

INTERNATIONAL JOURNAL OF AGRICULTURE, MANAGEMENT AND TECHNOLOGY



Vol 7(1) 2023

Published by
Federal College of Agriculture,
Ishiagu Ebonyi State

GROWTH PERFORMANCE OF GROWING PIGS FED GRADED LEVELS OF SWEET POTATO WASTE MEAL (*Ipomea batatas*) SUPPLEMENTED WITH YEAST IN THEIR DIETS

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ABSTRACT

A study was conducted to determine the growth performance of growing pigs fed graded levels of sweet potato waste meal (*Ipomea batatas*) supplemented with yeast additive in their diets. Sun-dried sweet potato waste meal supplemented with yeast was used to replace maize at various levels of 20%, 40% and 60% to determine the best replacement that would give optimal performance in growing pig diets. 24 unsexed young growing pig of large white cross breed at 8 weeks of age were used for this experiment. They were divided into 4 treatment groups of 6 pigs each. Each treatment was subdivided into three replicates of 2 pigs each. Each replicate was housed in a pen. Each group was randomly assigned to experimental diet in a completely randomized design (CRD). The pigs were weighed individually at the beginning of the experiment and weekly thereafter for determination of their growth performance. The pigs were fed the experimental diets for 9 weeks. Both water and feed were given ad libitum. Feed intake was recorded daily by weighing the quantity of feed offered and the leftover the following morning. Parameters measured were initial body weight, final body weight, body weight gain, feed intake, feed conversion ratio (FCR), daily body weight gain, cost of production, internal organ weights and backfat thickness, cut-parts weights, dressed weight and percent dressed weight. Data collected were analysed using one way Analysis of Variance (ANOVA). The group on TMT3 consumed significantly ($P < 0.05$) less feed than the other groups. The pigs on treatment 1 (Control diet) recorded significantly ($P < 0.05$) higher body weight gain than those on TMT2 and 4. This was closely followed by the pigs on TMT3. The superior performance of the pigs on TMT3 could be due to inclusion of yeast in their diets. The feed conversion ratios of the pigs on TMT1 (Control diet) and TMT3 supplemented with yeast were similar ($P > 0.05$) and were significantly ($P < 0.05$) better than those on treatment 2 and 4. The poor feed conversion ratio of pigs on TMT4 could be due to the inclusion of high level of sundried sweet potato waste meal and the dustiness of the feed. The internal organs and cut parts as percent of the liveweight were not affected by the treatments. Only the pigs in TMT2 and 4 accumulated back fat thickness which were quite minimal. Cost of production was lowest for TMT2 followed by those on TMT3 and 1 while TMT4 had the highest cost of production. The pigs on TMT2 and the group on TMT3 recorded the lowest percent dressed weight. The cost of production of the growing pigs was lowest for those on TMT2 (₦6,626.92) while the highest was for those on TMT4 and control diet (TMT1). The result of the study showed that sundried sweet potato waste meal supplemented with yeast (*Saccharomyces cerevisiae*) could be used up to 40% in the diets of growing pigs without affecting body weight gain, feed intake, and feed conversion ratio.

Keywords: Growth performance, pigs, sweet potato, waste meal, supplemented, yeasts, diets

INTRODUCTION

Pig production has depended on maize as the source of dietary energy. However, cost of maize has been escalating within the last 20 years because of the demand pressure arising from its use as staple food for humans, feed for livestock and raw materials for some industries (Udedibe, 2003). This has adversely affected pig production in the country due to unbearable increase in feed cost and its concomitant effect on the cost of pig products. There is the need therefore to look for alternative to maize if pig enterprise in the country must be sustained. Agro by-products and wastes have been identified as alternative feedstuffs and can form a major source of energy in animal feeds (Adejumo, 2006). One of such

agro by-products that can be harnessed is sweet potato wastes. Sweet potato is a staple food in Nigeria. The average yearly production of sweet potato root crop in Nigeria is estimated at 75,860 metric tons and the yield in Kg/ha is 12,245 (FAO, 1990). The substantial fractional part of the root constitutes the waste meal.

