The Response Of Broilers And Cost Implications When Starter, Grower And Finisher Diets Feeding Durations Are Varied For Broilers Grown To 49 Days

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Abstract

A study was conducted to evaluate the response of broilers to changes in the duration of feeding starter, grower and finisher diets when grown to 49 days. A total of 2560 day-old commercial broiler chicks of mixed sex (straight run) were assigned to 32 pens and sixteen (16) treatments were randomly assigned resulting in a completely randomized design. Diets were formulated to meet nutrient levels typical of the current local industry. Diets were changed from starter (222g CP/kg, 12.77 MJ ME/kg) at 10, 15, 20, 25, or 28 days to grower (202 g CP/kg, 12.76 MJ ME/kg) and from grower to finisher (198g CP/kg, 12.77 MJ ME/kg) at 36, 41, 43, 46 days of age or not at all. Broilers grown to 49 days attained the desired weight of 2400g on all feeding programs evaluated. Feed consumption responses over time were quadratic for the durations of feeding starter diet (R^2=99.9%), grower diet (R^2=87.5%) and finisher diet (R^2=99.2%). Similarly responses of live body weight gain were quadratic for the durations of feeding starter diet (R^2=99.9%), grower diet (R^2=96.1%) and finisher diet (R^2=99.2%). Feed conversion and calorie conversion showed significant ($p<0.001$) linear trends for the duration of feeding starter diet (R^2=91.08 and 93.6%) and finisher diet (R^2=81.2 and 81.1%), respectively but not the grower diet (R^2=1.4%). Abdominal fat (AF) as a percentage of body weight at slaughter showed a quadratic (R^2=87.3%) response to the duration of feeding starter diet, peaking at 20 days and then declined. AF showed an inverse linear response (R^2=78.4%) as a function of duration of finisher diet. The cost of starter, grower, and finisher diets showed significant differences ($p<0.001$) between treatments. However, total feed cost per bird was not significantly ($p>0.506$) affected by the different treatments. Margin over feed cost (MOFC), marginal physical product (MPP), and the value of the marginal product (VMP) were not significantly affected ($p>0.325$) by treatments. However, it was noted that utilising a program consisting of starter 1-20d and grower 21-49 days as an alternative to the current industry program can improve the industry MOFC by approximately 10%.

Key Words: *Changing broiler diets, performance response, marginal cost analysis*

INTRODUCTION

The local broiler industry in Trinidad is based on intensive husbandry in which genetically improved strains are fed specific diets based on the physiological age of the bird. Studies in some tropical region (Farran *et. al.*, 2000) have shown that these improved strains grow very rapidly, resulting in reduced time to market. Generally, ration composition strategy adopted would involve reduction in the protein content of the diet while the energy content may be increased as the bird's age increases. This approach results in reduced feed cost, as protein tends to be the most expensive component of feeds, and could also lead to rapid turnover rate. However, broiler chickens are grown to different weights to provide a variety of products to consumers and as a result optimum time of changing rations may therefore vary depending on the desired products required (Saleh *et al.*, 1996; Saleh *et al.*, 1997ab). In Trinidad, one product in high demand by the poultry industry is a bird weighing approximately 2.4kg, and is marketed primarily as whole bird, and to a lesser extent cut-up parts and de-boned breast. Under the local conditions, depending on feeding regimes birds can attain such body weights at approximately 49 days.

The National Research Council (1994) nutrient recommendation for broiler chickens are based on feeding a starter diet for 21 days, followed by a grower diet fed to 42 days of age. However, in Trinidad and Tobago, broiler producers typically feed starter diets for 28 days. From work conducted by Saleh *et al.* (1997a) it was apparent that for birds grown to a target weight of approximately 2.2kg, feeding starter diet for no more than 14 days or approximately 10-12% of the total feed consumed was sufficient to maximize live performance and carcass characteristics, based on utilization of diets formulated to meet industrial standards. In addition some previous studies on broilers considered changes between two diets starter and grower (Waldroup *et al.*, 1992; Watkins *et. A.l,* 1993) or starter and finisher (Diambra and McCartney, 1985; Proudfoot and Hulan, 1980) all conducted under temperate conditions. Some of these reports also suggested that there could be economic benefits in modifying the durations of feeding starter, grower and finisher diets. Thus, based on the utilization of diets formulated to meet current industrial standard in Trinidad and Tobago a study was conducted to examine the response of broilers and cost implications using marginal cost concept when birds are grown to 49 days.

