Maize replacement value of fermented cassava in rations for sheep*

S. A. ADEYANJU**

COMPENDIO

Se alimentaron con raciones en las que la yuca fermentada reemplazó al maiz en niveles de 0, 20, 40 y 60 por ciento, en peso, durante 244 días, 24 ovinos West African Dwarf de 14 semanas de edad, en grupos de 12 carneros castrados y 12 corderos, con un peso inicial promedio de 15,68 kg. Se evaluaron los efectos sobre la digestiibilidad de las raciones, crecimiento, canal y características económicas de los ovinos.

La ingestión y digestibilidad aparente de la proteína cruda, fibra cruda, extracto etéreo, extracto libre de nitrógeno, y nutrientes digestibles toales fueron significativamente más bajos en las raciones que contenían 40 y 60 por ciento de yuca fermentada que en cualquier otra ración. Tanto la eficiencia de la utilización de los alimentos como la tasa de crecimiento fueron deprimidas conforme aumentaba la yuca fermentada en las raciones. El por ciento de desecho, el largo de la canal, y la grasa abdominal fueron más bajos mientras que los riñones e hígado fueron más grandes al aumentar el nivel de yuca fermentada. Los aumentos de yuca fermentada en las raciones también produjeron mayores beneficios económicos comparados con la ración testigo.

Introduction

THE need to search for alternatives to cereal grains as energy source in ivestock feeds caused by inadequate supply and, hence, extremely high prices of cereal grains in many parts of the world has led to the evaluation of cassava in livestock feeds. As an energy source, cassava yields 13 times more energy per hectare than maize or guineo corn (10). Furthermore, its ease of propagation, economy of production, relative freedom from pests and comparatively fewer storage problems compared with cereal grains make cassava an attractive proposition for energy source in livestock feeds.

The objectives of this study were to incorporate fermented cassava into rations for sheep and determine its effects on the intake, digestibility and efficiency of utilization of the rations and growth, carcass, organ and economic value for sheep.

Materials and methods

Cassava processing

Cassava root tubers purchased from farmers in the neighbourhood were subjected to a *lafunification* process* as follows: The unpeeled cassava tubers were washed to remove soil dirt before packing them into two 1000-litre fermentation tanks which had been filled with sufficient water to promote fermentation. The cassava tubers remained unpeeled to minimize the loss of cassava starch to the fermentation medium which usually occurs through desintegration when peeled cassava tubers have become softened in the process of fermentation. The fermentation tanks were left uncovered to avoid pressure building up inside them and fermentation was allowed to proceed uncontrolled for six days. Studies on microbial activities during the

* Received for publication October 8th. 1978

** Department of Animal Science. University of Ife. Ile-Ife. Nigeria

* This is one of the traditional methods of preparing cassava root into flour called *lafun* for human consumption in some of the Southern States of Nigeria.

Table 1.—Composition of experimental rations (air-dry basis)

Ingredients (%)	Levels of fermented cassava (%) 0	20	40	60
Maize	60.0	40.0	20.0	0.0
Fermented Cassava[1]	0.0	20.0	40.0	60.0
Groundnut cake	10.0	10.0	10.0	10.0
Brewers' dried grains	20.0	20.0	20:0	20.0
Sugar cane molasses	4.0	4.0	4.0	4.0
Dicalcium phosphate	3.0	3.0	3.0	3.0
Bone Meal	2.0	2.0	2.0	2.0
Salt	0.5	0.5	0.5	0.5
Agricare[2]	0.5	0.5	0.5	0.5

1 Contained on air-dry basis, 88.58% dry matter, 1.43% crude protein, 2.19% crude fibre, 0.75% ether extract, 3.05% ash, 81.16% NFE and 13.01 mg/kg HCN

2 A trace mineral - vitamin mix manufactured by Livestock Feeds Ltd., Lagos

fermentation process indicated that some species of yeasts, *Aspergillus, Pichia, Bacillus* and *Pseudomonas* were present in the fermentation tanks. The source of the *Aspergillus* species was traced to the soil from which the cassava root tubers were harvested.

From the third day until the end of fermentation any cassava tubers which had become softened were withdrawn from the fermentation tanks. The peels were then removed and discarded while the remaining starchy pulps were loaded into jute bags on which dilapidated parts of motor vehicles were piled so as to squeeze out as much water as possible thereby expediting the process of sun-drying. After about 48 hours, the starchy pulps were removed from the bags and grated by hand on a concrete floor. During this process, the inner fibrous core was removed and discarded before the starchy pulp was spread out to sun-dry. The dried fermented cassava was then ground and stored ready for mixing the experimental rations (Table 1).

