Global Journal of Agriculture and Food Sciences Research
Vol.1, No.2, pp.43-52, June 2014
Published by British Research Institute UK (www.gbjournals.org)

EVALUATION OF HEAT-TREATED SMALL RUMINANTS DROPPING AS AN ALTERNATIVE FEEDSTUFF IN WEANLING PIG DIETS.

Nwakpu P.E
Department of Animal Science, Ebonyi State University, Abakaliki, Nigeria

Ogbu C.C
Department of Animal Science, University of Nigeria, Nsukka, Nigeria.

Uchewa E.N
Department of Animal Science, Ebonyi State University, Abakaliki, Nigeria

ABSTRACT: *A 35 day feeding trial was conducted to evaluate the utilization of heat treated small ruminants dropping in the diet of weanling pigs. The aim of this study was to determine the influence of heat treated Small Ruminants Dropping (SRD) on the performance, carcass characteristics, digestibility and economics of production of weanling pigs. One hundred and forty four (144) crossbred pigs were weaned at approximately 14 days of age (averaged between 3.5kg in bodyweight) and randomly allocated to four dietary treatments in two replicates pens per diet with four pigs per pen in a Completely Randomized Design (CRD). Experimental diets were formulated such that diet I which served as the control contained 0% SRD (maize-based). Diet 2,3 and 4 contained 10, 30 and 50% SRD respectively. Results showed that the proximate analysis indicated that SRD contains reasonable amounts of protein, ether extract, nitrogen free extract and ash as well as high amount of fiber. There was a significant increase in feed intake with increase in dietary level of SRD. There was a significant depression of weight gain and protein efficiency ratio at 30 and 50% SRD inclusion levels while the weight gain and protein efficiency ratio of piglets fed treatment diets were not at variance with those fed 0% diet. The feed conversion ratio of the piglets depreciated numerically at 30, and 50% SRD dietary levels. The carcass parts expressed as percentages of live weight were not significantly influenced by the treatments except the thighs which had significantly high values in pigs fed control diet and less in the test diets. Result of the digestibility trial revealed significant (P<o.o5) differences between the control diet and the test diets. Significant improvements in digestibility and numerical improvements in DM, CP, CF and Energy digestibility were observed among the test diets. SRD inclusion at 50% proved more advantageous in terms of feed cost per kg of live pig and in percentage cost saving. It is concluded from the result of this study that SRD is a potential feedstuff in pig feeding at up to 50% dietary level beyond which, depression of growth can be expected.*

KEYWORDS: Heat-treated small ruminants dropping, Weanling pigs, Carcass characteristics, Growth performance.

INTRODUCTION

Feed costs represent the greatest operating expense in swine production. This is particularly evident in starter diets that rely on high-cost animal protein and energy sources as a means to enhance the transition of young pigs from Sow's Milk to grain based diets (Maxwell and Carter 2001). The phenomenal rise in the cost of feed caused by the high cost of the conventional energy and protein ingredients such as Maize, guinea corn, soybean meal and groundnut cake has further exacerbated the operating costs.

This situation therefore, calls for solutions that can urgently check the steadily increasing prices of feeds so as to encourage more people to get back into piggery farming. The utilization of non –conventional feed ingredients is gaining ground daily in Nigeria. For instance, Adeyemo and Oyejola (2004) reported that poultry droppings could be used to replace blood meal in guinea fowl diet up to 40% dietary level without any adverse effect on performance.

Small Ruminant Droppings are produced in large quantities in Nigeria. A Continuous accumulation of this waste is dangerous because it causes environmental pollution. Although, there is still scarcity of information concerning the utilization of heat-treated small ruminant droppings, its use in weanling diets is not questionable, considering its nutrient composition (Abeke et al, 2003; Egede, 2005). However, the extent of its usefulness and levels of utilization by weanling pigs need to be established as much of the previous works have been on layers and broiler finishers (Onu, 2007).

The objective of this study was to determine the effect of inclusion of small ruminant droppings in weanling diets of pigs. A secondary objective was to determine the apparent nutrient digestibility of Small Ruminants Dropping (SRD) diets in nursery pigs.

MATERIALS AND METHODS

The experiment was carried out at the Animal science Department of Ebonyi

State University Abakaliki, Nigeria, with the approval of the DRIC (Directorate of Research Innovation and Commercialization) of the institution.

