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Full Length Research Paper

Utilization of sun-dried on-farm generated poultry litter as a feed resource for growing-finishing pigs

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Forty eight (48) growing-finishing pigs (36.11 ± 1.26 kg) were allotted to three dietary treatment groups of 0, 33.33 and 66.67% sun-dried on-farm generated poultry litter (SOPL) as a replacement for 30% maize in diets of growing-finishing pigs on weight basis to assess its implication on the chemical composition of the feed, growth performance and blood chemistry of the pigs. Each treatment was replicated four times with 4 pigs/replicate in a completely randomized design. The diets were formulated to contain 16 - 19% crude protein and the pigs housed in concrete floored pens containing feeding and watering troughs for the duration of the study. The results obtained in this study revealed some numerical differences in the crude protein and fibre contents of the SOPL diets over the control diet. Increases were also recorded in the acid detergent fibre (ADF), neutral detergent fibre (NDF) and acid detergent lignin (ADL) fractions of the diets as a result of the replacement levels of SOPL. Daily weight gains and the efficiency of feed utilization of the growing pigs were not significantly (P > 0.05) influenced by the graded levels of SOPL. Replacement of maize with 33 and 66% SOPL resulted in 10.4 - 20.9% reduction in the cost of feed/kg. This in turn resulted in 15 - 25% reduction in the cost of feed required for an additional kg gain/pig when the graded levels of SOPL was fed to the pigs. An increased level of up to 66% SOPL resulted in a depression (P < 0.05) in the values of packed cell volume (PCV) and white blood cells (WBC) while the hemoglobin, serum glucose, urea, creatinine and glutamate pyruvate transaninase values of the pigs across the groups were unaffected (P > 0.05). However, variations recorded in the values of the red blood cells (RBC) and alkaline phosphatase did not follow any particular trend. The values of the serum total protein, albumin and cholesterol values increased significantly (P < 0.05).

Key words: Acid detergent fibre, neutral detergent fibre, acid detergent lignin, sun-dried on-farm generated poultry litter.

INTRODUCTION

Research results of over 45 years in Virginia Polytechnic Institute and State University, Blacksburg, Virginia, United States, on the nutritional value of feeding poultry litter, performance of cattle fed litter, animal health status, quality of animal products and studies on residues in animal products have been satisfactory, with no toxic effect on the cattle. About 20 - 25% of the 5.6 million tons of poultry litter (dry matter) produced annually in the U.S. is fed to beef cows and stock cattle in Virginia (Fontenot and Hancock, 2001). It was reported to be a rich source of essential minerals, with a crude protein content of between 25-50 and 55-60% total digestible nutrient (TDN) on dry matter basis, while the nutritional value was rated as similar to or higher than good quality legume hay. Dehydration, with or without pelleting, has also been reported to be a satisfactory process, if the cost is not too high.

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Abbreviations: TDN, Total digestible nutrient; **SOPL,** sun-dried on-farm generated poultry litter; **ADF,** acid detergent fibre, **NDF,** neutral detergent fibre; **ADL,** acid detergent lignin; **PCV,** packed cell volume; **WBC,** white blood cells; **ALT,** alanine transaminase; **GPT;** glutamate pyruvate transaminase; **AIBPs,** agro-industrial by-products; **PKC,** palm kernel cake; **IAA,** indispensable amino acids; **Hb,** haemoglobin.

Poultry litter includes excreta, bedding (mainly wood shavings in Nigeria), wasted feed and feathers (Fontenot and Hancock, 2001). Hence it represents a vast reservoir of cheap nutrient. Good management, including exclusion of dead birds/ other extraneous materials from the litter and appropriate processing prior to feeding, such as sun drying has been reported to prevent growth of micro-organisms (Fontenot and Hancock, 2001).

However, even in the face of the incidence of Avian Influenza, on-farm generated poultry litter in farms where integrated system is practiced, with no reported disease cases could be a potential cheap source of feedstuff for growing-finishing pigs. In recent years, the use of animal manure for livestock feeding has generated considerable interest due to the fact that the conventional feedstuffs can no longer adequately meet the need of the fast growing livestock industry (Abeke et al., 2003).

Poultry waste has been successfully used in ruminant rations in Egypt. The total bacterial count was considerably lower in sun dried poultry waste compared to the oven dried waste. Aflatoxins were not detectable in the concentrate mixtures containing poultry litter (Makkar, 2002). Both feed intake and milk production in ewes was not affected by the inclusion of 14% poultry waste as a dietary supplement, suggesting that cottonseed meal and other high protein feed ingredients could be, at least partially replaced, by poultry waste without any loss in productivity. The weight and age at puberty of lambs fed a ration containing 17% poultry waste was similar to those given a ration without any poultry waste. Similarly, poultry waste up to 20% in the diet had no detrimental effect on growth in cattle and buffaloes and on the reproductive performance in buffalo heifers evaluated.

