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GROWTH PERFORMANCE OF WEANER PIGS FED SOYBEAN HULL BASED DIETS

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ABSTRACT: *A study was conducted to evaluate the response of weaner pigs to diets containing graded levels of soybean hull (SBH). Twenty-four male hybrid (large white x landrace) weaner pigs, about 6 weeks old, weighing 5.92-6.85kg were randomly divided into four groups of six pigs each using a completely randomized design (CRD). Each group was randomly assigned to one of the four isocaloric (2800kcal ME/kg) and isonitrogenous (18% crude protein) diets containing 0% (control), 10, 15 and 20% SBH for 56 days. Each treatment was replicated 3 times with 2 pigs per replicate placed on a concrete-floored pen. Daily feed intake, body weight gain, feed conversion ratio, protein efficiency ratio and feed cost per kg weight gain were determined. During the 8th week of the experiment, blood samples were collected from two pigs per treatment for haematological evaluation. Results showed that pigs fed the 10% SBH diet had higher (P<0.05) average final body weight, average weight gain and better efficiency of feed conversion than those fed 20% SBH diet. Increasing levels of SBH in the diets had no significant effect (P>0.05) on the PER values. Differences between the treatments in total digestible nutrients (TDN) were significant (P<0.05). Feed cost per kg weight gain was reduced at the 10% SBH inclusion level as compared to other SBH diets. Dietary treatments did not have adverse effect on the haematology of pigs. Pigs fed the control diet (0% SBH) and those fed soybean hull based diets had comparable performance. It was concluded that soybean hull can be included in the diet of weaner pigs at 20% level without adverse effects on the growth performance and haematological values of the animals.*

Key words: *Soybean Hull, Diets, Growth Performance, Weaner Pigs*

ORIGINAL ARTICLE

INTRODUCTION

The scarcity of conventional feeds has hindered the growth of the livestock industry in Nigeria. The food deficit problem is indeed more serious with protein supply when compared with the availability of calories. Shortage of protein, particularly those of animal origin is prevalent in most parts of Africa where it is estimated that on the average 10g of animal protein is consumed per day compared to a recommended daily intake of 35g (FAO, 1997). Therefore, there is the need, to increase the production of such domestic animals as pigs and poultry which are conventional sources of animal protein. Pig production in particular represents one of the fastest ways of increasing animal protein, since pigs grow at a faster rate and are highly more prolific than cattle, sheep and goats. In growth rate pig is only surpassed by broilers (Holness, 2005). Apart from their high rate of reproduction, pigs and poultry are characterized by the best efficiency of nutrient transformation into high quality animal protein (Smith, 2001; Holness, 2005). However, the high cost of the conventional feedstuff most especially the protein supplement, necessitated the quest for locally available alternatives that can substitute for the conventional feedstuffs economically by reducing feeding cost, thereby making the pig enterprise a more profitable one (EL-Sabben et al., 1970; Fontenot, 1971). The alternative cheap and available feedstuff to be considered in this study is Soy bean hull. Soybean hulls referred to as soy hull, soybean mill-run or soybean flakes are by-products of soybean milling industry which do not attract competition between man and animals. Soybean hull is readily available when compared to other alternative sources of feed ingredient. This study was therefore, conducted to investigate the effect of varying dietary levels of toasted soybean hull on growth performance of weaner pigs.

MATERIALS AND METHODS

The study was conducted at the Piggery Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. Soybean hull and other feed ingredients used for the study were procured from Nsukka, Orba and Enugu in Enugu state, Nigeria.

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Formulation of experimental diets

Four diets were formulated to contain 0, 10, 15 and 20% soybean hull (SBH). The Composition of the diets is presented in Table 1.

Management of experimental animals

Twenty-four male hybrid (large white x landrace) weaner pigs, about 6 weeks old, weighing 5.92-6.85kg were randomly divided into four groups of six pigs each using a completely randomized design (CRD). Each group was randomly assigned to one of the four isocaloric (2800kcal ME/kg) and isonitrogenous (18% crude protein) diets (1, 2, 3 and 4) containing 0% (control), 5, 10 and 20% SBH for 56 days.

