Chemical Composition and Protein Quality of the Little-Known Legume, Velvet Bean (*Mucuna pruriens* (L.) DC.)

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The chemical composition and nutritional characteristics of seeds of *Mucuna pruriens* were investigated. The mature seeds contained 314.4 g/kg crude protein, 51.6 g/kg crude fiber, 67.3 g/kg crude fat, 41.1 g/kg ash, and 525.6 g/kg carbohydrates. Potassium, phosphorus, and calcium registered higher concentrations compared with the most commonly consumed pulses. The globulins and albumins together constituted the major storage proteins (22.7 g/100 g of seed flour). The essential amino acids profile of total seed proteins compared favorably with the FAO/WHO reference pattern except for deficiency of sulfo amino acids. When compared with globulins, albumins appeared to be a rich source of valine and tryptophan. However, cystine, methionine, and leucine were deficient in both the protein fractions. Both oleic and linoleic acids constituted the predominant fatty acids (65.5%) along with a substantial quantity of palmitic acid (20.16%). Dry heating as well as autoclaving significantly reduced the antinutritional factors. Protein effeciency ratio, true protein digestibility, biological value, net protein utilization, and utilizable protein were significantly improved by autoclaving as compared with dry heating. However, the values of true protein digestibility and net protein utilization of dry-heated samples were significantly higher than the raw samples.

Keywords: *Mucuna pruriens; chemical composition; amino acids; fatty acids; antrinutritional factors; heat treatments; biological evaluation*

INTRODUCTION

The mature seeds, seeds from unripe pods, and seeds from young pods of *Mucuna pruriens* (L.) DC. are soaked and boiled/roasted and eaten as such (or) mixed with salt by the Northeast Indian tribal sects Khasi, Naga, Kuki, Jaintia, Chakma, and Mizo (Arora, 1981) and other poor villagers. The tribals Garos of Meghalaya are consuming the seeds for increasing potency, and the hairs of the seed coat are used as vermifuge (Vasudeva and Shanpru, 1981).

However, the acceptability and utilization of legumes as food has been limited due to the presence of relatively high concentrations of certain antinutritional factors such as lectins, protease inhibitors, α-amylase inhibitor, allergens, polyphenols, and phytic acid (Liener, 1994). To overcome the aforesaid adverse factors, the various processing methods must be considered. A perusal of the literature reveals that only limited information on chemical composition of the above said legume is available (Prakash and Misra, 1987; Laurena et al., 1991; Mary Josephine and Janardhanan, 1992; Vijayakumari et al., 1995). However, no attempts seem to have been made to decipher the fatty acid profiles of the lipids, to study the effects of various processing methods to remove the antinutrients, and to evaluate the biological value of seed proteins of this little-known legume.

MATERIALS AND METHODS

Samples. About 5 kg of mature and dry seeds of *Mucuna pruriens* (L.) DC. were collected from five plants grown in the same ecosystem of the deciduous forests of Yercaud Hills, Salem District, Tamil Nadu, India. Furthermore, the seeds after collection were dried in the open sunlight for 2 days. The dried seeds were cleaned thoroughly, and any foreign matter, broken seeds, and immature seeds were removed. The seeds were stored in a plastic container at room temperature (25 °C).

Proximate Composition. Seed moisture was determined by following the method of Rajaram and Janardhanan (1990). The seeds were powdered separately in a Willey Mill to 60 mesh size. The fine seed powder so obtained was stored in screw-cap bottles at room temperature and used for further analysis. Nitrogen content was determined according to the Kjeldahl method (Humphries, 1956), and the percentage of crude protein was calculated using the factor 6.25. The contents of crude lipid, crude fiber, and ash were determined in accordance with the standard methods of the AOAC (1970). Carbohydrates was obtained by difference. The energy value of the seeds was estimated (in kJ) by multiplying the percentage of crude protein, crude fat, and carbohydrates by the factors 16.7, 37.7, and 16.7, respectively.

Fiber Analysis. The method of Goering and Van Soest (1970) was used to determine neutral detergent fiber (NDF) as well as acid detergent fiber (ADF). Insoluble hemicellulose was calculated as the loss in the weight of ADF residue after treatment with sulfuric acid. The loss in weight of the above residue upon ashing was used to calculate the lignin content.

