Journal of Animal and Veterinary Advances 5 (9): 758-761, 2006

Microbial Degradation of Cassava Root Sieviate (CRS) and its Utilization by Layers

F.A. Aderemi
Department of Animal Science and Fisheries Management,
Bowen University Iwo, Osun State, Nigeria

Abstract: The potential for the nutritional improvement of cassava root sieviate by microbial degradation using Aspergillus niger was investigated over a period of ten days. The proximate constituents of the biodegraded CRS were significantly improved ($p<0.01$) while the fibre constituents were reduced .As the fermentation period increases there was reduction in the crude fiber content of the CRS while the crude protein increased from 20.90 to 73.40%. Biodegraded and undegraded CRS were now incorporated into layers diet for feeding trial. One hundred and fifty laying birds of Nera strain at 48 weeks were divided into five groups and randomly assigned to the diets, each dietary treatment had three replica results indicated that layers fed on control were not ($p>0.05$) significantly different from those fed biodegraded diet in terms of body weight gain and feed consumption. Hen day production of layers on biodegraded compared favorably with control and were significantly higher than those fed undegraded diets. The metabolizable energy of layers fed biodegraded were significantly lower ($p<0.05$) than those on control but better than those fed undegraded diet. 10% mortality was recorded for layers on biodegraded possibly due to microbial contamination. It was concluded that biodegradation had favorable impact on the protein ether extract and ash content of CRS but not on performance of the layers.

Key words: Cassava Root Sieviate, (CRS), microbial degradation, layers performance

INTRODUCTION

Cassava root sieviate is the by product left after peeled cassava tubers have been processed to foofoo Over the past 25 years, significant market opportunities for cassava have opened up a new frontier in the animal feed industry. Initially in the EEC countries, but more recently, for the expanding animal feed industries of tropical developing countries. This no doubt signifies the increasing trend in the use of cassava as competitive livestock feed[1]. Cassava peels, leaves and starch residues constitute about 25% of the cassava plant[2] Utilization of these in non-ruminant feeding is limited because of their low protein and high fiber levels[3]. The concept of using microorganisms in enhancing the nutritive value of plant and animal products is not entirely a new one. A number of isolates from rotting Cassava were used to enrich cassava[4]. In recent years considerable emphasis has been placed on the improvement of fibrous crops by the growing of non-toxic fungi on straw[5]. The ability of fungi to produce enzymes, which bring about catalytic transformations in the wide range of desirable reactions, makes them interesting to Industrialists and agriculturists. A recent advance in biotechnological application Of this ability is opening a new frontier of bioconversion of agro-industrial wastes to products of significance in livestock production[6]. Microbial fermentation has been reported as an effective means of breaking down non starch polysaccharides of agro-industrial wastes to increase their metabolizable energy and their nutritive value in general[7]. The objective of the present study was to investigate the ability of enzymes from *Aspergillus niger* to break down the cell wall, fraction of CRS and to evaluate the importance of biodegraded CRS in layer nutrition.

MATERIALS AND METHODS

Experimental procedure: Micro-organism and inoculation technique. Cassava root sieviate was collected from the foofoo production unit Barracks Ibadan. It was sun dried to a constant weight and physical contaminants were removed. The CRS was submerged in ethanol (70% v/v) for 60 sec, subsequently it was forced-air dried at 55°C for 1 ½-2 h to reach a moisture content of 55-60%. This pretreatment was done to take care of microbial contaminants. Slants of Aspergillus niger were obtained from the culture bank of the Department of Microbiology University of Ibadan, Nigeria. The A Niger was maintained on Potato dextrose agar. About 60 gs of milled CRS was put into 250 mL Erlenmeyer flasks. The flasks with their contents were autoclaved at 120oc for about 1 h and allowed to cool then sugar in form of syrup was introduced to adjust the moisture content to about 25%.

The sugar syrup was added to provide more carbon for the organism to feed on and grow. After autoclaving the set of flasks were aseptically inoculated with the organism and placed in an incubator at 30°C. after about 4-5 days the microorganisms were fully grown. The larger samples of CRS with water to be used were later autoclaved and allowed to cool. Inoculations of the larger sample with the fully-grown *A niger* on CRS, as a substrate was done. It was moistened to create a conducive condition for growth of the fungus left for 10 days inside polythene that was tightened to prevent housefly contamination with occasional turning. At the end of the 10th day the larger sample was oven dried for about 4 h at 60°C, this sample was tagged Biodegraded CRS.

