CASSAVA LEAF MEALS IN BROILER DIETS

D Wyllie[1] and P J Chamanga[2]

Faculty of Agriculture, Forestry and Veterinary Science,
University of Dar es Salaam, Morogoro, Tanzania

In two experiments three types of dried cassava foliage meal were fed to broiler chicks. In the- first experiment a meal comprising leaves and petioles reduced performance when substituted for cottonseed meal. Liveweight gains were 1251, 1360, 1332 and 1238 g from 0 to 8 weeks for levels of inclusion of 0,5,10 and 15%. respectively. However, performance was improved when dried cassava tips were included at a level of 10% of the ration giving a liveweight gain of 1407g from 0 to 8 weeks. In a second experiment performance was reduced at levels of inclusion of 7.5 and 15% of a high quality foliage meal when substituted for a sunflower/sesame meal mixture. Liveweight gains from 0 to 4 weeks of age were 566, 533 and 504g for levels of inclusion of 0,7.5 and 152 respectively. Further additions of- methionine to the diet containing 15% foliage meal failed to improve performance as did inclusion of sodium sulphate. The results show that the low energy content of cassava foliage meals is a problem but that the importance of cyanoglucoside content and the protein quality of the total diet is more complex. The results suggest that in rural situations reasonable performance could be obtained through the use of foliage meals.

Key words: Cassava leaf meal, broilers, Methionine, sodium sulphate

There is great potential for the use of leaf meals for animal feeding in the tropics. This is due to the rapid plant growth possible when water is available as well as the fact that the availability, erratic supply or price of conventional feedstuffs frequently means that other, perhaps more local sources of protein, must be found. For example, in many rural areas in the tropics the unreliability of compound feed supplies means that poultry diets must be mixed locally using locally available ingredients. One possible such protein supplement is leaf meal made from dried cassava foliage.

Cassava can produce very high amounts of protein/ha even in the dry season in situations where no irrigation or fertilization is practised (Montaldo and Montilla 1976; Wyllie 1979), the seasonal distribution of the available forage being dependent on the cutting system used. While the use of cassava foliage has been demonstrated for feeding to ruminants there is less work on the use of cassava foliage for monogastrics. The following experiments were designed toexamine the use of cassava foliage meal in broiler diets and to determine if additional dietary methionine or sulphur was required to alleviate the presence of cyanogenic glucosides in the meal.

---

[1] Present address: Centre for Tropical Animal Production, University of Yucatan 116D, Merida, Mexico.
[2] Present address: Ministry of Agriculture, Mtwara Tanzania

Materials and Methods

Preparation of leaf meals in Experiment 1: The cassava leaf meal used was derived from 12-month-old plants of the variety Mzungu grown at Morogoro. Two types of meal were prepared: one using mature leaves and petioles and the other using the complete growing tip including the first four opened leaves. The material came from plants which had been continuously harvested in this way so that the tips harvested were of recent growth. The harvest of leaves and petioles comprised the bottom one third of the total leaves on the plant, the plants being stripped from the base upwards at the first sign of leaf senescence. Both types of material were dried in a forced air oven at 60!C for 48 hours before grinding in a hammermill through a 1.6mm screen.

Preparation of leaf meals in Experiment 2: The leaf meal for this experiment was prepared by obtaining tips and leaves plus petioles from the same source and in the same manner as in Experiment 1, except that the petioles were discarded leaving only the leaf laminas. The material was dried and ground as in Experiment 1. An equal weight of the dried lamina material was combined with an equal weight of the dried tips to produce a composite leaf meal mixture.

Diets: For Experiment 1 four diets were compounded containing 0, 5, 10 and 10% leaf meal (leaves plus petioles) and a fifth diet containing 15% cassava tip meal (plant tips).The composition of the diets is shown in Table 1. The cassava leaf and tip meals were used to replace cottonseed cake as a protein source and the diets were made isonitrogenous by the use of small amounts of cassava root meal. In Experiment 2 seven diets were fed as shown in Table 2. In these 0, 7.5 and 15% leaf meal were compared, the leaf meal being substituted for a 2:1 mixture of sunflower and sesame meals so that the diets were isonitrogenous. At the 15% level of inclusion further additions of methionine of 0.20 and 0.40%, with or without 0.20% sodium sulphate, were compared.

Experimental birds and management: In Experiment 1 each diet was fed to three pens, each containing 10 one-day-old chicks allotted at random on the basis of weight outcome groups and sex so that each pen contained 5 male and 5 female chicks. The pens were concrete floored and provided an area of 0.90 square metres. Rice hulls were used as litter. Supplementary heat was supplied electrically for the first three weeks . Food and water were supplied ad libitum and the birds were slaughtered after 8 weeks. At slaughter the weights of the fresh carcass, gizzard, liver, heart and pancreas were taken. The colour of the skin on the shanks and on the breast was scored using a Roche Colour Fan and analysis carried out using the mean of the two measurements.