Analysis of Mineral Elements. Determination of Ca, Mg, Fe, Cu, Zn, and Mn was carried out by using a Perkin Elmer atomic absorption spectrophotometer (Model 5000, Perkin Elmer), while a flame photometer (Elico, India) was used for the determination of potassium and sodium. Phosphorus was colorimetrically analyzed (APHA, 1980) at 630 nm using a spectrophotometer (Model Spectronic 20D, Milton Roy).

Lipid Extraction. Seed flour (2 g) was extracted overnight by shaking with 30 mL of a methanol−ethyl ether mixture (1+1) at room temperature (25 °C). The mixture was centrifuged at 10000*g* for 30 min at room temperature (25 °C). The extraction was repeated twice in the same manner. The extracted flour was air-dried and used for the extraction of total proteins and protein fractionations.

Extraction and Estimation of Total Seed Proteins and Seed Protein Fractionation. The total (true) proteins were extracted by the method of Rajaram and Janardhanan (1990). The extracted proteins were precipitated by adding cold TCA to a final concentration of 20%. The precipitate was separated by centrifugation at 20000*g* for 30 min at 4 °C and estimated

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by the method of Lowry et al. (1951). The remaining protein was lyophilized.

Albumins and Globulins. After lipid extraction from the seed flour residue, the albumin and globulin fractions of seed proteins were extracted and separated according to the method of Murray (1979).

Prolamins. The seed flour residue after albumin and globulin extraction was extracted with 30 mL of 80% ethanol overnight at 25 °C. The suspension was centrifuged at 20000*g* for 30 min, and the supernatant containing prolamins was air-dried and dissolved in 0.1 N NaOH.

Glutelins. The seed flour residue after prolamin extraction was extracted with 30 mL of 0.04 M NaOH overnight at 25 °C and centrifuged at 20000*g* for 30 min at room temperature.

Protein Content. All four protein fractions (albumins, globulins, prolamins, and glutelins) so obtained were precipitated and washed with cold 10% TCA. The precipitates were separated by centrifugation at 20000*g* for 1 h at 4 °C and redissolved in 0.1 M NaOH, and the protein content was determined according to the method of Lowry et al. (1951) with lipid-extracted bovine serum albumin as the standard. A portion of precipitated protein was centrifuged and freeze-dried prior to amino acid analysis.

Amino Acid Analysis. Known amounts of precipitated total seed proteins and protein fractions (albumins and globulins) were acid hydrolyzed with 6 N HCl for 24 h at 110 °C in sealed ampules under vacuum. The amino acid analysis was performed using an automated precolumn derivatization with *O*-phthaldialdehyde (OPA) using reverse-phase HPLC (Model 23250). The cystine content of protein samples was obtained separately by the method of Liddle and Saville (1959). For the determination of tryptophan content of proteins, aliquots containing known amounts of proteins were dispersed into glass ampules together with 0.75 mL of 5 M NaOH. The ampules were flame sealed and incubated at 110 °C for 18 h. The tryptophan contents of the alkaline hydrolysates were determined colorimetrically by the method of Spies and Chambers (1949). The contents of different amino acids recovered were presented as g/100 g of proteins and are compared with the FAO/WHO (1990) reference pattern. The essential amino acid (EAA) score was calculated as follows:

$$\text{EAA score} = \frac{\text{g of EAA in 100 g of test protein}}{\text{g of EAA in 100 g of FAO/WHO ref pattern}} \times 100$$

Fatty Acid Composition. The total lipids were extracted from the seeds according to the method of Folch et al. (1957) using a chloroform and methanol mixture in the ratio of 2:1 (v/v). Methyl esters were prepared from the total lipids by the method of Metcalfe et al. (1966). The fatty acid methyl esters were analyzed by gas chromatography (Shimadzu GC-R1A, Japan) using an instrument equipped with a flame ionization detector (FID) and a glass column (2 m × 3 mm) packed with 1% diethylene glycol succinate on chromosorb W (silanized 80/100 mesh). The carrier gas was nitrogen at a flow rate of 32 mL/min. The column temperature gradient of 4 °C/min ranged from 190 to 240 °C. A standard fatty acid methyl ester mixture (Sigma Chemical Co.) was run to use retention times in identifying sample peaks. Fatty acid levels were estimated on the basis of peak areas of known concentrations of the standards.

Heat Treatments. About 1.5 kg of seeds was roasted at 120 °C for 30 min, allowed to cool, and then powdered to 60 mesh size. A sample of 1.5 kg of seeds was autoclaved at 15 lb pressure for 30 min in water using a 10:1 water to seed ratio. The autoclaving liquid was separated, and the autoclaved seeds were dehydrated with a hot air oven at 50 °C to a constant weight and powdered for analysis of antinutritional components and feeding tests.