The Small Ruminants Dropping (SRD) used in the experiment was sourced from Abakpa Main Market (The Small Ruminants Market in Abakaliki Metropolis). The SRD was processed by destoning and heating (with stirring) in the oven at 60 ^{0}C for 20-25 minutes until it becomes crispy to the touch. Heat-treated SRD so prepared were ground in a hammer mill.

Proximate analysis of the SRD was conducted using standard methods (AOAC, 1995) to determine the percentage crude protein, crude fiber, total ash and Ether extract. Nitrogen Free extract was calculated by difference. The Metabolizable Energy (ME) of SRD was estimated using Pauzenga (1995) formula. (Me= 35 x CP% + 81. 8 x EE% + 35.5 x NFE (Table 2).

Small Ruminants Dropping (SRD). So processed was used to formulate four pig starter diets such that diet I which served as control contained 0% SRD, Diets 2,3, and 4 contained 10,30, and 50% inclusion rates) respectively. The feed ingredients were ground in a hammer mill and were then mixed together in a machine mixer. The ingredient composition of the experimental diet is shown in table 2.

The study was conducted with piglets from consecutive farrowing groups. One hundred and forty four (144) cross bred piglets from landrace males X large white females were weaned at approximately 14 days of age (averaged between 3. 5kg. in body weight). Pigs were housed in pens with dimensions of 1.20 X 2.50 meters. Temperature was maintained at 25. 5^{0}C. Pigs were allotted on basis of gender, ancestry, and weanling weight to 8 pens and fed I of the 4 dietary treatments (i.e. 2 replicate pens per diet with 4 pigs per pen. Gilts were penned separately in a completely randomized design. At weaning, pigs were given O.5kg/pig (as fed basis) of the diets.

The experiment was conducted for 35 days. The daily feed requirement per replicate was weighed and served daily. The left over feed per group was collected every morning, weighed and recorded. The daily feed intake of each replicate group was determined by difference between the amount served and the residual feed. The piglet were weighed at the beginning of the experiment to obtain their initial body weight and subsequently weighed weekly. At the end of the experiment, the body weight change were calculated by subtracting the initial weight from the final body weight. The daily weight gain was determined by dividing the body weight change by the number of days the experiment lasted. The feed conversion ratio was computed by dividing the feed intake by the weight gain. Daily protein consumption (g/piglet $-^{1}$) was calculated from feed consumption data and the Protein Efficiency Ratio (PER) grams of gain per gram of protein consumed calculated.

The Barrows for the digestibility trial were moved to a metabolism room for a single 10-days period that consisted of 6 days of adaptation and 4 days of collection. Pigs were housed individually in bamboo-based constructed Metabolism crates measuring 0. 60m high X 0.45m wide X 0.75m deep. Temperature was maintained at 26^{0}C. Pigs in the metabolism trial were fed similar starter diets as those in the growth trial. Pigs were fed ad-labium twice daily during the 6 days adjustment period, and water was freely accessible at all times. During the 4 days collection period, pigs were taken off feed at 1700hours and fecal trays were cleaned, this was done to prevent contamination of fecal samples with feed. At the end of the collection period, fecal samples were composited for each pig across the 4 days collection. Samples were freeze- dried, finely ground, and kept in a desicrator under constant vacuum until analysis.

STATISTICAL ANALYSIS

Data were analyzed using the GLM procedure of SAS where the growth experiment was analyzed as a 4x2 factorial with dietary treatment and gender as main effects, Replicate, block and their interactions were the effects included in the model. The experimental units in the trial was pen. Pig was considered the experimental unit in the digestibility portion which was analyzed using the GLM procedure. Least squares means, and standard error of the means (SEM) were obtained to evaluate differences among treatment means. Differences were considered significant at 5% level of probability.

TABLE 1: PROXIMATE ANALYSIS OF SMALL RUMINANT DROPPINGS[1]

Nutrients(%)	SRD
Dry Matter	86.80
Crude Protein	17.05
Crude Fiber	23.75

Global Journal of Agriculture and Food Sciences Research
Vol.1, No.2, pp.43-52, June 2014
Published by British Research Institute UK (www.gbjournals.org)

Ether Extract	3.50
Total ash	25.75
Nitrogen Free extract	28.75
Metabolizable energy	2,570

[1] Content based on analysis of duplicate samples conducted before the formulation and mixing of experimental diets.

