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RESPONSE OF WEANED PIGS TO DIFFERENT DIETARY PROTEIN SOURCES AND DIET TYPES

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ABSTRACT

Pig is one of the most consumed meat across the globe. However, its production is limited by high cost of feed ingredients. Hence, the search for alternative cheap feed ingredients without any loss to animal's performance is on the increase. The influence of different protein sources and feed types (wet or dry) was investigated on the growth performance, haematology and serum biochemistry of weaned pigs. Weight gain and feed conversion ratio were higher for soybean and full-fat soya-based diets. Feed and water intake were not significantly different amongst treatments. Nature of feed did not influence weight gain, feed intake and feed conversion ratio. Groundnut cake meal may compare with soybean meal in pig's diet, but it may have to be supplemented with lysine, methionine or fish meal.

Keywords: animal products, cost, food security, protein sources

INTRODUCTION

Africa is one of the food deficient countries (Ojo and Adebayo, 2012). Poverty, high price of food/feed, food wastage owing to crop and animal pests and diseases, unstable governmental policies and lack of adequate infrastructure, particularly in the rural areas are some of the factors affecting food security in Africa, particularly, Nigeria (Metu *et al.,* 2016). One of the ways to overcome the threatening food insecurity in Africa is to increase food production. Pigs are prolific and could be fed on variety of diets, which places them above some other animals the production of which can help to overcome food insecurity in areas plagued with this menace in Africa. However, cost of production is an important factor to be considered. Feed alone accounts for a large portion (about 70 %) of the total cost of production for monogastric animals.

In order to reduce cost of production of animal products, cheap and non-conventional feed ingredients have been assessed and the search is on-going (Babayemi and Bankole 2009; Adejumo and Bamidele, 2012; Adebiyi *et al.,* 2018). Soybean is widely used as a protein source for monogastric animals, particularly, poultry and swine. However, its major limitation is its limitation in methionine, presence of trypsin inhibitor and high cost. Trypsin inhibitor has been reported to cause pancreatic enlargement in chicks, necessitating its usual subjection to heat treatment (Ewan, 1985; Leiner, 1981; Adejumo and Ologhobo, 2012; Hittle, 1975).

Groundnut (*Arachis hypogea*) is widely farmed and relatively readily available in Nigeria and

at a cheaper cost (Adeniji, 2008). Its availability is due to the general wide acceptance of its oil among local consumers. It contains high protein content, has high digestibility as well as having accepted flavour, especially when roasted (Woldroof, 1985; Adeniji, 2008). The study was conducted to investigate the influence of replacing soybean meal and full fat soy with groundnut cake meal on the performance, haematological indices and serum biochemistry of weaned pigs, as well as to assess the influence of nature of feed, that is, dry and wet on the said animals.

MATERIALS AND METHODS

The protocol for this study was approved by the Animal Welfare and Ethics Committee of the Department of Animal Science, University of Ibadan, Nigeria. The study was carried out at the Piggery Unit of Teaching and Research Farm of University of Ibadan, Nigeria. Thirty-six weaned pigs were used, procured from a reputable farm and prior to the arrival, all necessary cleaning and disinfection of the pen was carried out.

The animals were allotted to three treatments in a completely randomized design using a 3 x 2 factorial arrangement, with twelve pigs per treatment. Each treatment consisted of four replicates with three pigs per replicate. The animals were fed groundnut cake meal-based diet (Group 1), soybean meal-based diet (Group 2) and full fat soybean-based diet (Group 3) respectively as presented in Table 2. Two replicates of each treatment were placed on wet and dry feed respectively. The feeding trial lasted for eight weeks. Proximate analysis of the diets was determined using he method of AOAC (1990), as presented in Table 1.

Daily records of feed intake were obtained for each replicate by subtracting left over from feed supply. Daily records of water intake were obtained for each replicate by subtracting left over from water supplied. The weight of pigs in each replicate were obtained weekly using weighing scale, average body weight were recorded for each replicate. Feed conversion ratio was computed using the following expression:

$$\text{Feed conversion ratio} = \frac{\text{Average feed intake (g)}}{\text{Average body weight (g)}}$$

At the end of the experiment, blood samples were collected from pigs according to treatments, using marginal ear vein method. For haematological indices and serum biochemistry, each sample were placed in EDTA and plain bottles respectively. The blood samples for serum analysis were allowed to clot before centrifuging to obtain the serum. The separated sera were decanted into bijoh bottles and stored at –200^{o}C until analyzed. The metabolites were estimated using commercial kits of Span Diagnostics, Surat, India. Hematological attributes were estimated in whole blood just after bleeding for its haemoglobin, red blood cells (RBC), packed cell volume (PCV) and white blood cells (WBC) contents, using standard procedures (Jain, 1986; Makinde *et al.,* 1991; Mafuvadze and Erlwanger, 2007; Tripathi *et al.* 2008). All data obtained were subjected to analysis of variance using statistical analytical software (2003) package and means were separated using least mean square of Turkey at $\alpha = 0.05$.