MATERIALS AND METHODS

Bird Management

A total of 2,560 commercial day old broiler chicks were housed in three adjacent conventional, open-sided and naturally ventilated poultry houses having concrete flooring. Each house was compartmentalized into 3m x 4m pens with a capacity of 80 birds where each bird had an average space of $0.15m^2$ and access to a mixture of sugarcane bagasse and rice hull in a deep litter system. Four chick drinkers and feeders per pen were utilized in the first two weeks. Subsequently, each pen was allotted two tube feeders and one bell type automatic/font drinker. All birds were weighed prior to being placed in each pen and also at the termination of a feeding phase. In addition, total feed consumption per pen was measured for each feeding phase and mortality was checked and noted daily, and birds that died were weighed then recorded for use in feed conversion adjustment. Calorific conversion was determined by multiplying the amounts of starter, grower and finisher diets consumed by their respective calorific density, and dividing the resultant sum by the sum of the weight of live and dead birds.

Day-old chicks were vaccinated against Newcastle-Bronchitis, Marex, and Fowl Pox at the hatchery. At ten days of age, the chicks were vaccinated for infectious Bursal disease applied through the drinking water that was allowed to stand for 72 hours.

Feeding and Experimental treatments

Birds were fed typical commercial diets (starter, grower, finisher) used by contract farmers in Trinidad and Tobago made available by a local feed miller. The composition of the diets fed is given in Table 1. All diets were fed *ad libitum.* There were sixteen dietary treatments consisting of various combinations of durations of feeding the starter, grower and finisher diets as summarized in Table 2. Treatments were assigned to pens randomly where each treatment had two replicates. No blocking was undertaken, as differences between pens are known to be negligible leading to the adoption of Completely Randomise Design.

Carcass Evaluation

The trial was terminated at 49 days and subsequently five (5) birds per replicate were randomly selected for carcass evaluation. Prior to selection, the birds in the pens were all subjected to a 12-hour feed withdrawal with access only to water up to two hours before slaughter. The selected individual bird was allotted an identification code based on dietary treatment and live body weight of each bird was recorded. The birds were then processed manually at the University's slaughter facility. Warm dressed carcass, abdominal fat, liver, kidney and heart weights were all taken and recorded for each individual bird. After processing and chilling, the labeled carcasses were individually packaged, frozen and transported to the animal science laboratory of the Department of Food Production. Carcasses were stored at –23 ^{0}C until they were evaluated. Thawed carcasses were drained, weighed and cut into wing, thigh, drumstick, breast and back with neck and ribs attached where each portion was weighed and recorded.

Chemical Analyses

All feed samples were analyzed according to the official methods of the Association of Official Analytical Chemists (AOAC, 1991).

Statistical Analysis

The data were subjected to analysis of variance and regression analyses using Minitab Statistical Package Release 12 (Minitab, 1998). Mortality data was transformed to arcsine for analysis.

RESULTS AND DISCUSSIONS

Broiler Performance

The performance of broilers grown to 49 days is summarized in Table 2. Final live body weight (FLBW) was not significantly affected ($p>0.66$) by the various feeding regimes. All treatments reached or exceeded the target body weight (BW) of 2400g at 49 days, ranging from 2439.7 to 2675.4 g. Varying the durations of feeding the various diets had no significant ($p>0.46$) effect on total feed intake. The results agreed with those of Lallo (2000), Waldroup et al. (1992) and Proudfoot and Hulan (1980). No significant difference between the treatments was observed for feed conversion ($p>0.240$) or calorific conversion ($p>0.74$) during the entire period where the values ranged from 1.94 to 3.06 g/g BW and 25.6 to 27.6 ME MJ/kg BW, respectively. These findings agree with results reported in other studies where starter, grower, and finisher durations varied in the same feeding program (Waldroup *et al.*, 1992; Saleh *et al.*, 1997a). Eviscerated carcass yield for treatment 6 where finisher was introduced at 36 days was significantly ($p<0.05$) lower than treatments 5, 12, 13 and 15, where finisher was introduced at 45 days or not at all. Regardless of the starter feeding time birds introduced to finisher at 36 days had an overall mean (±SEM) eviscerated carcass yield of 596.7 (±4.7) g/kg BW compared to 634.7 (±3.2) g/kg BW for those introduced at 45 days. Abdominal fat showed significant differences ($p<0.036$) between treatments ranging from 18.9 to 29.9 g/kg BW. Mortality was not significantly different between treatments ($p>0.86$).

Broiler Response to Duration of Feeding Starter, Grower and Finisher Diets

Total Feed Intake

Response of feed intake to durations of feeding starter, grower and finisher diets was examined using regression analysis.

Regression Analysis of Feed Intake in Various Phases:

Starter Phase:

(1) $Is = -55.80 + 17.44S + 1.83S^2$ ($p<0.001$, $R^2 = 99.9\%$)
where Is = the amount of starter diet consumed (g); and S = duration of the starter feeding phase in days.

Grower Phase:

(2) $Ig = 71.51 + 145.14G - 0.45G^2$ ($p<0.001$, $R^2 = 87.3\%$);
where Ig = the amount of grower diet consumed (g); and G = duration of the grower feeding phase in days.