RESULTS AND DISCUSSION

The chemical composition of SRD and the experimental diets are shown in table 1 and 2 respectively. The results indicated that Small Ruminant Droppings (SRD) has a lot of potentials as a high-quality feedstuff (Table 1). The results indicated that SRD contained reasonable amount of crude protein (17.05%); fat (EE) (3.50%). Ash (25.75%), Nitrogen Free Extract (NFE) (28.75%) and high amount of fiber (CF) (23.75%).

These valves were nevertheless in agreement with the values of 16.88% Cp; 2.95% EE, 26.31% ash and 24.42% NFE reported by Abeke et al, (2003). The crude protein content of the experimental diets seemed to decrease with increase in the level of SRD inclusion in the diets. However, these values still met the crude protein requirements of piglets as recommended by NRC (1994). In the same vein, the energy values of the diets also decreased with increase in the level of SRD. Ash and crude fiber values of the diets increased progressively as dietary inclusion of SRD increased. However, SRD diets compared favorably with the control diet in terms of ether extract and dry matter content.

The performance assessment of the piglets fed the respective experimental diets is shown in Table 3. Feed intake, body weight, feed conversion ratio and protein efficiency ratio of the piglets were significantly ($P<0.05$) affected by the treatments. There was a significant difference ($P<0.05$) in feed intake with increase in the dietary level of SRD. The daily feed intake of the piglets feed on the control $T_{1,}$ T_2 and T_3 did not differ significantly ($P>0.05$). However, there were significant differences ($P<0.05$) between these values and the value obtained in T_4 diet. It was however observed that there was a significant improvement in the feed consumption at each incremental dietary level of SRD.

This might be due to the difference in the metabolizable energy content of the diets as a consequence of high amount of fiber in SRD, a situation that may have compelled the piglets fed 10, 30 and 50% SRD to consume more than the control diet (T_1) in other to satisfy their energy requirements. (Abeke et al, 2003; Tequia et. al, 2004; Onu, et. al, 2006). In addition, the high fiber in the diet may have affected gut function by increasing digesta passage rate and modulating nutrient digestibility (Hetland et al, 2004). Consequently, the higher feed intake of piglets fed 10, 30 and 50% SRD diets can be related to faster gut emptying of those piglets. Nevertheless, this position may have contradicted the reports of Olubamiwa et. al, 2002 and Shakouri et. al, (2006) that high fiber decreased feed intake as a result of increased digesta viscosity which causes increase of feed retention time in the gastro intestinal track. Further more, dietary fiber has laxative effect as was reported by Abeke et. al, (2003) which increased the rate of gastric evacuation and is usually compensated for by increased feed intake as similarly reported by Aduku (1993).

TABLE 2: INGREDIENT COMPOSITION OF THE EXPERIMENTAL DIETS

Ingredient (%)	T_1(0)	T_2(10)	T_3(30)	T_4(50)
Maize	48.13	40.09	25.00	15.00
SBM	21.12	21.16	18.25	10.25
GNC	10.00	8.00	6.00	4.00
Fish dust	5.00	5.00	5.00	5.00
SRD	0.00	10.00	30.00	50.00
PKC	5.00	5.00	5.00	5.00
Bone Meal	2.00	2.00	2.00	2.00
Spentgrain	8.00	8.00	8.00	8.00
Salt	0.50	0.50	0.50	0.50
Premix	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Chemical composition				
Dry Matter (%)				
Crude Proten (%)				
Crude Fiber (%)				
Ether extract (%)				
Ash (%)				
ME (Kcal/Kg - ^{1})				

SBM= Soyabean meal, GNC= Groundnut Cake, SRD= Small Ruminants Dropping, PKC= Palm Kernel Cake.

* Premix to supply the following per kg of diet: 1500 IV Vit. A; 1500 IV Vit D; 3000 IV Vit E; 3.0g Vit. K; 2.5g VitB2, 0.3g Vit B6; 8.0mg Vit B12, Nicotinic acid 3.0g; ca-pantothenate, 5.0mg choline chloride 500mg, Fe 10.0mg; AI 0.2mg; Cu 3.5mg; in 0.15mg; 10.02g Co’ 0.0lg se; 0.02g Ethoxy guin 3mg

ME = Metabolizable Energy.