Determination of Total Free Phenolics, Tannins, Hydrogen Cyanide, and Phytic Acid. The antinutritional components, total free phenolics (Sadasivam and Manickam, 1992), tannins (Burns, 1971), and hydrogen cyanide (HCN) (Jackson, 1967) were quantified in raw as well as in moist and dry heat-treated seeds. The colorimetric procedure of Wheeler and Ferrel (1971) was followed to estimate phytic acid.

Determination of L-DOPA. L-DOPA [3-(3,4-dihydroxyphenyl)-L-alanine] content was determined by extracting with 0.1 N HCl and ethanol (Brain, 1976).

Trypsin Inhibitor Analysis. Trypsin inhibitor activity was determined by the enzymic assay of Kakade et al. (1974). One trypsin unit is expressed as an increase of 0.01 absorbance unit per 10 mL of reaction mixture at 410 nm. Trypsin inhibitor activity is defined in terms of trypsin units inhibited per milligram of protein.

α-Amylase Assay. α-Amylase activity was determined according to the procedure outlined by Moneam (1990). One unit of enzyme activity was defined as that which liberates 1 μmol of reducing groups (calculated as maltose)/min at 27 °C and pH 7.0 under the specified conditions (Deshpande et al., 1982) from soluble starch.

α-Amylase Inhibitor Analysis. α-Amylase inhibitor activity was evaluated according to the method of Deshpande et al. (1982). A 1-g sample was extracted with 10 mL of distilled water for 12 h at 4 °C and centrifuged at 5000*g* for 20 min, and the supernatants were tested for α-amylase inhibitory activity. Extract-containing inhibitor (0.25 mL) was incubated with 0.25 mL of enzyme solution for 15 min at 37 °C. To this mixture after preincubation was added 0.5 mL of 1% starch solution. At the end of 30 min, the reaction was stopped by the addition of 2 mL of dinitrosalicylic acid reagent and heated in a boiling water bath for 10 min. The test tubes were then cooled under running cold tap water and made to a final volume of 13 mL with distilled water. The absorbance was recorded at 540 nm in a Spectronic 20 D spectrophotometer. The liberated reducing sugars were expressed as maltose. One unit of α-amylase activity inhibited was defined as one α-amylase inhibitory unit.

Phytohemagglutinating Activity. The total crude lectins were extracted by the method of Almeida et al. (1991). The protein content of the extract was estimated by the method of Lowry et al. (1951). The phytohemagglutinating activity of raw and treated seed samples was determined by the method of Tan et al. (1983) and expressed as hemagglutinating unit (HU) per milligram of protein.

Rat Bioassay. The diet consisted of test material contributing 10% protein in the diet, 4% mineral mixture, 1% vitamin mixture, 10% oil, 5% cellulose, and corn starch to make up the remaining diet. A control diet containing 10% casein protein was also prepared. For the determination of protein efficiency ratio, groups of five Wistar strain male rats (Pasteur Research Institute, Coonnoor, The Nilgiris district, India) aged 21−23 days, each weighing about 40 g, were used. Water and food were given ad libitum. Weighed diet was given, and unconsumed diet was collected, dried, and weighed. The experiment was conducted for 28 days (Pellett and Young, 1980). The rats were weighed twice a week. Food and protein intakes during the period of study were calculated on dry matter basis. Protein efficiency ratio (PER) and food efficiency ratio (FER) were determined as follows:

$$\text{PER} = \frac{\text{gain in body weight (g)}}{\text{proein intake (g)}}$$

$$\text{FER} = \frac{\text{gain in body weight}}{\text{food intake (g)}}$$

Biological evaluation of protein quality of raw and heat-treated seed samples was conducted according to the method of Eggum (1973). Groups of five Wistar strain male rats, each weighing about 60 g, were used. Each rat was daily fed a 10-g diet (dry weight basis) containing 150 mg of nitrogen. The experiments consisted of a 4-day preliminary period and a 5-day balance period. During the balance period, urine and feces were separately collected each day from each rat and pooled separately for 5 days. At the end of 5 days, unconsumed diet weight was recorded, and total nitrogen intake was calculated. Another group of rats of the same weight and age were fed a nitrogen-free diet to calculate the endogenous and

