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Research Article

Evaluation of Reproductive and Growth Performance of Three Zambian Village Chicken Types

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Received: September 30, 2019; **Published:** October 17, 2019

Abstract

A study was conducted at the University of Zambia Farm to evaluate the reproductive and growth performance of three village chicken types, namely, Guinea Fowl type (GF), Naked-Neck type (NN) and Feather-Hill on Head type (FH). Fifteen point-of-lay pullets of each type were utilized in the experiment. They scavenged and ran around freely with cocks and were supplemented with maize bran and either sunflower cake or soybean cake. The results showed that the average number of clutches per year was higher ($P < 0.01$) in the GF (4.9 clutches) and FH (4.2 clutches) than in the NN (3 clutches) chickens. The total number of eggs laid per year was higher ($P < 0.01$) in the GF (45.7 eggs) and FH (38.7 eggs) than in the NN (25.8 eggs) chickens. Further, the number of eggs hatched per year was higher ($P < 0.05$) in the GF (32.2 eggs) and FH (27.9 eggs) than in the NN (19.3 eggs) chickens. With respect to growth performance of chicks, the ADG was 7.0 g/d for GF, 6.9 g/d for FH and 5.5 g/d for NN chickens; the body weight on d 196 was 1435g for GF, 1520g for FH and 1102g for NN chickens. It is concluded that there is diversity among different types of village chickens, with widely varying performance in terms of reproductive and growth traits. On average, the GF type had greater performance, followed by the FH type, while the NN type performed poorly.

Keywords: *Village Chickens; Laying Capacity; Hatchability; Growth Performance; Zambia*

Introduction

Village poultry are the prominent livestock species in many rural areas [1], with the majority being kept in free-range scavenging systems [1,2]. They play a significant role in poverty alleviation and improvement of family food security in many poor rural households of developing countries [4].

In Zambia, village chickens are kept by more than 90% of the rural dwellers [5]. Production of rural poultry and other small stocks such as goats, has gained significant importance in the past twenty years, particularly in view of occasional droughts that hit the country in the 1990s and early 2000s resulting in crop failure. Unfortunately, however, rural poultry does not rate highly in the mainstream national economy of Zambia because of lack of measurable indicators of its contribution to gross national product (GDP) and other macroeconomic indices. Reliable data on commercial broiler and egg production is readily available while there is a paucity of information on rural poultry production. Thus, while more than 90% of smallholder traditional farmers keep local chickens, the actual value to the national economy is not known.

One of the major problems of rural poultry production is the low productivity of chickens [3]. This is mainly due to factors such as lack of breeding and selection for high performance, inadequate nutrition, poor housing, and lack of comprehensive health programmes.

While the farmers themselves have knowledge on the performance of the different chicken types [6], there is no empirical data on which strategies for improvement can be based. The current available information is based on surveys only.

This research was, therefore, conducted to evaluate the reproductive and growth performance of three village chicken types commonly kept by smallholder traditional farmers in Zambia.

Materials and Methods

Birds and experimental location

Three village chicken types (Figure 1) were used in the experiment. Fifteen point-of-lay pullets for each type were purchased from an open market in Lusaka, the Capital of Zambia. The chicken types were Guinea Fowl Spotted type (GF), Naked-Neck type (NN) and Feather-Hill on Head type (FH). For each type, two young cocks that were ready to serve were included in the flock.

Figure 1: *Point-of-lay village chicken pullets: (a) Guinea Fowl Spotted type, (b) Feather-Hill on Head type, and (c) Naked-Neck type.*

The birds were immediately transported to the University of Zambia Farm (Liempe) where the experimental poultry unit had been prepared. The unit was partitioned into three big pens, each one measuring 5.8m x 5.1m (29.6 m^2). Added to each main partition were two extra pens, one measuring 4m x 2m (enough to hold 4 - 5 hens with their chicks), and the other one measuring 5m x 2m (enough to hold 80-100 growing birds). Each main partition had its own yard with a fence so that the birds from the different treatments could not mix. Each pen was fitted with fifteen box nests, about one-and-half metres above the ground. Ladders were fitted to enable chickens climb on the nests freely.

With this arrangement, the pullets within each treatment could freely scavenge and run around with the cocks in their own yard. An adjustment period of two weeks was given for the birds to adapt to the new environment before commencing the research.

