EFFECT OF FEEDING REGIMES ON GROWTH AND CARCASS CHARACTERISTICS OF GROWER-FINISHER PIGS

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ABSTRACT

Forty-two (42) Large White grower pigs with an average liveweight of 28.6±0.01 kg were allocated to three dietary treatments with 14 pigs per treatment in a completely randomised design. Each treatment was replicated 14 times with a pig per replicate. The study was conducted to establish appropriate restricted-fed scale on the growth performance and carcass characteristics of grower-finishers pigs. The three treatments received a standard diet (CP 15.87%) fed at different levels designated as GF5 (diet offered at a quantity equivalent to 5% of liveweight), GF6 (diet offered at a quantity equivalent to 6% of liveweight) and GF7 (diet offered at a quantity equivalent to 7% of liveweight). Feeding levels were directly proportional to the growth parameters studied. Treatment had significant (p<0.05) effect on final body weight, daily weight gain, daily feed intake, feed conversion ratio and economy of gain. Pigs fed the GF7 levels had the highest values for total weight gain, daily weight, total and daily feed intake, followed by pigs fed GF6 and then GF5 and they attained market weight earlier than the rest. The carcass measurements evaluated were found to be similar for all dietary treatments (p>0.05) except for loin eye area and the back-fat thickness which increased as the feeding level increased. Pigs can be fed up to 7% of their body weight without any adverse effect on growth performance and carcass characteristics although back fat thickness may be compromised.

Keywords: *Carcass traits, final body weight, feed intake, restricted feeding*

INTRODUCTION

Feed represents between 60 and 70% of the total cost of pork production in modern capital-intensive systems. Within feed, energy alone may represent 50% or more of the total cost (Gutierrez, 2012). The pig production industry in Ghana is demanding updated information on nutrition in order to define more economical feeding programmes while at the same time ensuring the best possible products for the consumer (Asiedu *et al*., 2014). Feeding strategy is the most actively used management tool for controlling quality in meat production, animal performance, and eating (Andersen *et al*., 2005). The efficiency of lean pork production can be improved by using pig growth models to evaluate genetic, nutritional and management alternatives (De Lange *et al*., 2006). The meat industry requires pigs to be as lean as possible since pork with low-fat content reduces human caloric intake and intramuscular fat is related to lower sensory quality traits (Affentranger *et al*., 1996). Pigs are usually restricted-fed in order to control the quality of the pork, as the pig has the tendency of eating more feed than it can put to good use leading to a fatty carcass (Schiavon *et al*., 2015). Constant feed variations may lead to reduced feed costs and improved intramuscular and subcutaneous fat deposition (Candek-Potokar *et al*., 2012).

It is well established that feed restriction when imposed at the right stage of growth of the pig, tends to increase the proportion of lean cuts in relation to fat (Malgwi *et al*., 2022). Most reports have dealt primarily with physical factors such as growth rate, feed efficiency, back fat thickness, loin eye area, percent lean cuts and carcass length. Information regarding feeding levels and possible impact on pig liveweight gain and carcass quality in Ghana is barely available (Galassi *et al.*, 2015). It is essential that pigs being restricted-fed on Agro-Industrial by-products (AIBP) based diets are adequately fed as on cereal-based diets. (Rhule, 2015) This study was to determine an appropriate restricted-fed scale or regime for growth performance and carcass characteristics of grower-finishers pigs.

MATERIALS AND METHODS

Study location

The study was carried out at the Piggery Section of the Council for Scientific and Industrial Research - Animal Research Institute (CSIR-ARI), Katamanso, Accra. The location of the farm is in the coastal savannah zone and situated at the Adentan Metropolitan Assembly area of the Greater Accra Region of Ghana. The monthly temperature varies between 26 and 29°C. The highest mean monthly temperature of 29°C occurs during March and April while the lowest of 26°C is in August. The zone has a bimodal rainfall pattern with the major rainy season occurring between April and July while the minor season occurs between September and October. A short dry period separates the two periods in August. The major dry season lasts from November to February. The average relative humidity for the year is about 65% (mid-afternoon) and 95% (nighttime) while wind speed usually ranges between 8 and 16 km/h (Wallace *et al*., 2012).

Experimental animals

Forty-two (42) crossbred Large White grower, entire male pigs at an average live weight of 28.6±0.01 kg were selected from the herd at Katamanso piggery section of the CSIR-Animal Research Institute for the feeding trial.