Tewe (1997) projected that the crop residue from sweet potato waste meals will be 4.72 metric tons per hectare as of the year 2000. Osuagwu (2006) reported that 5% dietary level of inclusion of sweet potato meal gave good performance in weaner rabbits' diets. The sweet potato wastes are a good source of quality carbohydrate. Sweet potato waste contains about 5.36 percent crude protein and metabolizable energy of

about 3,180 Kcal/Kg (Oyenuga, 1968; Jansen, 1989 and Osuagwu, 2006; Ameh, 2010). Considering the various attributes of sweet potato waste meal, it would appear that its proper utilization can be efficient to replace maize as energy source in the diets of growing pigs and can promote their performance.

MATERIALS AND METHODS

Experimental site/location

The study was conducted at the Piggery Unit of Teaching and Research Farm of Michael Okpara University of Agriculture Umudike, Abia State. The site is located on latitude 05° 29'N and longitude 07° 33' E of an altitude of 123m above sea level. Umudike has an annual rainfall of 2177mm, with maximum and minimum daily temperature of 27°C - 36°C and 20° - 26°C respectively. It has a relative humidity of 57 – 91% (NRCRI, 2010).

Procurement and processing of sweet potato waste and feed ingredients

The sweet potato waste was collected from sweet potato dealers (traders) at Oriagu market in Imo State. They were dried under the Harmattan sunshine for one week before it was milled to sweet potato waste meal and bagged for use. Other feed ingredients like palm kernel meal, maize, premix, salt, methionine, soyabean meal, lysine, fishmeal, bone meal were procured from Jocan Livestock Services, Umuahia.

Anti-nutrient determination

The test materials, fresh and sundried sweet potato waste meal were analysed for the anti-nutrient

contents such as oxalate, phytic acid, saponins, tannin, alkaloids and flavonoids. Total oxalate were determined according to Association of Official Analytical Chemist (AOAC, 2005). Phytic acid was determined according to Joslyn (1970), Saponin was determined according to Brunner (1984), Tannins was determined using the spectrometric method of AOAC (2005).

Chemical analysis of feed ingredients

All the processed feed ingredients; sweet potato waste meal, palm kernel cake, soyabean meal, fishmeal were subjected to proximate analysis according to AOAC (1995) to determine their nutrient composition and gross energy. All analysis was based on 100% dry matter. This was done to use the value obtained to determine the nutrient composition of the experimental diets that were formulated from them. The components that were determined include: Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), and Nitrogen Free Extract (NFE).

Experimental growing pig diets

For growing pigs, a control diet based on maize as the major source of energy was made. Three (3) other diets were formulated such that diets 2, 3 and 4 contained 20%, 40% and 60% of processed sweet potato waste meal supplemented with yeast (*Saccharomyces cerevisia*) to replace maize in the control diet (Diet 1) (Table 1). The other dietary ingredients were varied in other to provide the required protein and energy for the pigs. The following diets were produced and tested in the feeding trial.

Table 1 Ingredients and Nutrient Composition of the Experimental Growing Pig Diets Supplemented with Yeast (1g/kg) diet

Ingredients %	Diet 1 (Control)	Diet 2 20% SPWM	Diet 3 40% SPWM	Diet 4 60% SPWM
Maize	60.00	48.00	36.00	24.00
SPWM*	-	12.00	24.00	36.00
SYBM	25.00	25.00	25.00	25.00
PKC	8.15	8.15	8.15	8.15
Fish meal	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00
Vit/mineral/premix**	0.25	0.25	0.25	0.25
L. methionine	0.10	0.10	0.10	0.10
L-lysine	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculate nutrient composition of the growing pig diets				
Crude protein (%)	20.92	20.33	19.90	19.60
Crude fibre (%)	5.27	5.25	5.25	5.20
Ether extract (%)	8.65	8.30	7.92	7.55
Ash (%)	2.28	2.29	2.30	2.25
Calcium (%)	1.65	1.64	1.64	1.64
Phosphorus (%)	1.63	1.60	1.57	1.54
ME Kcal/Kg	3288.55	3109.75	3080.95	3052.15.