Formulation of experimental diets and management of the layers: The biodegraded and undegraded CRS were incorporated into layer diets. The ingredients were taken to feed depot and milled separately using commercial miller. The diets were formulated as shown in Table 2. Dried pure yeast was added to aid feed intake as it had earlier been established that yeast boost feed intake. Five diets were compounded Diet I control, (maize-based diet) II, III, IV, V (cassava-based diets) Diet II had undegraded CRS, replacing wheat bran diet III had Undegraded CRS replacing wheat bran with brewers yeast inclusion, IV and V had biodegraded CRS replacing wheat bran; diet IV was without brewers yeast While diet V had brewers yeast inclusion.

One hundred and fifty laying birds of Nera strain at 48 weeks were divided into fifteen groups. Three groups were assigned to each dietary treatment. Feed and water were provided *ad libitum*. Records of feed consumption, weight gain, feed efficiency and egg production were determined on a group basis.

Chemical analysis: The samples of the experimental diets were analyzed for their proximate contents[8]. The detergent fibre constituents, Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) and lignin were determined[9]. The NDF was analyzed by extraction with neutral detergent Sodium Lauryl Sulfate (SLS)/ ethylenediaminetetraacetic acid (EDTA) followed by drying and ashing. ADF was determined through treatments with H_2SO_4. Hemicellulose and cellulose were also estimated according to standard methods. Hemicellulose content was the difference of NDF and ADF and cellulose content was the difference of ADF and Lignin.

Statistical analysis: Results obtained from inoculation of CRS were subjected to paired t-test analysis other results obtained were examined by analysis of variance technique using the General Linear Model (GLM) procedure[10].

RESULTS AND DISCUSSION

The proximate constituents of the undegraded and biodegraded CRS are shown in Table 1. Paired t -test analysis revealed the level of significance for each constituents. The composition of the diet is shown in Table 2. It will be observed that the sieviate inclusion was about 11 g kg in the feed and other ingredients were varied to keep the protein content up except the control. This was so because it has been established that cassava-based diets should be fortified with protein source so as to get results comparable to control or maize-based diets. It was observed that biodegraded CRS had an improved CP from 20.90 to 73.40%.This was about 351% increment while the CF was found to decrease by 81.61%. These changes could be due to the ability of the microorganisms in converting carbohydrates and non-cellulosic cell wall polysaccharides into protein. It could also be due to conversion of non-protein nitrogen into protein by the microorganism used in inoculating the substrates. This result agrees with the findings of Iyayi

Table 1: Chemical composition of Biodegraded and undegraded cassava sieviate

Parameters	Biodegraded CRS	Undegraded CRS	SEM	Sig.
Dry matter	899.800	892.90	0.33	**
Crude protein	73.400	20.90	0.18	**
Crude fiber	67.400	127.80	0.13	**
Ether extract	9.600	2.00	0.12	**
Nitrogen free extract	653.500	668.40	6.28	*
Ash	90.800	73.83	3.09	*
Neutral detergent fiber	282.80	379.10	3.36	*
Acid detergent fiber	123.60	162.60	1.08	**
Acid detergent lignin	67.70	66.20	0.52	*
Hemicellulose	159.20	216.50	0.65	*
Cellulose	53.90	96.40	0.35	**

*Means significant at 5%, **Means significant at 1%

Table 2: Gross Composition of the layer diets

Ingredients (Kg/1000Kg)	Control		Undegraded	Biodegraded	
	I	II	III	IV	V
Maize	405.0	-	-	-	-
Cassava flour	-	305.	305.	305.	305
Palm kernel cake	200.0	200	200	200	200
Wheat bran	150.0	-	-	-	-
Cassava root sieviate	-	150	150	150	150
Groundnut cake	110.0	210	180	210	180
Fish meal	30.00	30.0	30.0	30.0	30.0
Oyster shell	70.00	70.0	70.0	70.0	70.0
Bone meal	30.00	30.0	30.0	30.0	30.0
*Premix	2.500	2.50	2.50	2.50	2.50
Brewers yeast	-	-	30.0	-	30.0
Crude protein %	166.2	151.5	152.5	153.8	154.3
Crude fibre %	79.60	86.10	82.10	79.70	75.10
Gross energy($MJkg^{-1}$)	17.17	16.50	16.46	16.80	16.58

*Premix providing/kg diet 800 in, Vitamin A, 1200, Vitan in C^3 11 mg, Vitamin E 2 mg, Vitamin K.3 7 mg. Riboflavin 10 mg, Nicotinic acid 7 mg Pantothenic acid, 0.8 mg cobalamin 900 mg choline 1.5. folic acid 1.5 mg biotin 125 mg antioxidant (Santoquin), 25 mg Fe, 80 mg Mn, 0.2 mg Co. and 0.1 mg Se