Table 1: Proximate composition of feed

Parameters (%)	T1	T2	T3
Crude Protein	20.05	21.35	21.50
Ash	4.18	4.02	4.90
Ether Extract	6.10	5.50	6.70
Crude Fibre	4.50	4.70	4.40
Dry Matter	93.40	93.07	92.94

T1= Groundnut cake meal-based diet; T2 = Soybean meal-based diet; T3 = Full fat soybean meal-based diet

Table 2: Gross composition of experimental weaned pigs (g/kg DM)

Ingredients	T1 (GNC)	T2 (SBM)	T3 (FFS)
Maize	45.00	45.00	40.00
Wheat Offal	28.00	28.00	28.00
Dicalcium Phosphate	1.50	1.50	1.50
Salt	0.25	0.25	0.25
*Premix	0.25	0.25	0.25
Groundnut cake (GNC)	24.5	-	-
Soyabean meal (SBM)	-	24.5	-
Full-fat soya (FFS)	-	-	29.5
Methionine	0.25	0.25	0.25
Lysine	0.25	0.25	0.25
Total	100.00	100.00	100.00
Calculated Analysis			
Crude Protein (%)	19.31	19.84	19.73
Metabolisable Energy (kcal/kg)			

**Premix composition (per kg of diet) Vit (Vitamin) A = 1000 IU; Vitamin D_3 = 2000 IU; Vit E = 4000 mg; Vit K_3 = 900 mg; Vit B_1 = 500 mg; Vit B_2 = 2200 mg; Vit B_3 = 5500 mg; Vit B12 = 4 mg; pp = 18000; Folic acid = 400 mg; choline chloride = 150000 mg; antioxidant BHT = 0.05%; iron = 1.80%; copper = 0.20%; Mn = 2.40%; cobalt = 0.04%; Zn = 2.80%; iodine = 0.04%; selenium = 0.016%; Ca = 12.8570% in 2.5kg. GNC = groundnut cake, SBM = soyabean meal, FFS = full-fat soya*

RESULTS

Tables 3, 5 and 7 show the main effect of protein sources and nature of feed on performance characteristics, haematological indices and serum biochemistry of weaned pigs. Weight gain was higher for soybean and full fat soya-based diets. A similar pattern was obtained for feed conversion ratio, while

feed intake and water intake were not significantly different amongst treatments. Nature of feed did not influence weight gain, feed intake and feed conversion ratio. However, dry feeds resulted in higher water intake. No significant differences were observed amongst protein sources for all the parameters assessed. Packed cell volume ad haemoglobin values were higher for wet diets. Protein sources and nature of feed did not influence serum biochemistry of weaned pigs.

The interactive effects of different dietary protein sources and diet types on growth performance, haematology and serum profile of weaned pigs are presented in Tables 4, 6 and 8 respectively. The values obtained for final body weight for GNC for both types of diet were statistically similar to the values obtained for dry SBM and FFS diets. However, the values obtained for both types of diets for SBM and FFS were statistically similar. The animals on GNC recorded the least body weight gain when compared with those on SBM (wet) and FFS. Animals on SBM (wet) had value which was statistically similar to other treatments. Initial weights and feed intake were not significantly different amongst the treatments. Feed conversion ratio was higher for animals on GNC (wet) when compared with other protein sources, while it was statistically similar to those on dry diet. Water intake was higher for dry diets. Haematological and serum parameters were not significantly different for all the parameters measured.