Feeding

The feeding plan was semi-free range. The chickens were let out of their respective pens every day from 08:00 hrs to 17:00 hrs. This allowed them to feed on green vegetation, grasshoppers, and other materials that were available within the environment. The birds were

supplemented once on a daily basis with maize bran and either sunflower cake or soybean cake, as energy and protein supplements, respectively. Rejects of green vegetables at the University Farm were also given whenever available.

Health management

As a preventive measure against poultry diseases, *Virukill* (active ingredient: Poly Dimethyl Ammonium Chloride) was sprayed in all the pens when the birds were brought in. During the study period, the pens were always kept clean moist-free.

Ethnoveterinary medications, *Aloe vera*, *Cissus quadrangularis* and *Amaranthus hybridus,* were given in water. *Aloe vera* leaves were cut in small slices and put in fresh drinking water, and given for three weeks, in 3-day courses, alternating with *Cissus quadrangularis.* Boiled *Amaranthus* tender leaves were given directly to the birds every 2 - 3 days for three weeks. These herbs have antiviral, antifungal and antibacterial activity [7,8]. Amaranthus provides vitamins A, C and E. Oxytetracycline (a broad spectrum antibiotic) was given in fresh drinking water as necessary; Piperazine was also given in water when deworming was necessary. Akhari powder was used against ecto-parasites, particularly fleas.

Data collection

Collection of data was done on the parent stock for a period of 12 months. The data collected included number of clutches per year, number of eggs per clutch, weight of eggs within each clutch, and number of eggs hatched. During the course of the study, however, there were twenty (20) losses of the parent stock through predators and health problems. The chickens were, however, not replaced. Full data was therefore collected on twenty-five (25) chickens as follows: Guinea Fowl Spotted type, 9; Naked Neck type, 7; and Feather-Hill on Head type, 9. With regard to chicks being hatched from the parent stock, they were weighed once a week for one month; and thereafter, once every month until sexual maturity.

Statistical analysis

The data was stored into Windows Excel (2007 version) which was used to calculate the average number of eggs per clutch, average egg weight per clutch and hatchability. The data was then imported into GenStat [9] for statistical analysis. Analysis of variance (ANOVA) was done to compare the chicken types in terms of reproductive performance. With regard to the growing chicks, the weekly and monthly weights were pooled within each chicken type, and the average daily gain (ADG) computed by regression analysis.

Results and Discussion

Reproductive performance

Hen laying capacity

The average number of clutches per year differed ($P < 0.01$) between the chicken types, with the GF and FH types having a higher number of clutches than the NN type (Table 1). While the GF type and FH type laid 4.9 clutches and 4.2 clutches, respectively, the NN type laid only 3 clutches per year. The results for the NN genetic type in the present study are similar to those reported in village hens in one sub-district of Botswana [10] where the researchers observed that village hens produced three clutches in a year. However, the authors indicated that other studies elsewhere had reported 3.5 to 5.2 clutches per year. The present study in Zambia is in agreement with these reports, but more importantly shows that different chicken types have different capacities to reproduce [11].

Chicken type	Number of hens	Number of clutches (range)	Mean ± SE
Guinea Fowl Spotted	9	3 - 6	4.9 ± 0.3^{a}
Naked-Neck	7	2 - 5	3.0 ± 0.4^{b}
Feather-Hill on Head	9	3 - 6	4.2 ± 0.3^{a}

Table 1: *Number of clutches per year for Guinea Fowl Spotted, Naked-Neck and Feather-Hill on Head types of village chickens.*
^{a,b}: Means within the same column differ ($P < 0.01$).

However, the average number of eggs per clutch did not differ between the three chicken types (Table 2) but there was a significant difference ($P < 0.01$) with regard to the total number of eggs laid per year, with the GF type and FH type laying more eggs (mean = 45.7 and 38.7 eggs, respectively) than the NN type (mean = 25.8 eggs) (Table 3). Annual egg production is a function of the number of clutches laid per year and the number of eggs per clutch. Evidently, although the average number of eggs per clutch was similar among the three chicken types, the GF and FH laid more eggs per year because of the higher number of clutches than the NN type.

