Dystocia in Ndama Cattle—Case Report

by

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SUMMARY

DYSTOCIA cases were observed in 8 Ndama cows bred by a particular German Brown bull at the University of Ibadan farm. The cases were caused by malpresentation and relative oversize of the foetuses. No dystocia was observed in the herd after this particular bull was culled. The sequelae of dystocia observed are discussed.

INTRODUCTION

Dystocia is an economically important problem in cattle in that cows having difficulty at calving produce a smaller percentage of live calves (Sagabiel *et al* 1969), (Rice and Wiltbank 1970).

Dystocia was observed to be high when Friesians, Ayrshires and Jerseys are crossed with Carolais bulls (Stables 1969). Dystocia cases have also been reported in reciprocally crossed Angus, Hereford and Charolais cattle (Sagabiel *et al* 1969), (Young 1970).

One of the duties of an obstetrician is to assist the farmer in the breeding programme and to advise on the culling of bulls which genetically produce malpresented calves leading to dystocia.

In the crossbreeding programme at the University of Ibadan, a German Brown bull GB 40 was used to breed Ndama cows in order to produce a crossbreed which will combine the tolerance to trypanosomiasis of Ndama with heavier carcass weight of the German Brown cattle.

The Ndama breed of cattle in Nigeria is a slow maturing beef breed which attains maximum weight of about 280–300 kg compared with the German Brown cattle which is an exotic breed with maturity weight of about 600 kg.

This paper reports observations of cases of dystocia mainly due to foetal malpresentation produced by crossbreeding a German Brown bull with Ndama cows.

CASE REPORTS

All the cases reported in this paper are of Ndama cows that were pasture bred to a German Brown bull GB 40 between February and August 1973. They were observed either in dystocia or dead as a result of dystocia at their overnight paddock at different dates between November 1973 and June 1974 during routine morning inspections before the herd was released out for grazing.

All the foetuses were found dead during clinical examinations.

Case 1

The dam in Case 1 was Ndama cow ND 12.

The foetus in this case was in anterior presentation, dorso-sacral position and bilateral shoulder flexion posture. The fetal head was visible at the vulva. The posture was corrected and the foetus was delivered by forced traction. Its weight was 25 kg.

Case 2

The dam in Case 2 was Ndama cow ND 15.

The foetus was in anterior presentation dorso-sacral position with lateral deviation of the head. It was delivered by forced traction after correction of the postural abnormality. Its weight was 25.5 kg.

Case 3

The dam in Case 3 was ND 23.

The foetus was in anterior presentation dorso-sacral position and foot-nape posture. It was delivered, after correction of the abnormal posture by forced traction. It weighed 25 kg.

Case 4

The dam in Case 4 was ND 29.

The foetus was in breech presentation. The posture was corrected and the foetus was extracted after performing an episiotomy. The weight of the foetus was 24 kg. The vulval incision was closed with single interrupted sutures using monofilament nylon size 3. Parenteral penicillin and streptomycin injections were administered.

The vulval sutures were removed on the 14th day.

The temperature of the cow was 40°C on the first day and did not fall to the normal temperature of 38.3°C until the 8th day. The placenta was retained for four days before it was manually removed.

Twenty days after the dystocia was corrected, pus was observed draining from the external os of the cervix, when vaginal examination was performed using a coldlite vaginoscope. The condition was diagnosed to be metritis. The temperature at this time was subnormal 37.8°C. 1.33 mega units procaine penicillin and 1.67 gms streptomycin were infused into the uterus. The cow was found dead twenty-six days after it was presented with the dystocia.

Post Mortem Report

There was severe gangrenous metritis characterized grossly by darkblack mucosa, muscular layer and the scrota with accompanying yellow grey fluid in the uterine lumen. The edges of the liver were swollen. The muscles of the heart appeared cooked-pale-grey in colour. The kidney appeared mottled, pale-grey with pinpoint hyperaemic areas. This picture might have been as a result of toxæmia arising from gangrenous metritis.

Ndama Cows ND 226, ND 32, ND 47, ND 34 which were bred by the same bull GB 40 were found dead overnight at different dates. Postmortem examinations showed that these animals were carrying

foetuses which were fully developed and at term. The weights of the foetus were 23.5 kg, 24.5 kg, 25.5 kg, 25 kg respectively and they had different presentation and postural abnormalities.

The dams in Cases I, II and III calved normally when they were bred by other German Brown bulls.

