African Journal of Biotechnology Vol. 10(64), pp. 14203-14208, 19 October, 2011
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB10.2529
ISSN 1684–5315 © 2011 Academic Journals

Full Length Research Paper

Effect of altering the starter and finisher dietary phases on growth performance of broilers

C. S. Gajana[1], T. T. Nkukwana[1], M. Chimonyo[2] and V. Muchenje[1]

[1]Department of Livestock and Pasture Science, University of Fort Hare, P. Bag X1314, Alice 5700, Republic of South Africa.

[2]Discipline of Animal and Poultry Science, University of Kwazulu Natal, P. Bag X01, Scottsville 3209, South Africa.

Accepted 22 February, 2011

The current study was conducted to determine the effect of altering a starter and finisher diets of a three-phase commercial feeding program on growth performance and feed conversion efficiency (FCE) of broilers in a small-scale production system. A total of 2400 unsexed day-old chicks of commercial strain (Cobb 500) were housed in an open-sided house and randomly allocated to the following three treatments. Body weight (BW) and feed intake (FI) were recorded weekly starting from weeks 3 to 5. The BW, FI and the FCE were computed for each week. At week 5, the broilers on T_2 were heavier (P<0.05) than T_1 and T_3 birds and T_1 birds were heavier (P<0.05) than T_3 birds. Treatment effects (P<0.05) were observed on FI and BW at some stage of growth, as well as on FCE at all the stages of growth. It was concluded that altering dietary starter phases promised optimum production in birds fed starter diets, 0 to 15 days with feed cost per kilogram being better compared to birds fed starter diets, 0 to 18 days and starter diets, 0 to 21days.

Key words: Feeding programmes, feed intake, body weight, feed conversion efficiency, profitability.

INTRODUCTION

Feed represents over 70% of the cost of producing chicken meat (Agah and Norollahi, 2008). It is therefore, important to use high quality feed that will increase the performance of the birds aimed at optimising feed efficiency and therefore performance of the broiler chicken and profit on the farm. Sophisticated computer feed formulation programs have made precision nutrition a realistic goal, whereby numerous parameters, including nutritive quality of feed and feed ingredients and economic factors can be assessed (Emmert and Baker, 1997). The size of the operation and local circumstances determine the optimum feeding programme. Due to genetic and management improvement, the time and feed required to produce a broiler is continually decreasing (Leeson and summers, 2000; Sahraei and Shariatmadari, 2007). Therefore, the starter period now represents a much higher proportion of the growing cycle, emphasising the importance of a good starter diet. It has a significant impact on the overall farm and processing performance (Epol Broiler Feeding Brochure, 2009). Thus, determining economic means of production is important and small improvements in existing production practices could lead to substantial savings when multiplied by the large volumes produced by poultry companies (Pope and Emmert, 2002).

Broilers are commonly fed starter, grower and finisher diets formulated to meet relatively stable nutrient requirement levels for specific feeding programs (Skinner et al., 1993). It therefore implies that birds of a particular age are fed various nutrient levels with only a minimum consideration of economics. The National Research Council (1994) provides a single set of recommendations that includes males and females, with dietary amino acid requirements segregated into three fixed periods: starter (0 to 3 weeks of age), grower (3 to 6 weeks of age) and finisher (6 to 8 weeks of age). However, the starter feed

*Corresponding author. E-mail: vmuchenje@ufh.ac.za. Tel: +27 40 602 2059. Fax: +27 86 628 2967.

Abbreviations: **T_1,** Birds fed on starter (0 to 18 days) and finisher (19 to 35 days); **T_2,** birds fed on starter (1 to 15 days) and finisher (16 to 35 days); **T_3,** birds fed on starter (1 to 21days) and finisher (22 to 35 days); BW, body weight; FI, feed intake; FCE, feed conversion efficiency.

Table 1. Feed specification of the three phase Epol diets that was fed to the chickens.