Table 1 - Percentage composition of weaner pigs' diets

Ingredients (%)	0	10	15	20
Maize	49.8	47.2	45.2	44.2
Brewer's dried grain	7.00	5.00	4.00	4.00
Groundnut cake	18.4	16.4	15.2	14.00
Soybean hull	0	10	15	20
Palm Kernel meal	13.00	9.00	8.00	5.00
Fish waste (32%CP)	4.00	4.00	4.00	4.00
Palm oil	2.8	3.4	3.6	3.8
Bone meal	4.00	4.00	4.00	4.00
Salt	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Vitamin-mineral premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated composition:				
Crude protein (%)	18.06	18.07	18.09	18.05
Crude fibre (%)	5.00	5.80	6.28	6.74
Energy (MJ/ Kg ME)	12.26	12.26	12.22	2.22

Each treatment was replicated 3 times with 2 pigs per replicate placed on a concrete-floored pen with windows installed with wire nets to prevent flies from entering into the pens. Water was given *ad-libitum*. Pigs were fed 4% of their body weight in the first 2 weeks and later increased to 5% of their body weight as ration per replicate. The pigs were injected with Ivomec (0.5ml per pig) subcutaneously against endo and ectoparasites. At the beginning and at the end of the experiment, pigs in each replicate were weighed individually to determine the initial body and final body weights of pigs, respectively. Live weights were recorded weekly for each replicate to determine the body weight gain. Feed intake was determined daily by the weigh-back technique. Feed conversion ratio was then calculated from these data as quantity (grams) of feed consumed per unit (grams) weight gained over the same period. Protein efficiency ratio and feed cost per kg weight gain were also determined. All measurements were taken between 8.00am and 12.00 noons.

Hematological Evaluation

At the 8th week of the feeding trial, blood was sampled from three pigs per treatment by human puncture of the hind leg and ear vein. The blood samples were separately collected using sterile disposable syringes and needles into properly labeled sterilized bottles containing EDTA (Ethylene diamine tetra-acetic acid) for haematological analysis. Packed cell volume (PCV) and haemoglobin concentration (Hb) were determined by the methods described by Lamb (1991). Red blood cell (RBC) and total white blood cell (WBC) counts were estimated using the haemocytometer, while mean corpuscular volume (MCV) and mean corpuscular haemoglobin MCH) were calculated according to Mitruka and Rawnsley (1977). The design and implementation of the study conformed to with the relevant provisions of the Animal Use Act of the University of Nigeria, Nsukka (2006).

Proximate and Statistical Analyses

The proximate analysis of the diets was determined according to AOAC (1990) and the gross energy of each diet was also determined using the adiabatic bomb calorimeter. The data collected were subjected to analysis of variance (ANOVA) as described by Steel and Torrie (1980). Duncan's New Multiple Range Test was used in separating the significant means (Duncan, 1955).

RESULTS

Performance of weaner pigs

Table 2 shows the proximate composition of grower pigs' diets. Data on the performance of growing pigs fed diets containing graded levels of soybean hulls are presented in Table 3. The effect of the treatments on average final body weight was significant ($P<0.05$). The result shows that average final body weight (9.90kg) was highest at 15% SBH inclusion in the diet. However this did not differ significantly ($P>0.05$) from the final body weight of pigs fed 0% (control) and 20%SHB diets. Nevertheless it differed significantly ($P<0.05$) from the final body weight of pigs

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fed 5% SBH diet. Results show that average daily feed intake and average daily protein intake followed the same trend as the average final body weight. The average daily weight gain (ADWG) of pigs fed 10 and 15% SBH diets was significantly (P<0.05) higher than that of pigs fed 20% SBH diet. However pigs fed 0% SBH diet (control) had similar ADWG with those fed 10, 15 and 20% SBH diets.

Table 2 - Proximate composition of weaner pigs' diets (Experiment1)

Components	Dietary SBH levels (%)			
	0	5	15	20
Dry matter%	93.7	92.75	92.3	92.75
Crude Protein %	18.08	18.04	18.07	18.03
Ether extract %	9.40	9.20	7.66	10.60
Crude fibre %	5.70	4.20	4.30	5.05
Ash %	17.35	11.85	10.40	11.25
N- Free extract %	43.17	49.46	51.87	47.82
Gross energy (Mj/kg)	15.03	15.06	15.04	15.02

Table 3- Effect of graded level of soybean hull on performance of weaner pigs

Parameters	Dietary levels of SBH (%)				SEM
	0	10	15	20	
Av. initial body weight gain (kg)	6.30	5.92	6.33	6.85	-
Av. final body weight (kg)	9.52^{ab}	9.90^{a}	9.43^{ab}	9.12^{b}	0.22
Av. daily feed intake (g/day/pig)	852.50^{ab}	802.07^{b}	911.60^{a}	854.17^{ab}	22.42
Av. daily weight gain (g/day/pig)	277.38^{ab}	290.86^{a}	290.52^{a}	252.64^{b}	11.48
Feed conversion ratio (feed: gain)	3.09^{ab}	2.75^{b}	3.19^{ab}	3.47^{a}	0.14
Protein efficiency ratio	1.80^{b}	2.02^{a}	1.75^{b}	1.64^{b}	0.07
Av. daily protein intake	154.13^{ab}	144.69^{b}	164.74^{a}	154.01^{ab}	4.06
Total Digestible Nutrient	171.79^{b}	182.03^{a}	184.27^{a}	183.38^{a}	1.51

a,b means with different superscripts across a given row differs significantly(P < 0.05)