DISCUSSION

Observations at the University farm show that the average birthweights of pure Ndama, pure German Brown and German Brown-Ndama cross breeds were 11.5 kg, 35.43 kg and 22.24 kg respectively. The average birthweight for the foetuses that caused dystocia in this paper was 24.75 kg. This can be expected because in most cases the birthweight of the crossbred calves exceeds the average of the pure-breeds (Sagabiel *et al.* 1973).

It seems that the average weight of foetuses produced by Ndama cows when bred by bull GB 40 is more than that of pure Ndama calves and other German Brown-Ndama cross bred calves. It seems therefore that the relatively oversized foetuses with postural abnormalities were responsible for the dystocia in the cases reported in this paper. This ability to produce relatively large foetuses with postural abnormalities is peculiar to basis GB 40. This bull was culled on this bull and since then no case of dystocia had been observed in the cross-breeding programme.

Possible sequelae of dystocia are placental retention, endometritis, pyometra, which may eventually lead to toxæmia and perhaps terminate in death as shown by one of the cases reported in this paper. Even when these conditions do not terminate in death, they may give rise to infertility or sterility. In this paper none of the surviving cases showed evidence of infertility or sterility.

From the cases reported in this paper it is evident that dystocia may be regarded as one of the factors that reduce productivity in farm animals because of loss of calves, leading to decreased calf crop,

increased intercalving interval where there is endometritis, pyometra and delayed uterine involution. Other indices of reproductive efficiency may be adversely affected.

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The Value of Cassava for Growth of Sheep

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SUMMARY

THREE experiments were conducted to investigate the value of cassava for sheep feeding. In Experiment 1 twelve Nigerian Dwarf sheep between five and six months of age, ranging in liveweight from 6 to 14 kg were randomly allotted by sex and weight to three experimental treatments. The treatment groups received either a maize-groundnut meal control diet, a fresh cassava + poultry litter mixture that had been ensiled and later mixed with protein supplement, or dried cassava-groundnut meal diet, during the 70-day experimental period.

In Experiment 2, unpeeled fresh cassava roots of the high HCN variety were used to replace maize in lamb diets. Fresh cassava was fed mixed daily with a protein supplement to the first treatment group while the other group received a maize-based control diet, over a 56-day period. In Experiment 3 the apparent digestibility of the nutrients in the unpeeled fresh roots, dried roots and peels were investigated.

The results of the three experiments indicated that total replacement of maize with either dried cassava, cassava ensiled with poultry litter or unpeeled fresh roots for growing lambs gave responses equal to the control diet. Ensiling of fresh cassava roots destroyed 99% of the HCN while the addition of poultry litter increased the crude protein content of the silage by about 270% when compared with the unpeeled fresh roots and by about 435% when compared with ensiled roots to which no poultry litter was added. All the nutrients in cassava roots, except crude protein were well digested by sheep. Ether extract digestibility was however generally low. In all cases no symptoms of toxicity were noticed.

INTRODUCTION

Cassava *Manihot esculenta* Crantz. continues to assume an increasingly important role in Tropical animal nutrition. Perhaps the most profitable way to take advantage of the low cost and great pro-

ductivity of cassava is by feeding it to livestock (Jones, 1959).

The utilization of cassava by monogastric animals is well documented but its value in ruminant nutrition has not been widely studied. While there is paucity of information on its utilization as part of cattle rations (Jobling, 1966; Cardoso, Campos, Hill and Da Silva, 1968; Neves, Fernandez, Estima, Caldas and Haines, 1969; Olaloku, Egbuiwe and Oyenuga, 1971), there appears to be no literature on its value to sheep.

Despite cassava's deficiency in protein, its significance as an energy source in stock nutrition should be appreciated and its desirability as a partial or total replacement for cereals, in a world of competition between man and livestock for these sources of energy, is noteworthy. It however has to be heavily supplemented with protein to meet the animals requirements for maintenance of tissue integrity and growth or production.

In commercial animal production great attention must be paid to the sources of protein for cassava supplementation and attempts should be made at utilizing cheap sources of protein especially for ruminants.

The quality of protein as indicated by level and balance of amino acids is not a critical factor in sheep nutrition. The sheep through rumen fermentation, can synthesize all the essential amino acids from non-protein sources (Loosli, Williams, Thomas, Fennis and Maynard, 1949). Such microbial protein synthesis compensates for any deficiency in protein quality. In general, the quantity fed is more important than the source.