Feed type	Starter	Finisher
Protein (min) (%)	22.0	17.0 / 18.0
Lysine (min) (%)	1.2	0.9
Moisture (max) (%)	12.0	12.0
Fat (min) (%)	2.5	2.5
Fibre (max) (%)	5.0	7.0
Calcium (min) (%)	0.9 / 0.8	0.8
Calcium (max) (%)	1.2	1.2
Phosphorus (min) (%)	0.6 / 0.7	0.5
Energy (MJ ME)	12.0	12.3

is most expensive feed in the broiler feeding programme, hence, the focus of the study is on reducing starter feeding at the same time increasing farm efficiency. The cost of feed generally declines as the protein content is reduced, therefore, the optimum time at which diets are changed is of economic importance (Saleh et al., 1996). When faced with increases in feed ingredient prices and rising feed costs, the first instinct is often to look at ways of off-setting the financial impact of this upon the business by reducing the nutrient specification of the feed to reduce feed cost per tonne (Waller, 2007). On the other hand, managerial factors such as feed and water availability to the birds, environmental management, stocking density and disease control are critical to consider at this point (Ferket and Gernat, 2006).

Small scale farmers want to engage in efficient broiler enterprises, but they do not understand the importance of the feeding programs on the development and growth of broiler chickens, as well as its effects on broiler meat quality that stands to be scrutinized by consumers when their birds reach the market. At the same time, small scale farmers are focused on reducing the costs of producing broilers at the farm. Early nutrition may appear to play a significant role in poultry production and profitability (Hooshmand, 2006). It is apparent that providing the optimum nutrition in the early hours of production can have a substantial impact on final bird performance. However, the cost of production can also be affected by environmental factors such as bird genetics, health status of the flock and the environment the birds are subjected to over the life of the flock. All these factors can affect bird performance leading to negative effects on financial returns when birds reach the market. Hence, the study was carried out to determine the effects of altering the starter and finisher dietary phases on growth performance of broilers.

MATERIALS AND METHODS

Description of study site

The research project was conducted at the Fort Cox College farm in Middle drift. The college is situated 547 mm above the sea level and is also located 32.45° latitude and 27.02°longitudes. The area receives approximately about 507 mm of rainfall per annum mostly occurs in summer with the average temperature of 22.9˚C.

A total of 2400 unsexed day-old Cobb 500 broiler chicks were purchased from an Agricultural Co-operation located in Berlin, South Africa. On arrival the chicks were given a stress pack for three days. The chicks were vaccinated against coccidiosis on days 7 and 21, infectious bronchitis on day 10, Newcastle on day 30 and Gumboro (infectious bursal) on days 14 and 17. Vaccination was administered via drinking water. The chicks were placed on deep litter floor containing saw dust. Temperatures and humidity were recorded daily. Feed and fresh water were supplied *ad libitum* during the experiment. Lighting was made available 24 h to the chicks throughout the experiment. Feed was purchased from Epol in Berlin, South Africa; as crumbs (starter) and pellets (finisher). Table 1 represent the feed specification of the two phases Epol diets that was fed to the chickens purchased from Epol in Berlin, South Africa.

The experiment was a completely randomised design. All the chicks were managed in one house as one treatment for the first 15 days. On day 15, the chicks were randomly allocated to the following three treatments: Chicks were randomly assigned to one of three treatments, with 800 birds per treatment. Treatments consisted of a control (T1), the birds were given starter (0 to 18 days) and finisher (19 to 35 days); T2, the birds were given starter (1 to 15 days) and finisher (16 to 35 days); and T3, the birds were given starter (1 to 21days) and finisher (22 to 35 days). Each treatment was replicated four times with 200 birds per replicate. Bird weight recorded on placement was 45 g/bird. Light was offered throughout the study and chicks had free access to water. All the birds were housed in a low-cost housing unit, where ventilation, humidity and temperatures were not artificially controlled.

