Performance Characteristics and Blood Metabolites of Weaner pigs Fed different Feed Grade Coded *MUSARPOMS*

Abstract

A new feed grade coded *MUSARPOMS* 25 %, 50 % and 75 % at 10 and 20 % replacement level was used as a case study to determine growth performance and blood metabolites of weaner pigs. Twelve weeks feeding trial was conducted to determine the performance and some haematological paremeters of weaner pigs fed *MUSARPOMS* diets as replacement for maize. Twenty eight six weeks' old weaner pigs with an average weight of 8.00kg were randomly allocated to seven treatments of 0 (Control), 25 %, 50% and 75% at 10 and 20 % replacement levels of *MUSARPOMS* 25 % Grade (25 % ripe plantain peels and 75 % Palm oil mill slurry mixture), *MUSARPOMS* 50 % Grade (50 % ripe plantain peels and 50 % Palm oil mill slurry mixture), and *MUSARPOMS* 75 % Grade (75 % ripe plantain peels and 25 % Palm oil mill slurry mixture). Each treatment had four replicate made up of two male and two female. Data were collected on live weight, weight gained and feed intake while feed efficiency and feed conversion ratio were determined. The average initial weight, final live weight, total weight gained and daily weight gained showed no significant ($P > 0.05$) differences in growing pigs across the treatments. Feed conversion ratio and feed efficiency did not differ significantly ($P>0.05$) from the control. Some haematological parameters, fasting blood sugar and serum protein were tested for each 28 growing pigs at the end of the feeding experiment. Results of the full blood count revealed that the white blood cells and its differentials showed no significant ($P<0.05$) differences except monocyte. Serum protein and glucose showed no significance ($P>0.05$) differences in globulin, total protein and glucose. Based on the results of this experiment, it can be concluded that feeding "*MUSARPOMS*" grades at 10% and 20% levels compared well with the conventional energy feedstuff. The growth performance of the pigs indicated adequate utilization of the three *MUSARPOMS* grades developed.

Keywords: *MUSARPOMS*, Weaned Pigs, Performance Characteristics, Proximate Analysis, Mineral Analysis Blood Metabolites

Introduction

Animal feed is an essential part of livestock production; the availability and affordability are key factors for maintaining sustainability of the livestock industry Ekhorutomwen (2019). Monogastrics (especially swine and poultry), have made very important contributions to the production of animal protein in many Countries around the world (Olomu, 2011). Conventional energy and protein feed sources

for livestock feed production are extremely expensive and scarce (Tewe, 2004; Ogunwole *et al*., 2017) Plantain peels are discarded as waste after the inner fleshy portion has been eaten, thereby constituting menace to the environment (Okareh *et al.,* 2015). Palm oil mill slurry is basically a waste material from the palm oil mill industry which is a major waste product usually more than palm oil, which is the primary product (Heuzé *et al*., 2015). Ripe or unripe plantain wastes can be used to feed livestock or in the production of local soap but in the areas where these are not feasible, these wastes end up polluting the environment (Williams 2001; Ekhorutomwen and Nwokoro, 2022). These two agro by-products are abundant, constitute a waste and are capable of compromising the ecosystem when improperly disposed. Ekhorutomwen and Nwokoro, 2022 reported the proximate composition of ripe plantain peels as 10.50 % Crude Protein, 23.84 % Crude Fat, 10.66 % Crude Fibre, 11.00 % Ash, 37.17 % NFE. Ighodaro (2012) reported the proximate composition of ripe and unripe plantain peels to be respectively; 7.04 and 7.47 % moisture, 22.30 and 17.59 % ash, 14.31 and 16.20 % fibre, 6.22 and 3.67 % crude fat, 42.95 and 48.18 % carbohydrate, 7.18 and 6.89 % crude protein. It was however observed from these reports and some others that the nutritional compositions differ slightly, which could be attributed to sampling locations. Ripe plantain peel meals replaced up to 31 % of maize in growing pig diet without adverse effect on growth performance (Calles *et al*., 2000). Ironkwe and Oruwari (2012) reported that maize can conveniently be replaced with plantain peel meal in broiler finisher diet up to 50 % inclusion. However, above 50 % inclusion level of plantain peel, feed intake was reduced (Ironkwe and Oruwari, 2012); these two agro by-products are abundant, constitute a waste and are capable of compromising the ecosystem when improperly disposed. It is predictive that the usability of the plantain peels can be enhanced by combination with palm oil mill slurry (Ekhorutomwen, 2019). Fermentation process in cassava peels and palm oil mill mixture enables the breaking down of the fibre a content through microbial metabolic activities has help to improve the quality of the feed (Abiola-Olagunju *et al*. 2014; Ekhorutomwen, 2019). Therefore, the objective of this study was to determine the performance characteristics and blood metabolites of weaner pigs fed different feed grade coded *MUSARPOMS* at 10 and 20 % replacement level for maize.