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The presence of HCN (hydrocyanic acid) in cassava roots is of far reaching significance from a nutritional standpoint since HCN is poisonous to humans and livestock. The amount of HCN that can be safely consumed without grave consequences varies from person to person and also appears to be affected by the variety of other foods that are eaten with it (Nicholls, 1951). The role of HCN in nutrition has been reviewed (Oke, 1969).

The first study reported here was carried out in an attempt to utilize poultry litter as a source of protein enrichment for cassava roots during the process of ensiling, and compare the utilization of such product with that of sundried cassava roots. The second experiment was aimed at replacing maize in the diet of growing lambs with a high HCN cassava variety to observe any toxic effects and measure its influence on growth. The third study estimated the digestibility for sheep of fresh and dried cassava roots and the peels.

MATERIALS AND METHODS

Feed Ingredients

Cassava roots for silage making were obtained by special arrangement from the experimental plots of the International Institute of Tropical Agriculture, Ibadan. Dried cassava was prepared by chopping unpeeled fresh cassava roots and sun-drying. Broiler house litter was collected from the University of Ibadan poultry farm. Groundnut meal, maize, molasses and the mineral mixture were obtained from the stock in the University farm feed depot.

Preparation of Cassava plus poultry litter silage

Fresh cassava roots were obtained from the field and milled with fairly dry broiler

house litter containing about 25% crude protein, in a ratio of about 8:1. The milled material was placed in empty steel drums perforated at the base to allow drainage of excess water and lined with banana leaves. The sides were lined with cellophane paper. The drums were packed tight, covered with banana leaves and a plastic sheet and weighted down with heavy stones. They were allowed to stand for about eight weeks. On opening the product was a light-brown, sweet smelling mass.

Preparation of dried cassava

Unpeeled fresh cassava roots were chopped into small pieces with a cutlass and spread out on a canvas in the sun to dry. They were periodically turned over to ensure complete exposure to the sun to reduce fungal attack. Drying was completed within two weeks. The dried pieces were then milled into a powdery form coloured brown by the peels. It was stored in sacks until used.

Cassava peels were obtained from peeled roots and sun-dried. The peels were not milled before feeding.

Preparation of experimental diets

The maize and dried cassava based diets were prepared by mixing the ingredients thoroughly in a feed mixer.

The protein supplement for the cassava + poultry litter silage based diet (Experiment 1) and that for the fresh cassava diet (Experiment 2) were prepared separately and a calculated amount was mixed with the silage or fresh cassava as the case might be to prevent overconsumption of supplement.

Grass was cut every morning and offered to all the experimental groups.

The percent and proximate composition of the experimental diets are presented in Tables 1-5.

TABLE 1
Percent Composition of Diets Experiment 1

	<i>Diets</i>		
	1	2	3
	%	%	%
Maize ^a	83.68	—	—
Dried cassava	—	—	73.68
Cassava + poultry litter silage ^b	—	82.18	—
Groundnut meal	11.00	12.50	21.00
Molasses	5.00	5.00	5.00
Mineral Premix ^d	0.32	0.32	0.32
Total	100.00	100.00	100.00

a — Contained 10% crude protein

b — Value given on an air dry basis. Diet contained in the fresh mixture 93.1% silage and 6.9% of the 36% protein supplement. Containing 70.15% groundnut meal, 28.06% molasses and 1.79% mineral premix.

c — Contained 51.4% crude protein

d — Microzone C23A by Crosfields International Limited contained per kg of premix Vit. A, 2.5 I.U.; Vit.D₃ 1.25 I.U.; manganese, 80g; Zinc 60g; Iron 30g; Copper, 20g; Cobalt 1.5g; iodine, 6g; magnesium 100g. The mixture was used at 0.32% of diets.

TABLE 2
Proximate Composition of Diets^a Experiment 1

<i>Diets</i>	<i>Dry matter</i>	<i>Crude protein</i>	<i>Ether extract</i>	<i>Crude fibre</i>	<i>N.F.E.</i>	<i>Ash</i>
	%	%	%	%	%	%
Maize groundnut meal	86.85	17.60	2.59	2.08	71.98	5.75
Dried cassava-groundnut meal	89.33	15.80	0.46	5.62	72.05	6.07
Cassava + poultry litter silage-groundnut meal	44.34	16.50	0.54	3.92	72.66	6.38
Grass	21.00	11.58	1.26	28.49	49.07	9.60

a — Mean of 3 determinations; values expressed on a dry matter basis.