Data collection

The feed consumed by the birds in each treatment was estimated weekly. Body weights (BW) were recorded weekly starting from Weeks 3 to 5, by weighing each of the birds and recording the total weight for each treatment. Feed was supplied continuously by constantly topping up the empty troughs. Feed wastages were minimized by filling the troughs to about three quarter full. Feed intake (FI) was taken at the end of each week for each treatment by subtracting the amount of feed left from the known amount of feed supplied and dividing with the number of birds in each replicate to obtain the average feed intake per bird. Body weights were taken at the end of each week for each treatment and dividing with the number of birds in each treatment to obtain average body weight. Feed conversion efficiency was calculated by dividing BW by FI.

Statistical analysis

The effect of average feed intake, average body weight, feed conversion efficiency and feed cost per kilogram were analyzed using Generalized Linear Model procedures of SAS (2000). Significance differences between least square group means were compared using the PDIFF (SAS, 2000). All statements of significance are based on the 5% level of probability.

RESULTS

Body weights

No significant differences were detected in body weights

Table 2. Least square means and standard errors for feed intake (g/bird/day) of broilers in different weeks.

Treatments	Weeks		
	3	4	5
T1	40.7 ± 1.5^{a}	49.2 ± 1.5^{a}	56.4 ± 1.5^{a}
T2	48.2 ± 1.5^{c}	51.6 ± 1.5^{c}	60.9 ± 1.5^{c}
T3	45.8 ± 1.5^{b}	51.1 ± 1.5^{b}	60.2 ± 1.5^{b}
Significance	*	*	*

Means in the same columns with similar superscripts are not significantly different (P>0.05).

Table 3. Least square means and standard errors for body weight (g) of broilers in different weeks.

Treatments	Weeks		
	3	4	5
T1	834 ± 40.48^{a}	1256.6 ± 40.48^{b}	1845 ± 40.48^{b}
T2	836.3 ± 40.48^{a}	1273.3 ± 40.48^{c}	1901 ± 40.48^{c}
T3	812 ± 40.48^{a}	1199.9 ± 40.48^{a}	1719.7 ± 40.48^{a}
Significance	NS	*	*

Means in the same columns with similar superscripts are not significantly different (P>0.05).

of the birds on week 3 but on week 4 and week 5 of age, significant differences were observed in body weights (Table 3). At Week 3, there were no significant differences observed among all the treatments. At week 4, significant differences (P<0.05) were observed in body weights of birds in all the treatments. T_2 birds were heavier (P<0.05) than T_1 and T_3. T_1 birds were heavier (P<0.05) than T_3 whilst, T_3 birds were lighter (P<0.05) than T_1 and T_2. At week 5, significant differences (P<0.05) were also observed in body weights of birds in all the treatments. T_2 birds were heavier (P<0.05) than T_1 and T_3 birds but T_1 birds were heavier (P<0.05) than T_3 birds and T_3 birds were lighter (P<0.05) than T_1 and T_2 birds.

Feed intake

The effects of treatments on feed intake are shown in Table 2. Significant differences were detected on the feed intake of birds in the three weeks of experiment. At week 3, the feed intake of the T_1 birds were lower (P<0.05) than those of T_2 and T_3 birds with T_2 birds having the highest feed intake than all treatments. At week 4, significant differences (P<0.05) were observed in feed intakes of birds in all the treatments. T_2 birds had higher (P<0.05) feed intake than T_1 and T_3. T_3 birds had higher (P<0.05) feed intake than T_1 whilst T_1 birds had lower (P<0.05) feed intake than T_2 and T_3. At week 5, significant differences (P<0.05) were also observed in feed intakes of birds in all the treatments. T_2 birds having the highest (P<0.05) feed intake than T_1 and T_3 birds but T_1 birds had higher (P<0.05) feed intake than T_1 birds and T_1 birds had the lowest (P<0.05) feed intake than T_2 and T_3 birds.