Table 1:
Experimental diets used in Experiment 1.

Ingredient	Diet 1	2	3	4	5
Cassava leaf and petiole meal	-	5.00	10.00	15.00	-
Cassava tip meal	-	-	-	-	10.00
Cassava root real	5.79	3.86	1.93	-	1.93
Maize	54.5	54.50	54.5	54.5	54.5
Sunflower meal	12.00	12.00	12.00	12.00	12.00
Fish meal (dagaa)	15.00	15.00	15.00	15.00	15.00
Cottonseed meal	9.21	6.14	3.07	-	3.07
Bone meal	2.50	2.50	2.50	2.50	2.50
Salt	0.50	0.50	0.50	0.50	0.50
Vitamin/mineral premix.	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Calculated analysis					
Crude protein (N x 6.25)	21.46	21.43	21.39	21.36	21.99
Crude fibre	4.25	4.75	5.25	5.75	4.84

* Supplied the following per kilogram of diet: Vitamin A 15,000 IU; Vitamin D 3,000 IU; Vitamin E 10 IU; Nicotinic acid 35mg; Ribaflavin 12mg; Folic acid 1mg; Pantothenate 20mg; Choline chloride 500mg; Vitamin B12 10~g; Thiamine 50~g; Pyridoxine 60~g; Biotin 50~g; Vitamin K 3mg; Payzone 40mg; Zinc oxide 60mg; Manganous oxide 100mg; Potassium iodide 3mg; Copper sulphate 20mg;

Table 2:
Experimental diets used in Experiment 2

Ingredient	Diet I	2	3	4	5	6	7
Cassava leaf meal	-	7.50	15.00	15.00	15.00	15.00	15.00
Cassava root meal	4.23	2.11	-	-	-	-	-
Maize	54.50	54.50	54.50	54.50	54 50	54 50	54 50
Sunflower meal	10.18	6.59	3.00	3.00	3.00	3.00	3.00
Sesame meal	5.09	3.30	1.50	1.50	1.50	1.50	1.50
Cottonseed meal	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Fish meal (dagaa)	18.00	18.00	18.00	18.00	18.00	18.00	18.00
Bone meal	2.50	2.50	2.50	9.50	2.50	2.50	2.50
Salt	0 50	0.50	0.50	0.50	0.50	0.50	0.50
Vitamin/mineral premix*	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.25	0.25	0.25	0.45	0.65	0.25	0.45
Sodium sulphate	-	-	-	-	-	0.20	0.20
<u>Calculated Analysis</u>							
Crude protein (N x6.25)	21.27	21.25	21.20	21.20	21.20	21.20	21.20

Table 3:
Amino acid analysis of cassava foliage meals fed (mg animo acids per g dry matter).

	Cassava top meal (Expt 1)	Cassava leaf + petiole meal (Expt 1)	Cassava tip meal (Expt 2.)
Cysteine	3.44	2 16	3 82
Methionine	4.89	3 08	5 08
Asparagine	31.42	16.09	29 49
Threonine	9.39	6.50	10 98
Serine	10.09	6.54	12.08
Glutamine	32.30	22.73	34 59
Proline	11.89	8.54	13 70
Glycine	11.78	8.50	13.95
Alanine	14.43	9.27	15 70
Valine	13.30	9.04	14 76
Isoleucine	11. 56	7.35	11.80
Leucine	18.61	13.17	21 59
Tyrosine	9.16	5.98	10 96
Phenylalanine	12.56	8.59	14.00
Histidine	4.26	2.97	4 60
Lysine	11.83	8.11	13 14
Arginine	14.16	8.81	15.16
Ammonia	6.63	3.09	7.05

Analyses: Proximate analyses were made by standard methods and these are shown in Table 3 Cyanogenic glucosides were analysed by the method of Burns et al (1970). Amino acid analyses (Table 4) were made using acid hydrolysis and tryptophan was determined after alkaline hydrolysis.

The data was analysed statistically by standard methods using Duncan's New Multiple Range Test for treatment comparisons as well as orthogonal comparisons within treatments where appropriate (Steel and Torrie 1960).

Table 4:
Composition of the cassava foliage meals used.