The inclusion of 15% poultry waste in mixed concentrate feed decreased the cost of feed by about 10% (Makkar, 2002).

It is noteworthy that a number of farmers are already involved in the use of poultry litter/manure in the feeding of pigs in some parts of Nigeria. There is therefore the need for the right technology/package for the use of poultry litter as a feedstuff for growing pigs. The study was designed to investigate the effect of sun-dried on-farm generated poultry litter (SOPL) (from a stock of growing pullets on the farm) as a replacement for maize in diets of growing-finishing pigs on the growth performance, some carcass traits, serum metabolites and heamatological indices in an attempt to reduce feeding cost using non-conventional feed resources.

MATERIALS AND METHODS

On-farm generated poultry litter was processed by sun-drying in continuous sunlight (10-12 h/day) for three days during the dry period of the year (late November -late January) to a constant moisture content of 12% before being incorporated into the experimental diets.

Forty eight (48) growing-finishing pigs (36.11 ± 1.26 kg) were asigned to three dietary treatment groups of 0, 10 and 20% SOPL (as a replacement for 0, 33.33 and 66.67% of the 30% maize content) in diets of growing-finishing pigs, on weight basis (Table 1). Each treatment was replicated four times with 4 pigs/ replicate in a completely randomized design. The diets were formulated to contain 16 - 19% crude protein (Table 2) and the pigs housed in concrete floored pens containing feeding and watering troughs for the duration of the study. The pigs were allowed *ad libitum* access to the diets and water, served in concrete feeding and watering troughs, respectively. The growth performance and economy of production were monitored throughout the 42-day duration of the trial.

Table 1. Gross composition of test diets fed to growing-finishing pigs.

Ingredients	0% SOPL	33% SOPL	66% SOPL
Maize	30.0	20.0	10.0
SOPL	0.0	10.0	20.0
Palm kernel cake	30.0	30.0	30.0
Wheat offal	18.0	18.0	18.0
Groundnut cake	15.0	15.0	15.0
Fish meal (65%)	3.0	3.0	3.0
Bone meal	2.25	2.25	2.25
Oyster shell	1.0	1.0	1.0
Salt	0.50	0.50	0.50
Premix*	0.25	0.25	0.25

*Pfizer agricare grower premix supplied the following per kg diet: Vit. A 10,000,000 IU; Vit. D_3 2,000,000 IU; Vit. E 8,000 IU; Vit. K 2,000 mg; Vit. B_1 2,000 mg; Vit. B_2 5,500 mg; Vit. B_6 1,200 mg; Vit. B_{12} 12 mg; biotin 30 mg; folic acid 600 mg; niacin 10,000 mg; pantothenic acid 7,000 mg; choline chloride 500,000 mg; Vit. C 10,000 mg; Iron 60,000 mg; Mn 80,000 mg; Cu 8,00 mg; Zn 50,000 mg; iodine 2,000 mg; cobalt 450 mg; Selenium 100 mg; mg 100,000 mg and Anti oxidant 6,000 mg.

Proximate compositions of the test ingredients (SOPL) and experimental diets, as well as separation of fibre fractions were done according to the methods of A.O.A.C. (1990). Blood sample was randomly collected from 2 pigs/ replicate for the three treatment groups at the end of the feeding trial and analyzed for serum metabolites and hematological parameters. The bleeding was done in the morning before feeding and 10 ml of blood was obtained from the jugular vein into two sample bottles using a sterilized needle and syringe as described by Adesehinwa (2007).

The samples for the serum were allowed to clot before centrifuging to obtain the serum used in the determination of some serum metabolites (serum protein, albumin, glucose, cholesterol, creatinine, urea and hepatic serum enzyme activities of alanine transaminase (ALT), glutamate pyruvate transaminase (GPT) and alkaline phosphatase) using commercial kits of Span Diagnostics, Surat, India (Tripathi et al., 2008). The haematological attributes were estimated in whole blood just after bleeding, using standard procedures (Jain, 1986). Data generated on growth performance, serum metabolites and hematological parameters of the pigs were subjected to statistical analysis using SAS Computer software package (SAS, 1991).

RESULTS AND DISCUSSION

Chemical analysis

Proximate composition of the sun-dried on-farm poultry (growing pullets) litter (SOPL) used in the study is

Table 2. Proximate composition of SOPL and experimental diets.