Chicken type	Number of hens	Average number of eggs (range)	Mean ± SE
Guinea Fowl Spotted	9	7.7 - 10.8	9.2 ± 0.4
Naked-Neck	7	7.0 - 10.0	8.6 ± 0.4
Feather-Hill on Head	9	7.2 - 9.8	8.9 ± 0.4

Table 2: *Average number of eggs per clutch for Guinea Fowl Spotted, Naked-Neck and Feather-Hill on Head types of village chickens.*

Chicken type	Number of hens	Total number of eggs (range)	Mean ± SE
Guinea Fowl Spotted	9	21 - 58	45.7 ± 3.8[a]
Naked-Neck	7	14 - 42	25.8 ± 4.6[b]
Feather-Hill on Head	9	25 - 56	38.7 ± 3.8[a]

Table 3: *Total number of eggs laid per year for Guinea Fowl Spotted, Naked-Neck and Feather-Hill on Head types of village chickens.*
[a,b]: Means within the same column differ ($P < 0.01$).

According to Kitalyi [12], the clutch size parameter is highly influenced by management, although it could also be an indication of the potential for genetic improvement through selection. For example, in the Gambia and Ethiopia, it was found that the village hens laid 23 and 143 eggs per year, respectively [12]. The high egg production in Ethiopia was attributed to the manipulation of the hen laying cycle. In the present study in Zambia, the physical environment and management for the three chicken types were the same; thus the differences could only be explained from genetic differences.

Egg size

The egg size for all the three chicken types was classified as 'small' (40 - 50 grams) according to commercial classification (Table 4). Overall, there were no significant differences between the three chicken types. It was, however, observed that the NN type tended to have a wider range of egg size (38.2g - 50.0g) compared to the GF and FH types.

Chicken type	Number of hens	Average egg weight, g (range)	Mean ± SE
Guinea Fowl Spotted	9	40.7 - 47.2	43.4 ± 1.1
Naked-Neck	7	38.2 - 50.0	44.1 ± 1.3
Feather-Hill on Head	9	39.3 - 46.5	42.7 ± 1.1

Table 4: *Average egg weight per clutch for Guinea Fowl Spotted, Naked-Neck and Feather-Hill on Head types of village chickens.*

Hatchability of eggs

The number of eggs hatched per hen per year was higher ($P < 0.05$) in the GF type and FH type than in the NN type (Table 5). Essentially, this was because there were more eggs laid by GF and FH types than the NN type. However, there were no statistical differences among the three chicken types in terms of egg hatchability percentage, although the values tended to be higher for the NN type than the GF and

FH types (Table 6). The hatchability of NN eggs ranged between 75 and 100% while that for GF and FH types was 54.6 - 84.5% and 71.2-93.3%, respectively. Moreki., *et al.* [10] reported egg hatchability of 82% in the village chickens in Botswana. The results from the present study in Zambia were in line with those from Botswana.

Chicken type	Number of hens	Total number of eggs hatched (range)	Mean ± SE
Guinea Fowl Spotted	9	11 - 45	32.2 ± 3.0[a]
Naked-Neck	7	11 - 29	19.3 ± 3.7[b]
Feather-Hill on Head	9	15 - 42	27.9 ± 3.0[a]

Table 5: *Total number of eggs hatched per hen per year for Guinea Fowl Spotted, Naked-Neck and Feather-Hill on Head types of village chickens.*

[a,b]: Means within the same column differ (P < 0.05).

Chicken type	Number of hens	Hatchability (%) (range)	Mean ± SE
Guinea Fowl Spotted	9	54.6 - 84.5	72.7 ± 3.7
Naked-Neck	7	75.0 - 100.0	84.5 ± 4.5
Feather-Hill on Head	9	71.2 - 93.3	75.3 ± 3.7

Table 6: *Average hatchability per clutch for Guinea Fowl Spotted, Naked-Neck and Feather-Hill on Head types of village chickens.*

But interestingly, only the NN type recorded 100% hatchability in some clutches. Thus, while this chicken type laid fewer eggs in one year, most of those eggs hatched. This apparent high level of fertility in the NN chickens could possibly be a genetic factor; Haazele., *et al.* [6] who conducted a survey among 550 farmers in four districts of Zambia reported that the dwarf chicken types were more prolific (15 - 25 eggs per clutch) and produced 100% hatchability, while the taller types had lower hatchability. This information was, however, based on the knowledge of the farmers rather than based on empirical data. But the important point is that the genetics of village chickens is a factor in their reproductive capacity.

