Trop. J. Anim. Sci. 2(1): 33- 43 (1999)
ISSN: 1119-4308

PARTIAL REPLACEMENTS OF BREWERS' DRIED GRAINS WITH BIODEGRADED COWPEA AND SORGHUM SEEDHULLS IN BROILER DIETS

G. F. FANIYI AND A. D. OLOGHOBO
Department of Animal Science, University of Ibadan.

Target Audience: Poultry scientists, animal nutritionist, feedmillers

ABSTRACT

Cowpea and sorghum biodegraded in poultry faeces were used to replace brewers' dried grains (BDG) in the diet of broiler chicks for eight weeks in a completely randomised design. 180 (day - old) chicks were used for the two trials of the experiment. In the first trial, biodegraded cowpea seedhull replaced BDG at 0, 25 and 50% levels, whereas, in the second trial, biodegraded sorghum seedhull replaced BDG at 0.25 and 50% levels in broiler diets. In the first trial, average body weight gain and feed conversion efficiency (feed: gain) significantly decreased with increased levels of biodegraded cowpea seedhull. In the second trial, significant differences (P < 0.05) were observed in the average feed intake and body weight gain of broiler chickens fed biodegraded sorghum seedhull. Performance of the chickens increased as sorghum seedhull increased in the diets. Biodegradation of cowpea and sorghum seedhulls improved their nutritional quality but the level of inclusion of these biodegraded products should be monitored. Cowpea and sorghum seedhulls biodegraded in poultry faeces could be utilized by broiler chickens and could replace BDG in the diet of broilers up to 50%.

Key words: Cowpea seedhull, sorghum seedhull, broiler, poultry faeces.

DESCRIPTION OF PROBLEM

Protein is an important component of human food and animal feed because it is used for growth and repair of wear and tear in the body. It is, however, not produced sufficiently to meet the requirements of the teaming populations of the world particularly in Africa and other developinig countries of the world. Meat production by farm animals like cattle, sheep and goats, which are bigger than poultry, can solve the problem of protein malnutrition but these animals have longer gestation periods and their rate of regenerating themselves is slower than that of poultry. Poultry has a shorter generation interval, good feed conversion ratio and good effieciency of feed utilization. Therefore, any attempt to improve animal protein consumption in developing countries must include improving the production of poultry meat and eggs.

Biodegradation is the process by which living organisms are used to break down the structures of organic materials in order to improve their nutritional value (1). The use of poultry droppings for biodegradation is well documented in literature. It has also been used as animal feed to replace protein sources like groundnut cake meal (2). The use of poultry waste as animal feed is, however, limited because it contains non-protein nitrogen (3), which has little nutritional value in non-ruminant nutrition. But poultry waste can be used as a good medium for chemical and microbial degradation of fibrous materials and by this action enhance the nutritive value of the material. Its use as a feed supplement, therefore, becomes more promising. In this study, cowpea and sorgum seedhulls, which are discarded farm wastes, were biodegraded in poultry faeces in order to improve their feed quality and bring them into use as feed ingredients for poultry. The experiment was, designed to determine the effects of replacing brewers' dried grains (BDG) with cowpea and sorghum seedhull biodegraded in poultry faeces and fed to broilers.

MATERIALS AND METHODS

Cowpea and sorghun seedhulls were collected from various threshing slabs. They were sun-dried for 3 days and grains were removed from them. They were cut with a cutlass, chopped further at the harmermill and ground at the plate mill. Thereafter, poultry faeces were added to the seedhulls in plastic bowls at the rate of 3.00kg of poultry faeces to 1.00kg of each of cowpea and sorghum seedhulls. They were thoroughly mixed and left under a shade for 14 days. The mixture was wetted sparingly every two days to attract flies and to provide a moist condition for the proliferation of fly larva (maggots) and other micro-organisms. Temperature of the mixture was taken on every alternate day to wetting and at the end of the 14th day, the biodegraded cowpea and sorghum seedhulls were sun-dried, ground and used as a substitute for brewers' dried grains (BDG).