Finisher Phase:

(3) $IF = -7.58 + 137.26F + 2.66F^2$ ($p<0.001$, $R^2 = 99.9\%$)
where IF = the amount of finisher diet consumed (g); and F = duration of the finisher feeding phase in days.

In all instances a quadratic or second-degree polynomial curve was obtained. During the starter and finisher feeding phases, feed intake increased at an increasing rate as feeding duration increased. In contrast during the grower-feeding phase intake increased at a decreasing rate.

Feed intake diminishes at high ambient temperatures and this reduction in feed intake in response to high temperatures is a regulatory mechanism to limit the increase in body temperature (Etches *et al.*, 1995). On the other hand both the inclusion and increment of dietary fat in the feed improved intake in hot weather conditions (Dale and Fuller, 1979). It has also been reported that, the inclusion of fat in diets increases net energy (Pesti and Smith, 1984), with a comparatively lower heat increment (Dale and Fuller, 1979). In this trial, the level of fat in the grower diet was 39g/kg DM compared to 49 and 52g/kg DM for starter and finisher diets, respectively.

Feed and Calorie Conversion

Feed and calorie conversions improved with increasing time on both starter and finisher diets (Figures 1). However, during the grower phase these trends were not observed for feed ($r = 0.06$) and calorie ($r = 0.11$) conversion. Feed conversion is a complex measure reflecting the influence of both environmental and genetic factors and the interaction between these and the physiological changes during the growth of the birds. This may also be described in terms of energetic relationships associating growth to feed intake, heat generation, and rate of tissue production. Thus, one reason for the increase in the requirement of feed for older birds is the increased need for energy (calories) to maintain heavier bodyweights. During the early stages of life the gastro-intestinal tract of the young bird is not fully developed and its digestive capability is a limiting factor in food intake and growth (Nitsan *et al.*, 1991), and could account for the response observed in the starter phase.

During the finisher phase both feed and calorie conversion improved with increasing duration on finisher diet. Stage of growth is an important consideration relative to feed conversion. Chambers and Lin (1988) indicated that 85 to 90% of the variation in feed efficiency and feed consumption among broiler chickens was due to age, and bodyweight differences. Thus, birds kept for longer duration on finisher were placed at a lighter weight and at an earlier age resulting in the observed pattern of response. Body fat deposition also influences differences in feed conversion. These current trends observed were also supported by the trends observed for abdominal fat (Figure 2).

Response of Live Body Weight Gain in Various Phases

The response of live body weight gained during each of the three phases was adequately described by significant ($p<0.001$) regression equations:

Starter Phase:

(4) $Ys = 36.52 - 2.41S + 1.55S^2$ ($n = 16$, $R^2 = 99.9\%$)
Where Ys = live body weight gained (g) during the starter phase, S = duration of feeding starter diet in days.

Grower Phase:

(5) $Yg = -88.61 + 81.63G - 0.47G^2$ ($n = 16$, $R^2 = 96.1\%$)
Where Yg = live body weight gained (g) during the grower phase; G = duration of feeding grower diet in days.

Finisher Phase:

(6) $YF = -5.57 + 43.07F + 1.83F^2$ ($n = 16$, $R^2 = 99.2\%$)

Where YF = live body weight gained (g) during the finisher phase; F = finisher diet feeding duration in days.

In all instances a second order polynomial curve was obtained. The second-order polynomial curve is in keeping with reports in the literature (Pesti and Rogers, 1997). The estimated rate of weight gain during the starter phase was -2.41+3.1S. The corresponding rate during the finisher phase was 43.05+3.66F, which indicates that by the time the trial was terminated weight gains during the finisher phase was increasing at increasing rates. However, during the grower feeding phase live bodyweight gain was increasing at a diminishing rate of 81.63-0.94G mirroring the feed intake response during the same phase. This response may be indicative of the need for greater inclusion of fat calorie in the grower diet, since only 11.0 % of calorie was supplied from fat (Dale and Fuller, 1979).

Live Body Weight Response to Starter, Grower and Finisher Diet Intake

The effect of total intake of starter, grower and finisher diets on live bodyweight gain during each phase was explored using regression models. A simple linear regression model adequately described live weight gain (Ys) as a function of starter diet consumed (Is) during the starter phase.

Starter Phase:

(7) $Ys = -39.08 + 0.64Is$ ($n = 16$, $R^2 = 99.6\%$)

The gradient was significantly ($p<0.001$) greater than zero and live weight increased at a rate of 0.64 g for every gram of starter diet consumed.

Grower Phase:

(8) $Yg = 498 + 0.39Ig - 0.22Is$ ($n = 16$, $R^2 = 97.8\%$)

Where Yg = the live body weight gained during the grower phase, and Ig = the amount of grower diet consumed in grams. Is= the amount of starter diet intake during the starter phase.

