Nutritive Value of Defatted Seed Cake of *Cleome Viscosa*

C. RUKMINI and Y.G. DEOSTHALE, National Institute of Nutrition, Indian Council of Medical Research, Jamai Osmania (P.O.). Hyderabad – 500 007, A.P. India

ABSTRACT

Defatted seed cake of *Cleome viscosa* was analysed for protein, amino acids, vitamins and minerals. It was found to be a fairly good source of protein and other nutrients. The most limiting amino acid of the protein in the defatted seed cake was tryptophan. Like other *Capparidaceous* plants, seeds of *Cleome viscosa* contained thioglucosinolates. The concentration of which in defatted seed cake before and after detoxification was 3 and 0.12 mg per 100 g. Except for the loss of B-complex vitamins, on detoxification the nutrient composition of the defatted cake remained unaltered. Rats fed diets based on defatted cake containing the toxic compounds lost weight, but those fed detoxified cake showed improved growth. However, the relative protein value (RPV) of the processed cake was poor and suggested the presence of other antinutritional factors.

INTRODUCTION

Cleome viscosa, a member of the Capparidaceae family, is an annual herb which grows in tropical waste lands. The seeds of this herb resemble those of mustard and are rich in oil content. The oil expressed from the seeds appears to be safe as judged by studies in rats (1). Like other members of the Capparidaceae family, the viscosa seeds are known to contain antinutritional factors, thioglucosinolates (2). Treatment with soda ash followed by aqueous extraction is a suggested method of removal of these compounds (3). Information on economic statistics of the herb is not available. The plant as such is used as a green leafy vegetable and the seeds as condiment by the poor segments of the population. Being rich in oil which is reported to be edible (1), the seeds of *Cleome viscosa* may be of commercial importance. On the other hand, the defatted seed cake, if suitably processed, could be useful as feed. The present study reports the nutritive value of the defatted seed cake before and after detoxification.

MATERIALS AND METHODS

Seeds of *Cleome viscosa* were purchased from the local market and the oil was extracted by solvent extraction procedure (1). The deoiled meal was air dried to remove the traces of the solvent and then analyzed for moisture, protein, fat, crude fibre, total ash, calcium, phosphorus and iron content by AOAC methods (4). Riboflavin and niacin content of the defatted cake were estimated by the methods described by Srinivas Rao and Ramasastry (5). Thiamine content was estimated by thiochrome method (6). The amino acid profile of the protein was obtained using Spinco-Beckman automatic amino acid analyser (7). Tryptophan content was estimated by microbiological technique (6). The thioglucosinolates were estimated by the method of McGhee et al (8). The cake was detoxified by removal of thioglucosinolates using the method of Mustakas et al. (3) described for crambe seeds. The detoxified cake was also analyzed for its nutrient composition and amino acid profile of its protein.

The biological value of the defatted cake was evaluated by the relative protein value (RPV) method (9). Forty male weanling rats from the stock colony, age 21-23 days were housed individually and fed, for 2 days, 9.1 g % protein diet based on casein. The animals were then distributed four per group, equalized for body weight. One group was fed protein-free basal diet, three groups were given diet based on casein, either 2.58, 3.58 and 9.1 g% protein. Three other groups were assigned to diets containing 1.42, 2.51 or 8.67 g% protein from defatted cake of *Cleome viscosa.* The remaining three groups received diets containing either 3.10, 3.93 or 9.0 g% protein of detoxified cake. All the animals in different groups received their diets *ad-libitum* for 14 days. Daily food consumption and body weight were determined for each animal. Regressions of body weight change (G) in 14 days on nitrogen intake (N) for the same period were calculated separately for the casein, unprocessed and detoxified cake fed groups of rats. Relative protein values for the test proteins, namely processed and unprocessed defatted cakes of *Cleome viscosa,* were calculated by expressing the corresponding slopes as percent of the slope for Casein as a reference protein.

RESULTS AND DISCUSSION

Data on proximate analysis, mineral and vitamin content presented in Table I show that the defatted cake with 21% protein is a fairly good source of protein. The total ash and iron content of the defatted cake was found to be high as compared to other oil seed cakes. On the other hand, the calcium content was relatively poor. The nutrient composition of the defatted cake before and after detoxification

TABLE I

Nutrient Composition of Defatted Cake of *Cleome viscosa* before and after Detoxification

Nutrient		Defatted *Cleome viscosa* cake	
		Before detoxification	After detoxification
Moisture	g/100 g	7.0	6.4
Protein (N x 6.25)	g/100 g	21.4	20.4
Total ash	g/100 g	5.1	6.3
Total lipids	g/100 g	0.43	0.83
Crude fibre	g/100 g	7.30	7.20
Phosphorus	mg/100 g	600	873
Calcium	mg/100 g	71	68
Iron	mg/100 g	78	78
Thiamine	mg/100 g	0.25	0.11
Riboflavin	mg/100 g	0.20	0.15
Niacin	mg/100 g	2.45	1.05
Thioglucosinolate	mg/100 g	3.00	0.12