***MUSARPOMS* Development:**

Fresh palm oil mill slurry was used to mix the ground ripe plantain peels properly. The component mixture was weighed and mixed at different proportion to produce the MUSARPOMS 25 %, MUSARPOMS 50 % and MUSARPOMS 75 % grades. These were then spread on flat trays and allowed to age before drying. The sundried MUSARPOMS grades were milled and bagged for chemical analysis. Samples of each MUSARPOMS grade (25 %, 50 % and 75 %) after drying were taken for proximate analysis (crude protein, crude fibre, ether extract, and ash and nitrogen free extract) using AOAC (2010) procedures. The mineral content of the ripe plantain peel was determined using the flame photometer. *MUSARPOMS* were also examined for some physical characteristics (colour, smell, etc) (Ekhorutomwen and Nwokoro, 2022).

MUSARPOMS 25% Grade: This contained 25 % ripe plantain peels and 75 % palm oil slurry. The fresh palm oil mill slurry (POMS) was collected in a plastic container. A total of 250 g of the milled ripe plantain peels (91.11 % DM) mixture was measured out in a wide plastic bowl

and then 750 g of the palm oil mill slurry (26.48 % DM) were weighed out and put in the bowl while stirring thoroughly. The palm oil slurry and the plantain peels were thoroughly mixed. The mixture was dispensed into containers for ageing at 3 days with intermittent turning and overturning, when completely dried, the *MUSARPOMS* 25 % grade was milled and bagged (Ekhorutomwen and Nwokoro, 2022).

***MUSARPOMS* 50 % Grade**: This Contains 50 % plantain peels and 50 % palm oil mill slurry (POMS). The procedure for development was exactly the same as in the formulation of MUSARPOMS 25 % except that 500 g palm oil mill slurry was measured out and mixed with 500 g ripe plantain peels (Ekhorutomwen and Nwokoro, 2022).

***MUSARPOMS* 75 % Grade**: This contains 75 % plantain peels and 25 % palm oil mill slurry (POMS). Also 750 g ripe plantain peels was measured out and mixed with 250 g palm oil mill slurry. The procedure for development was exactly the same as in the formulation of MUSARPOMS 25 %. (Ekhorutomwen and Nwokoro, 2022).

Materials and Methods

Location of Experiment

This study was carried out at the Piggery Unit of the University of Benin Teaching and Research Farm, Ugbowo Campus, Benin City, Edo State, Nigeria. Benin City is located between latitude 6^{o} and 30^{1}N of the Equator and longitude 5^{o} 40^{1} and 6 ^{o}E of the Greenwich meridian in the rain forest zone, with mean monthly temperature of 27.6 ^{o}C. The area has an average annual rainfall and relative humidity of 2162 mm and 72.5 % respectively (Metrological Section of the Nigeria Airport Authority, Benin City, Edo State, Nigeria, 2021).

Housing and Experimental Design

The experiment was a 4 x 2 factorial arrangement with pigs randomly allocated in a Completely Randomized Design (CRD). The study comprises of a total of seven diets [i.e. 0, 25% (10, 20), 50% (10, 20) and 75% (10, 20)]. These seven (7) diets were replicated four times on weight equalization basis such that there were four (4) pigs per Treatment (2 male and 2 female) thereby using each animal as a replicate. The pigs were housed in a concrete floor with metallic sheet roof partitioned with rods. The housing system ensured cross ventilation.