TABLE 3
Percent Composition of Diets
Experiment 2

<i>Ingredients</i>	<i>Diets</i>	
	<i>1</i>	<i>2</i>
	%	%
Maize	84.68	—
Unpeeled fresh cassava ^a	—	72.50
Groundnut meal	10.00	22.18
Molasses	5.00	5.00
Mineral premix ^b	0.32	0.32
Total	100.00	100.00

a—Value expressed on an air dry basis. Diet contained in the fresh mixture 88.16% fresh cassava and 11.8% of the 41.6% protein supplement containing 80.38% groundnut meal 17.97% molasses and 1.15% mineral premix.

b—See Table 1 for detailed composition of mineral premix.

TABLE 4
Proximate Composition of Diets^a
Experiment 2

<i>Diets</i>	<i>Dry matter</i>	<i>Crude protein</i>	<i>Ether extract</i>	<i>Crude fibre</i>	<i>Nitrogen free extract</i>	<i>Ash</i>
	%	%	%	%	%	%
Maize-groundnut meal control	89.15	18.50	5.30	3.50	68.20	4.50
Fresh cassava-groundnut meal	46.26	17.30	1.90	4.30	70.70	5.80
Grass	41.87	8.60	1.00	32.90	48.80	8.70

a—Mean of 3 determinations; values expressed on dry matter basis.

TABLE 5
Proximate Composition of the Unpeeled Fresh and Dried Cassava Roots and Peels Fed in Digestibility Studies^a

<i>Composition</i>	<i>ITEMS</i>		
	<i>Unpeeled fresh roots</i>	<i>Unpeeled dried roots</i>	<i>Dried peels</i>
Gross Energy Kcal/g	5.40	4.19	3.86
Dry matter %	30.10	82.20	89.09
Organic matter %	96.40	95.87	89.04
Crude protein %	2.36	4.23	4.85
Ether extract %	0.46	0.93	0.95
Crude fibre %	3.67	5.14	10.48
Nitrogen free extract %	91.58	85.57	72.76
Ash %	1.93	4.13	10.96

a. Mean of 3 determinations.

Experimental Animals

Twelve Nigerian Dwarf sheep between five and six months of age with a weight range of 6–14 kg were randomly allotted on the basis of sex and weight to the following three experimental treatments:

1. Maize groundnut meal: control.
2. Fresh cassava that had been ensiled with poultry litter and later mixed with protein supplement.
3. Dried cassava-groundnut meal.

There were four animals per treatment consisting of two males and two females with an average initial weight of 9.56 kg. They were housed in iron-roofed pens with concrete floors covered with sawdust. Movable wooden feeders and concrete water troughs were provided.

Concentrate was given *ad libitum* in two approximately equal instalments at 8.00 a.m. and 12.00 noon. *Cynodon nlemfuensis* var. robustus grass was given *ad libitum* at about 10.00 a.m. and 2.00 p.m. to ensure maximum intake and reduce soiling and wastage. Water was given *ad libitum*.

Any feed not consumed within 24 hours was collected, weighed and discarded. Body weight changes were recorded once a week throughout the 70-day experimental period. The litter was changed periodically.

Experiment 2

Eight sheep between 3–4 months of age and having a weight range of 4.5–8.9 kg were used in the study. The animals were allotted to either of the following treatments.

1. Maize-groundnut meal: control.
2. Fresh cassava mixed with protein supplement.

There were four sheep per treatment consisting of two males and two females with an average initial weight of 7.2 kg. They were housed as in Experiment 1.

Feeding was done *ad libitum* in two approximately equal meals of concentrate one 8.00 a.m. and the other at 12.00 noon.

Grass was given *ad libitum* at about 10.00 a.m. and 2.00 p.m. to ensure maximum intake and reduce soiling and wastage. The experiment lasted 56 days.

Experiment 3

Four male sheep, between 10–12 months old and weighing 11–14 kg were used in the studies. They were individually housed in metabolic cages designed for faeces and urine collection.

Grass was offered for a 5–7 day preliminary period followed by a 7-day collection period. This was followed by another preliminary period of 5–7 days after which collection was made on the test samples. Total faecal collection was made and weighed daily before taking 25% of output for moisture determination. Faecal samples for each animal were bulked, milled and analysed for proximate composition. Digestibility of the test samples was calculated by difference.

Analytical methods

Proximate analysis of feed was done according to A.O.A.C. (1970) Hydrocyanic acid was assayed by the method of Knowles and Watkins (1950). Statistical analysis, were carried out, was done by the analysis of variance (ANOVA) procedure of Snedecor and Cochran (1967) using a Litton Monroe model 1860 statistical programmable printing calculator. Comparison of treatment means were done by the Bayes exact test for symmetrical comparisons (BET) of Waller and Duncan (1969).