*sweet potato waste meal

**to provide per kg diets

Vit. A 2000000; vit D3, 4000iu; Vit e, 0.8g; Vit K, 0.49; Vit b, 0.39; Vit B2, 10g; Folic acid, 0.2g; Biotin, 8.00g; Choline 48.00mg; BHT, 32.00g; Manganese 16.00g; Iron 8.00g; zinc, 7.2g; Copper, 0.32g; Iodine 0.25; cobalt, 36.00mg; Selenium 16.00mg

Management of experimental growing pigs

A 9-week feeding trial was conducted using 24 unsexed young growing pigs of large white cross breed at 8 weeks of age. They were divided into 4 treatment groups of 6 pigs each and each treatment were subdivided into 3 replicates of 2 pigs each. Each replicate was housed in a pen. The pigs were weighed individually at the beginning of the experiment and their average weight and sex balanced and weighed weekly thereafter for determination of their growth performance. The pigs were assigned the experimental diets using completely randomized design for 9 weeks. Both water and feed were given ad-libitum.

Carcass evaluation

Carcass evaluation was carried out at the end of the experiment. 2 pigs were randomly selected from each treatment, starved of feed but not water for 24 hours (day), weighed and slaughtered for the determination of the weights of the following: internal organs (heart, liver, kidney, spleen, lungs), dressed meat, backfat thickness. The head, neck, legs and viscera were removed to obtain the dressed weight and percentage dressed weight calculated. The internal organs weight were expressed as percentage of live weights.

Data collection and analysis

$$i. \quad \text{Daily feed intake} = \frac{\text{Feed offered} - \text{leftover}}{\text{Number of pigs}}$$

Data collected in the pig feeding trial were: feed intake, body weight gain, feed conversion ratio, weight of internal organs (liver, heart, kidney, spleen, lungs, and abdominal fat), dressed carcass, back fat thickness. These data were subjected to one way analysis of variance (ANOVA) as outlined by Snedecor and Cochran (1978), where significant treatment effect are detected, means were compared using Duncan's New Multiple Range Test (Steel and Torrie, 1989).

Experimental design

The experimental design was completely randomized design (CRD). The design model was:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where:

Y_{ij} = observation

μ = Mean

T_i = effects of treatment

e = error mean

Growth performance parameters

Initial weight of the growing pigs was taking at the beginning of the feeding trial and mean weight was taken on weekly basis. Feed intake was taken daily.

- ii. Daily weight gain = $\frac{\text{Body weight change}}{\text{Number of days of feeding trial}}$
- iii. Feed conversion = $\frac{\text{Average daily feed intake}}{\text{Average daily weight gain}}$
- iv. Cost of production = Feed conversion ratio x average weight gain

Economics of production

Economics of production was calculated using the following parameters

- i. Cost/Kg of diet = total cost of producing 1kg of feed
- ii. Cost of feed consumed = Cost/Kg x total feed consumed.
- iii. Cost/Kg weight gain = $\frac{\text{Cost of feed consumed}}{\text{Body weight gain}}$
- iv. Cost/Kg production = Feed conversion ratio x cost of feed / kg
- v. Revenue = Price of 1 kg meat x weight gain
- vi. Gross Margin = Revenue – cost of production
- vii. Return on Investment = $\frac{\text{Gross margin}}{\text{Cost of Production}} \times \frac{100}{1}$

RESULTS AND DISCUSSION

Anti-nutrient and proximate composition of fresh (raw) and sun-dried sweet potato waste meal

Table 2: Anti-nutrients of raw (fresh) and sun-dried sweet potato waste meal

Parameters	Fresh (Raw) sweet potato waste	Sundried sweet potato waste
	meal	meal
Tannin (mg/g)	1.62	1.60
Saponin (mg/g)	0.05	0.05
Alkaloid (mg/g)	4.86	4.75
Oxalate (mg/g)	0.45	0.45
Phytate (mg/g)	0.07	0.47
Flavonoid (mg/g)	1.06	1.00

Anti-nutritional factors are substances that when present in animal feed hinders or reduces the availability of one or more nutrients. In other instances, they form complexes with some of those nutrients thus making it impossible for them to be digested and or degraded. Phytate lowers absorption and impairs the solubility of proteins. Saponin

decreases performance and growth rate. The values of tannin (1.62mg/g), Saponin (0.05mg/g), alkaloids (4.86 mg/g), oxalate (0.45 mg/g), phytate (0.07 mg/g), 1.06 mg/g recorded in this study fall within range reported by (Akinmutimi and Anakebe, 2008; Ameh (2010).