Adaptation, Management and Data Collection

A total of twenty eight (28) weaned pigs with an initial weight ranging from 8.00kg - 10.13kg were used for this study. The pigs were fed *ad libitum* and watered for 10 weeks of study during the preliminary (adaptation) period of two week prior to the commencement of the feeding trial, during which animals were prophylactically treated for any diseases and stabilized to the new environment. The weight of the weaner pigs were taken at the end of the acclimatization period. Thereafter, the weight was taken weekly till the experiment was terminated. Some haematological parameters, fasting blood sugar and serum protein were tested for each of the 28 growing pigs at the end of the feeding experiment and placed in three different sample bottles. One containing speck of ethylenediamine tetra acetate (EDTA). Parameters were measured using the procedures by Loeb and Quimby (1999) and Dhanotiya (2004).

Statistical analysis

Data's collected during the experiment were subjected to analysis of variance using Genstat 2009 (12^{th} Edition) package. The separation of means was carried out using Duncan`s Multiple Range Tests (Steel and Torrie, 1980) at 5 % level of probability.

COMPOSITION OF THE WEANER PIG DIET

The composition and chemical components of the diets used to feed weaned in the feeding trails are presented in Table 1 and Table 2.

Table 1: Gross Composition of Experimental Diets (Percent)

	Control		**$MSP_{25\%}$**		**$MSP_{50\%}$**		**$MSP_{75\%}$**
Ingredient	Diet 1 (0 %)	Diet 2 (10 %)	Diet 3 (20 %)	Diet 4 (10 %)	Diet 5 (20 %)	Diet 6 (10 %)	Diet 7 (20 %)
Yellow maize	55.00	49.50	44.00	49.50	44.00	49.50	44.00
MUSARPOMS	0.00	5.50	11.00	5.50	11.00	5.50	11.00
Soya bean meal	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Wheat bran	19.50	19.50	19.50	19.50	19.50	19.50	19.50
Bone meal	2.30	2.30	2.30	2.30	2.30	2.30	2.30
Limestone	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Salt (NaCl)	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Pig Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25
L-lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10
TOTAL (%)	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Nutrient Composition

DM (%)	87.19	86.82	87.96	88.09	88.25	85.65	85.14
Crude protein (%)	18.67	19.64	20.47	19.68	20.58	19.08	20.19
Crude fibre (%)	27.74	26.19	26.74	26.57	18.02	18.99	18.53
Ether extract (%)	24.21	27.06	27.67	15.50	23.98	25.01	20.53
Ash (%)	9.61	7.23	11.43	11.12	10.03	10.02	12.39
NFE (%)	19.77	19.88	13.69	27.13	27.39	26.90	28.36
Energy (kcal/ kg Diet)	3178.45	3066.49	2,954.55	3,065.30	2952.16	3131.30	3084.15
Calcium (mg/kg)	0.92	0.92	1.00	0.98	1.00	0.98	1.00
Total Phosph. (mg/kg)	0.69	0.67	0.70	0.68	0.73	0.66	0.69

*Composition of vitamin – mineral premix per kg of diet: vit A., 5,000 IU; Vit. D, 800IU; Vit E. 12mg; vit. B , 1.5mg; Niacin, 12mg; pantothenic acid, 5mg; Biotin, 0.02mg; vit. B12, 0.01mg; Folic acid, 0.3mg; choline chloride, 150mg; manganese, 60mg; iron, 10mg; zinc, 15mg; copper, 0.8mg; iodine, 0.4mg; cobalt, 0.08mg; selenium, 0.04mg; antioxidants, 40mg.

