Original Research Article

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 (28) 6 weeks' old weaner pigs with an average weight of 8.00kg were randomly allocated to 7 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 (4) replicate made up of 2 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 shows 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. 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) and 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). Consequently, a study was carried out using plantain peels and palm oil mill slurry to develop a feed stocked- named *Musarpoms* from locally derived non-coventional feed-stuffs for animal production. Plantain peels and palm oil mill slurry were in proportion to develop feed grade 25, 50 and 75 % *Musarpoms.* It was observed that the reducing levels of *MUSARPOMS* fermented mixture grade formulations, resulted in proportional increase in the Crude protein of the emerging ingredients Ekhorutomwen and Nwokoro (2022) as presented in Table 2

However, Formulation and Development of a Feed Stock Code-Named Musarpoms from LocallyDerived Non-Conventional Feed-Stuffs for Animal Production was developed by Ekhorutomwen and Nwokoro (2022). Performance characteristics and blood metabolites of weaner pigs fed different feed grade coded *MUSARPOMS* was determined in this study.

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, ash and nitrogen free extract) using AOAC (2010) procedures. The mineral content of the plantain peel were determined using the flame photometer. MUSARPOMS were also examined for some physical characteristics (colour, smell, etc).

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. 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.

***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.

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 %. Experimental design and statistical analysis: Data collected were subjected to a one way Analysis of Variance using,

GENSTAT 2009 (12th Edition) package. Means were separated using Duncans Multiple Range tests (Steel and Torrie, 1980) at 5 % level of probability.

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 comprise 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 (12th Edition) package. The separation of means were carried out using Duncan`s Multiple Range Tests (Steel and Torrie, 1980) at 5 % level of probability.

Table 1: Gross Composition of Experimental Diets (Percent)

Ingredient	Control	$MSP_{25\%}$		$MSP_{50\%}$		$MSP_{75\%}$	
	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
Soyabean 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

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 ingredient 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.

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.

reflecting the highest value (8.01 $x10^3$ µ/L) and differed only from treatment 2 6.40 $x10^3$ µ/L. All values however, were within normal reference ranges (5 - 10 $x10^3$µL) by Mitruka and Rawnsley (1977) and 4.33 – 11.02 $x10^3$µL by Eze *et al*. (2010). These results are in agreement with the report of Eze *et al*. (2010) who observed no association of sex and age with haematological values. According to Swenson (1990) red blood cell counts are influenced among other factors by nutrition, physical activities and volume and its reduction indicates anaemia. RBC values significantly (P<0.05) differed from each other with Treatment 6 (P<0.05) differences in the RBC of pigs. Treatment 6 recorded the highest red blood cell (RBC) value (8.01 $x10^3$ µ/L) while the lowest value was obtained from pigs on Diet 2 (10% inclusion of $MSP_{25\%}$), 6.40 $x10^3$ µ/L. White blood cells and its differentials as well showed no significant (P<0.05) differences except Monocyte. Percentage Monocyte of Treatment 1 (17.45%) and 7 (17.70 %) however differed significantly (P>0.05) from Treatment 6 (12.15%). However, Treatment 4 recorded the highest Packed Cell Volume (PCV) (38.98 %) while the lowest PCV was recorded for pigs on Treatment 2 with a value of 32.73%.The highest haemoglobin concentration were recorded from Treatment 7(15.65 g/dL) followed by those on Treatment 6 (11.92 g/dL); while the pigs on the Control diet recorded 11.25 g/dL. There were however, no significant differences in the Hgb concentrations of the diets. The platelet concentration (PCT) showed that Treatment 6 recorded the highest concentration (0.39 $x10^3$ µ/L) and lowest concentration 0.14 $x10^3$ µ/L in Treatment 2. All values however (irrespective of, were within normal reference ranges (5 - 10 $x10^3$µL) by Mitruka and Rawnsley (1977) and 4.33 – 11.02 $x10^3$µL by Eze *et al*. (2010). These results are in agreement with the report of Eze *et al*. (2010) who observed no association of sex and age with haematological values.

Conclusion

The results from this study showed that Utilizing these ingredient 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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