Finisher Phase:

(9) $YF = -102 + 0.02Ig + 0.40IF$ ($n = 16$, $R^2 = 99.5\%$)

Where YF = the live body weight gained (g) during the finisher phase; IF = the amount of finisher diet consumed (g); and Ig = the amount of grower diet consumed during the grower phase (g).

In all phases a linear response was observed. During the grower phase the relationship included a residual effect of the starter diet intake. The effect was negative, where for every gram of starter diet consumed, weight gain decreased by 0.22 grams when the grower diet intake was kept constant. Similarly during the finisher phase the model included the residual effect of the grower diet. However, in this case the effect was positive, where for every gram of grower diet consumed in the grower phase, weight gain increased by 0.02g during the finisher phase when finisher diet intake was kept constant.

In the present model, performance has been considered to be a function of feed intake (starter, grower and finisher diets).

Implicit in this is the intake of energy and protein over time as it relates to the dietary concentration. Environmental temperature is also known to affect feed intake as noted earlier (and therefore protein and energy intake) and as a result the quantity of assimilated metabolizable energy that is stored in the body. House temperature during this present study was cyclical (diurnal). According to Seigel and Drury (1970) a significant reduction in growth was observed when temperatures were cycled within amplitudes of 11.1 ºC. and 16.7 ºC per 12-hour period, when compared to non-cycling (constant) or a narrow (±5.5 ºC) temperature. In the current study the amplitude was 10.5 ºC. Dietary fat content of the grower diet as suggested earlier may not have been enough to support better weight gain under the cyclic temperature regime experienced during the grower-feeding phase (Dale and Fuller, 1980).

Further, Pesti and Fletcher (1983) observed that birds fed 175g CP /kg diet during the grower phase (21 to 42 days) were more efficient during the finisher phase (42-49 days) than those fed 220g CP /kg during the grower phase. The residual effect observed in the finisher phase in this study tends to confirm this suggestion. More over, the significant residual terms observed during the grower and finisher phases lend credence to the suggestion made by Pesti *et al.* (1986) that, the technical relationship between broiler performance and nutrient intake will probably be dependent on nutrient concentrations previously fed.

Eviscerated Carcass Yield Response to Duration of Feeding Starter, Grower, and Finisher Diets

The highly significant model ($p<0.001$) equation (10) characterised the relationship between eviscerated carcass weight and starter, grower, and finisher diets feeding durations.

(10) $Ew = -4.4S+1.31S^2+41.1G+31.6F$
($n=16$, $R^2=97.7\%$)

Where Ew=the eviscerated carcass weight in grams; S=the duration of starter feeding in days; G=the duration of the grower feeding in days ; and F=the duration of finisher feeding in days.

Every day on grower diet resulted in the highest eviscerated weight gain of 41.1g/d for fixed days on starter and finisher diets. The eviscerated weight gain of $-4.4 + 2.62S$ g/d was obtained for starter feeding duration when grower and finisher diets feeding durations are fixed. This is not surprising since a large share of early growth goes in the rapid development of supply organs (e.g. heart, lungs, kidney, liver and digestive tract) at the expense of the development of demand organs (e.g. muscles, and feather) (Lilja, 1983).

Eviscerated Carcass Yield Response to Starter, Grower and Finisher Diet Intake

One unit of starter diet intake yielded the highest eviscerated carcass weight as shown in the highly significant ($p<0.001$) equation:

(11) $Ew = 0.363Is + 0.317Ig + 0.230IF$ ($n = 16$, $R^2 = 97.3\%$)
where Is = the amount of starter diet consumed (g); and Ig =the amount of grower diet consumed during the grower phase (g), and IF = the amount of finisher diet consumed (g).

The relationship indicates that every gram of starter consumed resulted in 0.363g eviscerated carcass weight gained for fixed levels of grower and finisher consumed. Similarly, the corresponding value for grower and finisher were 0.317 and 0.230g, respectively. These results would confirm that of Holsheimer and Ruesenk (1993) that eviscerated carcass yield was highly influenced by the starter diet phase. Growth pattern observed for eviscerated carcass weight was in keeping with expected growth pattern for broiler chicken (Tzeng and Becker, 1981).

Abdominal Fat Response to Duration and Intake of starter, Grower and Finisher Diets

The opportunity to market Abdominal fat (AF) is drastically reduced when broilers are processed for the further processed market. Thus, the reduction of AF is of importance to the broiler processing industry. Consumers are also more health conscious and are consuming less fat in their diet. Therefore, it is important to understand how any change in feeding and nutrition will impact on AF in broilers.

The response of abdominal fat to the duration of feeding starter, grower and finisher diets to broilers grown to 49 days is graphically depicted in Figure 3. The AF response to starter-feeding duration showed a curvilinear response (R^2=87.3%) that peaked at 20 days and then declined. Abdominal fat also showed an inverse linear relationship to finisher feeding duration (R^2=78.4%). These results are in agreement with other reports (Tzeng and Becker, 1981; Bilgili *et al.*, 1992). Tzeng and Becker (1981) observed that after AF peak at 19 days and the percentage gain tended towards zero by 70 days of age.

