Online Journal of Animal and Feed Research

Volume 2, Issue 3: 218-223 (2012) *ISSN 2228-7701*

A COMPARATIVE STUDY OF LOCAL GHANAIAN MAIZE, IMPORTED YELLOW MAIZE AND TWO NEW QUALITY PROTEIN MAIZE (QPM) VARIETIES – ETUBI AND GOLDEN JUBILEE – EFFECTS ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF PIGS

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ABSTRACT: *The experiment was conducted to determine growth performance and carcass characteristics of growing-finishing pigs fed diets containing four different varieties of maize. Twenty individually- housed, Large White pigs (12 males and 8 females) with an average initial body weight of 13.3 kg were allotted to four dietary treatments labelled, Local Normal (LN), Imported Normal Yellow (INY), Golden Jubilee (GJ) and Etubi (ET) in a Completely Randomized Design (CRD). Each treatment was replicated five times, with a pig representing a replicate. Feed and water were offered ad-libitum and growth performance was monitored over the trial period (13-70kg liveweight). There were no significant effects of diets on ADFI and FCE but ADWG and feed cost per kg gain were influenced by the diets. The values were 0.64, 0.61, 0.56 and 0.60 kg and GH¢1.74, GH¢1.90, GH¢1.76 and GH¢1.75 for the LN, INY GJ and ET treatments respectively. The values for LN, GJ and ET were statistically similar (P>0.05). Values for carcass length, dressing percentage, shoulder, loin, belly, thigh, and bac kfat thickness were not statistically different (P>0.05) between the four dietary treatments. However, there were significant differences (P<0.05) in the values for heart, liver, spleen, full gastrointestinal tract (GIT) and the respiratory tract. The results indicated that using GJM and ETM varieties could be more economical and could lead to the production of leaner pork carcasses.*

ORIGINAL ARTICLE

Key words: *Growth Performance, Carcass Characteristics, Golden Jubilee Maize, Etubi Maize, Pigs*

INTRODUCTION

Maize is an indispensable cereal grain in the diets of monogastric animals and forms about 50-60% of such diets (Osei et al., 1999 and Okai and Boateng, 2007). Its use is the result of a combination of desirable nutritional characteristics. It is high in energy, low in fibre, palatable and easily digested (NRC, 1988). The normal maize varieties used in Ghana and elsewhere have two major limitations, namely, low protein (9-10%) and deficiency of some essential amino acids particularly lysine (0.23%) and tryptophan (0.06%) which do not meet the nutrient requirement of monogastric (Beeson et al., 1996). Maize-based diets are often supplemented with soyabean and fish meals to meet the requirements of the monogastric animal. Soybean meal and fish meal may be limited in supply in Ghana and the bulk of these are imported thus making fish meal and soybean meal very expensive at certain times of the year.

The quest of scientists for finding conventional ways of improving existing maize varieties with a better balance of essential amino acids led to the discovery of Opaque-2 and floury-2 and later, the development of QPM varieties. These varieties have nutritional superiority over the normal maize varieties (NRC, 1988) and elsewhere they have been evaluated with rats (Mertz et al., 1964, Nelson et al., 1965; Bressani et al., 1968; Maner et al., 1971, Maffia et al., 1976 and Serna-Saldivar et al., 1991). In growth trials, Sproule et al. (1988) and Sullivan et al., (1989) reported that QPM has a higher nutritive value than normal maize when fed in low protein diets containing the same level of supplemental protein. In Ghana, similar studies were carried on Obatanpa (an open pollinated QPM variety) upon its release. For example, Osei et al. (1999) reported that pigs on the QPM diets grew 2.36 times faster than those on the normal maize. Two new QPM varieties have recently been developed by the Crop Research Institute of Ghana based in Kumasi, namely; Golden Jubilee maize (GJ) and Etubi maize (ET). The Golden Jubilee is a yellow, dented and open-pollinated QPM variety with potential yields of 5 tons/ha and matures in 105 to 110 days whiles "Etubi" on the other hand, is a white flint and dented QPM hybrid with potential yield of 6.5 tons/ha and

To cite this paper: Salifu, A-R.S., Okai, D.B., Boateng, M. and Ewool, M.B. 2012. A comparative study of local Ghanaian maize, imported yellow maize and two new quality protein maize (QPM) varieties – Etubi and Golden Jubilee – Effects on growth performance and carcass characteristics of pigs. *Online J. Anim. Feed Res.*, 2 (3): 218-223.
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having the same months of maturity. In spite of these encouraging yield figures and positive agronomic attributes as well as the perceived nutritional value, there is a dearth of information on the responses of pigs to these new varieties. Therefore, this study therefore seeks to compare the effects of Local normal maize, imported normal yellow, GJM and ETM- based diets on growth performance and carcass characteristics of pigs.

