International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Carcass and Internal Organs Characteristics of Growing-Finishing Pigs Fed Diets Containing Four Different Maize Varieties

Abdul-Rahaman Saibu Salifu[a]*,Peter Tindukin Birteeb[b]

[a]*Department of Ecological Agriculture, School of Applied Science and Arts, Bolgatanga Polytechnic, P. O. Box 767, Bolgatanga-Ghana*

[b]*Department of Animal Science, Faculty of Agriculture, University for Development Studies, P. O. Box TL 1882, Nyankpala Campus, Tamale-Ghana*

[a]*Email: dipaarana@yahoo.com*

[b]*Email: bpetert2000@yahoo.com*

Abstract

The study was conducted to determine the carcass and internal organ characteristics of growing-finishing pigs fed diets containing four different maize varieties. Twenty individually-housed, Large White pigs (12 males and 8 females) with an average initial body weight of 13.2 kg were allotted to four dietary treatments labeled, Local Normal maize (LNM), Imported Normal Yellow maize (INYM), Golden Jubilee maize (GJM) and Etubi maize (ETM) in a Completely Randomized Design (CRD). The last two treatments were approved Quality Protein Maize (QPM) based diets. Each treatment was replicated five times, with a pig representing a replicate. Feed and water were provided ad-libitum. Values for the final weight, dressing percentage, shoulder, loin, belly, thigh, carcass length, backfat thickness, head and trotters were statistically similar (P>0.05). However, the values for heart, liver, kidney and respiratory tract were statistically different (P>0.05). The values for the liver (LNM=1.34, IMYM=1.26, GJM=1.51 and ETM=1.52) and the kidney (LNM=0.20, IMYM=0.17, GJM=0.21 and ETM=0.20) were significantly higher in favour of QPM-based diets. The results showed that using GJM and ETM varieties could be more profitable due to premium price placed on liver and lean pork in Ghana.

Keywords:Carcass characteristics; organs; Golden Jubilee maize; Etubi maize;pigs

---

* Corresponding author. Tel.: +233208472471.
E-mail address: dipaarana@yahoo.com

1. INTRODUCTION

Maize is a major cereal crop for both livestock feed and human nutrition [1] with high content of carbohydrates, fats and minerals. As a primary source of energy supplement in daily diets, maize contribute up to 30, 60 and 98% of the diet's protein, net energy and starch respectively [2] and constitutes the main bulk of the daily diets in most parts of the world[3].

Quality protein maize (QPM) varieties have played an increasingly important role in reducing protein malnutrition in humans where maize is a dietary staple [4]. The nutritional and biological superiority of QPM have been studied in rats [5;6;7;8], pigs [9;10;11;12], infants, children and adults [13; 14; 15; 16]. In Ghana, maize is by far, the most dominant of the grains being produced in large quantities [17] and it is estimated that 90% of the grown maize goes into human consumption while only 10% goes into animal feed [18].

In Africa, Ghana has played a pioneering role in the development of QPM varieties in the past two decades releasing Obatanpa, Mama-ba, Dada-ba, CIDA-ba and others [19]. Recently, two new QPM varieties have been developed by the Crop Research Institute of the Council for Scientific and Industrial Research of Ghana based in Kumasi, namely Golden Jubilee maize (GJM) and Etubi maize (ETM). The Golden Jubilee is a yellow, dented open-pollinated variety with a potential yield of 5 tons/ha and it 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 with the same maturity period. The encouraging yields and better agronomic attributes as well as the perceived nutritional value, there is a dearth of information on the response of pigs to the two new varieties. Therefore, this study is to investigate the effects of the GJM and ETM-based diets on carcass and internal organ characteristics of pigs.

2. MATERIALS AND METHODS

2.1. 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 over a 17 week period. The Department is located on latitude 06˚41' N and longitude 01˚33' W of the Equator and 261.4 m above Mean Sea Level (MSL). The average rainfall in the area is about 1400 mm with temperature ranging between 21.5 and 35˚C while relative humidity is between 67 and 89%.

2.2. Experimental Animals, Management, Housing and Feeding

Twenty Large White starter pigs (12 males and 8 females) with an average weight of 13.2 kg were used for the study. During the experiment, the pigs were housed individually in concrete-floored wire mesh cages measuring 160 x 65 x 103 cm. The cages were constructed within 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. The pigs were fed ad-libitum and had free access to drinking water. Feeding was terminated and pigs were slaughtered when each pig attained a liveweight of 70 $\pm$ 0.5 kg at the weekly weighing.