RESULTS AND DISCUSSION

Effect of sundrying and ensiling on cassava roots

The changes in crude protein and hydrocyanic acid in cassava roots on sundrying and ensiling with poultry litter are shown in Table 6.

The crude protein content of the roots increased by about 95% on sundrying while the HCN content decreased by 94%. Ensiling the fresh roots alone

TABLE 6

Effect of Sun-Drying and of Ensiling with Broiler House Litter on the Crude Protein and Hydrocyanic Acid Contents of Cassava Roots^a

<i>Material</i>	<i>HCN mg/kg</i>	<i>% of fresh root</i>	<i>% loss in HCN</i>	<i>% Crude protein content</i>
Unpeeled fresh root	1149	100	—	2.3
Sun-dried root	65	6	94	4.4
Root silage	17	2	98	1.6
Cassava + poultry litter silage	13	1	99	8.6

a. Mean of 4 determinations; values expressed on a dry matter basis.

decreased crude protein content by some 30% and the HCN by 98%. The addition of poultry litter before ensiling increased crude protein content by 270% and reduced HCN by 99%. (Table 6).

These results have great significance when viewed in the light of the potential usefulness of the various products as animal feeds. The increase in crude protein content of the roots on sun-drying was due to fungal growth incidental to an attempt to sundry cassava in bad weather. The extent of such fungal proliferation and the degree of biochemical changes induced by the fungi, would however be determined principally by the ability of the fungi to establish themselves quickly when the moisture content of the cassava chips was still high (Clerk and Caurie, (1968). That such fungal protein enrichment of cassava might be biologically valuable and with commercial possibilities lends itself to experimental support (Robinson and Davidson, 1959; Gray 1962a; Gray, Och and Abou-El-Seoud, 1964; Gray, 1966; Gray and Abou-El-Seoud, 1966).

The decrease of 30% in crude protein on ensiling of fresh roots probably resulted from detoxification processes taking place in ensiling. This contention is supported by the experimental evidence that a chemical link exists between cyanogenesis and protein metabolism in the plant (Nartey 1968). It is thus to be expected that the crude protein content of cyanogenic plants would be affected by their cyanide content such that any hydrolytic losses in cyanide would be reflected in the crude protein content determined as total

nitrogen. Much of the increase in crude protein resulting from the addition of poultry litter most probably came from the poultry litter nitrogen. This is of practical interest since poultry litter itself is a waste product.

The reduction in HCN content of cassava both on ensiling and on sun-drying is of nutritional and toxicological importance.

It highlights the significance of these processes in cassava detoxification and justifies the fermentation of cassava in traditional gari processing. The fermentation of cassava was found to be self-sterilizing, exothermic and anaerobic, and to proceed in two stages at an optimum temperature of about 35°C with the production of lactic and formic acids and a trace of gallic acid (Akinrele, 1964). Its significance has already been reported by Collard and Levi (1959) who, showed that it brings about the detoxification of cassava by the liberation of hydrocyanic acid at low pH through the combined activities of *Corynebacterium manihoti* and *Geotrichum candida*. Later work has shown that such detoxification processes could be accelerated by soaking in water, cutting or grating or by any other treatment such as exposes the enzyme to the substrate (Nartey, 1968). Ensiling is essentially a process of fermentation and preservation.

The additional reduction in HCN when poultry litter was added, bringing the observed value to 13 mg/kg (Table 6) was due to a dilution effect of the poultry litter on the cassava. When the dry matter content of 85% of the poultry litter and

the ratio 8:1 of the cassava to poultry litter in the silage were considered, the corrected value of 17mg/kg (Table 6) was obtained. The actual reduction in HCN however rested more on the mode of reactions taken place during the process of ensiling.

The foregoing discussion attempts to explain the fact that the raw materials used in the preparation of the experimental diets were relatively harmless from the HCN toxicity view point. It does not take into consideration such fractions of the glucosides as might have remained un-attacked by the enzyme during the various detoxification processes. Whether or not such residual glucoside remained is beyond the scope of the present investigation.

Performance Characteristics.

Experiment 1

Average daily gains: The animals gained an average of 27, 33 and 32g. per day on the maize control, dried cassava and silage diets respectively.

even under good management. For the purpose of this experiment however, comparative rather than maximum quantitative growth appeared most important.