TABLE 3: PERFORMANCE OF THE PIGLETS FED THE EXPERIMENTAL DIETS

Parameters	T_1	T_2	T_3	T_4	SEM
Initial Body Weight (kg)	5.20	5.10	5.13	5.14	
final Body weight (kg)	14.43[a]	13.61[b]	13.70[b]	13.34 [b]	1.24
Body Weight gain (g)	380	368	375	341	1.08
Daily Weight gain (g)	69	64	61	58	0.90
Total feed intake (kg)	4435[b]	4455[b]	4669[b]	4488[a]	2.14
Daily Feed intake (g)	180[b]	174[b]	181[b]	205[a]	1.14
Feed Conversion ratio	2.703[a]	2.573[b]	2.581[b]	2.688[b]	1.018
Daily Protein intake	11.25[b]	10.01[a]	11.96[b]	12.71[a]	0.33
Protein efficiency ratio	1.88[a]	1.86[a]	1.84[a]	1.69[b]	0.15
Survivability (%)	96	91	90	88	

Means within rows with different superscripts differ significantly ($P<0.05$). Treatments 1,2,3, and 4 contain, 10,30, and 50% heat- treated SRD respectively.

SEM: Standard error of means.

TABLE 4: APPARENT NUTRIENT DIGESTIBILITY OF PIGLETS ON THE EXPERIMENTAL DIETS.

Parameters	T_1	T_2	T_3	T_4	SEM
DM digestibility (%)	79.82[a]	82.77[b]	80.02[a]	81.60[b]	1.18
CP digestibility %	76.41[a]	76.73[a]	77.03[b]	79.10[b]	1.78
CF digestibility %	18.65[a]	19.05[b]	20.55[b]	20.80[b]	1.55
EE digestibility %	73.20[a]	63.50	64.20	64.60	5.96
NFE%	50.20[a]	56.31[b]	57.70[b]	59.30[b]	1.10
DE %	74.10[a]	76.56[b]	74.41[a]	74.53[a]	1.94

a, b:- Means within a row having different superscripts differ significantly ($P<0.05$)

TABLE 5: ECONOMICS OF PRODUCTION

Parameters	T_1	T_2	T_3	T_4
Cost of feed per kg (₦)	1168.40	1062.70	957.00	851.30
Cost of feed consumed/pig (₦)	4233.13	3218.03	2209.78	1213.82
Cost of daily feed intake/pig (₦)	118.33	107.79	97.49	87.64
Cost of feed per Kg gain (₦)	525.59	419.25	317.41	229.63
Cost saving in (%)	-	05.05	09.50	11.07

TABLE 6: CARCASS CHARACTERISTICS OF NURSERY/ PIG LETS FED SRD BASED DIET

Parameter	T_1	T_2	T_3	T_4	SEM
Carcass yield					
Eviscerated weight (kg)	4.59	4.55	3.96	3.91	11.90
Dressing (%)	85.75	85.65	80.55	80.10	1.94
Relative Weight of cut-up parts					
Thighs (Kg)	14.64^a	14.40^b	13.90^c	11.31^c	0.53
Hands head cages	4.07	4.04	4.01	4.00	0.26
Trotters	5.13	5.11	5.10	5.03	0.11
Organ weight	2.15	2.14	2.12	2.10	0.04
Heart	1.52	1.09	1.05	1.01	0.012
Liver	2.69	2.64	2.61	2.32	0.181
Intestines	2.73	2.54	2.33	2.11	1.05
Kidney	0.310	0.308	0.302	0.301	0.03
Sex organ	2.12	2.06	2.04	2.00	0.15

a, b, C: Means within the same row with different superscripts differ significantly (P<0.05).

The higher levels of inclusion of SRD in the diets gave rise to an expected numerical increment in the crude fiber content of the diets, which was predicated by the higher fiber contents of the SRD. This however, resulted in a gradual decrease in the energy levels of the diets. The protein values of the diets also reduced though it did not fall short of NRC recommendation levels for starter piglet. In the same vein, the ash content of the diets increased as the levels of SRD increased, whereas diets 2 to 4 compared favorably with the control diets in terms of fat contents.

