Nigerian J. Anim. Sci. 2022, 24 (1): 156-162

Performance evaluation of growing pigs fed graded levels of pineapple (*Ananas comosus*) wine sediment

Nkwocha, G. A.,* Ekenyem, B.U. Anukam, K.U.*and Iwalola, M.K. *****

**Department of Animal Production and Health Technology, Imo State Polytechnic, Umuagwo, Ohaji, P.M.B 1472, Owerri, Nigeria.*
***Department of Animal Science and Fisheries, Faculty of Agriculture and Veterinary Medicine, Imo State University, PMB 2000 ,Owerri, Nigeria.*
***** *Department of Animal Production, Federal Polytechnic, Nekede, Owerri, Nigeria.*

***Corresponding Author**: geffmacnkwo@gmail.com;* ***Phone Number:** +23408035078259*

***Target Audience:** Pig Farmers, Animal Scientists, Nutritionists, Researchers.*

Abstract

This experiment was conducted to boost animal protein consumption in the Nigerian populace using an unconventional feedstuff–pineapple wine sediment meal (PWSM) which is a waste product of the winery. In the study, PWSM was used to evaluate the growth performance of grower pigs using 32 large white x landrace strains of pigs with average initial weight of 32 ± 0.07kg. Four treatment diets coded T_1, T_2, T_3 and T_4 replicated 3 times were formulated to replace maize at 0%, 10%, 20% and 30% levels respectively and the study lasted for 35 days. The result of the experiment indicated that PWSM enhanced the palatability and feed intake of the growing pigs because of the proteolytic enzyme, bromelain which stimulated healthy metabolism. It was established from the result that PWSM could replace maize partially up to 10% dietary levels for optimum performance of grower pigs and that at higher levels of 20% despite positive impacts on the economy of production; growth rate and feed conversion are negatively affected. Hence, 10% inclusion level is recommended for optimum productivity and for maximization of profit in the industry.

***Key words*:** Grower pigs, Pineapple wine sediment, Palatability, Unconventional feedstuff, Feed intake.

Description of Problem

Population in the globe is increasing in geometric progression and in the year 2050, the world population is predicted to increase to 8.9 billion (1). The implication is that the global demand for food will increase and the fate of Sub-Saharan Africa of which Nigeria is a classical example will hitherto become bleak as extreme hunger and poverty would revolve in vicious cycle. Increasing the production of animal protein at a reasonable cost to enhance the diet quality of the populace has been part of the objectives of the National Agriculture Policy of Nigeria (2).

The world trend today is towards the consumption of more white than red meat because white meat yields less cholesterol than red meat (3). As a matter of fact, pork account for 38% of worldwide meat production and hitherto, attracting a new generation of African entrepreneurs (4). Pineapple wine sediment meal (PWSM) is a residue obtained from a major wine industry, Jacobs wines Ltd. Mgbidi, Imo State. It is obtained as a viscous residue deposited at the bottom of stock-fermenting vessels over a period of time after filtering out the pure

wine. The lees or sediment are made up of precipitated solids and dead yeast cells that accumulate at the bottom of the fermentation vessel in wine making (5). Pineapple wine sediment is separated from pure wine after re-racked wine has attained final attenuation, where final attenuation is the point reached when all the convertible alcohol in a fruit juice had been converted to alcohol leaving only inconvertible residue called pineapple sediment. The residue is extracted from mixture of raw materials such as pineapple pulp, brewer's yeast slurry, peptic enzymes, residual sugar, bentonite, glycerin, vitamins and mineral components, stabilizers, caramel, acetic acid, tannin and alcohol.

Pineapple wine sediment meal contains essential minerals and vitamins more especially the essential growth substance biotin (6), Biotin is an imidazole derivative widely distributed in natural foods (7). Biotin is an essential B-vitamin which serves as prosthetic group of many enzyme systems in intermediary metabolism. In pigs, biotin plays an important role in maintaining the integrity of the hoof tissues and in the improvement of reproductive performance (8). Biotin affects litter performance, length of weaning, rebreeding interval and conception rate.