A daily growth difference of 6g. between the control and dried cassava diet and of 5g. between the control and silage diet did not appear to be of any significance from a practical standpoint. The gains were in fact not statistically ($P > 0.05$) different.

Average daily intake

Average daily intake of total dry matter was highest on the dried cassava diet while the maize control diet had the lowest. A higher daily intake of concentrate dry matter on the dried cassava diet was compensated for by a higher consumption of grass dry matter on the silage diet. There was however no indication of any remarkable difference in palatability of the diets, all of which had 5% supplemental cane molasses (Table 1).

TABLE 7

Performance of Growing Lambs fed Cassava-Poultry Litter Silage, Dried Cassava or a Maize Control Diet^a

EXPERIMENT 1

Parameters	Diets		
	Maize control	Dried cassava	Cassava + poultry litter
<i>Average daily dry matter Intake (g)</i>			
Grass	82	114	152
Supplement	224	288	236
Total	306	402	388
<i>Average daily gain (g)</i>	27	33	32
Feed/gain	11.33	12.18	12.13

a. Mean of four lambs per treatment: 70-day trial: means not significantly ($P > 0.05$) different.

Feed efficiency

Low daily gains of the sort reported in this experiment are not unexpected with the Nigerian Dwarf sheep. The animals are characterized by very poor growth

Feed efficiency calculated as feed/gain was found to be 11.3, 12.2 and 12.1 for the maize control, dried cassava and silage diets respectively (Table 7).

The maize control diet gave the highest feed efficiency and the lambs required less feed per unit of gain. This indicated that the lower dry matter intake did not affect performance. The effect would in fact only be noticeable where feed was restricted and intake became inadequate for growth and maintenance or where diet palatability became a limiting factor to consumption. The silage fed animals required more feed per unit of gain than those on the control diet while those fed dried cassava required more feed than those fed silage. The differences were not significantly ($P > 0.05$) different.

Experiment 2

Average Daily gains. Average daily gains were 65.0 and 48.7g per head on the maize control and fresh cassava diets respectively (Table 8). The differences were not significant ($P < 0.01$). It would thus appear that the only variable factor of diet did not have any serious effect on growth in this experiment.

Feed efficiency

Feed efficiency was higher in the maize control group than the fresh cassava group. The maize control group required (30%) less feed per unit of gain than the fresh

TABLE 8
Performance of Sheep Fed Unpeeled Fresh Cassava Roots with Restricted Protein Supplement or a Maize Control Diet

Parameters	Diets	
	Maize-groundnut meal control	Unpeeled fresh cassava-groundnut meal supplement
Average daily dry matter intake, g		
Grass	102	143
Supplement	223	205
Total	325	348
Average daily gain, g	65.0	48.7
Feed/gain	5.0	7.2

TABLE 9
Apparent Digestibility of the Nutrients in Unpeeled Fresh Cassava Roots, Unpeeled Dried Roots and Dried Peels Fed to Sheep^a

Nutrient	Feed		
	Fresh cassava	Dried cassava	Cassava peels
Dry Matter %	82.59 ± 0.57	65.32 ± 1.93	70.2 ± 0.89
Gross Energy %	85.48 ± 0.78	68.32 ± 1.68	72.71 ± 0.99
Organic Matter %	86.03 ± 0.57	70.32 ± 1.87	74.47 ± 0.91
Crude Protein %	0.73	20.79 ± 2.39	37.26 ± 2.72
Ether extract %	30.17 ± 3.74	30.38 ± 2.79	49.69 ± 2.35
Crude fibre %	44.61 ± 0.11	8.07 ± 1.58	30.57 ± 2.42
Nitrogen free extract, %	100.28 ± 0.46	94.94 ± 2.09	92.09 ± 0.70

^a Mean of four sheep
± = S. E. of Mean

cassava group. It would therefore appear that the relative value of the two energy sources would be dependent more on the relative prices of cassava and maize at any particular time as well as the protein supplement used. No toxicity symptoms were noted throughout the experiment.

Experiment 3

Apparent digestibility coefficients of the nutrients in unpeeled fresh and dried cassava roots and the peels are shown in Table 9.

The results indicated that all nutrients except perhaps the crude protein and ether extract were well digested by the sheep. The very high NFE digestibility for fresh cassava and the negative protein digestibility for dried cassava was probably due to the method of determination employed. The indirect method of determining apparent digestibility has frequently yielded impossible coefficients, either negative or greater than 100. Such coefficients are especially likely to be obtained for those nutrients present in small amounts in the supplemental feed and in relatively large amounts in the basal ration.

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