The relationship between abdominal fat and the intake of starter, grower and finisher diet was explored. A highly significant ($p<0.001$) second order polynomial function was obtained and is represented in the following equation:

(12) $AF_w = 0.0141Is + 0.0114Ig + 0.0240IF - 0.000007IF^2$ ($n = 16$, R^2=98.1%)
where AF_w = fat pad weight; Is = starter diet intake (g); Ig = grower diet intake (g); and IF = finisher diet intake (g).

Approximately 98.1% of the total variation is accounted for by equation (12). The equation showed that abdominal fat deposition is increasing but at a diminishing rate for finisher diet consumed when starter and grower diets are kept constant. These results indicates that starter feeding durations less than 21 days could be more beneficial to reducing AF in the carcass.

Marginal Analysis and Financial Implications

The principle of such economic theories as the law of diminishing returns, total physical product (TPP), average physical product (APP), marginal physical product (MPP), and the value of marginal product (VMP) are not new, but have been rarely employed by workers in nutrition and production. Unlike the normal TPP curve generally illustrated in economic literature for a crop commodity (Penson *et al.*, 1986), the broiler production function curve shows that broiler body weight increases at a decreasing rate with respect to feed intake at all points (Pesti and Miller, 1997). Consequently, the theory of marginal physical product MPP is of key interest. For a given crop commodity, within stage I both TPP and APP are increasing, and MPP is greater than APP (Penson *et al.*, 1986). However, unlike crop-based commodities there is no stage 1 to be found on the production curve obtained when body weight is plotted against feed intake. From such a production function curve, MPP is at most equal or less than APP. The factor influencing the nature of this curve is the fact that as the bird grows, it becomes progressively less efficient in feed utilisation as increasing nutrients are required for maintenance. Using only the physical information, it is not possible to determine which input level in stage II will actually maximise profit. More information, specifically price information is needed (Kay and Edwards, 1994). Comparing the dollar value of an added unit of feed to the VMP curve determines the point of maximum economic efficiency. Producers should be willing to continue investing in feed intake as long as the added value of broiler produced (VMP) is greater than the added cost of feed or marginal feed cost (MFC) required for production. For profit efficiency, the bird should be slaughtered within stage II and should not be allowed to enter stage III where the MPP is negative (Kay and Edwards, 1994).

Marginal Physical Product (MPP, g gained/g feed intake) defines feed conversion. Multiplying MPP by the price of broiler gives the value of the Marginal Products (VMP). Thus, VMP represents the added dollar value for broilers expected from each additional unit of feed intake for the feed program used. Margin over feed cost (MOFC), marginal physical product (MPP), and the value of the marginal product (VMP) were not significantly affected ($p>0.325$) by treatments Table 3.

However, three treatments were identified based on the performance data and MOFC T6 /program-1 (starter 1-15d, grower 16-35d and finisher 36-49d), T9 /program-2 (starter 1-15d and grower 16-49d), and T13 /program-3 (starter 1-20d, and grower 21-49d). Basic economic logic of feeding dictates that producers should be willing to continue investing in feed intake as long as the added value of broiler produced is greater than added cost of feed required for production (Figure 3). VMP of TT$2.03 for the current feeding program utilised by the local industry suggested that the MOFC was about to be maximised and birds should be slaughtered. This also suggests that integrators and farmers need to keep tight schedules for harvesting birds at the end of 49 days growing period.

Results (Table 3) would suggest that program-3 was the most promising giving a 9.8% improvement for MOFC over the current industry program. Thus, indicating that starter diet can be fed to broilers up to 20 days rather than 28 days. The starter diet consumed for programs-1, 2 and 3 represented 11.2, 11.5 and 19.5% of total feed consumed, respectively compared to 35.2% for the current program used by the local industry. Further, a typical contracted farmer rearing 20,000 birds per batch would stand to generate an additional TT $8000 using programs-3, compared to TT $4200, TT $3200 for programs 1, and 2, respectively.

CONCLUSIONS

The conclusions are as follows:

1. In humid tropical environment, starter diet feeding can be reduced from 28 days to between 15 to 20 days with out impacting negatively on the final live body weight.
2. Starter feeding duration less than 20 days would be more beneficial to lowering AF in broilers grown to 49 days.
3. Diets with different nutrient profile and pricing may alter responses observed.
4. The industry need to examine feeding programs for different products produced.