Feeding and management of experimental animals

Twenty-four 14-weeks old West African Dwarf sheep comprising 12 wethers and 12 lambs with an average initial body weight of 15.68 kg were divided into four groups of six equalized as to sex, mean weight and weight distribution among groups. The experimental rations were alloted randomly to the four groups of growing sheep which were fed *ad libitum* for a period of 224 days during which all animals had free access to water. Prior to this experiment the sheep had been dewormed with thiabendazole and this operation was repeated three months after the study had commenced. Records of feed intake and individual body weight changes were kept on weekly and bi-weekly basis, respectively.

During the last three weeks, two wethers were withdrawn from each treatment group and placed in metabolism cages for a digestibility study. They were each offered daily 90 per cent of the average daily feed intake of their respective treatment groups in the week prior to the metabolism trial and given free access to water. Any refused feed was weighed daily before the day's ration was put in the feeder. After an initial adjustment period of 7 days in the metabolism cages, faeces were collected daily from each animal for 10 days. The 10-day fecal samples were pooled into two 5-day composite samples for chemical analysis. Samples of the refused feed, experimental rations and feces drawn from the composite samples of each were then analyzed for proximate components by the methods of AOAC (1).

At the end of the experiment all animals were starved for 24 hours but water was provided. They were then weighed individually to obtain the final body weight. Operating market prices of feed ingredients used in the experimental rations and sheep were used to estimate feed costs and gross income. The wethers from each treatment group were slaughtered for carcass evaluation.

The data obtained were analyzed statistically using analysis of variance and Duncan's new multiple range test (13).

Results and discussion

Digestibility of experimental rations

Digestibility coefficients (Table 2) indicate consistent decrease in digestible crude protein, crude fibre, ether extract, nitrogen free extract and total digestible nutrients as the level of fermented cassava increased in the rations. Rations containing 40% or more fermented cassava were significantly ($P \leq 0.05$) inferior to others in digestibility of the proximate components of the rations studied. This depression in digestibility might

Table 2.—Digestibility coefficients (%)

Feed components	Levels of fermented cassava (%) 0	20	40	60	S. E. Mean
Crude protein	91.38a	88.80a	74.96bc	65.41c	± 4.63
Crude fibre	75.28a	65.79ab	57.87b	54.85b	± 2.97
Ether extract	83.43a	91.03a	83.98b	79.82b	± 2.86
Nitrogen free extract	94.74a	91.41a	87.36ab	82.48b	± 1.79
Total digestible nutrients	81.20a	76.80ab	69.74bc	62.43	± 1.95

a, b, c Means with different letters within the same row are significantly ($P \leq 0.05$) different.

be due to the toxic effect (15) of the residual hydrocyanic acid in the fermented casava rations on the microbial population in the rumen. Both their growth rate and, hence, breakdown of the feed components might have been hindered considerably. It has been observed (12) that ruminal ammonia concentration was lower in heifers fed rations supplemented with cassava meal, which also gained less weight, compared with those fed corn supplemented rations. Similar observations have been made (9) on dairy cows fed rations in which oats were replaced with tapioca.

Growth response

Table 3 presents the performance of sheep fed fermented cassava rations. Average body weight gains and final body weight decreased, however, non-significantly ($P \geq 0.05$), as fermented cassava increased in the rations. There were significant ($P \leq 0.05$) decreases in feed intake but non-significant ($P \geq 0.05$) decreases in feed required per kg body weight gain with increases in the dietary level of fermented cassava. The reduced growth rate might be due to reduced feed intake, poor digestibility and decreased efficiency of feed utilization as the level of fermented cassava increased. Many other workers (3, 4, 5, 10) have made similar observations on ruminants fed cassava meals.

Economic performance

Both the feed cost and estimated gross income (Table 3) decreased significantly ($P \leq 0.05$) while the revenue less feed cost and the returns index increased with increases in the fermented cassava level. Inspite of the decline in gross revenue which might be related to the depression in growth rate as fermented cassava increased in the rations, the increases in the returns index indicate greater economic benefit with increases in the corn replacement level of fermented cassava. Similar observations in economic gain from replacing cereals with cassava in diets for livestock have been reported by may others (2, 7, 8, 14).

Table 3.—Performance of sheep fed fermented cassava rations.