The experiment is made up of two trials. The first trial involved repacing BDG with biodegraded cowpea seedhull at 0, 25 and 50% levels while in the second trial, biodegraded sorghum seedhull was used to replace BDG at the same levels (Table 1). In the two trials, feed and water were made available to the birds ad libitum. Gross energy (GE) of the biodegraded products was determined with a bomb calorimeter while their metabolizable energies (ME) were calculated (4). Ninety, birds were used for each trial, with 30 birds allocated to each treatment, and replicated three times.

In the two trials the lengths and weights of parts of the gastro-intestinal tracts of broilers were measured. Chemical composition of processed and unprocessed cowpea and sorgum seedhulls, feeds and faeces were determined by the method of A0AC (5). Detergent fractions were determined by the method of Goering and Van soest (6). Data collected were subjected to analysis of variance and means were sorted with Duncan multiple range test (7).

Table 1. Composition of starter and finisher diets containing biodegraded cowpea seedhull.

	Replacement levels (%)					
	Starter diets			Finisher diets		
Ingredients	0%	25%	50%	0%	25%	50%
Yellow Maize	54.25	54.25	54.25	61.50	61.50	61.50
Soyabean meal	30.00	30.00	30.00	22.00	22.00	22.00
Fish Meal	6.00	6.00	6.00	5.50	5.50	5.50
BDG	6.25	4.69	3.13	7.50	5.63	3.75
Biodegraded cowpea Seedhull product	–	1.56	3.13	–	1.88	3.75
Bone meal	2.25	2.25	2.24	2.50	2.49	2.50
Oyster shell	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50	0.50
Premix*	0.25	0.25	0.25	–	–	–
Total	100.00	100.00	100.00	100.00	100.00	100.00
Determined Chemical composition (g/100g)						
Dry Matter:	93.26	92.76	91.96	92.88	91.98	93.29
Crude Protein	24.25	23.89	24.12	21.52	21.38	21.43
Crude Fibre	8.33	9.31	9.46	9.87	10.25	10.53
Ether extract	7.06	6.42	6.29	6.44	6.37	6.32
Ash (Total)	9.41	9.68	9.85	10.43	9.89	10.22
Nitrogen free extract	42.11	43.34	42.25	44.62	44.09	44.79
M.E. (KCal kg^{-1})	2967.21	2953.68	2940.14	3001.90	2985.66	2978.00

* Chick broiler premix provided (per tonne of feed): Vit A. 15,000 iu, D3000,000iu, K 100mg, B 1000mg, B2 1000mg B6 1000mg, B12 10mg, Biotin 100mg, Niacin 30,000mg, Vitamin C 10,000mg, Fe 60,000mg, Mn 3000mg, Mg 0, Cu 10,000mg, Zn 70,000mg, Co 500mg, 1200mg, Se 100mg, Anti-oxidant 6000mg.

The chemical compositions (proximate and detergent fibre analysis) of unprocessed and processed cowpea and sorghum seedhulls are shown in Table 3. Biodegradation of cowpea and sorghum seedhulls affected some changes in the chemical composition of tbe seedhulls. For instance, there was an increase in the crude protein, ash (total), nitrogen free extract and acid detergent lignin but there was a decrease in the neutral detergent fibre (NDF), acid detergent fibre (ADF), hemi-cellulose and cellulose of the biodegraded seedhulls compared with unprocessed seedhulls.

Table 2. Composition of starter and finisher diets containing biodegraded sorghum seedhull.