Pineapple wine sediment, a by-product of pineapple wine manufacture and as individual ingredient have been extensively studied for various monogastric species including rabbits and poultry (9;10). Analysis of air-dried (PWSM) showed that it contains relatively high levels of crude protein, metabolizable energy, soluble carbohydrate, crude fibre and ash (9). The interest in this research was generated due to high cost and scarcity of conventional feedstuffs such as maize and soyabeans in the country and since pineapple wine sediment is not directly consumed by man but could be utilized by monogastrics and its availability is ensured, the study is therefore a vista in the road towards agro-industrial revolution in Nigeria.

Materials and Methods

Location of study

The study was carried out at the Teaching and Research Farm of the Imo State University, Owerri which lies within the humid tropical rainforest zone of South Eastern Nigeria. The climatic data of Owerri obtained from (11) Official Website (nimet.gov.ng/content/nimet-weather) showed that Owerri lies within latitudes 5°45'N and 7°15'N, and longitude 6°50'E and 7°25'E with an annual rainfall range of 2400-2500mm and annual temperature range of 26°C-29°C while relative humidity is between 70-78% annually.

Experimental Animals and Design

Thirty- two (32) grower pigs of 3-4 months old with similar live weights averaging between 21±0.7kg were used for the study. The pigs were housed in pens measuring $48m^2$ divided into 16 compartments with each floor measuring 2.0 x1.5 m. The 32 grower pigs of mixed sexes used for the study were randomly divided into 4 treatment groups of eight pigs and fed the experimental diets as specified in Table 2. Each treatment was replicated four times in a Completely Randomized Design (CRD) experiment with 2 grower pigs per replicate.

Experimental Diets/Feed Preparation

The wet pineapple wine sediment was collected from a reputable winery in Imo State, and sun-dried for seven days after which it was pulverized and subjected to proximate analysis using (12) method (Table 1) before incorporation into the experimental ration. Four experimental diets were formulated such that PWSM replaced maize

at 0%, 10%. 20% and 30% dietary levels coded as T_1, T_2, T_3 and T_4 respectively (Table 2). Other ingredients apart from PWSM in the diets were included at equal ratios.

Table 1: Proximate composition of sun-dried Pineapple Wine Sediment Meal

Parameters	Concentration (%)
Crude Protein	22.88
Ether extract	4.43
Nitrogen free extract	53.76
Crude fibre	7.28
Ash	11.65
Moisture content	14.19
Metabolizable Energy(kcal/kg)	2778.24 kcal/kg.

ME = Metabolizable energy calculated; ME (kcal/kg) = 37 x %CP+81.8 x %EE+35.5 x %NFE (13)

Table 2: Percentage composition of grower pig's ration containing graded levels of PWSM.

Ingredients	Dietary treatments			
	T_1	T_2	T_3	T_4
Pineapple wine sediment meal	0.00	4.00	8.00	12.00
Maize	40.00	36.00	32.00	28.00
Groundnut cake	12.00	12.00	12.00	12.00
Wheat offal	20.00	20.00	20.00	20.00
Rice meal	11.00	11.00	11.00	11.00
Fish meal	3.00	3.00	3.00	3.00
Palm kernel cake	10.50	10.50	10.50	10.50
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Vit/min.premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
Crude protein (%)	17.84	17.94	17.47	17.98
Ether extract (%)	6.03	6.00	6.05	6.10
Ash (%)	8.77	9.49	9.55	9.66
Crude fiber (%)	5.70	5.76	7.27	7.45
Nitrogen free extract (%)	57.61	56.78	55 44	55.64
ME (Kcal/kg)	2682	2768	2828	2827
Lysine (%)	0.70	0.63	0.67	0.84
Methionine (%)	0.33	0.36	0.36	0.32
Calcium (%)	0. 93	0.94	1.79	1.17
Available Phosphorus	0.61	0.69	1.81	1.70

* Composition per 2.5kg: Vitamin A 10000000IU, Vit.D 2000000IU, Vit E 20000IU, Vit K 2250mg, Thiamine 1750mg, Riboflavin 5000mg, Pyridoxine 2750 mg, Niacin 27500mg, Vit B12 15mg, Pantothenic acid 7500mg, Folic acid 7500mg, Biotin 50mg, Choline chloride 400gm, Antioxidant 125g, Manganese 80g, Zinc 50g, Iron 20g, Copper 5g, Iodine 1.2g Selenium 200mg, Cobalt 200mg.