Table 3: Main effect of protein sources and nature of feed on performance characteristics of weaned pigs

Parameters	Weight gain (kg)	Feed intake (kg)	Feed conversion ratio	Water intake (cl)
Protein Source				
T1	5.59^{b}	23.23	4.28^{a}	8609.00
T2	9.80^{a}	21.17	2.18^{b}	8714.00
T3	10.65^{a}	21.57	2.04^{b}	8625.50
Nature of feed				
DRY	8.65	21.64	2.76	8988.17^{a}
WET	8.71	22.35	2.91	8310.83^{b}
SEM	0.32	0.30	0.16	114.32

^{ab}Means along the same row with different superscripts are significantly different ($P< 0.05$). T1= Groundnut cake meal-based diet; T2 = Soybean meal-based diet; T3 = Full fat soybean meal-based diet

Table 4. Interactive effects of protein sources and diet types on growth performance of weaned pigs

Treatments	Feed types	Initial weight (kg)	Final weight (kg)	Weight gain (kg)	Feed intake (kg)	Feed conversion ratio	Water intake (cl)
GNC	Dry	6.05	11.82^{b}	5.77^{b}	22.57	4.01^{ab}	9700.00^{a}
	Wet	6.35	11.75^{b}	5.40^{b}	23.90	4.56^{a}	7518.00^{b}
SBM	Dry	5.23	14.39^{ab}	9.16^{ab}	20.89	2.31^{b}	9745.00^{a}
	Wet	7.42	17.86^{a}	10.45^{a}	21.45	2.05^{b}	7683.00^{b}
FFS	Dry	6.02	17.06^{a}	11.03^{a}	21.46	1.95^{b}	9701.5^{a}
	Wet	5.98	16.25^{ab}	10.28^{a}	21.69	2.13^{b}	7549.50^{b}
	SEM	0.40	0.34	0.32	0.30	0.16	114.32

^{ab}Means within the same column with different superscripts are significantly (P<0.05) different.

GNC = groundnut cake meal, SBM = soybean meal, FFS = full fat soybean meal

Table 5: Main effect of protein sources and nature of feed on haematological indices of weaned pigs

Parameters	PCV (%)	Hb (g/dl)	RBC (x 10^6/ µ)	WBC (x 10^3/µ)	MCHC (%)	MCH(g/dl)	MCV(fl)
Protein source							
T1	35.75	11.55	5.75	12.53	32.23	20.11	62.26
T2	37.50	12.38	5.40	10.95	32.97	23.20	70.29
T3	37.00	12.10	5.84	9.36	32.70	20.85	63.77
Nature of feed							
DRY	34.50^{b}	11.20^{b}	5.43	11.09	32.46	20.73	63.84
WET	39.00^{a}	12.82^{a}	5.90	10.80	32.80	22.04	67.03
SEM	0.79	0.26	0.23	0.67	0.07	0.70	2.05

^{ab}Means along the same row with different superscripts are significantly different (P< 0.05).

T1= Groundnut cake meal-based diet; T2 = Soybean meal-based diet; T3 = Full fat soybean meal-based diet; PCV = Packed cell volume; HB = Hemoglobin; RBC = Red blood cell; WBC = White blood cell; MCHC = Mean Corpuscular Hemoglobin Concentration; MCH = Mean Corpuscular Haemoglobin; MCV = Mean Corpuscular Volume; SEM = Standard error of mean.

Table 6. Interactive effects of protein sources and diet types on haematological profile of weaned pigs

Treatments	Feed types	PCV (%)	Hb (g/dl)	RBC ($10^6/\mu$)	WBC ($10^3/\mu$)	MCH C (%)	MCH (g/dl)	MCV (fl)
GNC	Dry	34.50	11.10	5.69	13.60	32.17	19.57	60.82
	Wet	37.00	12.00	5.82	11.45	32.28	20.66	63.70
SBM	Dry	35.00	11.40	5.35	10.23	32.57	21.33	65.49
	Wet	40.00	13.35	5.46	11.68	33.38	25.07	75.09
FFS	Dry	34.80	11.10	5.27	9.45	32.65	21.30	65.23
	Wet	40.00	13.10	6.42	9.28	32.75	20.41	62.31
	SEM	0.79	0.26	0.23	0.67	0.07	0.70	2.05

GNC = groundnut cake meal; SBM = soybean meal; FFS = full fat soybean meal; PCV = packed cell volume; Hb = haemoglobin; RBC = red blood cell counts; WBC = white blood cell counts; MCHC = mean corpuscular haemoglobin concentration; MCH = mean corpuscular haemoglobin; MCV = mean cell volume

Table 7: Main effect of protein sources and nature of feed on serum biochemistry of weaned pigs

Parameters	STP(g/L)	BUN (mg/dl)	ALB (g/d)	GLO (g/dl)	A.G Ratio	AST (U/I)	ALT (U/I)	ALP (U/I)	Glucose (mmol/L)
Protein sources									
T1	6.28	10.13	2.90	3.38^{b}	0.83	18.25	28.25	101.25	70.25
T2	6.80	12.95	2.98	3.83^{a}	0.70	17.50	21.25	75.50	78.25
T3	6.75	12.70	3.10	3.65^{ab}	0.83	19.25	24.50	94.25	73.25
Nature of feed									
DRY	6.83	10.45	2.85	3.53	0.78	19.00	25.33	83.33	76.67
WET	6.83	13.40	3.13	3.70	0.78	17.67	24.00	97.33	71.17
SEM	0.04	0.30	0.03	0.01	0.02	0.31	0.34	1.38	0.57

^{ab}Means along the same row with different superscripts are significantly different ($P< 0.05$).

