GROWTH RESPONSE AND APPARENT NUTRIENT DIGESTIBILITY OF GROWING PIGS FED DIETS CONTAINING VARYING LEVELS OF PINEAPPLE (*Ananas comosus*) WINE SEDIMENT BASED DIETS

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ABSTRACT

This experiment was conducted to boost animal protein consumption in the Nigerian populace using an unconventional feedstuff –pineapple wine sediment (PWS) which is a waste product of the winery. In the study, PWS was used to evaluate the growth performance and apparent nutrient digestibility 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 35 days. The result of this study indicated that the control group ($T_1$0%) has the highest nitrogen free extract (NFE) nutrient digestibility (93.40%) than grower pigs on PWS based diets which ranged between (79.31-85.27%) and marginal significant differences ($p<0.05$) existed between the treatment means. Pigs could be fed up to 30% PWS in the diet without compromising growth performance and nutrient digestibility.

Keywords: Grower pigs, pineapple wine sediment. Digestibility, unconventional feedstuff, Growth response

INTRODUCTION

Nigerian population is growing at an alarming rate and the need to strengthen the productivity of the swine industry for more sustainable meat production becomes very uppermost. The world trend today is towards the consumption of more white than red meat because white meat provides high-quality protein, iron and many B vitamins, yields less cholesterol and more beneficial fatty acid profile than red meat (Nordic Nutrition Recommendation, 2023). There is a need, therefore, to encourage the production of pigs in the third world countries because of its potentials as an omnivorous polytoccus, fast growing animal with very high mortgage value accounting for 36% of worldwide meat production (Food Industry, 2024). This high percentage indicates pork's popularity, driven by its flavour, versatility in cooking, and cultural significance in many regions (Food Industry, 2024). The population of pigs in Nigeria as at 2023 was 9.5 million (Statista, 2024). This value is grossly inadequate for the Nigerian populace since population and economic growth in developing countries like Nigeria is increasing the demand for food, particularly meat and milk (Protein Challenge, 2020). Comparing the values of 434 million pigs in China, 75 million pigs in the USA, 133 million pigs in European Union, 33 million pigs in Brazil and 27.5 million in Russia, Nigeria is therefore, ranked least in the world pig supply (Statista, 2024).

A closer look at the Nigerian Livestock Industry speaks volume of the detrimental rise of the cost of commercial feeds (Mosaku, 2023). The cost of pork in recent times has skyrocketed due to high cost of production emanating from conventional feed ingredients even before the emergence of Russian-Ukraine crisis which exacerbated the situation. High production cost reduces the profit margin of pig farmers and many pig operators have shut down. Looking inwards into alternative feed ingredients to replace conventional ones will boost economic prosperity and enhance animal protein supply in the country. It is on this line of thought that an agro-industrial by-product, pineapple wine sediment (PWS), a residue obtained from wine industry, is seen as an alternative to most of the expensive conventional ingredients used in livestock feeding.

The PWS 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. There is a need, therefore, to determine the extent to which pigs could utilize and digest nutrients based on high levels of PWS for optimum productivity.

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 NIMET, (NIMET, 2015) 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 different sexes, 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 used for the study were randomly divided into 4 treatment groups of eight pigs and fed the experimental diets as specified in Table 1. 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 Jacobs Wines Limited, Mgbidi, Imo State, and sun-dried for seven days after which it was pulverized and proximate analysis was carried out using theAOAC (2016) method before incorporation into ration formulation (Table 1).

Table 1: Percentage composition of grower pigs ration containing graded levels of PWS.

Ingredients	Dietary treatments			
	T_1	T_2	T_3	T_4
Pineapple wine sediment meal	0.00	4.00	8.00	12.00
Maize meal	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**

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 PWS in the diets were included at equal ratios. Table 2 shows the ingredient composition of the experimental diets.

The proximate composition of the PWS used in the study were dry matter 85.81%, organic matter 95.80%, crude protein (N x 6.5) 19.63%, ether extract (crude ether) 3.80%, crude fibre 6.25%, crude ash 9.99%, and Nitrogen free extract (NFE) 46.14% respectively.

Apparent Nutrient Digestibility Assay

At the fourth week of the trial, 8 grower pigs, two from one treatment group, were randomly selected and kept in locally constructed metabolism cages (107cm x 60cm x 50cm) for nutrient digestibility assay. Grower pigs were acclimatized for three days in the metabolism cages followed by four days collection period. The grower pigs were fed daily with known weights of feed (which march their daily intake). The faeces (free of feed and other contaminants) were collected daily from the pen and dried at

60^0C, weighed and put in labeled plastic bags and stored in a deep freezer at 20^0C before the analysis. At the end of the four days collection period, faeces from each replicate were dried, mixed, ground and representative samples were taken for proximate composition determination.
The faecal and feed samples from the four treatment diets were then analysed for ash, crude protein, ether extract, crude fibre and nitrogen free extract according to the procedures of Official Methods of Association of Analytical Chemists (AOAC, 2016).
Proximate composition of the feed and faecal samples were determined from which the apparent digestibility coefficients of nutrients were calculated using the formula below:

$$\text{Apparent Digestibility of Nutrient} = \frac{\text{Nutrient in the feed} - \text{Nutrient in the faeces} \times 100}{\text{Nutrient in the feed}}$$

Data Analysis
Data collected from the study were subjected to analysis of variance (ANOVA) by Steel and Torrie (1980) while significant treatment means were separated using Duncan's New Multiple Range Test (DNMRT) as outlined by Obi (2002).