2.3. Experimental diets and design

The pigs were randomly allotted to four dietary treatments; Local Normal Maize (LNM), Imported Normal Yellow Maize (INYM), Golden Jubilee Maize (GJM) and Etubi (ETM) diets in a Completely Randomized Design with 5 replicates per treatment. The GJM and ETM are both Quality Protein Maize (QPM) materials whilst LNM and INYM are both normal maize varieties. The compositions of the four diets are shown in Table 1. The diets were formulated to be isocaloric and isonitrogenous.

2.4. Carcass evaluation

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 cold-room at a temperature of 4°C for 24 hours for the chilled dressed weight. Other measurements taken were the weights of the primal cuts, carcass length and backfat thickness.

2.5. Chemical and Statistical analyses

The proximate composition of the four diets was determined using procedures outlined by [20]. All data collected were subjected to analysis of variance (ANOVA) using GenStat (Discovery Edition 3) and means separated by least significance differences.

Table 1. Percentage composition of the experimental diets

Ingredients	LNM	INYM	GJM	ETM
LNM	60	-	-	-
INYM	-	60	-	-
GJM	-	-	60	-
ETM	-	-	-	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
Analysed composition (%, as fed-basis)				
Crude protein	17.50	17.50	17.00	17.00
Ether extract	7.00	2.50	6.50	3.50
Crude fibre	3.80	3.68	3.72	3.68
Moisture	15.50	14.00	16.50	15.00
Ash	3.00	4.50	5.50	6.00
Nitrogen free extract	53.60	58.42	51.28	56.22
Dry matter	84.50	86.00	83.50	85.00

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.

3. Results and Discussion

3.1. Analyzed Composition of the Experimental Diets

The analyzed composition of the diets is shown in Table 1. The percentage dry matter contents of the diets were 84.50, 86.00, 83.50 and 85.00 % for LNM, INYM, GJM and ETM diets respectively. These values were lower compared to those obtained by [21] who had 88.10, 86.70, 86.60 and 86.80 % for normal maize and 3 Obatanpa-based diets. The differences observed in the current study may be attributed to the differences in moisture content of the maize varieties used.

3.2. Carcass characteristics

The summary of the mean carcass traits for the pigs fed the four dietary treatments are shown in Table 2.

Table 2: Carcass traits of pigs fed the 4 diets

Parameter	Dietary treatment				LSD	Sign.
	LNM	INYM	GJM	ETM		
Mean liveweight @ slaughter, kg	71.30	70.50	70.20	70.10	1.242	NS
Mean dressed weight, kg	47.10	47.30	47.40	46.70	1.882	NS
Mean dressing %	66.04	67.09	67.51	66.61	1.894	NS
Mean chilled dressed weight, kg	45.76	45.50	46.00	45.30	1.9 17	NS
Mean chilled dressing %	64.16	64.58	65.52	64.62	1.915	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	6.20	6.40	0.400	NS
Mean backfat thickness, cm	3.18	3.25	3.07	3.14	0.449	NS

LSD-Least significant difference, Sign.-Level of significance ($P \leq 0.05$), NS-Not significant

There were no significant ($P > 0.05$) differences between the treatment means for the final weight, dressed weight, chilled dressed weight and their dressing percentages. These findings tallied with the earlier reports by [12] and [22]. It is quite interesting to note that pigs on the yellow maize treatments (i.e. INYM and GJM) recorded relatively higher dressed weights resulting in higher dressing percentages. As presented in Table 2, there were no significant ($P > 0.05$) differences among treatment means of the shoulder, loin, belly and thigh weights, carcass length and backfat thickness. Again, this finding agrees with the results of previous works by [23], [24], [12] and [22].

3.3. Absolute and relative weights of some organs of the pigs

The mean absolute weights of the head for the four dietary treatments were 4.93, 4.67, 4.85 and 4.90 kg with corresponding relative values of 6.92, 6.63, 6.91 and 6.99 % for the LNM, INYM, GJM and ETM diets respectively (Table 3). There were no significant ($P >0.05$) differences among the treatment means for both absolute and relative weights. The means for both absolute and relative values of trotters weights were 0.90, 0.90, 0.97 and 0.89 kg; and 1.26, 1.28, 1.38 and 1.27 % for LNM, INYM, GJM and ETM diets respectively. In both cases the values were statistically similar ($P > 0.05$).

Furthermore, the mean absolute weight of the viscera were 11.26, 11.14, 10.72 and 11.34 kg with corresponding relative values of 15.79, 15.79, 15.28 and 16.18 % for the LNM, INYM, GJM and ETM diets respectively. Again, no statistically significant ($P > 0.05$) differences were observed. [25; 12] made similar observations.
There were significant ($P < 0.05$) differences among treatments means for both absolute and relative weights of the heart, liver, kidney and respiratory tract. This work contradicts the findings by [25; 21] of non-significant ($P >0.05$) differences between normal and QPM diets. It is clear from Table 3 that livers from the QPM-based diets (GJM and ETM) are significantly higher than those from the normal maize counterparts. This suggests that QPM diets may

have positive influence on the development of liver in pigs.