Data analysis

Data collected from the study were subjected to analysis of variance (ANOVA) by (14) while significant treatment means were separated using Duncan's New Multiple Range Test (DNMRT) as outlined by (15).

Results and Discussion

The average feed intake (Table 3) showed that T_4 recorded the highest while T_1 was numerically the least consumed though there was no significant difference ($P > 0.05$) among the treatment diets. There was a proportional increase in daily feed intake as PWSM increased in diets and this was because of the PWSM appetizing properties and palatability attributes which according to (16) and (17) enhances the palatability of livestock feeds.

Average daily feed intake recorded in this trial aligns with the values obtained by (18) in his study on the response of weaner-grower pigs to diets containing sun-dried mixtures of brewer's yeast slurry with maize grain and cassava root meal and the stipulation of (19) and (20) for grower pigs.

Table 3: Performance of grower pigs fed PWSM based diets

	Dietary treatments				
Parameters	T_1	T_2	T_3	T_4	SEM
Initial body Weight (kg)	21.01	21.50	21.21	21.41	0.11
Final body weight (kg)	44.30^{b}	46.81^{a}	45.55^{a}	44.67^{b}	0.65
Body weight change (kg)	23.29^{b}	25.31^{a}	24.34^{a}	23.23^{b}	0.57
Daily feed intake (kg)	1.84	1.86	1.86	1.87	0.01
Daily body weight gain (kg)	0.67	0.72	0.70	0.67	0.01
Feed conversion ratio (FCR)	2.75^{a}	2.58^{b}	2.66^{ab}	2.79^{a}	0.05
Feed cost/KG weight gain (₦)	263.57^{a}	254.13^{ab}	244.89^{bc}	235.24^{c}	6.10

^{abcd} Means along the row having different superscript differ significantly ($P<0.05$ level).
SEM: Standard error of mean.

The variability in daily feed intake recorded in this study may not be attributed to the metabolizable energy content of the treatment diets since the energy contents of T_4 (30% PWSM) notably 2827kcal/kg was higher than that of T_1 (0% level of PWSM) which has an energy level of 2682 kcal/kg. This finding disagrees with the work of (21), (22) and (23) that pigs will continue to eat until their energy requirements are met.

The body weight gain of the growing pigs was highest in T_2 (10% PWSM) with value of 0.72kg while the least value of 0.67kg was recorded by T_1 (control) and T_4 (30%) respectively. There were no significant differences ($P > 0.05$) among grower pigs fed PWSM based diets and the control diet. T_2 (10% PWSM) diet has crude protein value of 17.42% (Table 2) slightly higher than the values recorded in T_1 (17.38%) but lower than the values recorded for T_3 (17.48%) and T_4 (17.51%).

True growth according to (24), is an increase in the amount of protein and mineral matter accumulated in the body of animals and this as a matter of fact is transmitted to the muscles, bones, heart, brain and other body tissues. Based on the protein profiles of dietary treatment 3 (20% PWSM) and T_4 (30% PWSM) inclusion, the expectation would have been that grower pigs in these diets would have superseded T_2 (10%) in average daily weight gain, but the reverse was observed in this study. The inability of T_3 (17.97%) and T_4 (17.98%) to

perform modestly in weight gain may be attributed to amino acid imbalances (19).

On the other hand, decreased weight gain may be attributed to high level of crude fibre that often dilute nutrients and impairs absorption and assimilation (25). T_1 and T_2 have crude fibre values of 5.70 and 5.76 while T_3 and T_4 recorded 7.27 and 7.45 respectively. Conversely, the level of crude fibre in T_1 is lowest while T_2 which promoted the highest weight gain has lower fibre level than T_3 and T_4. Generally, the crude fibre fraction of diets (cellulose, hemicellulose, lignin, pectins, gums, mucilages) reduces digestibility, metabolism and nutrient absorption of rations (19).