Experimental design and dietary treatments

The Forty-two (42) pigs were randomly allocated to the 3 dietary treatments in a completely randomized design (CRD) experiment. Each treatment was replicated 14 times, with a pig per replicate. The pigs were individually housed in concrete floor pens. The 3 dietary treatments were designated as GF5 (Grower-finisher diet fed at a quantity equivalent to 5% of live-weight), GF6 (Grower-finisher diet fed at a quantity equivalent to 6% of liveweight) and GF7 (Grower-finisher diet fed at a quantity equivalent to 7% of liveweight) (Table 1). The diet was formulated to have recommended CP level (NRC, 1998).

Table 1: Composition of the grower-finisher ration (%)

Ingredient	Diet
Maize bran	30
Wheat bran	30
Soybean meal	5
Fish meal	2
Palm kernel cake	31.25
Oyster shell	1
Salt	0.50
Premix*	0.25
Total	100.00
Determined composition (%)	
Moisture	10.99
Ash	10.15
Crude protein	15.87
Crude fibre	10.54
Ether Extract	7.60
Calcium	0.68
Phosphorus	0.59
Metabolizable energy (MJ/kg)	12.53

**Vitamin and TMP (Trace Mineral Premix): Inclusion rate is 25 kg/tonne to supply the following per tonne of feed: Vit. A, 2,000,000 IU; Vit. E, 15000 mg; Vit.B1, 1500 mg; Niacin 30,000 mg; Vit.B6, 1500 mg; Vit.D3, 4500,000 mg; Vit. K3, 3,000 mg; Pantothenic acid,12000 mg; Vit.B12, 10,000 mg; Vit. B2,6000 mg; Folic acid, 800 mg, Iron, 60,000 mg; Copper 75,00 mg; Iodine, 750 mg; Manganese, 130,000 mg; zinc, 70,000 mg; Selenium, 300mg. calcium,17.50%, Lysine,1,330 mg; Methionine, 1,075 mg; B-Corotenic acid, 350 mg.*

Housing and management of experimental animals

The pigs (one per replicate) were housed in well-ventilated concrete-floored pens measuring (4 x 3.5 m^2). Kepromec (Ivermectin), a broad-spectrum anthelminthic, was administered by injection for the control of both internal and external parasites. Each pen had both nipple drinkers and concrete water troughs as well as molded galvanized plates as their feeding troughs. The walls and floors of the pens, feed and water troughs were thoroughly cleaned and disinfected (with Quincide) prior to the start of the study. The pigs were ear tagged for easy identification. The pigs were restricted-fed daily a ration equivalent to 5, 6 and 7% of the individual live weight and water was provided *ad libitum*. The pigs were individually weighed weekly and the feed offered was adjusted. A pig was slaughtered on attaining a liveweight of 80±5 kg.

Parameters Measured

Feed Intake

Feed offered weekly and weekly leftover feed was measured using a Camry Scale. The difference between the feed offered and the leftover was considered to be the amount of feed consumed by the pigs. The average daily feed intake by pigs was also computed for as the ratio of the total feed consumed weekly to the number of days (7).

Live Weight Changes and Weight Gains

Pigs were weighed individually before the start of the experiment and subsequently on weekly basis using a Gascoigne Precision Scale. Total weight gain was calculated by subtracting the final weight of a pig from its initial weight whilst the daily weight gain was calculated by dividing the weight gained by a pig by the number of days it spent on the experiment.

Feed Conversion Ratio (FCR)

The efficiency of gain was calculated as the ratio of total feed consumed to the total weightgained by each pig.

Feed Cost and Economy of Gain

The cost of feed was calculated using the prevailing prices of the feed ingredients on the open market. Feed cost per kg weight gain was calculated by multiplying the cost of a kg of feed by the FCR.

Slaughtering of pigs

Pigs were slaughtered on attaining an individual target or market live weight of 80±5 kg after the weekly weighing, for the carcass quality evaluation. Seven (7) out of the 14 grower-finisher pigs were randomly selected from each dietary treatment and weighed on a Gascoigne weighing scale. Before slaughter, the pigs were fasted overnight (24 hours) but had access to water and they were slaughtered at the Meat Processing Center of the Council for Scientific and Industrial Research-Animal Research Institute (CSIR-ARI).