Parameters	0% SOPL	33% SOPL	66% SOPL	SOPL
Dry matter (%)	88.59	88.65	88.72	88.61
Crude protein (%)	16.58	19.67	19.85	23.76
Crude fibre (%)	6.52	7.29	7.37	11.22
Ether extract (%)	3.51	3.69	3.75	3.49
Ash (%)	7.46	8.21	8.46	13.15
NDF (%)	34.97	49.77	51.28	42.68
ADF (%)	15.87	31.24	33.54	22.87
ADL (%)	5.12	13.58	13.76	8.77

Table 3. Performance, carcass and cost of feed conversion growing-finishing pigs.

Parameters	0% SOPL	33% SOPL	66% SOPL	SEM (±)
Daily feed intake (kg)	1.39	1.44	1.37	0.07
Daily weight gain (kg)	0.42	0.46	0.44	0.02
Feed: Gain	3.32	3.12	3.11	0.13
Cost of feed consumed/day (N)	40.07[a]	39.13[a]	33.27[b]	0.82
% Reduction in cost of feed consumed	-	2.35	16.97	-
Cost of Feed/Weight Gain (N/kg)	105.35[a]	90.09[b]	78.94[b]	4.23
% Reduction in cost of feed/ Gain	-	14.48	25.06	-
Dressing percentage (%)	67.71	67.25	65.80	0.78
Back fat Thickness (cm)	2.35	2.28	2.38	0.11

$1 (US dollar) = N150.00 (Nigerian Naira).

shown in Table 2. Slight increases were observed in the crude protein and fibre contents of the SOPL diets over the control diet. Aro and Tewe (2007) reported a high fibre content for the dried poultry waste fed to barrows, while the higher protein content (23.76%) of the test ingredient (SOPL) could be responsible for the higher values obtained for diets containing SOPL compared to the maize-control diet. However, the crude protein of the litter used in this study was slightly lower than the range reported by Fontenot and Hancock (2001) for broiler birds.

Increases of about double were recorded in the acid detergent fibre (ADF), neutral detergent fibre (NDF) and acid detergent lignin (ADL) fractions of the diets as a result of the replacement levels of the SOPL (Table 2). This could be said to be in agreement with the findings of Aro and Tewe (2007), who reported high indigestible component even though the fibre fractions were not separated in their study with dried poultry waste for barrows. This is expected, taking into consideration the fact that wood shavings, which is generally used as beddings in Nigeria is a highly fibrous material, being a by-product of the wood processing industry. Heat treated sheep dropping inclusion in broiler finisher diet was reported by Onu and Otuma (2008) to result in increased crude fibre content with a resultant dilution in the energy values.

Growth performance

Daily weight gains and the efficiency of feed utilization (feed: gain) of the growing pigs were not significantly ($P > 0.05$) influenced by the graded levels of SOPL (Table 3). The performance results of the pigs fed with the waste (SOPL) was similar to that of the maize-based control. However, the values obtained in this study were lower compared to the range of 550 - 610 g reported by Aro and Tewe (2007). Processing of poultry litter (inclusive of sun-drying as obtained in this study) has been reported to destroy potential pathogens, improve handling and storage characteristics, as well as enhance palatability (Fontenot and Hancock, 2001), hence, its efficient utilization, as also shown in the findings of this study. There was no mortality recorded throughout the study period.

The cost of feed consumed per day for the 66% SOPL inclusion was significantly ($P < 0.05$) lowered by 17% when compared with the control diet (33% SOPL). The resultant effect of the diets on the pigs in terms of cost per kilogramme gain in body weight was lowered by 15 and 25% at the two inclusion levels respectively. Phillip (1984) reported that reducing feed cost was not only to obtain cheaper feed, but was also dependent on the production result obtained with this cheaper feed. The efficiency with which the feed was utilized was that which

Table 4. Hematological indices of growing-finishing pigs fed graded levels of SOPL.

Parameters	0% SOPL	33% SOPL	66% SOPL	SEM (±)
Packed cell volume (PCV) %	37.63[a]	36.13[ab]	34.50[b]	0.61
Hemoglobin (Hb) g/dl	11.93	11.30	10.60	0.29
Red blood cell (RBC) x 10^6/µl	805.00[a]	648.75[b]	736.25[ab]	31.67
White blood cell (WBC) x 10^3/µl	395.75[a]	336.00[ab]	251.25[b]	24.93

was of major importance (Phillip, 1984).