Feed conversion efficiency

Table 4 shows the treatment effects on feed conversion efficiency of broilers. Significant differences were detected on the feed conversion efficiency of birds in the three weeks of experiment. At week 3, the feed efficiency of the T_1 birds were higher (P<0.05) than those of T_2 and T_3 birds with T_3 birds having the lowest feed conversion efficiency than all treatments. At week 4, significant differences (P<0.05) were observed in feed conversion efficiency of birds in all the treatments. T_1 birds had higher (P<0.05) feed conversion efficiency than T_2 and T_3. T_3 birds had lower (P<0.05) feed conversion efficiency than T_1 whilst T_3 birds had lower (P<0.05) feed conversion efficiency than T_1 and T_2. At week 5, significant differences (P<0.05) were also observed in feed intakes of birds in all the treatments. T_1 birds having the highest (P<0.05) feed conversion efficiency than T_2 and T_3 birds but T_1 birds had higher (P<0.05) feed conversion efficiency than T_2 birds and T_3 birds had the lowest (P<0.05) feed intake than T_1 and T_2 birds.

Table 4. Least square means and standard errors for feed conversion efficiency of broilers in different weeks.

Treatments	Weeks		
	3	4	5
T_1	1.7 ± 0.08[c]	2.2 ± 0.08[c]	2.8 ± 0.08[c]
T_2	1.4 ± 0.08[a]	2.1 ± 0.08[b]	2.7 ± 0.08[b]
T_3	1.5 ± 0.08[b]	2.0 ± 0.08[a]	2.4 ± 0.08[a]
Significance	*	*	*

Means in the same columns with similar superscripts are not significantly different (P>0.05).

Table 5. Least square means and standard errors for feed cost per kilograms (SAR/kg) in different weeks.

Treatments	Weeks		
	3	4	5
T1	4.96±0.14[b]	3.98±0.14[a]	3.49±0.14[a]
T2	4.15±0.14[a]	3.80±0.14[a]	3.22±0.14[a]
T3	4.37±0.14[a]	3.84±0.14[a]	3.26±0.14[a]
Significance	*	NS	NS

Means in the same columns with similar superscripts are not significantly different (P>0.05).

Farm and financial performance

Table 5 shows the least square means and standard errors for feed cost per kilograms between treatments in different weeks. At week 3, the feed cost per kilograms for T_1 birds were higher (P<0.05) than those of T_2 and T_3 birds with T_2 birds having the lowest feed cost per kilograms than all treatments. At weeks 4 and 5, no significant differences (P>0.05) were observed in feed cost per kilograms for birds in all the treatments. Even though there are no significant differences between the treatments in feed cost per kilograms, T_2 birds had lower (P>0.05) feed cost per kilogram than T_1 and T_3 birds with T_1 birds having the highest feed cost per kilograms.

DISCUSSION

As expected, feed consumption differed significantly during the whole experimental period. Feed consumption depends on the quality of feed, growth rate of chicks and management conditions. In a controlled feeding programme bird density, feeder space, nutrient density and environmental conditions are given special attention. The amount of time the birds are allowed to eat should increase with age, meaning that as the broiler grows, its nutrient requirements change. Similarly, with increasing age, the feed efficiency of the broiler will deteriorate and feed intake will increase (Epol Broiler Feeding Brochure, 2009). Saleh et al. (1997) argued that increasing the length of time the starter diet was fed, significantly increased total feed consumed and as finisher diets have a higher energy value than starter diet, this increase in feed consumption should be expected. However, the results of the present study showed significant effect on feed intake when feeding the starter diet to 15, 18 or 21 days of age. Higher feed intake was observed in birds fed starter diets from 0 to 15days than T_3 birds fed starter diets (0 to 21days) and T_1 birds fed starter diets (0 to 18 days). The difference feed intake between the birds shows that the birds fed starter diets from 0 to 15 days were able to fully compensate for the altering effect of 15 days starter by consuming more. These results agree with Kamran et al. (2008) that feed intake is linearly increased with reduced crude protein during grower, finisher and overall periods. The increased feed intake is probably due to greater energy requirements of the broiler birds to cope with the high growth rate which is achieved by high intake in low energy diets. Khetani et al. (2009) reported that when feed was only restricted in time, feed utilisation efficiency was not improved. The birds which were restricted of feed, would, therefore, consume more feed to compensate for the time they would have been deprived of feed. On the other hand, our results contradict with Saleh et al. (1997) who reported no significant difference in feed intake when feeding the starter diet to 7, 14, or 21 days of age. Also, the environment was not controlled, which meant that birds were partially exposed to fluctuating external conditions that have a direct impact on feed consumption and therefore growth rate. However, our results show that where the environments are not controlled, there could be some form of compensation in birds fed less starter and therefore, conditions where the environments are not controlled could suite the 15 days of starter. It is apparent that providing 15 days of starter in an uncontrolled environment have a positive impact on final bird performance.