	Replacement levels (%)					
	Starter diets			Finisher diets		
Ingredients	0% Seed M.	25% Seedm.	50% Seedm.	0% Seedm.	25% Seedm.	50% Seedm.
Yellow Maize	54.25	54.25	54.25	61.50	61.50	61.50
Soyabean meal	30.00	30.00	30.00	22.00	22.00	22.00
Fish Meal	6.00	6.00	6.00	5.50	5.50	5.50
BDG	6.25	4.69	3.13	7.50	5.63	3.75
Biodegraded cowpea						
Seedhull product	–	1.56	3.13	–	1.88	3.75
Bone meal	2.25	2.25	2.24	2.50	2.49	2.50
Oyster shell	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50	0.50	0.50
Premix*	.0.25	0.25	0.25	–	–	–
Total	100.00	100.00	100.00	100.00	100.00	100.00
Determined Chemical composition (g/100g)						
Crude Protein	23.79	24.05	23.86	21.34	21.67	20.89
Crude fibre	8.48	9.29	10.08	9.24	10.32	11.04
Ether extract	5.88	6.41	6.71	6.51	5.89	6.38
Ash (Total)	10.06	9.88	10.42	10.11	11.24	10.99
Nitrogen free extract	42.27	42.06	41.09	44.99	41.84	43.14
M.E. (KCal kg^{-1})	2967.21	2956.52	2942.97	3001.90	2996.22	2983.39

* Chick broiler premix provided (per tonne of feed): Vit A. 15,000 iu, D3000,000iu, K 100mg, B1 1000mg, B2 1000mg B6 1000mg, B12 10mg, Biotin 100mg, Niacin 30,000mg, Panthothnic acid 10,000mg, Folic acid 1000mg, Choline chloride 400,000mg, Vitamin C 10,000mg, Fe 60,000mg, Mn 3000mg, Mg 0, Cu 10,000mg, Zn 70,000mg, C_0 500mg, 1200mg, Se 100mg, Anti-oxidant 6000mg.

Table 3. Chemical composition of unprocessed and biodegraded cowpea and sorghum seedhull products.

	Cowpea		Sorghum	
	Unprocessed cowpea seedhull	seedhull biodegraded in poultry faeces	Unprocessed sorghum seedhull	seedhull biodegraded in poultry faeces
Proximate chemical composition (g/100g Dry Matter)				
Dry matter	91.02	93.30	93.75	92.40
Crude Protein	13.59	14.78	5.86	12.95
Crude Fibre	30.31	30.00	34.20	28.50
Ether Extract	0.69	0.70	1.05	0.50
Ash (Total)	8.80	36.60	5.21	36.30
Nitrogen free extract	37.73	11.22	47.43	14.25
Detergent fibre analysis (g/100g Dry matter)				
NDF	89.57	42.00	77.85	39.60
ADF	57.30	14.00	52.96	18.00
ADL (Lignin)	10.05	11.00	6.25	15.00
Hemi-cellulose	32.27	28.00	24.89	21.60
Cellulose	47.26	2.00	46.71	3.00
G. E. (KCal /Kg^{-1})	3923.00	3345.00	4112.00	3115.00
M. E. (KCal/ kg^{-1})	2945.46	2152.34	3253.90	2103.04

Trial 1: The performance of broiler chicks fed diets in which biodegraded cowpea seedhull product replaced BDG is shown in Table 4. It was observed that average body weight gain and feed conversion efficiency significantly ($P < 0.05$) decreased with increasing levels of biodegraded cowpea seedhull product in the diets. Average body weight ranged between 1700.00 g/bird in diet 3 and 2076.00 g/bird in diets 1 while average weekly body weight gain was highest (P 0.05) in the control diet (255.13 g/bird) and least in diet 3 (208.13 g/bird). Mortality was significantly higher in diets 1 and 2 than in diet 3.

Table 4. Performance of broiler chickens fed biodegraded cowpea seedhull product.