	DM	Ash	Crude Protein (Nx6.25)	Crude fibre	Ether extract	NFE	HCN (Mg/kg)
Cassava tips meal (Expt 1)	10.75	10.03	23.36	16.39	4.10	35.47	95
Cassava leaves + Petioles (Expt 1)	8.51	8.58	17.62	20.67	4.43	40.55	94
Cassava leaf meal (Expt 2)	9.76	*	28.63	*	*	*	130

* Not available

Results

In Experiment 1 the best liveweight gain over the eight week period was shown by chicks fed the cassava tip meal, this effect becoming apparent after the fourth week (Table 5). Additions of 5% leaf and petiole meal gave a small improvement in performance compared to the controls over the eight week period but further additions of 10 and 15% decreased performance as shown by the significant quadratic effect. With increasing levels of leaf meal there was a linear increase in food consumption and decrease in food conversion efficiency. There were no large differences between treatments for dressing percentage or for the weights of various internal organs (Table 6).Additions of cassava foliage meal influenced skin colour greatly: at the highest levels of inclusion the birds were very markedly pigmented.

In Experiment 2 (Table 7) performance was reduced with the addition of 7.5% leaf meal and still further with 15% leaf meal. At a level of inclusion of 15% leaf meal increasing the level of methionine added from 0.25 to 0.45 or 0.65% caused a depression in performance. Further additions of 0.20% sodium sulphate to diets containing 15% leaf meal with either 0.25 or 0.45% added methionine produced the same performance as did diets containing additional methionine only.

Table 5:
Weight gain, food consumption and food conversion in Experiment 1.

	Diet					SE	Significance Diets 1-4
	1	2	3	4	5		
Leaf and Petiole meal %	-	5.0	10.0	15.0	-		
Tip meal %	-	-	-	-	10.0		
Liveweight gain, g							
0 - 2 weeks	l73a	172ab	159b	144c	168b	5.92	Linear*
0 - 4 Weeks	470bc	505a	471bc	443c	488ab	11.12	Linear**
0 - 6 weeks	939a	941a	944a	849b	957a	20.55	Linear**
0 - 8 weeks	1251b	1360a	1332a	1238b	1407a	23.31	Quadratic**
Food consumption, g/d							
0 - 2 weeks	20.8	21.1	21.6	22.6	21.9	0.681	
0 - 4 weeks	33.7b	34.0b	35.9 b	38.7a	36.3	1.098	
0- 6 weeks	48.1c	49.8b	51.4	55.6a	53.6	1.533	Linear**
0 - 8 weeks	58.9	63.8	63.8	67.7	67.8	2.636	
Gain/Feed							
0 - 2 weeks	0.589a	0.578	0.497	0.459	0.547ab	0.021	Linear**
0 - 4 weeks	0.496a	0.512	0.454	0.408	0.483a	0.024	
0 - 6 weeks	0.439	0.453	0.466	0.378	0.419	0.024	
0- 8 weeks	0.383ab	0.382a	0.366 b	0.331	0.388	0.010	Linear**

+ Means with the same subscript are not significantly different (P<0.05)

Table 6 :
Carcass weights and weights of internal organs expressed as a percentage of body weight of chicks fed cassava foliage meals in Experiment 1.

	Diet					SE	Significance Diets 1-4
	1	2	3	4	5		
Leaf and Petiole meal %	-	5.0	10.0	15.0	-		
Tip meal %	-	-	-	-	10.0		
Dressing percentage	60. 70	60.39	60.26	60.25	60.38	0.528	NS
Gizzard	2.80	2.70	2.82	2.71	2.78	0.400	NS
Liver	2.60	2.56	2.67	2.61	2.52	0.439	NS
Heart	0.42	0.39	0.42	0.38	0.40	0.110	NS
Pancreas	0.27	0.25	0.29	0.26	0.22	0.020	NS
Carcass weight	789ac	840bc	820ac	775a	878b	20.4	Quadratic*
Skin colour score	1.0a	2.5b	3.4a	4.3d	4.3d	0.14	Quadratic**

NS not significant
+ Means with the same subscript are not significantly different (P< 0.05)

Table 7:
Performance of chicks fed cassava leaf meal from 1- to 4 weeks of age in Experiment 2*

	Diets							
	1	2	3	4	5	6	7	SE
Leaf meal, %	-	7.5	15.0	15.0	15.0	15.0	15.0	
Methionine, %	0.25	0.25	0.25	0.45	0.65	0.25	0.45	
Sulphate, %	-	-	-	-	-	0.20	0.20	
Mean liveweight gain, g	566	533	504b	484b	480b	482b	479b	8.19
Gain/food	0.952	0.878	0.801	0.736	0.712	0.728	0.702	0.032

*Means with the same subscript are not significantly different ($P<0.05$)