Table 2: Proximate and Some Mineral Composition of "MUSARPOMS" Feedstuff Grades (25 %, 50 % and 75 %)

COMPOSITION	**MUSARPOMS GRADES**			**±SEM**
	25 %	**50 %**	**75%**	
Dry Matter (%)	91.98[a]	89.46[b]	89.15[b]	0.37
Crude Protein (%)	22.17[a]	20.42[ab]	19.25[b]	0.75
Crude Fat (%)	28.41[a]	27.86[ab]	27.20[b]	0.29
Crude Fibre (%)	18.95[a]	18.71[a]	19.13[a]	0.31
Ash (%)	19.31[a]	17.39[b]	15.30[c]	0.05
NFE (%)	3.32[a]	4.99[b]	8.280[c]	0.39
Ca (mg/kg)	474.20	497.70	515.60	13.71

Mg (mg/kg)	272.50	335.20	196.80	56.80
Na (mg/kg)	0.10	0.14	0.11	0.06
K (mg/kg)	1136.00[a]	1275.00[b]	984.00[c]	28.60
P (mg/kg)	631.80	924.30	591.50	170.70
Pb (mg/kg)	0.02	0.02	0.02	0.001
Fe (mg/kg)	535.10	427.00	569.80	134.90

[abc] means with different superscripts in the same row differ significantly (P<0.05). SEM - Standard Error of Means, $MP_{25\%}$ - 25 % *MUSARPOMS*, $MP_{50\%}$ -50 % *MUSARPOMS*, $MP_{75\%}$ - 75 % *MUSARPOMS*

Source: Ekhorutomwen and Nwokoro (2022)

Results and Discussion

The performances of growing pigs fed diet with *MUSARPOMS* are represented in Table 3.

Table 3: Performance of Growing pigs Fed Diets containing graded levels of "*MUSARPOMS*" Grades (25%, 50%, 75%)

PARAMETER	CONTROL	MSP25%		MSP50%		MSP75%		±SEM
	1 (0%)	2 (10%)	3 (20%)	4 (10%)	5 (20%)	6 (10%)	7 (20%)	
Initial live weight (kg/pig)	10.13	10.13	8.63	9.25	8.50	8.88	8.50	1.31
Final live weight (kg/pig)	37.12	38.40	31.75	38.38	38.12	33.75	33.82	3.55
Daily weight gained (kg/pig/day)	0.39	0.40	0.33	0.42	0.42	0.36	0.36	0.04
Total weight gained (kg/pig/10wks)	27.00	28.28	23.12	29.12	29.62	24.88	25.32	2.65
Daily feed intake (kg/pig/day)	1.67	1.81	1.57	1.64	1.71	1.65	1.39	0.17
Total feed intake (kg/pig/10wks)	117.00	126.50	109.80	115.00	119.70	115.30	97.50	12.13
Feed efficiency	0.23	0.23	0.21	0.26	0.25	0.22	0.27	0.02
Feed Conversion Ratio	4.41	4.57	4.89	3.95	4.04	4.65	3.80	0.35

SEM – Standard error of means, MSP- *MUSARPOMS*

The average initial weight, final live weight, total weight gained and daily weight gained showed no significant (P > 0.05) differences in growing pigs across the treatments. Feed conversion ratio and feed efficiency did not differ significantly (P>0.05). Treatment 7 ($MSP_{75\%}$ with 20 % replacement) recorded the least feed consumption (97.50 kg) whereas Treatment 2 ($MSP_{25\%}$ with 10 % replacement of maize) recorded 126.50 kg. The results from this study showed that utilizing these ingredients as a partial replacement for the conventional energy source (yellow maize) did not have significant influence on the performance of the growing pigs in both sexes. Weight gain in particular did not differ significantly among Treatments. It is therefore indicative that the *MUSARPOMS* grades at the respective replacement levels (10 and 20 %) compared well with maize (0%) of their inclusion in diets.

The Haematological Response of Growing pigs Fed Diets Containing "MUSARPOMS" Grades are shown in table 4

Table 4: Haematological Response of Growing pigs Fed Diets Containing "MUSARPOMS" Grades.