Indices for measuring carcass traits were taken on the left side of the slaughtered finisher pigs and this was based on Pork Carcass Evaluation and Procedures by Rey (2006).

Statistical analysis

All data collected were subjected to the general analysis of variance technique using Genstat Discovery Edition (2016) and Tukey's test was used to determine differences between means. Differences were considered significant at $p<0.05$.

RESULTS

The response of pigs to the quantity of feed offered is shown in Table 2. There was no significant ($p>0.05$) difference in the initial body weights of pigs fed at different levels. The final body weight, total weight gain and its corresponding daily weight gain were significantly different ($p<0.05$) on GF5, GF6 and GF7. Pigs on GF7 recorded the highest weight followed by those fed GF6 and GF5.

The mean total feed intake values and their resultant mean daily feed intake followed a similar pattern as the weight gain. There were significant ($p<0.05$) differences across the three dietary treatments studied. The feed conversion ratio values were similar ($p>0.05$) on GF6 and GF7 but significantly different ($p<0.05$) compared to GF5. The pigs fed GF6 and GF7 diets had significantly ($p<0.05$) better economy of gain than those fed GF5. Pigs on GF7 had the least number of days (97 days) to slaughter compared to GF6 (104 days) and GF5 (120 days).

Carcass characteristics

The indices considered for the pig carcass evaluation were found to be similar for all the dietary treatments ($p>0.05$), except for the loin eye area and backfat thickness (Table 3), indicating that pigs can tolerate up to GF 7% dietary inclusion of their body weight. However, back-fat thickness and loin eye area increased as the feeding levels increased ($p<0.05$).

Table 2: Growth performance of grower finisher pigs fed different feeding regime

Parameters	GF 5%	GF 6%	GF 7%	SEM
Initial weight, kg	28.35	28.93	28.43	0.18
Final weight, kg	75.67^{c}	78.84^{b}	80.71^{a}	1.45
Total weight gain, kg	47.32^{c}	49.91^{b}	52.28^{a}	1.42
Daily weight gain, kg/day	0.39^{c}	0.48^{b}	0.54^{a}	0.04
Total feed intake, kg	184.66^{c}	191.16^{b}	199.45^{a}	4.28
Daily feed intake, kg/day	1.54^{c}	1.84^{b}	2.06^{a}	0.15
FCR	3.90^{b}	3.83^{a}	3.82^{a}	0.03
Feed cost per kg (GHS)	0.50	0.50	0.50	-
Economy of gain (GHS)	1.95^{b}	1.92^{a}	1.91^{a}	0.01
No. of days to slaughter	120^{c}	104^{b}	97^{a}	3.61

SEM– Standard Error of Mean; GHS – Ghana cedis; FCR – Feed Conversion Ratio
^{abc}*Means in the same row with different superscripts differ significantly ($p<0.05$)*

Table 3: Some mean carcass characteristics of grower-finisher pigs fed restricted feed

Parameters	GF 5%	GF 6%	GF 7%	SEM
Warm dressed weight, kg	51.80	51.70	57.00	2.13
Chilled dressed weight, kg	50.83	50.10	55.70	1.73
Carcass length, cm	79.70	79.00	80.00	2.19
Loin eye area, cm^2	26.73^{a}	28.47^{b}	32.49^{c}	0.24
Full GIT, kg	11.23	11.07	11.67	0.88
Empty GIT, kg	2.60	3.00	2.95	0.29
Empty stomach, kg	0.73	0.72	0.83	0.05
Trotters, kg	1.05	1.18	1.10	0.06
Liver, kg	1.37	1.27	1.28	0.10
Shoulder, kg	3.79	3.82	4.18	0.26
Rip back, kg	2.98	2.50	2.65	0.25
Rip streak, kg	2.13	2.27	1.92	0.09
Heart, g	233.00	236.00	234.00	20.6
Kidney, g	185.00	212.70	184.80	17.08
P2 measurement, cm	0.77	0.93	1.10	0.26
Back fat thickness, cm	1.27^{a}	1.57^{ab}	1.79^{b}	0.01

SEM – Standard Error of Mean
^{abc}*Means in the same row with different superscripts differ significantly ($p < 0.05$)*

DISCUSSION

Average daily gain, feed intake, body weight change and feed conversion ratios (FCR)