MATERIALS AND METHODS

Study Area and Duration of Experiment

The study was conducted at the Livestock Section of the Department of Animal Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana and the feeding trial lasted for 17 weeks.

Sources of feed ingredients

The Local Normal (LN), Etubi (ET) and Golden Jubilee (GJ) maize varieties were provided by Alpha Seeds Enterprise, Kumasi while the Imported Normal Yellow (INY) maize and other ingredients were bought from open markets in the Kumasi Metropolis.

Experimental pigs and design of the experiment

Twenty Large White starter pigs (12 males and 8 females) with an average age of 11 weeks obtained from the Livestock Section of the Department of Animal Science, KNUST were used in the experiment. The pigs were randomly allotted to four dietary treatments; namely LN, INY, GJ and ET diets on the basis of sex, litter origin, age and weight. A Completely Randomized Design, with 5 replicates per treatment was used. The compositions of the four isonitrogenous and isocaloric diets are shown in Table 1.

Table 1 - Percentage composition of the experimental diets

Ingredient	LN	INY	GJ	ET
LN	60	-	-	-
INY	-	60	-	-
GJ	-	-	60	-
ET	-	-	-	60
Fishmeal	9	9	8	8
Soyabean meal	6	6	6	6
Wheat bran	23.5	23.5	24.5	24.5
Oyster shell	1.00	1.00	1.00	1.00
Common salt	0.25	0.25	0.25	0.25
Vitamin-Trace mineral premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
Nutrient composition (Calculated)				
CP, (%)	17.50	17.50	17.00	17.00
Ca, (%)	0.81	0.81	0.80	0.80
P, (%)	0.72	0.72	0.71	0.71
Lysine, (%)	0.94	0.94	0.95	0.95
Tryptophan, (%)	0.19	0.19	0.21	0.21
DE (kcal/kg)	3184	3184	3176	3176

Vitamin Trace Mineral Premix: Inclusion rate is 2.5g/kg to supply Vit. A = 8000 IU, Vit. D = 500 IU, Vit. E = 2.5 mg, Vit. K_3 = 1mg, Vit. B_2 = 2 mg, Vit. B_{12} = 0.005 mg, Folic Acid = 0.5 mg, Nicotinic Acid = 8 mg, Calcium Panthotenate = 2 mg, Choline Chloride = 50 mg, Manganese = 50 mg, Zinc = 4 mg, Copper = 4.5 mg, Cobalt = 0.1 mg, Iodine = 1 mg, Selenium = 0.1 mg.

Housing and feeding

The pigs were housed individually in concrete-floored wire mesh cages measuring 160 x 65 x 103 cm. The cages were located in roofed pens measuring 365 x 315 x 100 cm and each pen had four of the individual cages. Wooden feed and concrete water troughs were provided in each cage. Feed and water were provided *ad libitum.* Feeding was terminated and pigs were slaughtered when each pig attained a liveweight of 70 + 0.5 kg at the weekly weighing.

Parameters measured

During the experiment, weekly feed intake and weekly weight gains were recorded and corresponding average daily feed intake and average daily weight gain were calculated. The experimental pigs were removed and slaughtered for carcass evaluation after each pig attained a liveweight of 70 + 0.5 kg at the weekly weighing. The pigs were stunned, bled, scalded, singed and eviscerated. The dressed weights and weights of the viscera, head, trotters and the internal organs were recorded on the day of slaughter. The eviscerated carcasses were chilled in a coldroom at a temperature of 4^{o}C for 24 hours and other parameters taken.

Chemical and Statistical Analyses

The proximate compositions of the four maize varieties and diets were determined using procedures outlined by AOAC (1990). All data collected were subjected to analysis of variance using GenStat (Discovery Edition 3) and means separated by least significant difference.

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RESULTS AND DISCUSSION

Proximate composition of the maize varieties used

The proximate composition of the four maize varieties is shown in Table 2. The ET and INY maize varieties had almost the same levels of crude protein (8.10 vrs 7.90 %) while the GJ had a higher value (9.10 %) than the two mentioned earlier. However, the highest value of 10.0 % CP was obtained from the LN maize. Cromwell et al. (1983) reported similar higher values for normal maize but De Oliveira et al. (2011) reported 7.70, 9.87 and 7.36 % for common corn, high lysine corn and high oil corn respectively. These differences from De Oliveira et al. (2011) could be due to the differing environments in which the maize were cultivated and the variety as reported by Bressani et al. (1962). The GJ variety had higher ether extract content than the other three varieties and those varieties studied by O'Quinn et al. (2000) and De Oliveira et al. (2011). The dry matter content of the maize varieties were 85.0, 88.0, 85.0 and 86.0 % for the LN, INY, GJ and ET varieties respectively. These values are comparable to the values reported by Asche et al. (1985), O'Quinn et al. (2000) and De Oliveira et al. (2011). The ash percentages were lower than those recorded by De Oliveira et al. (2011).