Performance characteristics	Levels of fermented cassava (%)				S. E. Mean
	0	20	40	60	
Initial bwt. (kg)	15.53	15.68	15.68	15.84	± 1.07
Final bwt. (kg)	30.35	29.37	25.77	25.63	± 1.96
Body wt. gain (kg)	14.82	13.69	10.09	9.80	± 1.19
Feed intake (kg)	109.28a	107.79a	103.52b	100.46b	± 0.42
Feed/kg bwt. gain (kg)	7.34	7.86	10.25	10.27	± 2.51
Feed cost (N)[1]	25.73c	21.06bc	16.09ab	11.62a	± 1.65
Gros revenue (N)	45.53	44.05	38.65	38.44	± 2.95
Revenue less feed cost (N)	19.80	22.99	22.56	26.82	± 1.78
Returns index[2]	100	116	114	136	

1 Naira, the Nigerian currency, in which N1.00 = US 1.58

2 Revenue less feed cost for the control diet is 100.

a, b, c Means with different letters within the same row are significantly ($P \leq 0.05$), different

Table 4.—Carcass and organ characteristic of sheep fed fermented cassava rations

Characteristics	Levels of fermented cassava (%)				S. E. Mean
	0	20	40	60	
Slaughter wt. (kg)	33.60	28.10	22.60	27.70	± 4.69
Carcass length (cm)	84.45	83.82	69.85	81.28	± 6.05
Dressing percent (%)	49.50	47.61	47.64	46.03	± 1.45
Visceral fat (% EBW[1])	24.65b	15.71a	13.12a	12.45a	± 2.28
Hide (% EBW)	8.84	9.81	10.00	9.60	± 0.93
Liver (% EBW)	1.51	2.13	1.79	1.87	± 0.71
Heart (% EBW)	0.51b	0.49b	0.55a	0.58a	± 0.01
Kidney (% EBW)	0.27	0.36	0.38	0.44	± 0.12

a, b Means with different letters within the same row are significantly ($P \leq 0.05$) different

1 Empty body weight

Carcass and organ characteristics

Carcass and organ characteristics (Table 4) indicate non-significant ($P \geq 0.05$) decreases in slaughter weight, carcass length, dressing percent, but a significant ($P \leq 0.05$) decrease in visceral fat. Hide, liver and kidney, in contrast, became larger with increases in the level of fermented cassava. Hearts from chickens fed diets containing more than 20 per cent fermented cassava were also significantly ($P \leq 0.05$) larger than those fed the control diet (15). The general reduction in the carcass value as the fermented cassava level increased appears related to the final body weight of the sheep. Devendra and Lee Kok Choo (6) have reported highly significant ($P \leq 0.01$) correlations of mean live weight with heart girth, height at withers, body length and hip width in Kedah-Kelantan heifers fed diets supplement with cassava.

The results of this study suggest that fermented cassava could replace corn w/w up to 60 per cent in rations for sheep without significant depression in efficiency of feed utilization, growth rate but with increases in economic benefit.

Summary

Twenty-four 14-week old West Agrican Dwarf sheep comprising 12 wethers and 12 lambs with an average initial body weight of 15.68 kg were fed rations in which fermented cassava replaced corn w/w at 0, 20, 40 and 60% levels, respectively for 224 days. The effect on digestibility of the rations, live performance, carcass and economic characteristics of the sheep were evaluated.

Feed intake and apparent digestibility of crude protein, crude fibre, ether extracts, nitrogen free extract and total digestible nutrients were significantly lower in rations containing 40 and 60 per cent fermented cassava than any other ration. Both efficiency of feed utilization and growth rate were depressed as fermented cassava increased in the rations. Dressing percentage, carcass length and abdominal fat were lower while the kidney and liver were larger with increases in the level of fermented cassava. Increases in fermented cassava in the rations also produced greater economic benefits compared with the control ration

Literature cited

1 A.O.A.C. Association of Official Agricultural Chemists Official methods of analysis (11th ed.) Washington D.C. 1094 p.

2 CARDOSO, R.M., CAMPOS, J., HILL, D. H. and de SILVA COELHO, J. F. Effeto de substitutição gradativa de milho pela raspa de mandioca, na produção de leite. Revista Ceres 14: 308 - 328. 1968.

3 CARVALHO, A. R. I., FARIAS, M. S. and LOFGREEN, G. P. Molasses, cassava and cotton seed meal as supplements to fresh or ensiled sugar cane tops. Pesquisa Agropecuaria Brasileira 2: 411 - 420. 1967.