Energy and protein are the critical dietary constituents that support maintenance, as well as tissue accretion, and knowledge of energy metabolism and growth is essential to the understanding of feed efficiency (Gutierrez and Patience, 2012). The daily weight gain observed here was generally similar to those of Asiedu *et al*. (2014) who fed restricted levels of Gliricidia leaf meal-based diet (0, 2.5, 5 and 7.5%) to pigs in the tropics and observed significant ($p<0.05$) differences in the average daily gain and final weight measurements. The feeding level of protein:energy ratio can be used to manipulate the growth rate or composition of weight gain. Restricted feed allowance strongly reduces growth rate and carcass fatness and also intramuscular fat (IMF) level, resulting in decreased meat tenderness or juiciness (Lebret, 2008). The level of animal response to this feeding strategy depends on the onset, duration and intensity of the feed restriction, and the onset and duration of realimentation (Campbell *et al*., 1985). When restriction occurs during early growth (28-90 days), a full compensatory response can be observed at slaughter at 140 days (Therkildsen *et al*., 2004).

Pigs with high feed intakes reach the peak earlier in life, and daily nitrogen retention is therefore constant over a wide range of live weights thereafter (Tullis, 1982). Similar observations have been reported in male turkeys where the growth rate was accelerated to a plateau early in life, and this rate did not further increase but held at a relatively constant daily gain until reaching 70% of the matured body weight (Whittemore and Kyriazakis, 2006). Lean growth increases linearly with feed supply but reaches a plateau at the maximum lean growth potential of the animal. This trend is similar to results obtained by (Kim *et al*., 2014), but at variance with results by (Boddicker *et al*., 2011) who also observed an 8% increase in grower-finisher body weight when the feed allowance was reduced by 15%.

It was observed that increasing levels of the feed to the experimental pigs resulted in decreasing number of days to slaughter and this is in agreement with Rhule *et al*. (2006). Amoah (2010) on the other hand, also recorded 115 days when grower-finisher pigs were fed a cereal-based diet supplemented with RE3 probiotic additive (over initial live weight range of 10.38 kg to a final body weight of 70±0.3 kg). The number of days to slaughter obtained on GF 5% in this study could be considered low compared to other studies by Rhule *et al*. (2006) who observed that pigs fed cassava-based diets took an average of 131 days to attain the live weight of 70 kg. However, the number of days observed in the present study was comparable to those reported for grower-finisher pigs slaughtered at 70±3 kg body weight fed corn cob-based diet (Ziema, 2017).

The FCR values of all the diets could be considered similar to the recommendations of Rhule *et al*. (2006), Okai *et al*. (2008) and low than Asiedu *et al*. (2014). The FCR obtained when pigs were fed GF 5% was higher than values obtained in other studies (Asiedu *et al*., 2014; Rhule, 2015). Pigs on the GF 7% were the most efficient users of feed to weight gain as compared to GF 6% and GF 5%. The amount of feed required for tissue maintenance and the biological need of the pigs increases over time. It is common knowledge that pigs take more feed for more efficient growth and increased intramuscular fat as it continued to age. Feeds of high energy density tend to promote the synthesis of body fat which is inefficient in terms of feed conversion (Okai *et al*., 2008).

Feed cost and economics of gain (EG)

Lower feed costs were obtained for all the dietary treatments (Table 2). This might be attributed to the low feed cost per kg of the diet as well as the better feed conversion ratio of the pigs on the diet compared to GF 5%. The results may suggest that the feeding regime imparted positively on the growth rate of the pigs.

Carcass characteristics

Restricted feed allowance strongly reduces carcass fatness and also intramuscular fat (IMF) levels, resulting in decreased meat tenderness or juiciness (Lebret, 2008). Garcia-Valverde *et al*. (2008) reported that pigs on a high level of nutrition deposited both lean and fat at a faster rate than those fed a moderate level of nutrition. Amoah (2010) had earlier made a similar observation. This again suggests that pigs fed the GF

7% used much of their feed energy for fat deposition. In a similar studies, Maselyne *et al.* (2015) found that pigs that consumed larger amounts of feed and at faster rates of eating exhibited greater growth rates, thicker carcass backfat depths and lower lean percentages. In the current study, the feeding rate had a strong influence on fat measurement.

CONCLUSION

The study has indicated that grower-finisher pig diets can be fed up to GF 7% of their body weight without any adverse effects on growth performance and carcass characteristics. Pigs get to market weight earliest when fed 7% of their body weight but one has to be conscious about the fat deposition which were compromised.

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