Discussion

The experiments here demonstrate that the response by broilers to cassava foliage meal inclusion in the diet will depend on the type of cassava leaf meal used as well as the level of inclusion. In Experiment 1 the best response was given by the tip meal at an inclusion rate of 10%. This was presumably largely because the tip meal contained more protein than did the leaf plus petioles. In the second experiment, however, the addition of a high protein cassava meal did not increase performance up to 4 weeks of age. Why there should have been this difference in response is unclear. However, the basal diet in Experiment 2 had a slightly better protein quality although the total protein content was the same, and it also contained 0.05% more additional methionine. While both these factors may have influenced the response, the more likely cause is the difference in protein quality; the cottonseed meal substituted in Experiment 1 had a lower protein quality than the sunflower/sesame meal mixture in Experiment 2. Cassava leaf protein was shown by Eggum (1970) to have a digestibility of from 70 to 80% and a biological value of 44% , rising to 57% if, as in this study, adequate nitrogen was available. Given the amino acid contents of the leaf meals used here, it would appear that the substitution value of different cassava meals for different protein supplements would need to be determined by experiment given that the dietary amino acid composition does not seem to be a reliable indicator of performance.

Montilla, Vargas and Montaldo (1976), Ross and Enriquez (1969) and Siwardene and Ranaweera (1974) found that performance was depressed with additions of cassava foliage meal at all levels of inclusion of 10 to 30%, 3 to 20% and 3 to 10% respectively. Pelleting improved the performance slightly with diets containing cassava leaf meal (Montilla et al 1976) as did the addition of corn oil (Ross and Enriquez 1969) indicating that reduction of dietary energy caused by-addition of cassava leaf meals can be a factor in reduced performance, although some compensation in food consumption can be seen in the experiments here.

Oke (1973) has described various metabolic pathways for the detoxification of cyanide demonstrating the roles of rhodanese, sulphur, vitamin B12, cystine and the thyroid glands. Ross and Enriquez (1969) obtained a response to additional methionine and suggested that this was partly due to the presence of additional dietary sulphur to increase the detoxification of cyanide. They also found that the addition of sodium thiosulphide improved growth. In the basal diets used here, additional methionine was added at levels previously found to be optimal under Tanzanian conditions (Wyllie, unpublished). Higher levels of either methionine or sodium sulphate failed to improve performance further in Experiment 2 in which the foliage meal contained a higher level of cyanoglucosides than in the first experiment. It is possible that lower levels of sodium sulphate might prove to have a beneficial effect particularly with lower levels of additional methionine.

Additions of leaf meal caused large changes in broiler skin colour so that birds fed diets containing 15% leaf meal were very yellow. While birds of this colour were perfectly acceptable in Tanzania, this could be less so elsewhere.

The economics of using cassava leaf meal for poultry production will depend on the local situation. However, given the ease with which it can be produced, this meal could prove especially useful in rural areas where poultry feed supplies are uncertain or non-existent. It should be remembered, too that with low capital investment it is impossible to achieve the levels of nutritional inputs and maximum performance recommended by the Experts but that small producers in rural areas can often achieve be satisfactory economic performances with a low turnover.

Conclusions

The data from these experiments show that cassava foliage meals can produce reasonable performances at levels of up to 15% inclusion in the diet, although performance depends on the quality of the foliage leaf and of the rest of the dietary protein. Performance is sufficiently high for cassava foliage meal to have a potential as an ingredient for locally mixed rural poultry rations.

Acknowledgernents

The financial assistance of the Research and Publications Committee of the University of Dar es Salaam is gratefully acknowledged.

Burns J C, Smith L H, Moline WJ, Wedin W F, Noller C H & Rhykerd C L 1970 Quantification of hydrocyanic acid in green forageCrop Science 10:578-581

Eggum B 0 1970 The protein quality of cassava leaves British Journal of Nutrition 24:761-76B

Montaldo A 6 Montilla J J 1976 Production of cassava foliage Proceedings of the 4th Symposium of the International Society for Tropical Root Crops, Cali, Colombia Pp 142-143

Montilla J J, Vargas R & Montaldo A 1976 The effect of various levels of cassava leaf meal in broiler chicken rations Proceedings of the 4th Symposium of the International Society for Tropical Root Crops, Cali Colombia Pp 143-145

Oke O L 1973 The mode of cyanide detoxication Chronic Cassava Toxicity (Eta Nestel B & MacIntyre R) IDRC Ottawa

Ross E 6 Enriquez F Q 1969 m e nutritive value of cassava leaf meal Poultry Science 48:846-853

Siwardene J A De 5 & Ranaweera K N P 1976 Manioc leaf meal in poultry diets Ceylon Veterinary Journal 22:53-57

Steel G D and Torrie J H 1960 Principles and Procedures of Statistics McGraw-Hill Book Company Inc, New York, New York

Wyllie D 1979 Systems of cassava forage production for the semi-arid tropics Tropical Animal Production 4:95 (Abstracts)