Table 3: Absoluteand relative weights of some organs of the pigs fed the 4 diets

Parameter	Dietary treatment				LSD	Sign.
	LNM	INYM	GJM	ETM	-	-
Absolute weights (kg)						
Mean head weight	4.93	4.67	4.85	4.90	0.352	NS
Mean trotters weight	0.90	0.90	0.97	0.89	0.096	NS
Mean viscera weight	11.26	11.14	10.72	11.34	0.935	NS
Mean GIT weight (full)	7.88^{a}	7.78^{ab}	6.99^{b}	7.80^{ab}	0.829	*
Mean GIT weight (empty)	2.89	2.96	2.87	2.86	0.398	NS
Mean heart weight	0.19^{b}	0.17^{c}	0.21^{ab}	0.22^{ab}	0.030	*
Mean liver weight	1.34^{b}	1.26^{c}	1.51^{a}	1.52^{a}	0.167	*
Mean kidney weight	0.20^{a}	0.17^{b}	0.21^{a}	0.20^{a}	0.026	*
Mean spleen weight	0.11^{b}	0.10^{b}	0.14^{a}	0.11^{b}	0.026	*
Mean Resp. Tract weight	1.00^{ab}	0.99^{b}	1.11^{a}	0.97^{b}	0.114	*
Relative weight (%)						
Mean head weight	6.92	6.63	6.91	6.99	0.482	NS
Mean trotters weight	1.26	1.28	1.38	1.27	0.132	NS
Mean viscera weight	15.79	15.79	15.28	16.18	1.326	NS
Mean GIT weight (full)	11.05	11.03	9.96	11.13	1.175	NS
Mean GIT weight (empty)	4.05	4.20	4.09	4.08	0.551	NS
Mean heart weight	1.88^{b}	1.79^{b}	2.15^{a}	2.17^{a}	0.244	*
Mean liver weight	0.28^{a}	0.24^{b}	0.30^{a}	0.29^{a}	0.039	*
Mean kidney weight	$0.27b^{c}$	0.24^{c}	0.30^{ab}	$o.31^{a}$	0.044	*
Mean Resp. Tract weight	1.40^{b}	1.41^{b}	1.58^{a}	1.38^{b}	0.161	*

LSD-Least significant difference, Sign.-Level of significance, a,b,c, values in the same row with different letters are significantly different at (*P < 0.05)

4. CONCLUSION

The results from the studies suggest that, all the carcass parameters were statistically not different (P>0.05) for all the dietary treatments but GJM and ETM diets gave relatively higher values for carcass length and liver and slightly lower values in backfat thickness. It can therefore, be concluded that the inclusion of GJM and ETM varieties in the diets of pigs may offer an advantage in the production of lean pork.

ACKNOWLEDGEMENTS

The author wishes to express most sincere thanks to Alpha Seeds Enterprise Ltd, Kumasi for providing the test maize varieties (GJM and ETM) for the experiment.