Improved body weight was also observed in birds fed on starter diets (0 to 15 days) and finisher diets (16 to 35 days). These observations may be due to the differences on the time of feeding finisher diets. The present study showed significant improvements in the body weights as the time of feeding finisher diets was increased. Therefore, body weight was directly related to time of feeding finisher diet. These findings suggest that body weights of birds can be significantly influenced by the time of feeding finisher diets. Thus, the results of the present study showed that body weights of T_2 birds were higher ($P<0.05$) than those of T_1 and T_3 birds. However, these findings differ significantly to the findings by Saleh et al. (1997). They showed that body weight was inversely related to time of feeding finisher diet. This implies that as the time of feeding finisher diet was reduced, body weights significantly improved.

Feed conversion also improved significantly as the time of feeding the finisher diet was reduced, although, the overall feed consumption was not affected. Improved FCE was observed in birds fed on control birds (0 to 18 days) and finisher diets (19 to 35 days) but changing time of feeding starter for (0 to 15 days) and finisher (16 to 35 days) resulted in improvements in feed intake and body weights of the birds. The present study shows that feed efficiency will be significantly affected by energy content of the diet. Our results show that FCE were similar in birds fed starter 15 days and 21days. However, FCE in birds is can be significantly affected by the amounts of the dietary protein or energy (Nawaz et al., 2006). On the other hand, the feed efficiency of the broiler will deteriorate with an increase in feed intake and age of the bird (Epol Broiler Feeding Brochure, 2009). Improvements in FCE with increasing the energy levels for broilers have been reported by (Leeson et al., 1996; Nawaz et al., 2006).

Since feed represents over 70% of the cost of producing chicken meat (Agah and Norollahi, 2008), our study focused more on costs of production when the starter and finisher dietary phases are altered. The findings of the present study showed that feed cost per bird will be reduced if starter 15 days is maintained. Furthermore, this will be accompanied by an increment in farm performance. In addition, if the starter dietary phases are reduced (T_2), farm performance in terms of body weights will be increased resulting to better profit. However, if starter dietary phases are maintained at starter 18 days, feed cost per kilogram (per bird) will be increased. On the other hand, it was observed in T_3 that if the starter dietary phases are increased beyond the standard (starter 18 days), feed cost per kilograms (per bird) will be also increased. The results of the present study suggest that it is important for smallholder broiler producers to appreciate the effect on margin when looking to minimise feed cost. Furthermore, when starter dietary phases are reduced, feed intake increases leading to increased feed cost (per bird). However, the maximum margin is clearly not produced by minimising feed cost, but is achieved at the point where the difference between revenue and cost is greatest (Waller, 2007). According to Cevger and Yalin (2003), Modern broiler enterprises are characterised by mass production with a high turnover of capital, but low profit margin per bird. Therefore, success in business is mainly determined by the abilities of entrepreneurs to control production costs. Also, small holder broiler producers need to appreciate that all modern broilers are responsive to amino acid and energy density and that margin over feed cost must be considered when determining an appropriate feeding strategy (Waller, 2007).