Parameters	Replacement levels (%) Dietary treatments 0%	25%	50%	SEX
Average final body weight (g/bird)	2076.00[a]	1030.00[a]	1700.00[b]	132.35
Average weekly feed intake (g/bird)	633.52	613.13	578.59	82.34
Average weekly body weight gain (g/bird)	255.13[a]	236.88[b]	208.13[c]	23.27
Feed conversion efficiency	2.48[a]	2.59	2.78[b]	0.20
Mortality (%)	1.38[a]	1.38[a]	0.28[b]	0.13
Cost of Production:				
Feed cost Kg $^{-1}$ (₦)	26.30	26.11	26.26	
Feed cost Kg^{-1} live weight gain (₦)	65.22	67.62	73.00	

a,b,c, = Means on the same horizontal line without a common superscript differ significantly (P<0.05)

The measurements of length of parts of gastro-intestinal tract are presented in Table 5. Values obtained in respect of the lengths of duodenum, jejunum, ileum, combined caecum, colo-rectum, small and large intestines were respectively similar. However, values obtained for length in respect of birds on diets 1 and 3 were usually higher than values obtained for birds on diet 2 except ileum which was a little longer in diet 2 than in diet 3.

The average weights of crop, gizzard, proventriculus, small and large intestines, are shown on Table 5. Weights of crop, gizzard, proventriculus and large intestine were higher in diets 2 and 3 than in diet 1 and there were slightly significant differences (P<0.05) in the weights of these parts.

Trial 2: Performance of birds fed diets in which BDG was replaced with biodegraded sorghum seedhull product is shown in Table 6. There were significant differences (P<0.05) in the average feed intake and average body weight gain. The performance of the birds increased as the biodegraded sorghum seedhull content of diets increased from 0% to 50%. Average body weight gain was highest at 50%, followed by 25% and least at 0% level of inclusion (control diet). Average feed intake was similar in diets 2 and 3 and values obtained for both diets were significantly higher (P<0.05) than was obtained in diet 1. Feed conversion efficiency and mortality were not significantly different (P>0.05) among dietary treatments.

Table 5. Average length and weight of parts of gastro-intestinal tract of broiler chickens fed diets containing cowpea seedhull product.

Parameters	Replacement levels (%) Dietary treatments 0%	25%	50%	SEX
Length (CM)				
Duodenum	25.25	25.00	25.25	1.53
Jejunum	64.00	58.75	62.38	4.54
Ileum	68.00	64.75	61.75	4.86
Combined Caecum	14.88	14.25	16.13	1.19
Colo-rectum	9.50	9.38	10.38	0.63
Small intestine	157.25	148.50	149.25	10.66
Large intestine	24.38	23.63	26.50	1.68
Weight (g)				
Crop	3.23	4.90	4.29	0.72
Proventriculus	4.85	5.13	5.19	0.59
Small intestine	38.33	35.22	42.67	5.14
Large intestine	9.43	10.07	12.96	1.40
Gizzard	22.70	28.24	24.90	3.13

Table 6. Performance of broiler chickens fed biodegraded sorghum seedhull product.

Parameters	Replacement levels (%) Dietary treatments 0%	25%	50%	SEX
Average final body weight (g/bird)	1621.43[c]	1850.00[b]	1908.33[a]	122.19
Average weekly feed intake (g/bird)	497.48[b]	602.02[a]	586.75[a]	69.01
Average weekly body weight gain (g/bird)	198.30[b]	226.88[ab]	234.17[a]	22.51
Feed conversion efficiency	2.51	2.65	2.51	0.26
Mortality (%)	0.83	1.39	1.11	0.06
Cost of Production:				
Feed cost Kg^{-1} (x)	26.18	26.28	26.59	—
Feed cost Kg^{-1} live weight gain (x)	65.68	69.73	66.63	—

a,b,c, = means on the same horizontal line without a common superscript differ significantly (P<0.05)

It was observed that there were no significant differences (P 0.05) in the length of parts of the gastro-intestinal tract measured (Table 7). The weights of crop, proventriculus, small and large intestines were similar among dietary treatments. However, values obtained for birds on both biodegraded sorghum-based diets were higher for crop, gizzard, proventriculus, and small intestine than values obtained for BDG-based (control) diet.

Table 7. Average length and weight of parts of gastro-intestinal tract of broiler chickens fed diets containing sorghum seedhull product.