Table 3: Performance Characteristics of layers fed the experimental diets

Parameters	I	II	III	IV	V	SEM
Initial body weight (Kg)	1.65	1.65	1.64	1.65	1.65	0.10
Final body weight (Kg)	1.79	1.81	1.80	1.80	1.81	0.15
Weight gain/bird/day(kg)	2.00	2.29	2.29	2.14	2.29	0.24
Hen day production (%)	47.44^b	45.33^a	44.53^a	46.71^b	45.08^a	0.04
Feed intake (Kg)	8.26	8.26	8.26	8.32	8.32	0.22
*Trays of eggs produced	32.1^b	31.7^b	30.1^b	31.7^b	28.4^a	0.02
Mortality (%)	3.3^b	0.0^a	3.3^b	10.0^c	10.0^c	0.04
ME (MJ kg^{-1})	8.44^b	7.06^b	7.30^a	7.96^a	7.74^a	0.46

Means along a row with the same superscripts are not significantly different (>0.05) *Trays of egg means 30 eggs in a crate

and Losel[6] who reported protein enrichment and reduction of fibre in cassava peel after being biodegraded with fungi under solid-state fermentation. This result was also similar to the findings of that was reported on the increase of CP in cassava peel from 3.5 to 7.0% after inoculation with *A. niger*[11]. The possibility of ether extract serving as source of energy for the microbes in the process of biodegradation coupled with the fact that the Aspergillus specie have hydrolytic enzymes might be responsible for the rate of improvement of the ether extract.

Performance characteristics of layers fed cassava-based diet with undegraded and biodegraded CRS are shown in Table 3. Body weight gains of layers on Control diet were not significantly ($p>0.05$) different from those on cassava-based diets. This result agrees with Bedford[12] who worked with laying hens and enzyme and reported no effect of dietary treatment, according to him the result could probably be due to increased digestive capacity and gut motility/maturity of the birds because of their age.

A similar result was also reported[13]. It has been indicated in an earlier studies that consequences of a poorly digested diet and hence the benefits of enzyme addition to such a diet is more apparent in conventional compared with germ free chicks[14,15]. Since the microflora increase in numbers as the animal progresses from essentially germ free to fully populated some three weeks later, it was concluded that the benefit of added enzyme (commercial or microbial) is mediated through the microfloral route in older birds. In the present study, benefit of biodegradation and brewers yeast supplementation was probably mediated through the microfloral route of the layers. Feed intake also revealed that dietary treatment had no significant ($p>0.05$) effects as layers on control and cassava-based diet with either biodegraded or undegraded CRS had similar intakes. . The similar feed intake of the layers across the diets was contrary to the findings of[16] who reported that brewers yeast supplementation improved the feed intake of the layers. Mortality differed significantly ($p<0.05$) with layers on diets IV and V having the highest value of 10%. It is worth mentioning that the metabolizable of CRS had earlier been determined using invivo method and reported as 1.76 kcal g^{-1}[17]. The gross energy of the diet containing biodegraded CRS also showed an improvement as Gross Energy (GE) of both diets IV and V were higher when compared with diets II and III. The Metabolizable Energy (ME) of the rations had a similar trend as GE. This is in agreement with many workers who had worked with various microbes namely fungi and bacteria which produce enzymes to breakdown non-starch polysaccharides of agro-industrial wastes to increase their metabolizable energy and their nutritive value in general [18-21,11]. Although the metabolizable energy content of the layers on biodegraded CRS with brewers yeast showed improvement as compared to the diet with undegraded CRS, but this was not reflected on the body weight gain of the layers fed. Mortality recorded for layers on diet I and II was 3.3% while 10% was recorded for layers in diet IV and V(diets with biodegraded CRS).

No mortality was recorded for diet II post mortem report shows there was laceration on some intestinal organs, which indicated coccidiosis disease. Also the mortality could possibly be due to reason advocated by[21] who emphasized the importance of mold growth on cassava substrates under traditional processing. This worker reported a remarkable growth depression resulting from high microbial infestations of cassava peels fed to cockerels in line with this[22] advocated that mycotoxins and contaminants might be the more serious problem in cassava-based diets for livestock feeds.

Hen day Production was generally low for all layers on cassava-based diets. This might be due to reason advocated by[23] that laying hens consumed energy to satisfy both maintenance and egg production. And in a situation when one is high it is usually at the expense of the other from indications in this study Perhaps the layers were using their feed intake for egg production at the expense of growth.

Conclusively biodegradation was found to improve the protein content of CRS but the effect on layers was not seen possibly because the organism converted the protein to microbial biomass which was also not available for use of the layers .It was obvious also that the inclusion of brewers yeast had no positive effect on the feed intake of the layers.

REFERENCES

1. Tewe, O.O., 1981. Supplentation of cassava/Urea based ration with elemental sulphur for sheep and goat: effect on growth, serum and urinary thiocyanate concentrations. Nutrition Report Intl., 24: 1263-1269.

