GROWTH PERFORMANCE OF INDIGENOUS CHICKENS FED LOCALLY AVAILABLE FEED RESOURCES UNDER INTENSIVE MANAGEMENT IN MAZABUKA DISTRICT

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GROWTH PERFORMANCE OF INDIGENOUS CHICKENS FED LOCALLY AVAILABLE FEED RESOURCES UNDER INTENSIVE MANAGEMENT IN MAZABUKA DISTRICT

BY

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A REPORT SUBMITTED TO THE FACULTY OF AGRICULTURE IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF SCIENCE (AGRICULTURE)

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DECLARATION

I declare that this project report is my own original work and has not been accepted in any other application for a degree. All sources of information have been acknowledged by references.

Name: Diana Ilinanga Mwendaweli

Signature:.....

June, 2012.

DEDICATION

This project report is dedicated to my parents Mr. Collins Muteletwa Mwendaweli and Ms. Rosemary Kabisa who fought restlessly to see me where I am today.

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ABSTRACT

A study was conducted to evaluate growth performance of three strains of indigenous chickens, using locally available feed resources at different nutritional levels under intensive management in Mazabuka District of Zambia. The strains were Frizzle feathered, Naked neck and Zambi. The control diet (FEED 1) mainly comprised maize bran and number three meal in a 1:1 ratio and the experimental diet (FEED 2) comprised maize bran, number three meal and sunflower cake mixed in 1:1:1 ratio. Salt was also added to both feeds.

The experimental layout was a completely randomised design (CRD) with three replications for a total of 56 birds. Data were collected over a period of 6 weeks and the parameters measured were body weight, average daily gain and feed efficiency at different levels of feeding. These were; control diet (ad libitum) and experimental diet at 100 g/d, 75 g/d and 50 g/d respectively. Data were analysed using one-way Analysis of Variance using Genstat statistical package. Strain and feeding level were the fixed effects in the model. Means for each variable effect were compared using the Duncans multiple range test.

Results showed that there were no significant differences ($p>0.05$) found between strains fed on the control diet and experimental diet at 100 g/d and 50 g/d feeding levels, although the Zambi tended to record higher weekly weights. However, significant differences ($p=0.05$) were observed in the weekly weights between the strains of chickens fed at 75 g/d level. The frizzle feathered tended to record higher average daily gain in weight and the zambi exhibited a higher feed efficiency among the strains.

Mortalities throughout the study were moderately high for all strains, varying from 40 % (Frizzled), 45% (Naked neck) to 46% (Zambi) respectively.

It is concluded that the Frizzle feathered and Naked necks were the faster growers among the strains identified.

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CHAPTER ONE

INTRODUCTION

Chickens, both indigenous and exotic are the most common species of poultry in Zambia (Musiime, 1992). In fact, indigenous chickens contribute about 80% of total poultry products in Africa (Kitalyi, 1997). While commercial farmers keep exotic breeds, small holder farmers in rural areas keep the local or indigenous chickens, commonly referred to as village chickens. According to Safaloah (1997), these indigenous chickens remain predominant in African villages despite the introduction of exotic and crossbred types, because farmers have not been able to afford the high input requirement of introduced breeds.

In Zambia, village chicken production plays an important role in the economy of the rural house hold in spite of low output because it provides an available source of protein (Wilson, 1986). Majority of the small scale farmers in rural areas keep indigenous chickens. This may be owed to the unique traits that indigenous chickens possess i.e. disease resistance and adaptability to local environment (Kozacznskii and Honeyborne, 1994).

In most African countries, the indigenous chickens have no regular health control programme and may or may not have shelter, and scavenge for most of their nutritional needs (Yongolo, 1996). Scavenging village chickens find their feed from the surrounding environment (Gunaratne, 1992). It is understood that compounded commercial feed or purchased feed is generally not used in this system (Prawirokusomo, 1988). This production system is referred to as low-input-low-output system, also known as village, traditional or extensive system. According to Pandey (1992) and Bagust (1999), the low-input-low-output system is ascribable mainly to diseases, lack of adequate supplementation and sub-optimal management.

Over the past decade, a lot of interest in village chicken production has been generated in Zambia. This is because of the changing dynamics of the economy and also due to more people wanting to venture into agricultural related ventures.