The feed conversion ratio (FCR) of pigs fed 20% SBH diet was significantly (P<0.05) higher than that of pigs fed 10% SBH diet. Pigs fed 0%SBH diet had comparable (P>0.05) FCR with those fed 10, 15 and 20% SBH diets. The protein efficiency ratio (PER) value of pigs fed 10% SBH was significantly (P<0.05) higher than that of pigs fed 0, 15 and 20% SBH diets. Pigs fed 0, 15 and 20% SBH diets had comparable PER (P>0.05). The effect of treatments on the total digestible nutrient (TDN) was significant (P<0.05). Pigs fed 10, 15 and 20% SBH diets had comparable (P>0.05) TDN and this was significantly (P<0.05) higher than that of pigs fed the control diet.

Cost implication of feeding graded levels of soybean hull to weaner pigs

Table 4 shows data on cost implication observed in this experiment. Feed cost per kg weight gain did not follow any particular trend. Pigs on the control diet (0% SBH) had the same cost of per kg weight gain value with pigs fed other SBH diets. However, feed cost per kg weight of pigs fed 20% SBH diet differed significantly (P<0.05) from values observed in treatment 2(10%SBH diet). The effect of treatment on total weight gain was significant (P<0.05). Pigs fed 10 and 15% SBH diets had significantly (P<0.05) higher value (3.57kg) than pigs fed 20% SBH diet. Pigs fed 0, 10, 15 and 20% SBH diets had comparable (P>0.05) total weight gain. There were significant (P<0.05) differences among treatments in total feed intake were. Pigs fed 15% SBH diet had total feed intake value of 25.53kg and this differed significantly (P<0.05) from the value (22.46kg) observed interatment 2 (10% SBH diet). Pigs fed the control diet (0% SBH) had total fed intake of 23.87kg and this did not differ significantly (P>0.05) from the value (23.92kg) observed in other treatments (10, 15 and 20% SBH diets). The cost of total feed intake and cost of daily feed consumed followed the same trend as total feed intake.

Table 4 - Cost implication of feeding graded levels of soybean hull to weaner pigs

Parameters	Dietary levels of SBH (%)				
	0	10	15	20	SEM
Cost of 1kg feed ₦	92.71	91.40	89.87	89.09	-
Feed cost per kg weight gain ₦	286.47^{ab}	251.65^{b}	286.99^{a}	309.44^{a}	11.72
Total feed intake (kg)	23.87^{ab}	22.46^{b}	25.53^{a}	23.92^{ab}	0.63
Total weight gain (kg)	3.18^{ab}	3.20^{a}	3.57^{a}	2.58^{b}	0.21
Cost of total feed intake ₦	$2,212.99^{ab}$	$2,052.54^{b}$	$2,294.08^{a}$	$2,130.74^{ab}$	55.50
Cost of daily feed consumed ₦	79.04^{ab}	73.31^{b}	81.93^{a}	76.10^{ab}	1.98

a,b – means with different superscript across a given row differ significant (P< 0.05)

Effect of graded levels of soybean hull on haematology of weaner pigs

The effects of treatments on haematologiical values of pigs are presented in Table 5. The results show that the effect of treatment on haemoglobin concentration (Hb), packed cell volume (PCV), red blood cell count (RBC)

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and white blood cell count (WBC) were all significantly (P<0.05) influenced by the SBH levels in the diets. The Hb, PCV, RBC, and WBC values of pigs fed 15% SBH diet differed significantly (P<0.05) from the values observed in treatment 1(0% SBH diet) However, pigs fed 10 and 20% SBH diets had comparable (P>0.05) Hb, PCV and RBC, and WBC values. There were no significant differences (P>0.05) among treatments in mean corpuscular haemoglobin concentration (MCHC), mean corpuscular haemoglobin (MCH) and mean corpuscular volume (MCV).