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Table 1: Composition and Nutrient Content of Diets

Ingredients (g/kg DM)	Starter	Grower	Finisher
Ground Yellow Corn	538.4	574.7	690.4
Soyabean Meal (470g CP/kg)	324.0	282.7	263.0
Rice Bran	60.6	70.0	0
Soyabean Oil (Spray)	20.0	4.0	0
Soyabean Oil	11.7	25.0	9.3
Limestone	8.7	8.3	7.3
Dicalcium Phosphate	15.1	14.4	14.7
DL Methionine (980g/kg)	1.5	1.4	1.7
Lysine Hcl (980 g/kg)	0	0	0.9
Broiler Premix – 9943	10.0	10.0	9.0
Salt Nacl	4.3	4.3	3.7
Luprosil salt	1.2	1.2	0
Furazolidone 20	0.5	0	0
Salinomycin	1.0	1.0	0
Bentonite	3.0	3.0	0
Total	**1000**	**1000**	**1000**
Calculated Analysis (g/kg)	**Starter**	**Grower**	**Finisher**
[1]Dry Matter	885.0	888.0	882.0
ME MJ/kg	12.77	12.76	12.77
[1]Crude Protein	222.0	202.0	198.0
[1]Crude Fat	43.0	39.0	52.0
[1]Crude Fiber	34.0	25.0	34.0
Calcium	8.5	8.0	7.5
Available P	0.43	4.5	3.9
Sodium	0.17	1.7	1.5
Arginine	1.37	12.5	11.9
Lysine	1.12	10.2	10.1
Methionine	4.8	4.6	4.8
TSAA	8.3	7.9	7.9

Table 2: Live performances, Carcass yield and Abdominal Fat (AF) of straight run broilers grown to 49 days of age on various feeding regimes

Treatment	Time of Feeding Diets: Starter	Grower	Finisher	Body Weight	Feed Consumed	Feed Conversion	Calorie Conversion	Carcass Yield	AF
	Days			g	g	g/g BW	MJ/kg BW	g/kg BW	g/kg BW
1	0-28	29-42	43-49	2617.2	5321.7	2.28	25.9	618.8	23 6
2	0-10	11-35	36-49	2603.4	5345.5	2.06	26.2	607.7	19.2
3	0-10	11-40	41-49	2573.0	5280.0	2.12	26.3	602.2	24.6
4	0-10	11-45	46-49	2642.2	5326.5	2.34	25.9	618.0	25.7
5	0-10	11-49	0	2529.5	5352.5	1.95	27.1	628.1	21.8
6	0-15	16-35	36-49	2675.4	5355.6	2.00	25.6	585.6	18.9
7	0-15	16-40	41-49	2611.2	5322.1	2.09	26.0	592.7	25.5
8	0-15	16-45	46-49	2439.7	5250.4	3.06	27.6	603.8	26.4
9	0-15	16-49	0	2642.0	5316.5	1.93	25.7	597.1	25.0
10	0-20	21-35	36-49	2566.3	5362.2	2.09	26.7	593.2	22.7
11	0-20	21-40	41-49	2536.4	5317.4	2.22	26.8	609.1	28.2
12	0-20	21-45	46-49	2622.1	5266.3	2.19	25.6	642.0	29.9
13	0-20	21-49	0	2648.2	5348.8	1.94	25.9	637.8	20.9
14	0-25	26-35	36-49	2629.7	5397.5	2.10	26.2	600.1	21.0
15	0-25	26-45	46-49	2555.2	5300.6	2.29	26.5	630.9	26.0
16	0-25	26-49	0	2638.4	5410.1	1.98	26.2	590.8	25.2
±SEM				70.2	42.3	0.23	0.7	10.7	2.3
Probability				p>0.66	p>0.46	p>0.24	p>0.74	P<0.001	P<0.036

Table 3: Feed cost, MOFC, MPP and VMP for straight run broilers grown to 49 days

DURATION OF FEEDING DIETS: Treatment	Starter	Grower	Finisher	Total Feed Cost	Cost/kg of Feed	MOFC	MPP	VMP
	Days			TT$	TT$	TT$		TT$
1*	1-28	29-42	42-49	10.36	1.95	4.07	0.369	2.03
2	1-10	11-35	36-49	10.33	1.93	4.02	0.396	2.18
3	1-10	11-40	41-49	10.26	1.94	3.92	0.419	2.31
4	1-10	11-45	46-49	10.33	1.94	4.13	0.396	2.19
5	1-10	11-49	0	10.39	1.94	3.56	0.466	2.57
6	1-15	16-35	36-49	10.36	1.94	4.38	0.437	2.41
7	1-15	16-40	41-49	10.32	1.94	4.08	0.428	2.36
8	1-15	16-45	46-49	10.19	1.94	3.25	0.321	1.77
9	1-15	16-49	0	10.33	1.94	4.23	0.488	2.69
10	1-20	21-35	36-49	10.39	1.94	3.76	0.391	2.15
11	1-20	21-40	41-49	10.32	1.94	3.66	0.373	2.06
12	1-20	21-45	46-49	10.24	1.94	4.21	0.450	2.48
13	1-20	21-49	0	10.41	1.95	4.47	0.486	2.68
14	1-25	26-35	36-49	10.47	1.94	4.02	0.409	2.26
15	1-25	26-45	46-49	10.35	1.95	3.76	0.419	2.31
16	1-25	26-49	0	10.54	1.95	4.00	0.420	2.39
SEM				0.121	0.00177	0.519	0.056	0.306
P-value				p<0.506	p<0.001	p>0.727	p>0.325	p>0.325