While more people want to venture into village chicken production as a business, the real challenge is how to raise the chickens more efficiently. There is a paucity of evidence-based data with regard to nutrition, health, housing and reproduction of village chickens. Much of

the available information in various forms of reports is based on surveys where the information is obtained from the traditional farmers who mainly keep village chickens.

Undoubtedly, nutrition plays a very critical role in poultry production. But it will be appreciated that different strains of indigenous chickens will respond differently to feeding different levels of a particular feed. While some work has been done elsewhere (Hassen et al., 2006), there is little or no data on the Zambian indigenous chickens with respect to their growth performance under intensive management.

In Mazabuka District of Zambia, many small holder farmers use locally available feed materials, particularly maize bran and number three meal to try and intensively raise their local chickens. Indeed commercial feed would be uneconomical to feed the indigenous chickens. Given what is locally available, it is inevitable to scientifically investigate the response of the local chickens to such feeds.

1.1 Objectives

The main objective of this study was to investigate growth performance of three indigenous chickens fed locally available feed resources, under intensive management in Mazabuka District..

The specific objective was to compare growth rates in different strains of indigenous chickens fed locally available feed resources at different nutritional levels.

1.2 Null Hypothesis (H_0)

There is no variation in growth rate among different strains of village chickens fed at different nutritional levels.

CHAPTER TWO

LITERATURE REVIEW

2.1 Origin of the domesticated chicken

The chicken (*Gallus gallus domesticus*) is a domesticated fowl, subspecies of the red jungle fowl belonging to the Phasianidae family (Crawford, 1990). The red jungle fowl has the widest distribution of wild species and generally acknowledged that it is the progenitor of domestic poultry (Batty, 1985). The chicken has been domesticated since 2000 BC. Chicken is one of the most common and widespread domestic animals with an estimated global population of more than 47.6 billion (FAO, 2008). There are more chickens in the world than any other species of birds.

As stated in the *Encyclopaedia Britannica* (2007), humans first domesticated chickens of Indian origin for the purpose of cock fighting in Asia, Africa and Europe. Very little formal attention was given to egg or meat production. Multiple maternal origins are recognised in East and South Asia, America, Europe, the Middle East and Africa originating in the Indian sub continent. From India, the domesticated fowl made its way to the Persianised kingdom of Lydia in western Asia Minor. The domestic fowl were imported to Greece by the fifth century B.C. Fowl in Egypt had been known since the 18th Dynasty, with the "bird that lays every day" having come to Egypt from the land between Syria and Shinar, Babylonia.

There are over 300 breeds of fowl world wide (Say, 1987). Little is known about when the fowl was introduced in Zambia. However, Sauer (1969) indicated that chickens were already present in Africa at the time of first contact with Europe.

2.2 The livestock industry in Zambia

Zambia is a land locked country located between latitude 8° and 18 °S of the equator with an area of 752, 614 km^2. The country is divided into three main agro-ecological regions, which are defined based on climatic characteristics of which rainfall is the dominant factor. Region III has the highest rainfall at 1200 mm and is largely the Northern and Luapula provinces. Region II comprises largely the central parts of Zambia and part of Eastern province with rainfall between 800 mm and 1200 mm. Region I has the lowest rainfall of less than 800 mm. It comprises south western parts of Zambia and the mid-Zambezi area (Williams, 1993). Livestock and poultry production form an integral part of the agricultural activity of the small

holder farmers in Zambia. The 2009 estimates of livestock and poultry populations in Zambia were 3,038 000 cattle, 758, 501 goats, 466, 506 sheep, 711, 707 pigs, about 75, 938, 129 poultry (NALEIC, 2009). About 80% of cattle are owned by the traditional farmers and are of indigenous types and their crosses. Nearly all goats are of indigenous types and are owned by traditional small holder farmers. About 64% of the national sheep flock are of indigenous type owned by few rural households.

