.

Gunaratne, S.P., 1999. Feeding and nutrition of scavenging village chickens. Free communication 2, *The First IFNPD/FAO Electronic Conference on Family Poultry*.

Gunaratne, S.P., Chandrasiri, A.D.N., Hemalatha, W.A.P. M. and Roberts, J.A., 1993. The feed resource base for scavenging village chickens in Sri Lanka. *Tropical Animal Health and production* 26: 249-257.

Horst, P., 1997. Project coordinator. *Compendium of results of the EEC-Research Project, No.TS3-CT92-0091*. Final Workshop at M'Bour, Senegal. December 12, 1997.

Jalaludin, S. 1992. The development of poultry industry in Malaysia. *In: The Sixth Annual Science Congress of the Asian-Australian Association of Animal Production Societies (AAAP) proceedings, Volume of international Symposium. Sakhuthai, Thamathirat Open University*. 27 – 28 November, 1992, Bangkok, Thailand, 14 – 21.

Joubert, J.J., 1996. The story of the indigenous domestic animals in South Africa. Agricultural Research Centre, Private Bag X2, Irene, 0062. South Africa. (unpublished).

Kelly, P.J., Chituaro, D., Rohde, C., Rukwavo, J., Majok, A., Davelaar, F. & Mason, P.R., 1994. Diseases and management of backyard chicken flocks in Chitungwiza, Zimbabwe, *Avian diseases*, 38: 626-629.

Kingori, A.M., Tuitoek, J.K. & Wachira, A.M., 2003. Protein requirements of growing indigenous chickens during the 14-21 weeks growing period. *South African Journal of Animal Science.* 33: 2 78-82.

Kumer, D., Sharma, R.K., Banarjee, A.K. & Singh, H., 2002. Egg quality characteristics and their impact on fertility and hatchability in indigenous chickens and their crosses. *7th World congress on Genetic Applied to Livestock Production.* August 19-23. France.

Kitalyi, A.J., 1998. Village Chicken Production Systems in rural Africa. *FAO Animal Production and Health series.* No. 142 Rome.

Kitalyi, A.J., 1999. Family Poultry management systems in Africa. *The First IFNPD/FAO Electronic Conference on Family Poultry*.

Lebajoa, F.B., 2001. Country reports Lesotho. In: R.G. Alders & P.B. Spradbrow *(eds*). *SADC Planning workshop on Newcastle disease control in village chickens. Aciar proceedings* No.103 Maputo, Mozambique, 6-9 March 2000. 1-10.

MacDonald, K.C. & Edwards, D.N., 1993. The importance of Chickens in Africa. Qasr Ibrim, *Antequity*. 67: 584-590.

Maes, D., Larristra, A.A., Den, J. & Morrison, R.B., 2001. A retrospective study of mortality in grow-finishing pigs of a multisite production system. *Swine Health Production.* 9: (6) 267-274.

Matika, O., van Wyk, J.B., Erasmus, G.J. & Baker, R.L., 2002. Genetic parameter estimates in Sabi sheep. *Livestock Production Science*.

Mbugua, P.N., 1990. Rural Smallholder Poultry Production in Kenya. *In: Proceedings of International CTA – Seminar on Rural Smallholder production,* Thessaloniki, Greece.

McArdle, A.A., 1972. Methods of Poultry in developing areas. *World Animal Review.* 2:28 – 32.

Merat, P., 1996. Potential usefulness of the NA (Naked Neck) gene in poultry production. *World's poultry Science Journal.* 42:124 – 142.

Mignon-Grasteaus, S., Beamont, C. & Richard, F.H., 2001. Genetic Analysis of Selection Experiments on the Growth Curve of Chickens. *Poultry Science.* 80. 849-854.

Missohou, A., Dieye, P.N. & Talaki E., 2002. Rural poultry production and productivity in Southern Senegal. *Livestock Research for Rural Development.* 14 2.

Mosoeunyane, N.V. & Nkebenyane P.S., 2001-Seminar. The Development of Poultry Industry. Seminar. *Department of Livestock services*. Lesotho.

Pederson, C.V., 2002. Production of Semi-scavenging chickens in Zimbabwe. *Ph.D. thesis.* The Royal Veterinary and Agricultural University, Denmark.

Pitel F., Morun, C., Gellin, J. & Vignal A., 2000. The chicken LEP (OB) gene has not been mapped. *Animal. Genetics.*31:4 281

Prawirokusumo, S., 1988. Problems to improve small-scale native chickens' management in Southeast Asian countries. Proceedings, *18th World' poultry Congress, Japan, 113-117, The First IFNPD/FAO Electronic Conference on Family Poultry*.

Ramsey, K., Harris, L. & Kotze, A., 2000. Landrace Breeds: *South Africa's indigenous and locally adapted developed farm animals.* Ed. Ramsey, Harris & Kotzé. Farm Animal Conservation Trust, Pretoria.

Roberts, J.A. & Gunaratne, S.P., 1992. The scavenging feed resource base for village chickens in a developing country. Proceedings, 19th World's Poultry Congress, Vol. 1, 822-825, *The First IFNPD/FAO Electronic Conference on Family Poultry.*

Rodriguez, L. & Preston, T.R., 1997. Local feed resources and indigenous breeds: Fundamental issues in integrated farming systems. *Livestock Research for Rural Development*. 9:2.

SAS, 1996. Statistical Analysis Systems. SAS user's guide. SAS Institute Inc. Cary. North Carolina.

Shakir, M. K., Mian, M.A., Syed, M. & Farooq, M., 1999. Contribution of backyard chicken to household economy in Chitral, NWFP, Pakistan. *M.Sc. (Hons) Animal Husbandry*, NWFP, Agricultural University, Peshawar, Pakistan (unpublished).

Smith, A.J., 1990. The integration of rural production into the family food security system. CTA – *Seminar proceedings on Smallholder rural Poultry production 9–13 October, 1990.* Thessaloniki, Greece.

Siegel, P.B., 1993. Behavior-Genetic Analysis and Poultry husbandry. *Poultry Science* 72:1-7.

Sonaiya, E.B., 1997. African network on Rural Poultry Development: Progress report November 1989 to June 1995. *Proceedings ANRPD workshop*, Addis Ababa, Ethiopia pp.: 134-143.

Sonaiya, E.B., Brankaert, R.D.S, and Guèye, E.F., 1999: Research and Development options for family poultry. *Introductory paper to this First INFPD/FAO Electronic Conference.*

Van Lumen, T.A & Cole, A.D.J., 1998. Growth and body composition of highly selected boars and gilts. *Animal Science.* 67: 107-116.

Van Marle-Köster, E. & Nel, L. H., 2000. Genetic characteristics of native Southern African populations: evaluation and selection of polymorphic microsatellite markers. *South African Journal of Animal Science* 30: 1-6.

Van Marle-Köster, E. & Webb E. C., 2000. Carcass characteristics of South African native chicken lines. *South African Journal of Animal Science*. 30: 53-56.

Zulu, F.A., 1999. Current State of management of farm animal genetic resources In Zambia. *A paper presented at the national coordinators meeting of SADC/FAO on management of farm animal genetic resources (FanGRs)*, 5-8 July, 1999. Pretoria, South Africa.