	Replacement levels (%) Dietary treatments			
Parameters	0%	25%	50%	SEX
Length (CM)				
Duodenum	23.75	25.75	26.75	1.97
Jejunum	69.75	65.12	65.62	5.20
Ileum	69.75	96.75	68.50	4.29
Combined Caecum	15.50	17.00	15.13	1.10
Colo-rectum	10.00	10.00	11.13	0.72
Small intestine	164.50	160.62	160.87	11.11
	25.50	27.50	26.00	1.76
Weight (g)				
Crop	3.83	4.83	4.72	0.72
Proventriculus	5.23	5.78	5.88	0.77
Small intestine	38.29.	47.40	41.97	5.19
Large intestine	12.01	15.61	11.07	2.19
Gizzard	20.79	26.21	22.56	2.92

The significant differences (P<0.05) observed in the feed intake of broiler chickens could be attributed to high fibre content of diets because fibre reduces density of diets (8) and made broiler chickens to consume more feed in order to acquire enough energy for metabolic activities. Abdelsamie et al (9) also agreed that high or increased fibre content led to increased feed intake.

Fairly low average body weight gain observed among treatments could be due to hgh fibre content of the diets. It had been reported in literature that fibre caused decreased availability of nutrients and fibre reduced the period of exposure of the feed to digestive enzymes and absorptive surfaces (10). The increased rate of passage caused by fibre decreased growth and invariably nutrient utilization of chickens (9, 11).

High fibre content of diets might also have been responsible for high feed: gain observed in some treatments in the experiment. This opinion was similarly reported by (9) that fibre reduced growth rate and feed conversion efficiency which affected efficiency of protein utililzation.

A broad view of the experiment shcwed that the average final body weight of broiler chickens fed biodegraded products ranged between 1.70 – 1.93 kg/ bird (cowpea) and 1.85 – 1.90 kg/bird (sorghum) compared with broiler chickens on BDG-based (control) diet which ranged between 1.61 and 2.08kg/ bird. Evidently, there were slight significant differences ($P<0.05$) in the final average body weight of chickens among treatments, yet, sustainability of broiler chickens on cowpea and sorghum seedhulls biodegraded in poultry faeces gave credence to the feed quality of the biodegraded products and suitability of the biodegradation process towards improving the nutritional status of roughages like cowpea and sorghum seedhulls. In another reasoning, ammonium hydroxide (NH_4OH) from urea in the poultry faeces) might have initiated an ammoniation process while other alkali (Calcium and sodium hydroxides also from redual minerals in the faeces) might have caused swelling, hence, make cowpea and sorghum seedhulls succeptible to microbial action. It then implied that calcium hydroxide (CaOH), sodium hydroxide (N_aOH) and Ammonium hydroxide/urea (NH_4OH) might have caused some delignification (12, 13) of cowpea and sorghum seedhulls and residual fibre in the poultry faeces. Chemical action of alkali might have increased digestion of organic matter whose utilization by the broiler chickens might have resulted into high final body weight observed in the chickens.

Non-significant differences were observed in the lengths and weights of parts of the gastro-intestinal tract of broiler birds (Table 6 and 7). This observation indicated that the inclusion of biodegraded products was tolerable to the chicks up to a certain level. However, occasional discrepancy to this observation might have been due to the fibre content of the diets which increased as seedhull inclusion in the diets increased. Abdelsamie *et al* (g) shared a similar experience and reported that increased fibre content of diets led to increase in weight and length of the gastro-intestinal tract. When oat hull was added to corn-starch-case in diets of chicks, a significant increase in the length of the small intestine was reported (15) increase in the weights of crop, proventriculus and large intestine might have resulted from attemps by the birds to accommodate larger volume of the digesta in their gastro-intestinal tracts. Similarly, increase in the weight of gizzard was probably due to increased musculature or muscular activity of the gizzard to effect proper grinding of its increased fibre content of diets. Kass et al (16) on the other hand explained the entire phenomenon as a modification of the gut size to intestinal hypertrophy while Ogunlayi (17) described it as a form of structural adjustment. By the same reasoning, significant differences observed in the weight of the heart, spleen and liver could have been due to the extended effect of musculature, hypertrophy or morphological adjustment by these organs to balance the impact of the activity of the gizzard for the organism (bird) concerned.