The village chicken is the most common species of poultry that is owned by nearly all rural house holds. The main management system used is described as the scavenging or free range system. This is a low-input-low-output system which usually uses indigenous breeds (Oldenbroek, 1998). The system is characterised by small flock sizes (normally less than 20), no specific poultry houses, no regular health programme for disease control and no formal marketing programmes. Farmers rely on the use of local knowledge with very little extension services (Kitalyi, 1998). In cases where housing is provided, the house is usually made of local materials such as wood, mud bricks and cane stems (Atumbi and Sonaiya, 1994). These houses are usually small and low with very small outlets (Kitalyi, 1998). The birds feed on insects, worms, seeds, vegetation and household refuse. The indigenous chickens on free range spend most of the time in search of food, hence, only surplus energy when available is used for production (growth and eggs). This contributes to their low production (Bray and Moffat, 1990).

2.3 Village chicken distribution in Zambia

According to Bwalya (1990), village chickens are widely distributed in the three agro-ecological regions of Zambia. In region I, chickens are commonly found throughout the valley areas and ownership extends to all house holds. Region II has a wide ownership but has incurred frequent losses due to epidemics such as Newcastle especially in the Southern, Central and Lusaka Provinces. In region III, poultry are the most widely spread livestock (Bwalya, 1990).

2.4 Management system of local chickens

There are three major management systems of rearing local chickens; the extensive, semi intensive and intensive systems (Pandey, 1993). The extensive system or free range system is a low-input-low-output system in which the chickens are allowed to scavenge with little or no supplementary feeding, health programme or housing (Wilson, 1986). Under the semi-

intensive management system, birds are provided with housing and supplementary feeds especially in the dry season when food is limited. A health programme is also implemented in this system (Sonaiya, 2004). The intensive system completely confines the birds to houses where they are provided with all nutritional and health requirements.

2.5 Feeding system of local chickens

Local chickens in Zambia are kept under the three management systems mentioned earlier. In the extensive or free range or backyard system farmers balance stock numbers according to the scavenging feed resources available in the environment in each season. Under this system feed supplies during the dry season are usually inadequate for production above flock-maintenance level.

The semi intensive system involves supplementing the chickens with feed while allowing some level of scavenging. This supplementation may contain a mixture of an energy and protein source (Pandey, 1993).

Under the intensive system, all the nutrients required by the birds are provided in the feed, usually in the form of a balanced feed purchased from a feed mill. As these are expensive and difficult to obtain, small holder farmers use either unconventional feedstuffs or "dilute" the commercial feed by supplementing it with grain by-products for energy and protein supply (Sonaiya, 1998). Feed provided to the chickens under this system is, therefore, of a much poorer quality due to the unbalanced dilution with crop by-products as compared to the extensive or fully intensive system (Sonaiya, 1998).

2.6 Health and disease management

The most common poultry diseases in Zambia are New Castle Disease (NCD), Infectious Bursal Disease (IBD) or Gumboro, Coccidiosis, mycoplasmosis, cholera, fowl typhoid and Mareks Disease (MD) (Adene 1996). Among these, NCD is the most significant disease, limiting village poultry production (Bray and Moffatt, 1990). NCD is caused by a virus (paramyxovirus of the group 1 serotype) (Clubb et al., 1997) and commonly occurs during the hot dry and humid seasons. It is transmitted by exposure to faecal matter, secretions from infected birds such as nasal discharge and through contaminated feed, water, equipment and clothing.

Vaccination programmes that are administered orally have been developed over the years to prevent NCD as there is no known cure for this contagious disease (Msoffe et al., 2006). It was also observed (Sharma et al., 1988) that only 10% of traditional Zambian farmers vaccinate their chickens against NCD and this may be a contributing factor to the low productivity associated with poultry rearing in rural areas.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Location of study

The study was conducted at the National Artificial Insemination Service Centre (NAIS) in Mazabuka, about 125 km from the capital, Lusaka. It is located in Region I of the Agro-ecological zones and is dominated by Tonga speaking people. The centre is also the national focal point for conservation of Farm Animal Genetic Resources (FAnGR).

3.2 Birds

A total of 56 indigenous chickens aged between 4 and 10 weeks (average weight, 600g) were used in the study. The birds were purchased from small holder farmers in the Magoye area within Mazabuka district. They were immediately transported to National Artificial Insemination Centre where the poultry house designated as the experimental unit was located. The poultry house was thoroughly cleaned and disinfected before the birds were brought in.