T1= Groundnut cake meal-based diet; T2 = Soybean meal-based diet; T3 = Full fat soybean meal-based diet; STP = Serum total protein; BUN = blood urea nitrogen; ALB = albumin; GLO = globulin; A.G ratio = albumin/globulin ratio; AST = aspartate amino transferase; ALT = alanine amino transfesrase; ALP = alkaline phospahatase AST = Aspartate Amino Transferase, ALT = Alanine Amino Transferase, ALP = Alkaline Phosphatase

Table 8. Interactive effects of protein sources and diet types on serum profile of weaned pigs

Treatments	Feed types	Total protein (g/L)	Blood urea nitrogen (mg/dl)	Albumin (g/dl)	Globulin (g/dl)	Albumin/ globulin	AST (U/L)	ALT (U/L)	ALP (U/ L)	Glucose (mmol/L)
GNC	Dry	6.40	10.40	2.95	3.45	0.85	17.50	28.50	97.50	75.00
	Wet	6.15	9.85	2.85	3.30	0.80	19.00	28.00	105.00	65.50
SBM	Dry	6.50	10.70	2.70	3.80	0.65	19.00	18.50	72.50	78.50
	Wet	7.10	15.20	3.25	3.85	0.75	16.00	24.00	78.50	78.00
FFS	Dry	6.25	10.25	2.90	3.35	0.85	20.50	29.00	80.00	76.50
	Wet	7.25	15.15	3.30	3.95	0.80	18.00	20.00	108.50	70.00
	SEM	0.04	0.30	0.03	0.01	0.02	0.31	0.34	1.38	0.57

[ab]Means within the same column with different superscripts are significantly (P<0.05) different. GNC = groundnut cake meal, SBM = soybean meal, FFS = full fat soybean meal, AST=Aspartate Amino Transferase, ALT=Alanine Amino Transferase, ALP=Alkaline Phosphatase

DISCUSSION

Dietary protein for feeding animals plays a significant role in ensuring food security for all. It has been clear to all that what animals are fed with should not been in keen competition with man. Reliance on soybean meal which is in keen competition with man and which price is high may drastically affect livestock production in Africa.

The use of soyabean (*Glycine max*) as an economic crop spans for both animal and man. The major producers of soybean are the United States of America, Brazil, Argentina, China, India, Paraguay, Canada (FAS/ USDA, 2009). Its use in livestock feeding is on the increase and it is expected to increase in the future (Yin *et al*., 2011), necessitating the need to source for alternatives, particularly in Africa.

Finding alternatives to conventional feed ingredients, particularly dietary protein for monogastric such as swine and poultry, that are locally available cannot be overemphasised in order to ensure food security in developing countries, particularly the rural areas in sub-Saharan Africa. Of more importance to sourcing for locally available dietary protein for livestock feeding was the instability in exchange rate affecting pricing of the products to be imported, climate change and the threats arising from extinction of fish stocks used as feed ingredients. However, there is the need to ascertain that nothing important will be lost in terms of animals' response to the proposed ingredients. Soybean has been the main protein source for livestock, although groundnut cake meal is also used, but not frequently as soybean meal. Subjecting GNC to biotechnological processing using effective and affordable methods and techniques could enhance its value to make it compare effectively with soybean meal. GNC has been observed to have comparable amino acid profile to SBM, although limiting in lysine and methionine. Hence, for optimal performance it is recommended the diets with GNC be supplemented with adequate amount of lysine and methionine or fish meal, which could have been the reason for the low performance of GNC-based diet in the present study (Adeniji, 2008).

CONCLUSION

The influence of soybean meal-based diets was not too pronounced when compared with the groundnut cake meal-based diet, except for feed conversion ratio. Nature of feed did not influence weight gain, feed intake and feed conversion ratio. It can be suggested that supplementing the groundnut cake meal-diet with higher levels of lysine and methionine or fish meal will reverse the effect. Further studies in that direction are hereby recommended.

Declaration of interest

We have no conflicting interest regarding this manuscript.

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