The feed conversion ratio (FCR) of the experimental diets followed the same trend with that of weight gain. T_2 (10%) which recorded 2.58 was most efficiently utilized but not significantly different ($P > 0.05$) from T_3, T_1 and T_4 which recorded 2.66, 2.75 and 2.79 in that order. T_4 (30% PWSM) performed lowest with a value of 2.79 an implication that T_4 is least efficient when compared with other treatment diets of lower range values of 1.66 – 1.75. It is obvious that feed conversion ratio is a function of feed utilization and assimilation. Lower feed conversion value as observed in T_4 may be due to poor utilization of the treatment diets (26) and the inherent dietary fibre level (27). However, it is not the level of crude fibre that matters much in a ration but the degree of dilution (28). That T_2 (5.76) performed better than T_1 (5.70) may be due to the degree of insoluble fibre in the diet which influences the physical properties of the non-starch polysaccharides (29). However, the values obtained in this study aligns with the specifications of (19, 20, 30) and the result obtained by (31) in a study on the Evaluation of Roselle (*Hibiscus Sabdariffa lin*) calyx meal as dietary supplement in grower pig production. The cost of the diets reduced significantly ($P < 0.05$) as dietary levels of PWSM increased progressively. The cheapest cost per 25kg feed was obtained in T_4 (30%) with the value of N235.24 while the control diet T_1 (0% PWSM) recorded the highest value of N263.37. This cost saving trends which is an index of profit maximization was observed in the studies conducted by (18), on sun dried mixtures of Brewer's yeast slurry with maize grain and cassava; (31) on the evaluation of Roselle and (32) on the performance of weaned rabbits fed diets containing pineapple wine sediment.

Conclusion and Applications

1. Economic optimization which is one of the major reasons for use of alternative feed could be achieved with the inclusion of PWSM up to 10% level since feed cost of the diets reduced significantly ($P<0.05$) as dietary levels of PWSM increased progressively.
2. Pineapple wine sediment could be economically and successfully used in animal production for optimum performance and to reduce competition between man and monogastrics for cereal grains and hence a good check to global food crisis.

References

1. Nkwocha, G.A,, Madubuike, F.N., Ekenyem, B.U, and Ndubuisi, C.E. (2018). Growth performance of weaner pigs fed on varying dietary levels of pineapple wine sediment. Proc. 43rd Conf. of NSAP, March18th-22nd 2018, FUTO, Owerri.
2. Amaefule, K. U.; S.O., Okechukwu, S. N., Ukachukwu, F.C., Okoye and O.C., Onwudike (2006a). Digestibility and Nutrient utilization of pigs fed graded levels

of brewer's dried grains based diets. *Livestock Res. for Rural Development 18 (1).*