3.3 Experimental Design

A Completely Randomised Block Design (CRD) was used in the study involving three strains of chickens and four feeding levels of compounded feed. The chicken strains were Naked neck (NN), Zambi (ZZ) and Frizzle feathered (FF). Twenty chickens of each strain were randomly divided into replicates of 5, with each replicate allocated to one feeding level. With this design, the poultry house was subdivided into twelve 1.5 m x 1.5 m pens. Wooden poles and wire mesh were used in the subdivisions.

3.4 Feed and feeding

Based on the locally available feed resources and feeding practices among small holder farmers in Mazabuka, two types of feed were compounded. FEED 1 comprised a homogenous mixture of maize bran and number 3 meal in a 1:1 ratio. FEED 2 comprised a homogenous mixture of maize bran, number 3 meal and sunflower cake mixed in a 1:1:1 ratio. Salt was also added to both feeds. FEED 1 was taken as a control as this is what is practised by the majority of small holder farmers in the area. The nutrient composition of both feeds was determined by proximate analysis and is presented in Table 1.

Table 1: Nutrient composition of the feed

Nutrient	Feed 1	Feed 2
Energy(kcal/kg)	4015	4065
Crude protein (%)	13.18	14.01
Crude fibre (%)	8.98	9.58
Calcium (%)	0.63	0.67
Phosphorus (%)	0.48	0.54
Ash (%)	3.93	4.67

3.5 Health Management

The birds were vaccinated against Newcastle disease (NCD) on day 1 of the study. A commercial stress pack was administered weekly after every weighing activity to reduce stress levels. The poultry house was sprayed with virukill as a preventive measure against viruses, bacteria, fungi, mycoplasma, yeasts and algea. Oxytetracyline was given in fresh drinking water for three days. Piperazine (a dewormer) was also given in drinking water on days 14,15,16,17 and 18.

3.6 Data collection

Growth performance of the chickens was measured as the increase in body weight. Following a 14-day period of adaptation, the birds were weighed individually on day 1 of the experiment and every week thereafter for a period of five weeks. Mortalities were also recorded during the study.

3.7 Statistical analysis

The exploratory data analysis was carried out using windows excel (version 2010). Growth data were analysed by Genstat version 14.2 (2011) using linear models that included the fixed effects of strain (Naked neck, Frizzle feathered and Zambi), the feeding levels (ad libitum, 100g/d, 75g/d and 50g/d) and the interaction between the two fixed factors. The mean separation was by paired two-way analysis of variance with Duncans Multiple Range test to correct for unequal number of chickens between the strains. The differences between means were declared significantly different at $p=0.05$

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Weekly body weights

Results of the growth performance of chickens fed on the control diet (FEED 1) are presented in Table 2. There were no significant differences ($p > 0.05$) in weekly body weights between the three strains of indigenous chickens. These results are similar to the findings of Nsoso et al. (2011) who fed standard commercial broiler feeds to three strains of indigenous chickens under intensive management in Botswana. The authors found that there were no significant differences ($p>0.05$) in body weights between the chicken lines. In the present study, the compounded feed was not a commercial feed but only contained two major ingredients. This however, did not affect the chickens differently as similar body weights were also reported by Kadigi (1996) who fed commercial diets to Malawian chickens under intensive management conditions. It was also observed that there was a tendency for the Frizzle feathered to record higher body weights than the other chicken strains.

Tables 3, 4 and 5 show growth performance of chickens that were fed on FEED 2 at different nutritional levels of 100 g/d, 75 g/d and 50 g/d respectively. No significant differences ($p>0.05$) were found between strains of chickens fed at 100 g/d and 50 g/d. However, there were significant differences ($p=0.05$) in the weekly body weights between the different strains of chickens fed at the 75 g/d level (Table 4). It can be seen that apart from the weekly weights on d 28, there were significant differences between the strains on all other days. These results are in agreement with Hassen et al. (2006) who studied growth performance of indigenous chickens in Northwest Ethiopia. In that study, the authors reported that some indigenous chicken lines in Ethiopia are very well adapted and performed very well in their respective geographical locations. In the present study, the Zambi recorded significantly ($p=0.05$) higher body weight gain than the Naked neck and Frizzle feathered. This may be owed to the presence of major genes that are reported to have a pronounced effect on growth performance of indigenous chickens (Ibe, 1992). It has also been established that differences exist among the strains from a morphological point of view (Olawunmi, 2008).