REFERENCES

1. B. M. Prasanna, S. K. Vasal, B. Kassahun, and N. N. Singh. "Quality protein maize''.*Current Sci.* 81(10): 1308-1319. 2001.
2. R. G. Dado. "Nutritional benefits of speciality maize grain hybrids in dairy diets". *J. Anim. Sci.* 70: 811-817, 1991.
3. National Research Council (NRC). *Quality Protein Maize*. National Academy Press, Washington D.C. 1988, Pp 1-70.
4. H. S. Gupta, P. K. Agrawal, V. Mahajan, G. S. Bisht, A. Kumar, P. Verma, A. Srivastava, S. Saha, R. Babu, M. C. Pant, and V. P. Mani."Quality protein maize for nutritional security: rapid development of short duration hybrids through molecular marker assisted breeding". *Current Sci*.96(2): 230-237, 2009.
5. E. T. Mertz, O. A. Vernon,S. Bates, and O. E. Nelson."Protein value of Colombian opaque-2 corn for young adults men". *Sci.* 148:1741-1744, 1965.
6. G. G. Gomez, J. H. Maner, Z. Flores, C. A. Francis, and J. Buitrago."A comparison of vitreous and soft endosperm high-lysine and common maize in diets for growing rats and pigs".*J. Anim. Sci.* 41:1638-1644, 1975.
7. L. M. Maffia, H. E Clark, and E. T. Mertz."Protein quality of two varieties of high-lysine maize fed alone and with black beans or milk to normal and depleted rats". *Am. J. Clin. Nutr.* 29: 8 17-824, 1976.
8. S. O. Serna-Saldivar,L. W. Rooney, and L. W. Greene."Effect of lime treatment on the bioavailability of calcium in diets of tortillas and beans: Rats growth and balance studies". *Cereal chemistry*. 68(6): 565-570, 1991.
9. J. H. Maner,W. G. Pond, J. T. Gallo, A. Henao, R. Portella and F. Linares."Performance of rats and swine fed Collumbian Floury-2 or normal maize". *J. Anim. Sci*. 33: 791-796, 1971.
10. S. A. Osei, D. B. Okai and A. K. Tuah."Quality Protein Maize as the sole source of amino acids in the diets of starter pigs": A preliminary study. J. Univ. Sci. Tech. 19: 1-4, 1999.
11. D. B. Okai, S. A. Osei, W. L. Haag, B. D. Dzah and E. K. D. Nyannor. "Improving animal performance and reducing feed cost through the use of Obatanpa, a Quality Protein Maize (QPM).in Ghana".Paper presented at the Sasakawa Global 2000 Quality Protein Maize (QPM) workshop, Arusha, Tanzania, March, 2003.
12. D.B. Okai, E. K. D. Nyannor, E. L. K. Osafo and A. Amankwah."Effects of Obatanpa (A Quality Protein Maize) with little or no fishmeal diets on growth performance and some carcass characteristics of finisher pigs".*Ghanaian J. Anim. Sci*. 2,3(1): 63-70, 2007.
13. G. G. Graham,D. V. Glover, G. L. de Romana, E. Morales and W. C. MacLean. (1980). "Nutritional value of normal, Opaque-2 and Sugary-2 maize hybrids for infants and children: Digestibility and utilization". *J. Nutri*.110:1061 – 1069, 1980.
14. G.G. Graham, J. Lembcke and E. Morales."Quality Protein Maize as the sole source of dietary protein and fat for rapidly growing young children". *Pediatrics* 85: 85-91, 1990.
15. A. Akuamoa-Boateng. *Quality Protein Maize: Infant feeding trial in Ghana*". Ghana Health Service, Ashanti, Ghana. 2002, Pp1-17.
16. K. Mbuya, K. K. Nkongolo and A. Kalonji-Mbuyi."Nutritional analysis of Quality Protein Maize varieties selected for agronomic characteristics in breeding program". *Int. J. Plant Breeding andGenetics* 5(4): 3 17-327, 2011.

17. A-R. S. Salifu."Growth performance, carcass characteristics and blood profile of pigs fed diets containing two quality protein maize (Golden Jubilee and Etubi) and two normal maize (Local white and imported yellow) varieties". MSc. Thesis, Kwame Nkrumah University of Science and Technology, Ghana, 2011.
18. Global Agriculture Information Network (GAIN). *Ghana grain and feed update*. USDA Foreign Agricultural Service, GAIN report GH8001, Accra, Ghana. 2008.
19. S. R. Akande and G. O. Lamidi."Performance of quality protein maize varieties and disease reaction in the derived savanna agro-ecology of South-West Nigeria.African". *J. Biotech*. 5(19):1744-1748, 2006.
20. Association of Official Analytical Chemists. *Official Methods of Analysis*, 15th ed., AOAC, Arlington VA, USA, 1990.
21. D. B. Okai, A. K. Tuah and A. Owusu-Aseidu. "Phase feeding of pigs using Obatanpa-A Quality Protein Maize". *J. Univ. Sci. and Tech*. 21(1,2,3): 5-11, 2001b.
22. G. C. De Oliveira, I. Moveira, A. L. P. de Souza, A. E. Murakami, A. R. P. Parra,P. L. O. Carvalhoand M. D. Borile."Corns with differentnutritional profiles on growing and finishing pigs feeding".Asian-Aust. J. Anim. Sci. 24(7): 982-992, 2011.
23. G. L. Cromwell, R. A. Pickett, T. R. Cline and W. M. Beeson."Nitrogen balance and growth studies of pigs fed Opaque-2 and normal corn".*J. Anim. Sci*. 28: 478-483, 1969.
24. M. E. Spurlock, G. R. Frank, G. M. Willies, J. L. Kuskeand S. G. Cornelius."Effects of dietary energy source and immunological challenge on growth performance and immunological variables in growing pigs".*J. Anim. Sci.* 75: 720-726, 1997.
25. D. B. Okai, S. A. Oseiand A. K. Tuah. "Growth performance and economic traits of pigs fed diets containing either normal maize or Obatanpa-A Quality Protein Maize". *J. Univ. Sci. and Tech*. 21: 1-5, 2001a