Table 2 - Proximate composition (%) of the four maize varieties used in the experiment (as-fed basis)

Item	Maize variety			
	LN	INY	GJ	ET
Crude protein	10.0	7.9	9.1	8.1
Ether extract	5.5	3.0	7.0	5.5
Crude fibre	1.56	2.06	1.63	1.04
Ash	1.0	0.5	0.5	0.5
Moisture	15.0	12.0	15.0	14.0
Nitrogen free extract	66.94	74.54	66.77	70.86
Dry matter	85	88	85	86

Growth performance of the pigs

The summary of the growth performance of the pigs on the 4 dietary treatments is shown in Table 3. The mean total feed intake values were 205.6, 213.3, 207.90 and 207.2 kg for the LN, INY, GJ and ET diets respectively (Table 3).

Table 3 - Growth performance of pigs on the four dietary treatments

Parameter	Dietary treatment				LSD	Sign.
	LN	INY	GJ	ET		
No. of pigs	5	5	5	5	-	-
Mean initial weight, kg	13.3	13.2	13.3	13.2	1.368	NS
Mean final weight, kg	71.3	70.5	70.2	70.1	1.242	NS
Total feed intake, kg	205.6	213.3	207.9	207.2	14.28	NS
Mean daily feed intake, kg	2.27	2.26	2.06	2.19	0.272	NS
Mean weight gain, kg	56.9	56.9	57.3	58	1.724	NS
Average daily weight gain, kg	0.64^{a}	0.61^{a}	0.56^{b}	0.60^{ab}	0.079	*
Mean feed conversion ratio (feed/gain)	3.55	3.72	3.66	3.64	0.206	NS
Mean duration (days)	91.	95.2	102.2	95.2	14.17	NS
[g]Feed cost/kg, GH¢	0.49	0.51	0.48	0.48	-	-
Feed Cost/kg liveweight gain, GH¢	1.74^{b}	1.90^{a}	1.76^{b}	1.75^{b}	0.101	*

LSD-Least significant difference; Sign.-Level of significance; a,b: Values in the same row with different letters are significantly different (P<0.05).
[g]GH¢1 is equivalent to US$ 0.52

These values and the corresponding mean daily feed intakes of 2.27, 2.26, 2.06 and 2.19kg were not significantly (P > 0.05) different. The similarities in feed intake confirm that the energy content of the diets were similar as pigs eat to satisfy their energy requirements (Pond et al., 1995). The average daily weight gains (ADG) were 0.64, 0.61, 0.56 and 0.60 kg for LN, INY, GJ and ET diets respectively (Table 3). There were significant (P<0.05) differences among the treatment means with the LN, INY and ET values being similar but higher (P<0.05) than the value for the GJ diet. Rosa et al. (1977) stated that pigs fed Opaque-2 maize tended to grow slower than those fed non-opaque 2 maize but the differences in growth rate were not significant (P<0.05). Sullivan et al. (1989) had subsequently asserted that QPM diets reduced growth rate of starter pigs compared with pigs fed normal maize. Cromwell et al. (1969), Asche et al. (1985), Burgoon et al. (1992), Okai et al. (2001a, 2001b and 2007), De Oliveira et al. (2011), did not observe significant (P>0.05) differences in the ADG. However, Cromwell et al. (1983) and Osei et al. (1999) reported improved ADG of pigs fed QPM diets compared to normal maize diets. The differences in these findings may be attributable to the composition of diets and varieties of the maize used in these experiments. The feed conversion ratios were 3.55, 3.72, 3.66 and 3.64 for the LN, INY, GJ and ET diets respectively. It is apparent that the dietary treatments did not influence this parameter. Okai et al. (2001a, 2001b) had reported similar non-significant results when diets containing normal maize and Obatanpa (QPM) were fed to

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growing-finishing pigs. On the other hand, Maner et al. (1971) and Osei et al. (1999) reported results which showed improved FCE with the use of QPM varieties.