PARAMETER	CONTROL	MSP25%		MSP50%		MSP75%		±SEM
	1 (0%)	2 (10%)	3 (20%)	4 (10%)	5 (20%)	6 (10%)	7 (20%)	
PCV (%)	36.55	32.73	35.95	38.98	37.05	38.52	33.30	1.94
Hgb (g/dl)	11.25	10.30	11.38	11.20	11.68	11.92	15.65	1.72
RBC ($x10^3\mu/L$)	7.28^{ab}	6.40^{b}	7.57^{ab}	7.50^{ab}	7.36^{ab}	8.01^{a}	6.78^{ab}	0.39
WBC ($x10^3\mu/L$)	18.73	15.60	19.95	19.65	17.30	20.68	17.38	2.66
Lymphocyte (%)	29.00	43.20	35.90	43.10	35.40	41.60	38.80	5.20
Monocyte (%)	17.45^{a}	14.12^{ab}	17.98^{a}	17.05^{a}	15.70^{ab}	12.15^{b}	17.70^{a}	1.33
Neutrophil (%)	53.55	42.70	46.15	39.85	48.87	46.20	43.55	5.30
MCHC (g/dL)	30.70^{ab}	31.20^{ab}	29.50^{ab}	28.87^{b}	31.45^{b}	30.85^{ab}	49.15^{a}	5.97
MCH (pg)	15.42	16.00	14.92	15.12	15.82	14.82	15.42	0.67
MCV (fL)	50.18	50.98	47.62	52.18	50.35	48.15	49.35	1.52
MPV (fL)	8.18^{ab}	7.05^{c}	7.53^{abc}	8.35^{a}	7.38^{bc}	7.95^{ab}	7.43^{bc}	0.27
PCT (%)	0.33^{a}	0.14^{c}	0.30^{ab}	0.35^{a}	0.18^{bc}	0.39^{a}	0.19^{bc}	0.04
PDW (fL)	14.10^{a}	9.68^{b}	11.95^{ab}	14.00^{a}	12.90^{ab}	13.43^{ab}	12.72^{a}	1.29
PLT ($x10^3\mu/L$)	406.00^{abc}	194.00^{e}	392.80^{abcd}	419.00^{a}	246.00^{de}	486.80^{a}	256.00^{bde}	48.4
RDW (%)	18.43^{ab}	18.05^{b}	19.73^{ab}	18.95^{ab}	18.90^{ab}	19.97^{a}	19.18^{a}	0.51

^{abc}means with different superscripts in the same row differ significantly (P<0.05). Standard error of mean, MSP - MUSARPOMS, PCV - Packed Cell Volume, Hgb - Haemoglobin, RBC - Red Blood Cell, WBC - White Blood Cell, MCHC- Mean Corpuscular Haemoglobin Concentration, MCH - Mean Corpuscular Haemoglobim, MCV- Mean Corpuscular Volume, MPV- Mean Platelet Volume, PCT- Platelet Concentration, PDW- Platelet density of Whole Blood, PLT-Platelet, RDW - Relative Density Weight of Whole Blood.

RBC values significantly differed from each other with Treatment 6 reflecting the highest value and differed only from treatment 2. The WBC and its differentials in this study did not follow any particular trend and where not different from each other except the monocytes. All the WBC values in this study were within standard range (6 – 25 $x10^3\mu L$) but tended towards the upper limit of the range (Mitruka and Rawnsley, 1977). It also fell within range (14.26 – 32.04 $x10^3\mu L$) presented by Eze *et al*. (2010) for pigs managed under intensive system in Southeastern, Nigeria. Haematological parameters shown in this study were within normal physiological ranges reported for pigs by Mitruka and Rawnsley (1977) and Eze *et al*. (2010).

Conclusion

The results from this study showed that utilizing these ingredients as a replacement for the conventional energy source (maize), did not have significant influence on the performance and blood metabolites of the growing pigs. Weight gain in particular did not differ significantly among Treatments. It is therefore indicative that the *MUSARPOMS* grades at the respective replacement levels (10 and 20 %) compared well with maize (0 %) of their inclusion in diets.

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