4 CASTRO, M. E. D. and Da SILVA, J.F.C. Substituticão do milho desintegrado com palha e sabugo pela de mandioca integral en rações para rumiantes. II Confinamento de bovinos. Experientiae 20: 204 - 216. — 1975.

5 CHICCO, C. F., CARNEVALLI, A. A. SCHULIZ, I. A., SCHULTZ, E. and AMMERMAN, C. B. Yuca y melaza en la utilización de la urea en corderos. Asociación Latino Americana de Producción Animal 6: 7 - 17. 1971

6 DEVENDRA, C. and LEE KOK CHOO, I. Studies on Kedah-Kelantan cattle. I. The effect of feeding increasing levels of tapioca *(Manihot utilissima* Pohl) MARDI Research Bulletin 4: 81 - 88. 1976

7 ECHANDI, M. I. Valor de harina de hojas y tallos deshidratados de yuca la producción de leche. Turrialba 2: 166 - 169. 1952.

8 GOSSTIJO, R. M., VIVELA, H., CARNEIOR, G. G., VIDGAL, G. T. and MIRANDA, J. J. F. Estudo comparativo entre raspa de mendioca lavada e milho destintegrado como fontes de energia, para engorda de novilhos azebuados en confirmamento. Arquivos Escola Veterinaria 24: 27 - 31. 1972.

9 MATHUS, M. L., CAMPATH, S. R. and GHOSH, S. N. Studies on Tapioca in the concentrate mixture of dairy cows. Indian Journal of Dairy Science 22: 193 - 199. 1969

10 OYENUGA, V. A. Nutrition value of cereal and cassava diets for growing and fattening. British Journal of Nutrition 15: 327 - 338. 1961.

11 SCHULIZ, I. A. CHICCO, C. F., SCHULTZ, E. and CARNEVALLI, A. A. Effect of different sources of energy (cassava, maize, rice and molasses) on utilization of high proportion of urea by cattle. Agronomía Tropical (Maracay) 20: 185 - 194. 1970.

12 SOWARDI, B., SASTRADIPRADJA, D., NASUTION, A. H. and HUTASOIT, J. H. The influence of corn and cassava meal supplementation on the feeding value of alang-alang *(Imperata cylindrica* (L) Beauv) for Ongole grade heifers. Malaysian Agricultural Research 4: 123 - 130. 1975.

13 STEEL, R.G.D. and TORRIE, J. H. Principles and procedures of statistics. New York, McGraw-Hill, 1960 481 p.

14 VALDIVIESO, C. A. and de ALBA, J. Uso del maíz y la harina de yuca en mezclas simples para criar terneras de lechería. Turrialba 8: 148 - 152. 1958

15 VOGT, H. The use of tapioca meal in poultry rations. World's Poultry Science Journal 22: 113 - 125. 1966.

Notas y Comentarios

Publicaciones

Ciencias y Técnica en la Agricultura. Con este nombre el Ministerio de Agricultura de Cuba ha iniciado en 1978 la publicación de dos revistas semestrales de investigación. La primera tiene como subtítulo *Suelos y Agroquímica,* y tiene en su primer número cinco artículos sobre fertilizantes y análisis de suelos. La segunda *Protección de Plantas.* Tiene cuatro artículos sobre malezas, herbicidas y sobre sigatoka del plátano. La dirección es CIDA, Gaveta Postal 4149, La Habana

European Journal of Cell Biology. La revista alemana *Cytobiologie* se ha unido al selecto número de publicaciones que se están europeizando, y ha cambiado su nombre a *European Journal of Cell Biology.* Se trata de una revista que publica artículos de investigación sobre la estructura, función y organización macrocelular de células y componentes celulares. Se prefieren contribuciones sobre dinámica celular, diferenciación, bioquímica y biología molecular en relación con datos estructurales. A partir del volumen 19, número 1, abril 1979, la revista ha aparecido con el nuevo nombre. Ahora de tamaño 21 × 28 cm (el tamaño de *Turrialba),* los artículos se están publicando preferentemente en inglés (lo que también es una tendencia en la actualidad). Cada volumen se calcula que tendrá unas 340 páginas. El editor ejecutivo es Hans Rolta, de Stuttgart. La dirección es P.O. Box 40; Birkenwaldstrasse 44, D-7000 Stuttgart 1.; Alemania