Feed Cost and Economy of Gain

The costs of the various diets were GH¢0.49, GH¢0.51, GH¢0.48 and GH¢0.48/kg for the LN, INY, GJ and ET diets respectively (Table 3). The reduction in the feed costs of the GJ and ET diets was due to the reduction in the fish meal inclusion levels in the diets in view of higher lysine and tryptophan levels in the GJ and ET. The reduction in fishmeal levels apparently had no (P>0.05) detrimental effects on the main performance parameters studied i.e. feed intake, feed conversion efficiency, growth rate and carcass dressing yield. In this study, the feed cost was reduced in the QPM-based diets i.e. GJ and ET up to GH¢10.00 per metric tonne. A similar observation had earlier been made by Osei et al. (1999). They stated a reduction of US$21.00 per metric tonne when QPM was incorporated in broiler diets owing to a reduction in the fishmeal levels in the diets. The feed cost per kg liveweight gain values were GH¢ 1.74, GH¢ 1.90, GH¢ 1.76 and GH¢ 1.75 for LN, INY, GJ and ET diets respectively (Table 3). There were significant (P < 0.05) differences among treatment means with the feed cost per kg liveweight gain being higher (P<0.05) for the INY group than the rest due to the higher price of the INY (i.e. GH¢0.55/ kg vrs GH¢0.50/kg for the GJ, ET maize). The values for this parameter for the LN, GJ and ET diets were similar (P > 0.05).

Carcass traits

The summary of the mean carcass traits for the pigs fed the four dietary treatments are shown in Table 4. There were no significant (P > 0.05) differences among treatment means of the various diets for the final weight, dressed weight and dressing percentage. These observations confirm earlier findings by Okai et al. (2001a, 2001b) and De Oliveira et al. (2011). As shown in Table 4, there were no significant (P > 0.05) differences among the treatment means for the shoulder, loin, belly and thigh weights. These results are similar to those of Okai et al. (2001a, 2001b and 2007) when Obatanpa (QPM variety) and normal maize varieties were used in grower-finisher diets of pigs. Earlier, Cromwell et al. (1969) had similar results and concluded that pigs on normal or high lysine corn diets formulated on an equal lysine-basis produced the similar growth performance in weanlings, and the similar growth rates and meat quality in growing-finishing pigs. The results again tallied with the works of De Oliveira et al. (2011). They found no differences in all carcass parameters measured in pigs fed diets containing common corn, high lysine corn and high oil corn.

The mean carcass length and backfat thickness values were not affected (P>0.05) by the dietary treatments (Table 4). Again, this finding agrees with the results of previous studies (Okai et al. 2001a, 2001b, 2007 and De Oliveira et al. 2011). With respect to standards, the values fell within grade 3 category of USDA (1985) stipulations for pork carcass and above the maximum backfat thickness of 2.80 cm, a standard for pork carcass fat thickness (Sterle, 2000). Nevertheless, the backfat thickness values apparently met the guidelines for the regulation of livestock products by FDL (1992).

Table 4 - Carcass traits of pigs fed the 4 diets

Parameter	Dietary treatment				LSD	Sign.
	LN	INY	GJ	ET		
No. of pigs	5	5	5	5	-	-
Mean live weight, kg	71.3	70.5	70.2	70.1	1.242	NS
Mean dressed weight, kg	52.93	52.87	53.22	52.49	2.039	NS
Mean dressing %	74.22	74.98	75.8	74.87	2.032	NS
Mean chilled dressed weight, kg	51.59	51.11	51.82	51.69	2.025	NS
Mean chilled dressing %	72.34	72.49	73.81	72.87	1.951	NS
Mean carcass length, cm	72.48	72.78	73.22	72.94	1.882	NS
Mean shoulder weight, kg	4.01	3.92	4.14	3.98	0.481	NS
Mean loin weight, kg	6.46	6.43	6.48	6.53	0.699	NS
Mean belly weight, kg	4.57	4.69	4.81	4.53	0.361	NS
Mean thigh weight, kg	6.45	6.47	6.2	6.4	0.4	NS
Mean backfat thickness, cm	3.18	3.25	3.07	3.14	0.449	NS

LSD= Least significant difference, Sign.= Level of significance (P < 0.05)

CONCLUSION

The results from the studies suggest that, the reduction in the inclusion levels of fish meal in the QPM diets (GJM and ETM) resulted in economic savings of GH¢ 10.00 per metric tonne. All carcass parameters were similar for all the dietary treatments but GJM and ETM diets gave slightly lower values in backfat thickness in the carcasses of the pigs. The studies also revealed that rats fed the GJM diet out-performed their counterparts in all the parameters measured. It can therefore, be concluded that the use of GJM and ETM varieties may offer an advantage of economic savings in the production of pork in Ghana.

ACKNOWLEDGEMENTS

The authors wish to express most sincere thanks to Alpha Seeds Enterprise Ltd for providing the test maize varieties for the experiment.

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