CONCLUSION AND APPLICATIONS

1 Biodegradation of roughages in faeces can be employed for pre-treating roughages like cowpea and sorghum seedhulls. Biodegradation, improved the nutritional quality of cowpea and sorghum seedhulls.

2. The biodegraded cowpea and sorghum seedhull products can be utilized by broilers as a source of fibre in their diets.

3. Biodegraded cowpea and sorghum seedhull products can conveniently replace BDG as a source of fibre in the diet of broilers.

REFERENCES

1 Calvert C. C.; R. D. Martin and N. O. Morgan 1969a. Housefly pupae as food for poultry. J. Econ. Entomology 62:938–939.

2. Ogunmodede, B. K. and S. O. Afolabi 1978. Replacement of groundnut Cake by dried poultry manure in the diets of laying hens. Brit.Poult.Sci. 19(2): 143–147.

3. Bhattacharya, A. N. and J. C. Taylor 1975. Recycling animal wastes as a feedstuff: A Review, Jour. of Anim. Sci., 41(5): 1438 – 456.

4. Fisher, C. and J. M. McNab 1987. Recent Advances in animal nutrition. pp. 54 – 69

5. A. O. A. C. 1975. Official methods of Analysis, 12th edition, Association of Official Analytical Chemists, Washington, D. C.

6. Goering, H. K. and P. J. Van Soest 1975. Forage fibre analysis. Agric. Handbook No: 379, A. R. S., U. S. D. A.

7. Steel, R. G. D. and J. H. Torrie 1980. Principles and procedures of statistics. Biometric approach. 2nd edition, Mc-Graw-Hill Books Co. Inc. New York.

8. Savory, C. J. and M. J. Gentle 1976. Effects of dietary dilution with fibre on the food intake and gut dimensions of Japanese Quail. Brit. Poult. Sci. 17: 561 – 570

9. Abdelsamie, R.E, K. N. Ranaweera and W. E. Nano 1983. The influence of fibre content and physical texture of the diet on the performance of broilers in the tropics. Brit. Poult. Sc. 24: 383 – 390.

10. Dvorak, R. A. and D. J. Bray 1978. Influence of cellulose and ambient temperature on feed intake and growth of chicks. Poult. Sci. 57: 1351 – 1354.

11. Miles, R. D, A. S. Arafa, R. J. Bloomer and R. H Herms 1981. The influence of certain dietary fillers on the true metabolizable energy of diets for Turkeys. Brit. Poult. Sci. 22: 411 – 414.

12. Adeleye, I. O. A. 1988. Treatment of low quality roughages and agronomic waste for livestock feeding: Their technology, applicability and adaptability to the local conditions. Invited paper presented at the workshop on alternative formulation of livestock feeds in Nigeria. Nov. 21 – 25, 1988.

13. **Klopfenstein, T.** 1978. Chemical treatment of crop residues. Journ. of Animal Sci., 46(3): 841 – 848.

14. **Church, D. C. and K. A. Champe** 1980. Digestibility of untreated and hydroxide treated annual rye grass straw J. of Animal. Sci., 51(1): 20 – 24.

15. **Welch, R. W., D. M. Peterson and B. Schrawa** 1985. Hypocholestemic and gastro-intestinal effects of oat bran fractions in chicks. Nutr. Rep. Int. 38 (8): 55.

16. **Kass, P. J. Van Soest, W. G. Pond, B. Lewis and R. E. McDowel** 1980. Utilization of dietary fibre from alfafa by growing swine. 1. Apparent digestibility of diet components in specific segements of the gastro-intestinal tract. J. Anim. Sci. 50: 175.

17. **Ogunlayi, O. S.** 1989. Effects of a premix on performance of broilers fed fibrous cereal offals. M.Sc. Thesis, Department of Animal Science, University of Ibadan, Nigeria.