TABLE II

Amino Acid Composition of the Proteins of *Cleome viscosa* and other Oil Seeds (Values Are g Per 100 g Protein)

	Cleome viscosa	Groundnut[a]	Sesame[a]	Sunflower[a]
Isoleucine	3.71	3.84	4.00	4.02
Leucine	7.17	6.40	8.00	6.40
Lysine	3.12	3.68	2.72	3.68
Methionine	1.47[b]	0.96	2.88	1.92
Phenylalanine	5.28	4.96	4.48	5.92
Tyrosine	2.50	3.84	3.68	1.92
Threonine	3.81	2.72	3.66	3.68
Tryptophan[c]	0.59[d]	0.96	1.28	1.44
Valine	5.36	4.48	4.64	5.12
Arginine	11.56	10.72	12.00	8.00
Histidine	2.74	---	---	---
Alanine	5.54	---	---	---
Aspartic	9.86	---	---	---
Glutamic	23.59	---	---	---
Glycine	6.64	---	---	---
Proline	5.05	---	---	---
Serine	3.69	---	---	---

[a]Reference for data (12).
[b]Second limiting amino acid.
[c]By microbiological technique.
[d]First limiting amino acid.

was essentially the same except for the B-complex vitamins. About 55-60% of thiamine and niacin in the cake appeared to have been lost during detoxification process. Riboflavin was also lost to the extent of 25%. Besides being water soluble, these vitamins, especially thiamine and riboflavin, in food are known to be liable to alkaline conditions and this fact may explain the observed losses.

Total thioglucosinolate content of the unprocessed cake was 3.0 mg per 100 g and 0.12 mg per 100 g for the detoxified cake. Qualitative separation by thin layer plate chromatography (10) showed thiocapparin and thiocleomin (2) as the major glucosinolates. A third flavone glucoside, m.p. 294-95 C, which gave a dark green color with ferric chloride suggesting a highly hydroxylated structure, was also identified.

The amino acid composition of the protein of defatted cake (Table II) was similar before and after detoxification. Tryptophan and methionine were found to be the most limiting amino acids by the simple chemical score method (11). The essential amino acid pattern of the protein of *Cleome viscosa* compared well with that of groundnut protein except for lower levels of tryptophan and higher levels of methionine.

Animals fed unprocessed, defatted cake showed greater loss in body weight with increasing levels of protein in the diet (Table III), and there was a significant negative correlation between the change in body weight and nitrogen intake. This was probably due to the increasing levels of thioglucosinolates in the diets. Growth of animals fed detoxified cake was considerably better than those fed unprocessed cake and the RPV rose to 16 from a negative value obtained with the unprocessed cake. However, the

TABLE III

Body Weight Changes in Relation to Protein Intake in Rats Fed Casein and Defatted Cake of *Cleome viscosa*[a]

Source of protein in the diet	Level of protein in the diet (g %)	Food intake (g/14 days)	Nitrogen intake:N (g/14 days)	Change in body weight:G (g/14 days)	Coefficient of correlation between N and G	Regression of G over N	Relative protein value[b]
Protein free	1.05	38	0.068	-4.5	---	---	---
Casein	2.58	44.2	0.183	-0.75			
	3.58	47.2	0.271	1.50			
	9.10	79.0	1.150	31.25			
					0.990[c]	N = 51.8G -17.04	100
Defatted	1.42	32.0	0.073	-3.25			
Cleome viscosa	2.51	31.0	0.124	-3.50			
cake	8.67	22.7	0.316	-4.00			
					-0.5698[d]	N =-2.48G -3.16	-5
Detoxified	3.10	34.2	0.170	-3.75			
defatted	3.93	39.5	0.247	-2.25			
Cleome viscosa	9.00	55.7	0.801	2.25			
cake					0.8893[e]	N = 8.54G -4.72	16

[a]Mean of four rats per group.
[b]$\frac{\text{Slope of the regression for test protein}}{\text{Slope of the regression for casein protein}} \times 100$.
[c]Significant at P <0.001.
[d]Significant at P <0.05.
[e]Significant at P <0.01.

RPV 16 is very low, indicating the poor quality of the detoxified cake. This may be due to the presence of toxic compounds other than thioglucosinolates. The nature of these substances needs to be investigated. These observations thus suggest that the defatted cake of *Cleome viscosa* has a doubtful significance even as animal feed, unless a suitable method is found for its complete detoxification.

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