There was no significant (P>0.05) differences among piglets fed diets T_2,T_3 and T_4 on average final body weight, average total body weight gain and average daily weight gain. Piglets fed 50% SRD recorded non-significantly, (P>0.05), the lowest body weight gain. The incredible body weight gain performance of the piglets observed among the SRD diets relative to the piglets on the control diets goes to confirm the high level of resourcefulness of SRD in the diets of monogastrics and this had been cooborated by the findings of Onu and Otuma, (2008) among others.

The reduced performance in the growth rate of piglets at higher levels of 50% could be attributed to the drop in the digestive efficiency impaired by high crude fiber content leading to low dry matter digestibility. It is instructive to state that the PER (protein efficiency ratio) followed similar trend. Ruminant animals imported to the south East (Abakaliki) are mostly Eco-type breeds from the Northern Nigeria whose diets may have been predominated by dry grasses and pastures as against their counter-parts from the South East that have access to more fresh grasses, especially in the dry season when this droppings were collected and dried. The quality of the droppings depicts the quality of the grasses and pastures fed to the animals.

Even when these animals find themselves in the South East displayed for market, they still prefer dry pastures/grasses plus occasional supplementation of concentrates also brought from the North as by-products of farm processings.

Agbede et al (2002) had similarly observed in monogastrics that high fiber contents of diets decreases nutrient digestion and utilization which had also precipitated metabolic dysfunction with resultant weight reduction. The deflection in weight at 50% level of SRD goes to point to wards the tolerant limit of young piglets to diets of SRD because of the fiber contents.

The feed conversion ratio also showed no significant ($P>0.05$) differences among the diets of SRD but significant ($P<0.05$) differences existed between the control diet 1 and the other three diets (Table 3). The impressive feed conversion efficiency of piglets on test diets suggest that the piglets can handle the diets efficiently, and utilize it effectively too. This goes to affirm the earlier position of Onifade and Babatunde (1997) who reported that high fiber content of a diet interfered negatively with nutrients availability at the tissue level.

Data on the carcass quality showed that the dietary treatments did not significantly ($P>0.05$) influence the eviscerated weight, dressing percentage, and relative weight of cut-up parts except the thighs that was significantly ($P<0.05$) different. Piglets on the control diet had bigger thighs than diet 2 which was also fatter than the rest of the diets on SRD. The organ weights (Heart, liver, kidney, etc) expressed as a percentage of the live weight was not significantly affected by the treatments.

In view of the fact that the dressed weight showed no significant ($P>0.05$) differences among the diets, it goes to confirm that piglets can perform well on diets formulated with SRD up to 50% levels; since dressed weight represents the absolute value of saleable meat (Nwawe et al, 2005).

Results of the digestibility trial revealed significant ($P<0.05$) differences between the control diet and the test diets. Significant improvements in digestibility and numerical improvements in DM, CP, CF and Energy digestibility were observed among the test diets. This finding perhaps can be accounted for by the increase in Energy content of the test diets (10,30 and 50%) SRD diets, associated with a higher fat content. Increased fat intake tends to increase digestibility by decreasing passage rate through the digestive tract (Mateos et al, 1982). The heat treatment in which the SRD is subjected to, improves energy and Nitrogen digestibility in young piglets fed Maize grain, and increases ME of soybeans (Noland et al, 1976).

ECONOMICS OF PRODUCTION

Table 5 shows the economics of production of piglets fed the dietary treatments. The cost per kilogram feed and the cost of feed consumed decreased progressively as the level of SRD inclusion increased.

This could be attributed to the partial replacement of the more expensive maize and soybean with SRD that was collected free. The total cost of feed consumed per piglet, cost of daily feed intake per piglet (₦) and cost of feed per kilogram gain (₦) showed a reduction. However, it appreciated in $T_{4.}$ This may not be unconnected to the feed consumption of piglets fed diet 4. The highest cost saving value of 11.07% was observed in diet 4. It could be affirmed therefore, that SRD Can economically be substituted in piglet diets up to 50% level.