RESULTS AND DISCUSSION
Growth performance and apparent nutrient digestibility of grower pigs fed with diets containing PWS are shown in Tables 2 and 3, respectively. The feeding of graded levels of PWS based diets did not significantly ($P>0.05$) affect the DM intake of grower pigs (Table 2). The low apparent crude protein and NFE digestibility recorded with grower pigs containing 20% and 30% PWSM could be associated with increased dietary fibre as PWS inclusion increased, which reduced nutrient absorption and utilization (Ray et al., 2024; Corina-Bianca et al., 2022). Fibre utilization has been reported to modify the concentration of caecal volatile fatty acids, reduce nutrient digestibility and affect energy and nutrient balance (Liu et al., 2016). Moreover, the efficient utilization of fibre in a diet can be influenced by the physical and chemical composition of the whole feed, age and weight of the animal, adaptation to the fibre sources and individual variation among pigs (Lindberg, 2014; Ray et al., 2022) .In the current study, it was observed that grower pigs on 30% PWS recorded the poorest weight gain though not significantly different ($P>0.05$) from other treatment means.

Table 3 indicates high CF (78.88-81.26%) and ash content (75.89-80.80%) digestibility coefficient which appears to have originated from higher crude fibre level of PWS based diets. The marginal level of significance ($P<0.05$) that existed in comparison with the control suggests that the crude fibre fraction of the ingredient is mainly the soluble fibre that is more digestible than the insoluble fractions. Moreover, the bromelain, which is a proteolytic enzyme found in pineapple and bentonite must have contributed in the breakdown of pectins and tannins which are complex carbohydrate derivatives. This result is in agreement with the the report of Isikwenu et al. (2010) who found an inverse relationship between dietary fibre digestibility coefficient and bioavailability of nutrients. Ash digestibility was slightly higher in PWS based diets, and this, according to Ames et al. (1993), was as a result of the phenolic compounds contained in pineapple notably the flavonoids, vitamins and minerals. The ash percentage is an indication of the mineral constituent of the test ingredient.

Beyond 20% PWS inclusion level, weight gain and final live weight reduced significantly ($P<0.05$). This could be as a result of the presence of anti-nutritional factors in the test material notably pectins and tannins which have effect on growth (Ray et al., 2024). The spectrum and concentration of pectic substances in the gastro-intestinal tract (GIT) of grower pigs has been reported to distort the transient retention period of the caecal digesta, hence lower nutrient digestion and utilization (Zijlstra, and Beltranena, 2014).
From all indications, the control group ($T_1$0%) has the highest Nitrogen free extract (NFE) nutrient digestibility (93.40%) than grower pigs on PWSM based diets which ranged from 79.31-85.27%, while marginal significant differences ($P<0.05$) existed between the treatment means. The results obtained in this study are in line with the reports of Dung et al. (2002) and Amaefule et al. (2006) on apparent nutrient digestibility of grower pigs.

Table 2: 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[b]	0.72[a]	0.70[ab]	0.67[b]	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).

Table 3: Apparent nutrient digestibility of grower pigs fed diets containing PWSM

	Dietary inclusion of PWSM (%)			
Measurements	**T_1**	**T_2**	**T_3**	**T_4**
Apparent nutrient digestibility				
Dry matter (%)	86.80±3.18[a]	86.84±3.21[a]	80.50±2.62[c]	82.77±2.96[b]
Moisture content (%)	13.20±0.98[c]	13.16±0.91[c]	19.50±1.14[a]	17.23±1.05[b]
Crude protein (%)	86.72±0.81[a]	87.62±0.86[a]	76.64±0.77[b]	78.57±1.0[b]
Ether Extract (%)	88.46±1.52[c]	92.19± 1.87[a]	91.18±1.69[b]	90.86±1.66[a]
Ash (%)	79.29±1.62[a]	75.89±1.53[b]	80.80±1.86[a]	79.61±1.67[a]
Crude fibre (%)	66.07±1.45[b]	78.88± 1.96[b]	79.07±2.11[b]	81.26±2.18[a]
NFE (%)	93.40±4.16[a]	79.31±3.12[b]	85.27±3.6[b]	80.26±3.35[c]

[abc] Means within rows with same superscripts are not significantly different (P>0.05)

CONCLUSION AND APPLICATION

The results of this study indicate that PWSM has a great potential as an alternative ingredient for maize. Pigs could be fed up to 30% pineapple wine sediment (PWS) in the diet without compromising growth performance and nutrient digestibility. However, the optimum inclusion level in the diet should be 20%.

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