Further, it was observed in the present study that hatchability tended to be lower in the hot-dry (September to November) and hot-wet (December to March) seasons compared to the cold-dry (April to July) season. Moreki., *et al.* [10] and Haazele., *et al.* [6] reported similar results in the surveys carried out in Botswana and Zambia, respectively. As noted by Moreki., *et al.* [10], lower hatchability rates observed in the summer months could be attributed to high ambient temperatures and high relative humidity. The combination of high temperatures and rainfall (especially in December and January) could result in high egg deterioration and hence low hatchability during this period.

Growth performance of chicks

Table 7 shows weekly mean weights of chicks from hatching (d 0) up to the end of one month (d 28) and thereafter monthly mean weights up to six months of age (d 196) when some chickens attained sexual maturity. Although the growing chickens from the three chicken types had similar weekly weights during the first one month, the NN type seemed to slow down thereafter. Table 8 shows the average daily gain (ADG) of the growing chicks from the three types of chickens. There were no significant differences (P > 0.05) in mean ADG among the three chicken types, but the NN type tended to be on a lower side compared to the GF and FH types. Similarly, the d 196 mean weight for the NN type tended to be lower than the other two types.

These results are similar to those found in the phenotypic characterization of indigenous chickens as reported by Nthimo., *et al.* [13] in Lesotho. In this Lesotho study, the mean weight at d 3 varied among chicken types from 33.4g to 50.3g while at d 185, the range was

Chicken type	d 0	d 28	d 56	d 84	d 112	d 140	d 168	d 196
Guinea Fowl Spotted	29.9	87.3	231.4	445.2	811.6	1128.6	1196.7	1435.0
Naked-Neck	29.8	73.8	210.0	397.9	650.0	780.0	950.0	1102.0
Feather-Hill on Head	29.1	79.0	181.3	381.3	676.3	1062.5	1180.0	1520.0

Table 7: *Mean weights (g) of Guinea Fowl Spotted, Naked-Neck and Feather-Hill on Head types of village chickens from hatching (d 0) to sexual maturity (d 196).*

Chicken type	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Mean ADG
Guinea Fowl Spotted	2.1	5.2	7.6	13.1	11.3	2.4	7.0
Naked-Neck	1.6	4.9	6.7	9.0	4.6	6.1	5.5
Feather-Hill on Head	1.8	3.7	7.1	10.5	13.8	4.2	6.9

Table 8: *Average daily gain (g/d) of Guinea Fowl Spotted, Naked-Neck and Feather-Hill on Head types of village chickens from hatching to sexual maturity.*

from 917.0g to 1187.2g. The ADG varied from 4.6 to 9.9 g/d. In a similar study, Hassen., *et al.* [14] also reported ADG of 6.6 - 8.8 g/d in indigenous chickens that were intensively managed in Northwest Ethiopia. These differences in the various studies were attributed to genetic differences of the village chickens. Results from the present study demonstrated potential differences among the different chicken types in Zambia. This means that the potential for performance improvement through selection and breeding is high. But this calls for improvement in the management of rural poultry from an extensive system as practiced by many smallholder farmers to a semi-commercial system.

Conclusion

It is concluded from this study that there is diversity among village chickens, with widely varying performance in terms of reproductive and growth traits. On average, the reproductive and growth performance was similar between the GF and FH types while the NN type performance was lower than the other two types. There is great potential to breed and select for higher performance within the local breeds. Results in the present study could form the basis for improvement of village chickens in Zambia.

Village chicken production faces several constraints and needs a turn-around of practice for improved productivity. The extensive production system practiced by most smallholder traditional farmers does not offer hope in the quest to make rural poultry contribute to wealth creation and reduce poverty among rural households. A semi-commercial approach is recommended.

Acknowledgements

Ms Martha Musukwa of the Department of Animal Science at the University of Zambia is greatly thanked for providing herbal medicines during the initial phase of the study. Mr. Cassiano Hang'andu and Matimba Mwiinga at the University of Zambia Farm are thanked for help in looking after the chickens during the experimental period. Finally, the Government of the Republic of Zambia is acknowledged for funding the research through National Science and Technology Council under the science and technology development fund.

Ethical Standards

The experiment complies with the ethical standards under the current laws of Zambia.

Conflict of Interest

The author declares that there is no conflict of interest.

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Volume 4 Issue 9 November 2019