CONCLUSION

Owing to the encouraging performance of piglets on the test diets, it can be deduced from this study that SRD is a potential feedstuff in pig diets and can be included optimally at 50% levels in starter or weanling diets; above which, depression in performance occurs. SRD is very rich in essential nutrients which, when utilized as a component of feed ingredient will be of great benefit. Nevertheless, result also showed that inclusion of SRD at high levels of up to 50% resulted in increased fiber content that gave rise to dilution in energy value of the diets although, the dilution did not affect the Performance of the piglets. The digestibility trial of the piglets also was not affected adversely at high levels of 50% inclusion in the diets. The maxinum level of economic importance is at 50%, especially for growing and finishing pigs. The reduction in cost will lead to the provision of the much needed animal protein supply.

REFERENCES

Abeke, F.O, S.O Ogundipe, A.A Sekoric, I.A Adeyinkar, B.Y, Abubakar, O.O Oni and B.I Nwagu, 2003. Response of Laying hens to dietary levels of Heat-treated Sheep Manure (HSM). Trop J. Animal Science, 6:111-116

Adeyemo, A. I and O. Oyejola, 2004. Performance of guinea fowl (*Namida Melagris*) fed varying levels of poultry droppings. Int. J. Poult. Sci. PP: 357-360.

Aduku, A. O.1993. Tropical feedstuffs Analysis Table. Department of Animal Science, Faculty of Agriculture Ahmadu Bello University, zaria.

Agbede, J. O; K. Ajaja and V. A Aletor, 2002. Influence of Roxazyme G supplementation on the utilization of sorghum dust-based diets for broiler chicks. Proceedings of the 27th annual conference Nig. Soc. Anima. Product, Akure, pp: 105-108.

AOAC Official Methods of Analysis 1995.16th Edn. Association of official Analytical chemists, Washington, D.C .

Egede, W. E, 2005. Evaluation of the nutritional value of Heat- treated Sheep Manure

(HSM) for broiler finisher B. Sc project Ebonyi State University Abakaliki, Nigeria.

Hetland, H. M. Choet and B. Svihus, 2004. Role of insoluble non-starch polysaccharides in poultry nutrition. World Poult. Sci J. 60:415 - 422.

Mateos, G.G, J. L Sell, and J.A Eastwood. 1982. Rate of food passage (transit time) as influenced by level of supplemental fat. Poult Sci. 61:94- 100.

Maxwell, C. V; and S.D Carter. 2001. feeding the weaned pig- pages 691-715 in swine Nutrition. 2nd ed A. J lewis and L.L southern, ed. CRC press, Boca Ration, FL.

National Research Council, 1994. Nutrient requirement of domestic animals: Nutrient requirement of poultry. 9th Edn. National Academy Press, Washington DC.

Nwawe, A.K; S.O Omoikhoje and C.N Nwawe, 2005. replacement Value of groundnut cake with cooked bambara groundnut meal on the carcass quality and relative organ weights of broiler chickens. J. Agric. Forestry. Sci. 3: 121- 128.

Noland, P. R; D. R Campbell, R.K cage, R.N sharp and Z.B Johnson 1976. Evaluation of processed soybeans and grains in diets for young pigs. J. Animal Science 43: 763-769.

Onifade A. A and G. M babatunde 1997. Comparative utilization of three tropical by – product feed resources supplemented with or without molasses by broiler chicks Archive Zootec, 46: 137- 144.

Onu, P.N; P.E Nwakpu and L. O Chukwu, 2006. Performance of broiler chicks (Gallus domesticus) fed maize offal based supplemented with roxazyme G enzyme int. J. Poult. Sci, 5: 607-610.

Onu, P.N 2007. The influence of Heat-Treated Sheep Droppings on the Performance, carcass characteristics and Economics of production of starter broilers. J. Anim. And Vet. Advances, 6 (11): 1323- 1327.

Onu, P.N and M.O Otuma, 2008. Utilization of Heat-Treated Sheep Dropping in the diets of broiler Finisher Chicks. Int. J. Poult. Sci. 7(2): 169- 173.

Pauzenga, U. 1985. Feeding parent stock. J. zootech. Int. pp; 22- 24.

Shakouri, M.D; H Kermanshahi and M. Mohsenzadeh, 2006. Effect of dietary non starch polysaccharides in serin parified diets on performance and intestinal microflora of young broiler chiclcens. Int. J. Poult. Sci. 5: 557- 561.