Table 3: Proximate composition of fresh (raw) and sundried potato waste meal

Parameters	Fresh (Raw) sweet potato	Sundried sweet potato waste
	waste meal	meal
Dry matter (%)	61.25	88.75
Moisture	38.75	11.25
Ash/Mineral (%)	4.60	6.28
Crude protein (%)	3.28	4.95
Ether extract (%)	0.60	0.82
Crude fibre (%)	1.17	2.64
Nitrogen Free Extract (%)	51.60	74.06
Metabolizable Energy (Kcal/kg)	2068.66	3013.59

The proximate composition of fresh (raw) and sundried sweet potato waste meal were presented in (Table 2). All values obtained for crude protein, crude fat, moisture content, ash, nitrogen free extract and metabolizable energy fall within the range reported by Aduku (1993), oyenuga (1968), Osuagwu (2006), Akinmutimi and Anakebe (2008), Ameh (2010), AOAC (2005).

Growth performance of the experimental pigs fed diets containing sweet potato waste meal supplemented with yeast (*Saccharomyces cerevisiae*)

Table 4: Growth performance of the experimental pigs fed diets containing sweet potato waste meal supplemented with yeast (*Saccharomyces cerevisiae*)

Parameters	Sweet potato waste meal				SEM
	Diet (TMT 1)	Diet (TMT 2)	Diet (TMT 3)	Diet (TMT 4)	
Initial body weight (Kg)	4.17	4.19	5.53	5.05	0.29
Final Body weight (Kg)	17.00 ^{ab}	15.95 ^b	17.79 ^a	15.25 ^b	0.49
Body weight gain (Kg)	12.83 ^a	11.76 ^{ab}	12.26 ^a	10.20 ^b	0.49
Daily body weight gain (g)	20.37 ^a	18.67 ^{ab}	19.46 ^a	16.19 ^b	0.77
Daily feed intake (g)	96.23	96.13 ^a	95.65 ^b	96.86 ^a	0.22
Feed conversion ratio	4.72 ^a	5.15 ^{ab}	4.92 ^a	5.92 ^b	0.23

^{abc} means within the same row with different superscripts are significantly ($P < 0.05$) different.

SEM = Standard Error Mean

Data on the performance of the experimental pigs are shown in table 4.

Initial body weight

The average initial bodyweight of the growing pigs were 4.17kg, 4.19kg, 5.53kg and 5.05kg for the control diet (TMT 1), Treatment 2, 3 and 4 respectively. There were no significant differences (P

> 0.05) among the treatment groups in their initial body weight.

Final body weight

The final body weights of the experimental pigs were 17.00kg, 15.95kg, 17.79kg and 15.25kg for treatments 1, 2, 3 and 4 respectively. There were significant differences ($P < 0.05$) among the treatment groups. The pigs in Treatment 3 and those on the control diets significantly ($P < 0.05$) recorded heavier body weights than the pigs on the other diets. The final body weights of the pigs in TMT 2 and 4 were similar and significantly ($P < 0.05$) lower than those on the control diets and treatment 3. The heavier final body weight of pigs in TMT 3 (40% PWM) could be as the result of inclusion of yeast in their diets. The decreased final body weight in TMT 4 (60% PWM) could be as the result of high sweet potato tuber meal in their diets and the dustiness of the feed due to high sun dried sweet potato waste meal.