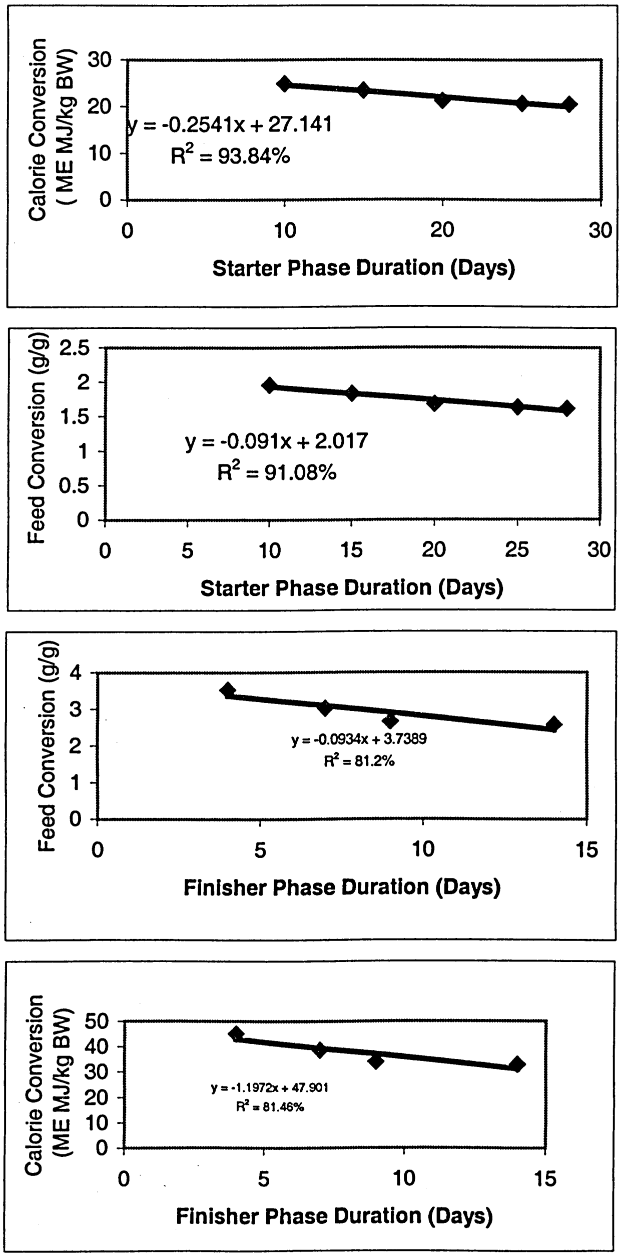

Figure 1: The Response of Feed and Calorie Conversion in Broiler to the Duration of feeding Starter and Finisher diets