2. Iyayi, E.A. and D.M. Losel, 2000. Cyanide detoxification in cassava by products by fungal state fermentation. J. cf dod Tech. In Africa, 5: 48-51.
3. Iyayi, E.A. and O.O. Tewe, 1994. Cassava feeding in small holder, Livestock Units Acta Horticultura, 375: 261-270.
4. Brook, E.J., W.R. Stanton and A.A. Walbridge, 1969. Fermentation methods of protein enrichment of cassava. Biotech. Bioeng, pp: 127-1282.
5. Leng, P.A., 1991. Application of biotechnology to nutrition of animals in developing countries F. A. O. Animal production Health Study. 90 FAOUN Rome.
6. Iyayi, E.A. and D.M. Losel, 1999. Changes in the nutritional status of Cassava products following solid substrate fermentation by fungi. A Technical Report Submitted to the Royal Society of the UK.
7. Onilude, A.A., 1999. Fermented poultry liter and fungal enzyme Supplementation of high fibre broiler diets: Growth responses, Carcass Characteristics and Blood Hpids of fed chicks Nahrung, 43: 54-60.
8. A.O.A.C., 1990. Association of Official Analytical Chemists. Official Methods of Analysis 11th Ed., Washington.
9. Wisker, E., W. Feldheim, Y.F. Pomeranz and Meuser, 1985. Dietary fibre in cereals Adv. Cereal Sci. Tech., 7:172-177.
10. SAS Institute Inc., 1987. SAS/STAT guide for personal computers, Version 6 et, Cary NC, SAS Institute Inc., pp: 1028.
11. Afolabi, K.D., 1999. Changes in the nutritional value of cassava and yam. Peels after solid substrate fermentation by Aspergillus niger and *Rhizopus sp.* MSc thesis. Anim. Sci. Dept. University of Ibadan. Nigeria.
12. Bedford, M.R., 1995. Mechanism of action and potential environment Benefits from the dose of food enzyme. Anim. Feed Sci. Tech., 53: 145-115.
13. Nasi, M., 1988. Effects of physical and enzymatic treatment on digestibility and Protein utilization of Soybean meal in diets for growing Pigs Physio. In the Pig Jablonna Poland. Oghonna J.U., Studies of cassava peel in the rations of coeferels Ph.D Thesis. Dept. of Animal Science University of Ibadan, Ibadan, Nigeria, pp: 381-388.
14. Langhout, D.J., 1998. The role of the intestinal flora as affected by non-strach polysaccharides in broiler chickens. Ph.D Thesis Wageningen Agricultural University, Wageningen, The Netherlands.
15. Schutte, J.B. and D.J. Langhout, 1999. Influence of the intenstinal microflora on health and performance of broiler chicks: Proceedings of the WPSA Spring Meeting, Scarborough, pp: 57-58.
16. Kumar, A. and J. Dingle, 1995. Australian experience with yeast culture in Broiler diets. Biotechnology in the feed industry being proceedings sof Alltech's 12th Annual Symposium (Lyons J.P and K. A. Jacques Eds.)
17. Aderemi, F.A., O.O. Tewe and F.I. Ogundola, 2000. Metabolisable Energy of supplemented and unsupplemented cassava root sieviate in cassava based diet of pullet chicks. Tropical Anim. Prod. Investigation, 3: 107-115.
18. Ravindran, V., 1991. Preparation of cassava lead products and their use as animal feeds. In Roots, Tubers Plantation and Banana in Anim. Feed., pp: 111-126.
19. Yahaya, B.A., 1997. Effect of Roxazyme-G enzyme supplement of diets containing 50 and 100% cassava peel levels on the performance of finisher broilers. MSc thesis Dept. Animal Science University of Ibadan, Nigeria.
20. Ogunlayi, O.S., T.E. Ekenyong, T.J. Ekunsanmi and A.C. Odebode, 1993. Effect of Microbial Collulose Aspergillus Niger Treatment on Nutritional Properties of Maize Bran. Proceedings of silver Anniversary of conference of NSAP Nigeria.
21. Abu, O.A., D.M. Losel and O.O. Tewe, 1997. Solid State Fermentation of Sweet Potato using Two Monoculture fungi: Changes in protein, fatty acid and mineral Composition. Proceedings of 2nd Annual Conference of Animal Science. Association of Nigeria Ikeja Lagos.
22. Tewe, O.O., 1994. Indices of cassava safety for livestock feeding international workshop on cassava safety, IITA, Ibadan, Nigeria. ACT Hoticultural, pp: 241-249.
23. Degen, A.A., M. Kam and S. Rosent Brauch, 1998. Efficiency of Utilization of energy for egg production in feed restrict of single comb white Leghorn hens. J. Agric. Sci. Camb., 3: 303-308.