Body weight gain

The body weight gain of the experimental pigs fed with sweet potato waste meal supplemented with yeast were 12.83kg, 11.76kg, 12.26kg and 10.20kg for treatments 1, 2, 3 and 4 respectively significant differences ($P < 0.05$) existed between the control and the other treatments. The pigs on treatment 1 (control diet) recorded significantly ($P < 0.05$) higher body weight gain than those of treatment 2 and 4. This was closely followed by the pigs on treatment 3. The superior performance of the pigs on treatment 3 could be due to inclusion of yeast in their diets. Previous studies indicated that supplementation with yeast additive enhances animal nutrition and health, and that dietary supplementation with yeast additive (*Saccharomyces cerevisiae*) could increase body weight and feed efficiency and promote the immune system in animals while decreasing the percentage of abdominal fat in broilers (Gao et al, 2008; Afsharmanesh et al., 2010).

Daily body weight gain

The daily body weight gains of the experimental pigs were 20.37g, 18.67g, 19.46g and 16.19g respectively for treatment 1, 2, 3 and 4 respectively. Significant differences ($P < 0.05$) existed between the control and the other treatment pigs. The daily body weight gain of the pigs follows the pattern of body weight gain. The pigs of the treatment (Control) and treatment 3

significantly recorded the higher daily body weight gain than those on treatment 2 and treatment 3. Those on treatment 4 recorded the lowest daily body weight gain. This could be due to the poor efficiency of utilization of the diet (60% PWM) supplemented with yeast as well as the dustiness of the feed.

Daily feed intake

The daily feed intake of the experimental pigs were 96.22g, 96.13g, 95.65g and 96.86g for treatment 1, 2, 3 and 4 respectively significant differences ($P < 0.05$) existed among the different treatment groups. The pigs in treatment 1, 2 and treatment 4 recorded similar daily feed intake which was significantly ($P < 0.05$) higher than those on treatment 3. The low feed intake of the pigs on treatment 3 supplemented with yeast was due to the dustiness of the feed. Some metabolites in yeast are beneficial for stimulating bacterial growth in the digestive tract and optimizing animal feed intake (Zhe et al, 2019).

Feed conversion ratio (FCR)

The feed conversion ratio of the experimental pigs was 4.72, 5.15, 4.92, and 5.92 for treatment 1, 2, 3 and 4 respectively. Significant differences ($P < 0.05$) existed among the treatment groups in their feed conversion ratios. The feed conversion ratio of the pigs on treatment 1 (control diet) and treatment 3 supplemented with yeast were similar ($P > 0.05$) and were significantly ($P < 0.05$) better than those on treatment 2 and 4. The poor feed conversion ratio of pigs on treatment 4 could be due to the dustiness of the feed. According to Landy and Kavyani, (2013), Probiotics (Yeast) can increase feed intake along with significant improvement in feed conversion ratio (FCR). It can also improve FCR without significant difference in feed intake (Mount zouris et al, 2010; Shim et al., Kim, 2014).

Mortality

One mortality occurred in treatment 2. There was no reason to blame the mortality on the dietary inclusion of the yeast material especially as the distribution of the mortality figure did not have a pattern and was quite low.

Internal organ weight of growing pigs fed experimental diets

Table 5: Internal organ weight of experimental pigs fed potato waste meal supplemented with yeast

Parameters	Diet (TMT 1)	Diet (TMT 2)	Diet (TMT 3)	Diet (TMT 4)	SEM
Live weight (kg)	26.50	19.50	25.50	23.50	1.34
% Heart	3.96	5.89	4.71	5.32	0.36
% Liver	3.7	3.13	2.55	3.49	0.78
% Spleen	0.25	0.18	0.18	0.13	0.022
% Lung	1.20	1.54	1.37	1.06	0.09
% Kidney	0.53	0.49	0.53	0.49	0.01
% Bile	0.11	0.23	0.20	0.17	0.06
% Abdominal	0.40	0.12	0.31	0.38	0.06
% Intestine	11.89	16.92	15.69	15.69	0.94
% Stomach	3.43	2.17	2.90	2.98	0.23

^{abc} means within the same row with different superscripts are significantly ($P < 0.05$) different.