Table 5 - Effect of graded levels of soybean hull on haematology of weaner pigs

Parameters	Dietary levels of SBH (%)				
	0	10	15	20	SEM
Haemoglobin concentration(g/100ml)	8.10^{b}	9.57^{ab}	10.85^{a}	9.57^{ab}	0.37
Packed cell volume (%)	24.30^{b}	28.70^{ab}	32.55^{a}	28.70^{ab}	1.11
RBC (x 10^6/mm^3)	4.05^{b}	4.78^{ab}	5.43^{a}	4.78^{ab}	0.18
WBC (x 10^3/mm^3)	17,283.33^{b}	20,600.00^{ab}	26,450.00^{a}	18,966.67^{b}	1,292.69
MCH (%)	20.00	20.00	19.99	20.00	0.01
MCV (µm^3)	60.00	60.00	59.98	60.00	0.50
MCHC (%)	33.30	33.30	33.30	33.30	0.01

a,b – means with different superscript across a given row differ significant (P< 0.05)

DISCUSSION

Performance of pigs

It was observed (Table 3) that pigs fed the 10% SBH diet had higher average final body weight, average weight gain, protein efficiency ratio and better efficiency of feed conversion than those fed 20% SBH diet. However, the overall performance of pigs fed the soybean hull based diets was not inferior to that of pigs fed the control diet (0% SBH).This tends to suggest that growing pigs can tolerate 20% SBH in their diet. The 6.74% crude in the 20% SBH diet is below the limit (20%) reported by MacDonald et al. (2002) as the highest level of crude fibre in the diet of simple stomached animals. Moreover, the positive effect of dietary fibre cannot be undermined. Dietary fibre had been found to activate the intestine, enhance peristaltic movement and ensure more enzyme production, thereby resulting in efficient digestion of nutrients (Esonu et al., 1997). The lack of increase in the feed intake of pigs on the diets containing soybean hull meal is quite remarkable. Although soybean hull meal contains high fibre, its inclusion in the diets at 20% level did not result in increased dietary fibre. Such a situation would have led to the dilution of other nutrients thereby leading to increased feed intake. Pigs as well as other farm animals eat to meet their energy requirements and to sustain rapid growth and development. The energy needs of the growing pigs were therefore satisfied even at 20% SBH inclusion, hence the pigs did not consume more feed than those on the control diet. Similar observations had been reported (Beynen, 1990; Esonu et al., 1997; Esonu, 1998; Anyanwu et al., 2003; Esonu et al., 2004). Generally, the comparable growth performance of pigs fed SBH diets and those fed the control diet is quite interesting in two ways. First, it showed that the utilization of soybean hull meal by pigs is relatively high at the level offered in this study. This observation contradicts earlier reports by Ash and Akoh -Petia (1992), Udedibie and Igwe (1989) and Cheeke et al. (1983). Secondly, it could be that the heat treatment applied to SBH before its inclusion in the diets helped to improve its texture, palatability and nutritive value by destroying or inactivating the heat – labile toxic compounds and anti-nutritional factors such as protease inhibitors, haemaglutinins, tannins, cyanogenic glycosides and flatulence factors in the raw soybean (Liener and Kakade, 1980; Ensminger, 1996; Enwere, 1998). This suggestion agrees with the findings of Khan et al. (1979) that heat treatment applied to legume foods improved their texture, palatability and nutritive value by destroying or inactivating heat – labile toxic compounds and other enzyme inhibitors. Palatability in particular had been shown to influence feed intake and hence the overall performance of animals (Holness, 2005; Jurgens, 2002). Perhaps, the palatability of the control diet was not superior to that of the test (SBH) diets.

Cost Implication

As shown in Table 4, the dietary inclusion of soybean hull meal reduced the cost of producing one kilogramme of feed. This observation was in line with that of Esonu et al. (1997) and Anyanwu et al. (2003). Feed cost per kg weight gain was reduced at the 10% SBH inclusion level as compared with other SBH diets. This agrees with the reports of Phillips (1984) Sonaiya et al. (1986) and Ukachukwu and Anugwa (1995) that reduction in feed cost per kg gain is not only dependent on cheap feed but is also dependent on the production result obtained with this cheap feed. The efficiency with which the feed is utilized is of major importance.

Haematological evaluation

As indicated in Table 5, dietary treatments did not have adverse effect on the haematology of weaner pigs. This could be attributed to the efficacy of toasting to completely remove or reduce the negative effect of the anti-nutritional factors (ANFs) and toxicants such as cyanogens, tannins and lectins in the raw bambara nut waste on the haematology of pigs. Liener (1986) and Ensminger *et al*. (1996) had shown that cyanogens, tannins and lectins in the raw bambara nut have the ability to destroy the red blood cells. The haematological values obtained in the present study are within the normal range as reported by Miller et al. (1961) and Schalm et al. (1975). Miller et al. (1961) reported a red blood cell count of 4.5 million/mm^3 as the lowest value and 7.6 million/mm^3 as the highest

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value for matured pigs. Schalm et al. (1975) reported a range of 5.3 million/mm^3 to 7.3 million/mm^3 average values for red blood cells in their work with 20 lactating sows, 20 weaned piglets and 15 fattening pigs.

CONCLUSION

It is evident from this study that soybean hull can be included in the diet of weaner pigs at 20% without adverse effects on the growth performance and haematological values of the animals.

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