Gondwe (1999) however, reported that Frizzle feathered and Naked necks are very well adapted to the tropical environment and perform better than the Zambi. This was a study on rural poultry biodiversity in Lilongwe, Malawi.

4.2 Average Daily Gain in weight

Table 7 shows the average daily gain in weight of the three strains of indigenous chickens that were fed at different nutritional levels of both FEED 1 (control) and FEED 2 diets. The results showed a tendency of the Frizzle feathered to have a higher daily gain in weight than the other strains. This means strain may have had an effect on daily body weight gain per bird. Between the strains, the Zambi had lower daily body weight gain than the frizzle feathered and the naked necks. These results are in agreement with Kgwatalala (2011) who studied the growth performance of Tswana chickens under intensive management conditions in Botswana. The author reported that the Frizzle feathered and Naked necks had a significantly ($p<0.05$) higher growth rate than the normal feathered chickens. In the present study, differences between the Frizzle feathered and the Naked neck were also notable whereas average daily gain in weight of the birds on the control diet were similar. These results were not consistent with those obtained by Gondwe (1999) and Mushota (2001) who studied the growth performance of Local chickens in Malawi and Chongwe district of Zambia respectively. They reported that Naked necks had significantly ($p<0.05$) higher daily weight gain than the frizzle feathered and normal feathered chickens. This may be owed to the nutritional composition of the commercial diets that were provided for the local chickens.

4.3 Feed Efficiency Ratio

Feed efficiency ratios of the three strains of indigenous chickens fed at different nutritional levels are presented in Table 8. The results showed that the Zambi recorded a higher feed efficiency compared to the other strains. This could be related to the genetic diversity that exists among the indigenous chickens (Ibe, 1992). The Zambi recorded feed efficiency ranging from 0.7 to 8.3 and this was higher than that of the frizzle feathered and the naked neck strains that recorded feed efficiencies ranging from 0.8 to 3.0 and 1.7 to 6.9 respectively. Feed conversion efficiency is a complex process and à highly aggregate trait which is the result of the interaction of behaviour, level of production, appetite and other factors (Hassen et al., 2006). Genotype has a significant effect on growth performance of indigenous chickens (Ibe, 1993). Zambi is genetically a result of crosses among several strains including the frizzle feathered and naked necks. Scientific evidence shows that cross

breeding the indigenous strains results in improved body weight and general performance of the birds (Safaloah et al., 2001). However, this was not the case as results obtained revealed a higher performance in the frizzle feathered and naked necks. This may be related to their genetic constitution. Ajayi (2010) also reported that the frizzle feathered and naked neck strains conferred better feed conversion, growth rate and feed efficiency than the normal feathered chickens.

4.4 Mortality

The mortality rate did not vary substantially between strains *viz.* from 40% (zambi) to 46 % (frizzle feathered) and naked neck recording 45% mortality. These results are in agreement with Brannang and Pearson (1990) for indigenous chickens kept under intensive management conditions in Ethiopia. They stated that it is possible that confinement of indigenous chickens results in high stress levels and associated high infection pressure from pathogens causing high morbidity and mortality. Based on post morterm examinations, the main cause of mortality was Infectious Bursal Disease (Gumboro).

4.5 The future for indigenous chickens in Zambia

The results from the study show that the frizzle feathered have a significantly higher growth response than the naked neck and zambi strains. Therefore, selection among the strains to produce may be based on this information in order to achieve the highest productivity in indigenous chicken rearing. However, multi-trait selection has to be taken into account when selecting these chickens for improvement programmes. This selection approach may be based on a selection index that involves gathering all the information available about the bird's breeding value combined into an index of merit (Falconer and Mackay, 1996). This will give farmers an option of either selecting for a single trait or more depending on their selection goals. Village breeding and selection programmes may offer an efficient system to improve performance of local chickens. However, this calls for record keeping for the farmers to conduct performance testing, which currently has scanty information available (Bruns and Wollny, 2000). Above all this, individual selection is the best selection method irrespective of family, as it takes into account all the additive genetic variation that is present in the population (Weiner, 1994).