The results obtained in this study is a pointer to the achievement of the objective of this study to reduce the cost of finishing pigs using agro-industrial by-products (AIBPs) or wastes. The dressing % and back-fat thickness were not significantly ($P > 0.05$) influenced by the increasing levels of SOPL in comparison to the maize-based control diet (Table 3). This is in agreement with the findings of Fontenot and Hancock (2001) who reported feeding of broiler litter not to adversely affect the carcass quality as observed in this study. The dressing % observed in this study was slightly lower compared to the values obtained by Aro and Tewe (2007). This may not be unconnected with the fact that a higher level of maize content (between 52 - 55%) was used in the diets utilized in this study. It should be noted that the SOPL was employed in this study to replace maize as against its replacement of palm kernel cake (PKC) in their study, noting that PKC has higher fat content compaed to maize.

Blood analysis

Hematology and blood biochemistry are routinely used in veterinary medicine to evaluate the health status of animals and poultry (Mafuvadze and Erlwanger, 2007). An increased level of SOPL up to 66% (that is, 20% SOPL inclusion) resulted in a decrease ($P < 0.05$) in the values of packed cell volume (PCV) and white blood cells (WBC) while the hemoglobin (Hb) values of the pigs across the groups were unaffected. The inclusion of SOPL up to this level seemed to have reduced the values of the PCV and WBC. Fluctuation in erythrocyte count, hematocrit (PCV) and hemoglobin concentration have been reported to be considerable during the growing period of the pig (Mitruka and Rawnsley, 1977). Variations recorded in the values of the red blood cells (RBC) did not follow any particular trend (Table 4). The value observed for the 66% SOPL was comparable to those of pigs on the control diet.

The influence of diets on haema-tological and serum biochemical variables have been established (Ologhobo et al., 1993; Otesile et al., 1991; Olorede et al 1995). Dietary protein quality is dependent upon the adequacy and balance of the ten indispensable amino acids (IAA). A deficiency of one or more of the IAA will not only result in poor growth and other productive functions but may also lower disease resistance (NRC, 1979). The urea values observed were comparable across the groups, as such, the animals could not have suffered muscular wastage but an efficient utilization of the diets, thereby resulting in high tissue deposition (Adesehinwa, 2004) across the groups. This result showed that the protein levels in the diets were able to support normal protein reserves in the pigs resulting from efficient protein utilization (Adesehinwa, 2007).

Reduction in concentrations of erythrocytic parameters (such as PCV, RBC counts and Hb concentration) and elevation in MCV are indications of macrocytic (regenerative) anaemia emanating from increased destruction and subsequent enhanced erythropoiesis in the liver, spleen and kidneys (Jain, 1986). However, the results obtained in this study were within the safe range reported in literature for this class of pigs (Mitruka and Rawnsley, 1977).

The serum glucose, urea, creatinine and glutamate pyruvate transaninase values were unaffected by the treatment. However, the serum total protein, albumin and cholesterol values were increased while alkaline phosphatase did not follow any trend (Table 5). Protein deficiency has been reported to reduce most haematological and serum parameters (Jain, 1986) through reduced or impaired synthesis of blood cells which are largely proteinaceous. Serum urea and creatinine levels in animals are indicative of muscular wastage (Fashina, 1991). Higher urea and creatinine values may be brought about by the inadequacy or unavailability of the dietary protein, poor digestibility or inefficient utilization of the protein (Adesehinwa and Ogunmodede, 2004), but this was not reflected in the overall performance of the pigs used in this study.

With these results, it is obvious that with good management, feeding SOPL has no adverse effect on the health status of the pigs, taking into consideration the results of the serum metabolites and hematological indices observed in this study. Rather it is beneficial for the poultry industry by helping to reduce the over-application of poultry litter to the soil which possibly results in high levels of nitrogen and phosphorus in soil water (Dilger et al., 2004).

Conclusion

From the above results, it could be inferred that growing-

Table 5. Serum metabolites of growing-finishing pigs fed graded levels of SOPL.

Parameters	0% SOPL	33% SOPL	66% SOPL	SEM (±)
Total protein (g/dl)	5.20[b]	7.05[a]	6.25[ab]	0.38
Albumin (g/dl)	3.98[b]	4.20[b]	5.63[a]	0.27
Glucose (mg/dl)	48.08	45.20	49.03	6.22
Cholesterol (mg/dl)	87.48[ab]	72.78[b]	101.20[a]	4.84
Urea (mg/dl)	22.73	20.90	16.80	2.61
Creatinine (mg/dl)	0.88	1.18	1.48	0.13
GPT (IU/L)	7.33	6.18	6.25	0.38
Alkaline phosphatase (IU/L)	36.35[a]	22.73[c]	28.40[b]	1.90

finishing pigs can tolerate the replacement of up to 66% of the 30 kg maize fraction of the diet (that is, 20 kg) with sun-dried on-farm poultry litter (SOPL) without any adverse effect on the performance, cost of feed conversion and the overall health status of the pigs.

