

Full Length Research Paper

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

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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 T₂ were heavier ($P < 0.05$) than T₁ and T₃ birds and T₁ birds were heavier ($P < 0.05$) than T₃ 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 21 days.

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

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Abbreviations: T₁, Birds fed on starter (0 to 18 days) and finisher (19 to 35 days); T₂, birds fed on starter (1 to 15 days) and finisher (16 to 35 days); T₃, birds fed on starter (1 to 21 days) 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 21 days) 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. T₂ birds were heavier ($P<0.05$) than T₁ and T₃. T₁ birds were heavier ($P<0.05$) than T₃ whilst, T₃ birds were lighter ($P<0.05$) than T₁ and T₂. At week 5, significant differences ($P<0.05$) were also observed in body weights of birds in all the treatments. T₂ birds were heavier ($P<0.05$) than T₁ and T₃ birds but T₁ birds were heavier ($P<0.05$) than T₃ birds and T₃ birds were lighter ($P<0.05$) than T₁ and T₂ 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 T₁ birds were lower ($P<0.05$) than those of T₂ and T₃ birds with T₂ 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. T₂ birds had higher ($P<0.05$) feed intake than T₁ and T₃. T₃ birds had higher ($P<0.05$) feed intake than T₁ whilst T₁ birds had lower ($P<0.05$) feed intake than T₂ and T₃. At week 5,

significant differences ($P<0.05$) were also observed in feed intakes of birds in all the treatments. T₂ birds having the highest ($P<0.05$) feed intake than T₁ and T₃ birds but T₁ birds had higher ($P<0.05$) feed intake than T₁ birds and T₁ birds had the lowest ($P<0.05$) feed intake than T₂ and T₃ 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 T₁ birds were higher ($P<0.05$) than those of T₂ and T₃ birds with T₃ 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. T₁ birds had higher ($P<0.05$) feed conversion efficiency than T₂ and T₃. T₃ birds had lower ($P<0.05$) feed conversion efficiency than T₁ whilst T₃ birds had lower ($P<0.05$) feed conversion efficiency than T₁ and T₂. At week 5, significant differences ($P<0.05$) were also observed in feed intakes of birds in all the treatments. T₁ birds having the highest ($P<0.05$) feed conversion efficiency than T₂ and T₃ birds but T₁ birds had higher ($P<0.05$) feed conversion efficiency than T₂ birds and T₃ birds had the lowest ($P<0.05$) feed intake than T₁ and T₂ 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
T ₁	4.96±0.14 ^b	3.98±0.14 ^a	3.49±0.14 ^a
T ₂	4.15±0.14 ^a	3.80±0.14 ^a	3.22±0.14 ^a
T ₃	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 T₁ birds were higher ($P<0.05$) than those of T₂ and T₃ birds with T₂ 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, T₂ birds had lower ($P>0.05$) feed cost per kilogram than T₁ and T₃ birds with T₁ 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 15 days than T₃ birds fed starter diets (0 to 21 days) and T₁ 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 21 days. 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.

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