SEM = Standard Error Mean

Cut parts weights of experimental pig feed experimental diet

Table 6: Cut parts weights of experimental pigs fed potato waste meal supplemented with yeast

Parameters	Diet (TMT 1)	Diet (TMT 2)	Diet (TMT 3)	Diet (TMT 4)	SEM
Live weight (kg)	26.50	19.50	25.50	23.50	1.32
% Dressed up	60.38	61.54	49.02	51.06	2.76
% Head	17.50	15.83	23.20	24.51	1.84
% Trotter	5.00	5.00	6.40	7.50	0.52
% Ham	16.25	16.67	16.80	17.50	0.22
% Loin	10.63	1.33	12.40	9.58	0.52
Back fat thickness (cm)	1.60	1.50	2.00	1.50	0.10

abc means within the same row with different superscripts are significantly ($P < 0.05$) different. SEM = Standard Error Mean

The carcass and organ weight of the experimental pigs were presented in Tables 4 and 5. The dressing out percentage of the groups ranged from 49.02 to 61.54%. The group on TMT 3 and 4 had the lowest dressing out percentage which was significantly different ($P < 0.05$) from those of the other treatments. However, there were no statistical differences among the dressed out percentage of the pigs on TMT1 and TMT2 respectively. The pigs on TMT2 recorded the

highest dressing out percentage of 61.54, which was significantly better ($P < 0.05$) than other treatment groups. The weights of the heart, liver, spleen, kidney, lungs, abdominal fat, intestine expressed as percentage of liveweight ranged from 3.96 – 5.89%, 2.55 – 3.49%, 0.13 – 0.25, 0.49 – 0.53%, 1.06 – 1.54%, 0.12 – 0.40%, and 11.89 – 16.92% respectively. The weights of the internal organs of the pigs were not affected by the treatments ($P > 0.05$).

Economics of production of experimental pigs

Table 7: Economics of Production of Experimental Pigs fed diets containing sweet potato waste meal supplemented with yeast.

Parameters	Diet (TMT 1)	Diet (TMT 2)	Diet (TMT 3)	Diet (TMT 4)
Cost/Kg Diet (₦)	332.06	212.34	290.46	272.17
Quantity of feed consumed (Kg)	6.06	6.06	6.03	6.10
Cost of feed consumed (₦)	2012.28	1286.78	1751.61	1660.25
Cost/Kg weight gain (₦)	1568	1044.21	1428.61	1627.69
Cost of production ₦/pig	9518.08	6626.92	8617.23	9828.60
Revenue (₦)	15306	14112.00	14712.00	12,420.00
Gross Margin (₦)	5841.9	7485.08	6094.77	2411.35
Return on Investment (%)	61.38	112.95	70.73	24.53

From Table 7 Economics of production of experimental pigs is summarized in (Table 7). Prices of feed ingredients at the time of the project was executed are shown in appendix 1. Using the prices, the cost of a kilogramme of each experimental diet was calculated and this was used to determine the cost of feed required to produce a kilogramme of pig live weight. The feed costs (₦/kg) for the treatment groups were ₦332.06, ₦212.34, ₦290.96, and ₦272.17 for the control (TMT 1), TMT2, TMT3 and TMT4 respectively. Treatment 1 (Control) had the highest cost while treatments 2, 3, and 4 were relatively low. The feed costs per kg body weight gain for the groups were ₦1,568, ₦1,044.21, ₦1,428.61 and ₦1,627.69 for the control (TMT1), 2 3, and 4 respectively. The groups on TMT2 recorded the least cost of production followed by those on TMT3 and 1 while TMT4 had the highest cost of production respectively.

CONCLUSION

The result of the study demonstrated that sun drying of sweet potatoes waste was not quite effective for eliminating the anti-nutrients in sweet potato waste

because there were still traces of anti-nutrients in the dried samples. Sun dried sweet potato waste meal supplemented with yeast could be used in the diets of

growing pigs up to 40% without affecting the body weight gain, feed intake and feed conversion ratio.

RECOMMENDATIONS

Based on the result of the study, it was therefore recommended that sundried sweet potato waste meal supplemented with yeast additive could be used up to 40% to replace maize in the diets of growing pigs for optimum performance.

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