REFERENCES

Abeke FO, Ogundipe SO, Sekoni AA, Adeyinka IA, Abubakar BY, Oni OO, Nwagu BI (2003). Response of Laying Hens to Dietary Levels of Heat Treated Sheep Manure (HSM). Trop. J. Anim. Sci. 6: 111-116.

Adesehinwa AOK (2007). Utilization of palm kernel cake as a replacement for maize in diets of growing pigs: effects on performance, serum metabolites, nutrient digestibility and cost of feed conversion. Bulg. J. Agric. Sci. 13: 593-600.

Adesehinwa AOK (2004). Implications of feeding high levels of maize offal as energy source on the growth and costs of feed conversion of growing pigs. J. Food, Agric. Environ. 2(3and4): 95-98.

Adesehinwa AOK, Ogunmodede BK (2004). Performance and serum metabolites of growing pigs fed diets containing "Dusa" and cashew nut testa as protein sources. Indian J. Anim. Sci. 74(1): 3-6.

AOAC (1990). Official methods of analysis (15th Ed). Association of Official Analytical Chemists, Arlington, V.A.

Aro SO, Tewe OO (2007). Performance and carcass yield of barrows fed dried poultry waste as a replacement for palm kernel cake. Afr. J. Biotechnol. 6(4): 487-492.

Dilger RN, Onyango EM, Sands JS, Adeola O (2004). Evaluation of microbial phytase in broiler diets. Poult. Sci. 83: 962-970.

Fashina HA (1991). Utilization of soybean based rations by grower and finisher pigs in hot humid tropics Ph. D Thesis, University of Ibadan. Nigeria.

Fontenot JP, Hancock JW (2001). Utillization of poultry litter as feed for beef cattle. Paper presentation at FDA Public Hearing, Kansas city, MO, October 30, 2001, on Animal feeding regulation Animal Protein Prohibited in Ruminant Feed- Code of Federal Regulations, Titled 21 Part 589, 2000.

Jain NC (1986). Schalm's Veterinary Haematology, 4th edn. Lea and Febiger, Philadelphia, PA, pp. 225-239.

Mafuvadze B, Erlwanger KH (2007). The effect of EDTA, heparin and storage on the erythrocyte osmotic fragility, plasma osmolality and haematocrit of adult ostriches (*Struthio camelus*). Vet. Arhiv. 77: 427-434.

Makkar HPS (2002). Development and field evaluation of animal feed supplementation packages (AFRA PROJECT 11-17 - RAF/5/041) - Project summary. Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture/International Atomic Energy Agency p. 6.

Mitruka BM, Rawnsley HM (1977). Chemical biochemical and heamatological reference values in normal experimental animals. Masson, N.Y.

National Research Council (NRC) (1979). Nutrient requirements for domestic animals. 2. Nutrient Requirement for swine. 8th Rev. Edn. National Acad. Press, Washington DC.

Ologhobo AD, Apata DF, Oyejide A, Akinpelu RO (1993). A comparison of protein fractions prepared from Lima beans (*Phaseolus lunatus*) in starter diets for broiler chicks. J. Appl. Anim. Res. 4: 13-30.

Olorede BR, Ajagbonna OP, Babatunde GM (1995). Comparism of air-dried poultry dropping in broiler rations: Effect on performance, organ weight and haematological parameters. Int. J. Anim. Sci. 10:289-293.

Onu PN, Otuma MO (2008). Utilization of Heat-Treated Sheep Dropping in the Diets of Broiler Finisher Chicks. Int. J. Poult. Sci. 7(2): 169-173.

Otesile EB, Fagbemi BO, Adeyemo O (1991). The effect of *Trypanosoma brucei* infection on serum biochemical parameters in boars on different planes of dietary energy. Vet. Parasitol. 40: 207-216.

Phillips GD (1984). Feed utilization: Principles and new developments in Physiology. Can. J. Anim. Sci. 64: 543-549.

SAS Institute (1991). SAS® User's Guide: Statistics. Version 6.03 edition. SAS Institute, Inc., Cary., NC.

Tripathi MK, Mondal D, Karim SA (2008). Growth, haematology, blood constituents and immunological status of lambs fed graded levels of animal feed grade damaged wheat as substitute of maize. J. Anim. Physiol. Anim. Nutr. 92: 75-85.