Conclusion

The present study demonstrated that the altering dietary starter phases promised optimum production in birds fed starter diets, 0 to 15 days with feed cost per kilogram being better compared to birds fed starter diets, 0 to 18 days and starter diets, 0 to 21 days. The findings imply that reducing starter dietary phase will increase feed intake leading to better feed cost per kilogram (per bird) and growth performance. In addition, the maximum margin is clearly not produced by minimising feed cost, but is achieved at the point where the difference between revenue and cost is greatest. There is, however, a need to determine the effect of this treatment on the meat quality of broilers.

ACKNOWLEDGEMENTS

The authors are grateful to Fort Cox College Farm where the broilers that were used in the current study were raised. The project was sponsored by Govan Mbeki Research and Development Centre of the University of Fort Hare.

REFERENCES

Agah MJ, Norollahi H (2008). Effect of Feed Form and Duration Time in Growing Period on Broilers Performance. Int. J. Poult. Sci. 7(11): 1074-1077.

Cevger Y, Yalin C (2003). A Quantitative Model to Determine Factors Affecting Profits of Broiler Enterprises. Turk. J. Vet. Anim. Sci. 27: 1201-1205.

Emmert JL, Baker DH (1997). Use of the ideal protein concept for precision formulation of amino acid levels in broiler diets. J. Appl. Poult Sci. 6: 462–470.

Epol Broiler Feeding Brochure (2009). WEBSITE: www.epol.co.za; E-MAIL: info@epol.co.za
Ferket PR, Gernat AG (2006). Factors That Affect Feed Intake of Meat Birds: A Review. Int. J. Poult. Sci. 5(10): 905-911.
Hooshmand M (2006). Effect of Early Feeding Programs on Broiler Performance. Int. J. Poult. Sci. 5(12): 1140-1143.
Kamran Z, Sarwar M, Nisa M, Nadeem MA, Mahmood S, Babar ME, Ahmed S (2008). Effect of Low-Protein Diets Having Constant Energy-to-Protein Ratio on Performance and Carcass Characteristics of Broiler Chickens from One to Thirty-Five Days of Age. Poult. Sci. 87: 468–474.
Khetani TL, Nkukwana TT, Chimonyo M, Muchenje V (2009). Effect of quantitative feed restriction on broiler performance. Trop. Anim. Health Prod. 41:379–384
Leeson S, Caston L, Summers JD (1996). Broiler response to energy or energy and protein dilution in the finisher diet. Poult. Sci. 75: 522-528.
Leeson S, Summers JD (2000). Industial development, genetics and breeding programs. Broiler breeder production. University books, Guelph, Ontario, Canada. pp. 1-2.
National Research Council. (1994). Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press, Washington, DC.
Nawaz H, Mushtaq T, Yaqoob M (2006). Effect of varying levels of energy and protein on live performance and carcass characteristics of broiler chicks. J. Poult. Sci. 43: 388-393.
Pope T, Emmert JL (2002). Impact of Phase-Feeding on the Growth Performance of Broilers Subjected to High Environmental Temperatures. Poult. Sci. 81: 504–511.
Sahraei M, Shariatmadari F (2007). Effect of Different Levels of Diet Dilution During Finisher Period on Broiler Chickens Performance and Carcass Characteristics. Int. J. Poult. Sci. 6 (4): 280-282.
Saleh EA, Watkins SE, Waldroup PW (1996). Effect of changing time of feeding starter, grower and finisher diets on broiler performance. 1. Birds grown to 1 kg. J. Appl. Res. 5: 269 – 275.
Saleh EA, Watkins SE, Waldroup PW (1997). Changing time of feeding starter, grower and finisher diets of broilers 2. Birds grown to 2.2 kg. J. Appl. Res. 6: 64 – 73.
Skinner JT, Cabel MC, Waldroui AL, Waldrou PM (1993). Effects of Abrust amd multiple changes in dietary nutrient density on performance of broilers. J. Appl. Poult. Res. 2: 33-39.
Statistical Analysis Systems (2000). SAS User's Guide: Statistics (Version 6 Ed.). SAS Institute Inc., Cary, NC. USA.
Waller A (2007). Economic Approach to Broiler Production. Tech notes. Aviagen Ltd.