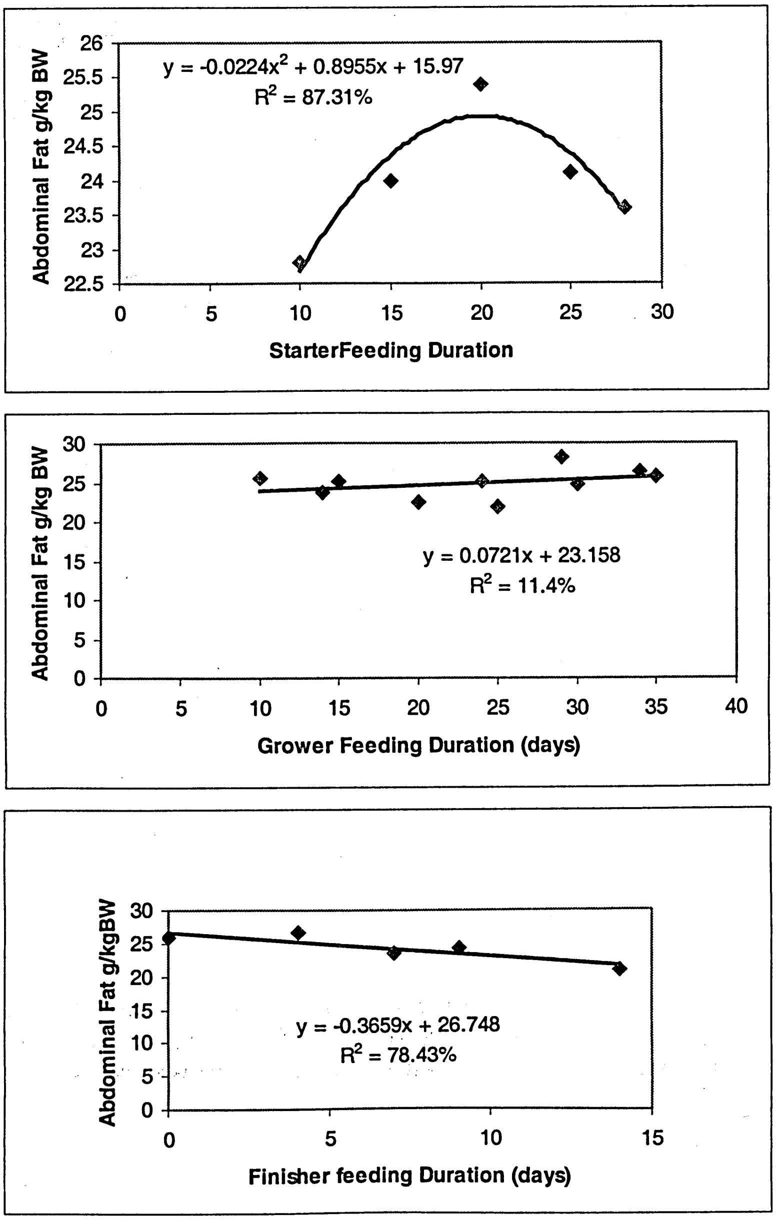

Figure 2. The Response of Abdominal Fat as g/kg Body Weight (BW) in Broilers to the Duration of Feeding Starter, Grower and Finisher diets.

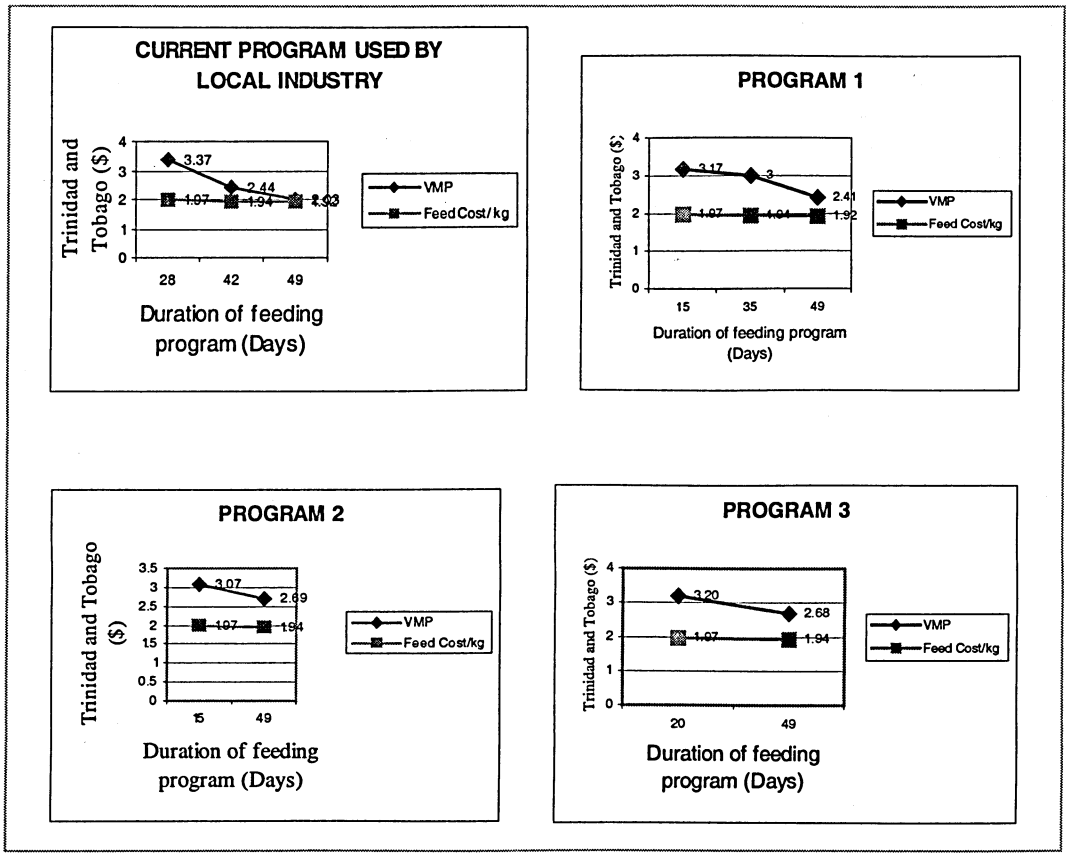

Figure 3: The relationship between the value of the marginal product (VMP) and cost per kilogram of feed for broilers grown to 49 days on experimental programs – 1, 2, 3 and the current program used by the local industry