Table 2: Mean weekly weights of three indigenous chickens fed ad libitum on the control [#] diet

Chicken Strain	Weekly weights (g)					
	d0	**d7**	**d14**	**d21**	**d28**	**d35**
Frizzle feathered	295.0	270.0	300.0	361.0	440.0	505.0
Naked neck	486.0	425.0	419.0	546.2	539.5	561.2
Zambi	515.0	470.0	424.0	616.7	771.7	790.0

[#] the diet contained a mixture of maize bran and number three meal in 1:1 ratio.

Table 3: Mean weekly weights of three strains of indigenous chickens fed at 100 g/d of experimental diet [#]

Chicken Strain	Weekly weights (g)					
	d0	**d7**	**d14**	**d21**	**d28**	**d35**
Frizzle feathered	551.7	510.0	541.0	640.0	753.3	786.7
Naked neck	712.0	674.0	638.3	698.3	763.3	815.0
Zambi	798.0	755.0	776.7	816.7	883.3	906.7

[#] the diet contained a mixture of maize bran, number three meal and sunflower cake in 1:1:1 ratio.

Table 5: Mean weekly weights of three indigenous chickens fed at 50 g/d of experimental diet [#]

Chicken Strain	Weekly weights (g)					
	d0	**d7**	**d14**	**d21**	**d28**	**d35**
Frizzle feathered	295.0	270.0	300.0	365.0	440.0	505.0
Naked neck	520.0	458.3	475.0	448.8	563.8	586.0
Zambi	555.0	502.5	508.8	616.7	771.7	790.0

[#] the diet contained a mixture of maize bran, number three meal and sunflower cake in 1:1:1 ratio.

Table 5: Mean weekly weights of three indigenous chickens fed at 50 g/d of experimental diet [#]

Chicken Strain	Weekly weights (g)					
	d0	**d7**	**d14**	**d21**	**d28**	**d35**
Frizzle feathered	295.0	270.0	300.0	365.0	440.0	505.0
Naked neck	520.0	458.3	475.0	448.8	563.8	586.0
Zambi	555.0	502.5	508.8	616.7	771.7	790.0

[#] the diet contained a mixture of maize bran, number three meal and sunflower cake in 1:1:1 ratio.

Table 6: Average Daily Gain (g/d) of three strains of indigenous chickens fed at different levels of compounded feed

	Level of feeding			
Chicken Strain	**Control (Ad libitum)**	**100 g/d**	**75 g/d**	**50 g/d**
Frizzle feathered	3.3	7.5	6.7	6.7
Naked neck	4.3	3.7	5.9	5.3
Zambi	2.1	5.8	0.5	1.8

Table 7: Feed Conversion Ratio (g feed/ g gain) of the three strains of indigenous chickens fed at different levels of compounded feed

Chicken Strain	Level of feeding			
	Control (Ad libitum)	**100 g/d**	**75 g/d**	**50 g/d**
Frizzle feathered	2.3	3.0	3.9	0.8
Naked neck	6.9	2.0	1.7	2.1
Zambi	8.3	4.3	0.7	2.7

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion and recommendations

With locally available feed resources under intensive management, the frizzle feathered and naked neck strains seemed to be the faster growers amongst the three strains identified. This could be a basis for improved productivity of indigenous chickens in Zambia. However, further studies on characterisation and performance evaluation of Zambian indigenous chicken strains under different management conditions are warranted. Care should be taken by government and NGO's developmental programs distributing exotic chicken breeds to farmers, to prevent uncontrolled crossbreeding and the consequent erosion of the valuable indigenous poultry genetic resources in Zambia.

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APPENDIX

Table 9: ANOVA table for control (ad libitum) feeding level

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Strain	2	126731.	63366.	2.30	0.181
Residual	6	165119.	27520.		
Total	8	291850.			

Table 10: ANOVA table for 100 g/d feeding level

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Strain	2	23606.	11803.	0.10	0.910
Residual	6	736833.	122806.		
Total	8	760439.			

Table 11: ANOVA table for 75 g/d feeding level

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Strain	2	444120.	222060.	4.71	0.059
Residual	6	282619.	47103.		
Total	8	726739.			

Table 12: ANOVA table for 50 g/d feeding level

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
strain	2	115370.	57685.	2.04	0.210
Residual	6	169369.	28228.		
Total	8	284739.			