3. Holness, D.A. (2005). *Pigs the Tropical Agriculturist.* Macmilian/ CTA, London, U.K.
4. Spore-CTA Magazine (2018). Pig opportunities- A passion for porcine production. In CTA Spore Magazine No, (189):8-9.
5. Jacobs, F.S.U. (2001). *Making wine from pineapple.* Ihem Davis Publishers, Owerri Imo State. 79pp.
6. Fowles, G. W.A. (1988). *Wine for all seasons*. 2nd edition, Ventura publisher plus Laserstar 6 Printers, USA 110 pp.
7. Murray, R.K.; D.K., Granner, P. A., Mayes and V.W., Rodwell (2000). *Harper's Biochemistry, 25th Edition.* Lange Medical book, McGraw-Hill, New York, USA.
8. Oyeleke, O. (1996). The case for Biotin. In. Livestock farmer Vol. 12, No l: 11-12.
9. Anyaehie, A. A. and G.A. Nkwocha (2003). Replacement value of pineapple wine sediment for maize offal in grower/finisher pig diets. *Journal of Agric. And food Science. 1 (2): 89-95.*
10. Nkwocha, G.A.; Anukam, K.U., and V.I., Nkwocha (2009). *Challenges of global food crisis and utilization of pineapple wine sediment meal in animal production. Proceedings of the International Conference on Global Food Crisis. FUT, Owerri*-April 19-24, 2009.
11. NIMET (Nigerian Institute of Meteorology), (2015). Nigerian meteorological Agency, Seasonal rainfall predictions. www.nimet-srp.com.
12. A.O.A.C. (2005). *Official Methods of Analysis, Association of Official Analytical Chemists*, 18th ed. Gathersburg, Maryland, USA, pg 66-68.
13. Pauzenga, U. (1985). Feeding Parent Stock. *Journal Zoological Technology International*, 22-24.
14. Steel, R.G.D. and Torrie, J.H. (1980). *Principles and procedures of Statistics*.2nd edition. McGraw-Hill, New York.
15. Obi, I.U. (2002). Statistical methods of detecting differences between treatment means and research methodology issue in laboratory and field experiments. A.P Company LTD.
16. Muller, Z.O. (1978). Feeding potential of pineapple waste for cattle. *World Animal Review* (25); 25- 29.
17. Rutagwenda, T.; M., Lechner Doll, H.J., Scharwartz, W., Schulkta, and W.W., Engelhardt (1990). Dietary preference and degradability of forage on a semi-arid thornbush Savana by indigenous ruminants. *Animal Feed Science. Technology 31: 179-192.*
18. Ikurior, S.A., Kaankuka, F.G. and David, S.I. (1995). Response of weaner pigs to diets containing sun-dried mixtures of Brewer's Yeast Slurry with maize grain and cassava root meal. *Nigeria Journal of Animal Production 22(1): 56-63.*
19. Olomu, J.M. (2010). *Monogastric Animal Nutrition (Principles and practice).* Jackson publishers, Benin, Nigeria.
20. National Research Council (2005). National Academy of Sciences, National Academy Press, Washington, DC. America.
21. Serres, H. (1992). *Manual of pig production in the tropics.* Published by C.A.B. International in collaboration with C.T.A., Wallingford, Oxon. U.K.
22. Ranjhan, S.L. (2000). *Animal Nutrition in the Tropics.* 2nd edition, Vikas pub. House, PvT Ltd. India.
23. Augenstein, M.L., L.J., Johnston, G.C., Shurson, J.D., Hawton and J.E.

Pettigrew (1997). Formulating farm-specific swine diets. Regents of the University of Minnesota Extension Service, America (pp 6-10).

24. Omeje, S.I. (1999). Animal Agriculture: Historical Perspectives. In: Issues In Animal Science (A Compendium of ideas, facts and methodology in the Science and Technology of Animal Agriculture). Published by Ray Kennedy Scientific publishing, 53 Obiagu road, Enugu.
25. Best, P. (2004). Precise on protein. In: Feed International Mag. *Watt pub. 25 (5), 14-15*.
26. Ani, A.O. and A.U. Okorie (2009). Performance of broiler finishers fed graded levels of processed castor oil bean (Ricinus Communis L) meal supplemented with dL Methionine. *Nigerian Journal Animal Production 36 (1): 61 – 73*.
27. Novo Nordisk, (1995). *Enzymes at work*. Novo Alle, DK. 2880 Bagsvaerd, Denmark.
28. O'Connell, J.M., Sweeney, T, Callan, J.J. and O'Doherty, J.V. (2005). The effect of cereal type and exogenous enzyme supplementation in pig's diets on nutrient digestibility, internal microflora, volatile fatty acid concentration and manure ammonia emissions from finisher pigs. Animal Science (18): 357-364.
29. Kim, J.C., Mullan, M.P. and Pluske, J.R. (2005). A comparison of waxy versus non-waxy wheat in diets for weaner pigs: effects of particle size, enzyme supplementation, and collection day on total tract apparent digestibility and pig performance. Anim. Feed Science Technology 120:51-65.
30. Izunobi, N.D. (2006). *Poultry Husbandry*. NAADS Publishers Inc. Onitsha, Anambra State, Nigeria.
31. Agbabiaka, L.A.; G.A., Nkwocha, K.U., Anukam and T.O., Beketin (2014). Evaluation of Roselle (*Hibiscus Sabdariffa linn*) calyx meal as dietary supplement in grower pig production. *International Journal of Agricultural Science, 4 (6): 293-300.*
32. Etuk, E.B., Nwachukwu, S.O. and Aladi, S.O (2013). Performance of weaned rabbits fed diet containing pineapple wine sediments. Proc. 38 Conference Nigeria Society of Animal Production 17-20 March, 2013. Rivers State University of Science and Technology Port Harcourt. Pp 218-223.