Table 1. Chemical, Fiber, and Mineral Composition of *Mucuna pruriens* Seeds[a]

component	g kg^{-1} DM
chemical composition	
moisture (g kg^{-1} FW)	71.0
crude protein (N × 6.25)	314.4
crude fiber	51.6
crude fat	67.3
ash	41.1
carbohydrates (by difference)	525.6
energy content (kJ kg^{-1} DM)	16565.2
fiber	
ADF	96.0
NDF	213.0
hemicellulose	117.0
cellulose	82.0
lignin	11.2
mineral composition	
sodium	174.2
potassium	13304.3
calcium	2857.1
magnesium	851.2
phosphorus	4065.2
manganese	5.6
iron	65.4
copper	23.0
zinc	20.4

[a] Average values of three determinations ± standard error. DM, dry matter basis.

metabolic nitrogen losses. The concentration of nitrogen in urine and feces was estimated by the Kjeldhal method. True protein digestibility (TD), biological value (BV), net protein utilization (NPU), and utilizable protein (UP) were determined for all samples.

Statistical Analysis. The data were statistically analyzed using Duncan's Multiple Range Test (DMRT) by the method of Alder and Roessler (1977), and the significant differences obtained are discussed in the text.

RESULTS AND DISCUSSION

The mean value of the proximate and fiber composition for *Mucuna pruriens* seeds are shown in Table 1. The seeds of *M. pruriens* contain an average of 314.4 g crude protein kg^{-1} DM, which seems to be higher compared to an earlier report (Laurena et al., 1991), suggesting that it is a better source of protein. Due to the presence of relatively high levels of crude fat and protein, the seeds appear to be a rich source of energy. Fiber helps to maintain the health of the gastrointestinal tract. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) values are found to be 213.0 and 96.0 g kg^{-1} DM, respectively. Hemicellulose content, obtained as the difference between NDF and ADF, registers a value of 117.0 g kg^{-1} DM. The presence of an adequate level of detergent fiber in *M. pruriens* reveals that the seeds can be utilized as a better source of fiber among the tribal people. The data on mineral composition (Table 1) indicate that the seeds of this little-known legume are found to be a rich source of potassium, calcium, and phosphorus.

As in other pulses, the seeds of *M. pruriens* exhibit globulins (16.7 g/100 g) and albumins (6.0 g/100 g) as the major seed protein fractions. The data on amino acid composition and essential amino acid score of total seed proteins, albumins, and globulins of *M. pruriens* are given in Table 2. The consumption of this legume can fulfill the essential amino acid requirement pattern (FAO/WHO 1990) among the people except for S-containing amino acids. Furthermore, the lysine content of the total proteins of this sample seems to be higher when compared with an earlier report from our laboratory (Mary Josephine and Janardhanan, 1992). The amino acid profiles of protein fractions, albumins, and globulins of *M. pruriens* reveal that cystine, methionine, and leucine, alone in albumins and beside the aforesaid amino acid tryptophan (also in globulins), are found to be the limiting amino acids.

The fatty acid composition of the total seed lipids is given in Table 3. It reveals that the seed lipids are rich in unsaturated fatty acids such as oleic acid (37.14%) and linoleic acid (28.71%). The mono- and polyunsaturated fatty acids together account for 70.85%, which seems to be a significant finding. The presence of high levels of the unsaturated fatty acids is desirable for the consuming tribals because it is a significant feature in human food. Although, the legume seeds contain high levels of protein, their digestibility and utilization is poor due to the presence of certain antinutritional compounds (Liener, 1994).

The high content of total free phenolics (Table 4) is undesirable for human consumption because they interfere with the digestion and absorption of protein. However, a significant reduction in the content of total free phenolics has been observed under both autoclaving (61%) and dry heat treatment (48%) conditions only in

Table 2. Amino Acid Composition, Essential Amino Acid Score, and Limiting Amino Acids of Total Seed Protein and Protein Fractions (Albumins and Globulins) of *Mucuna pruriens* (g/100 g of Protein)

amino acid	total (true) seed protein	essential amino acid score	albumins	essential amino acid score	globulins	essential amino acid score	FAO/WHO (1990) values
aspartic acid	8.16		10.41		14.18		
glutamic acid	17.23		12.20		20.35		
alanine	2.81		3.61		4.05		
valine	5.57	159.1	5.80	165.7	5.12	146.3	3.50
glycine	5.12		5.75		4.83		
arginine	7.16		6.87		5.71		
serine	4.10		4.91		6.05		
cystine }	0.84	84.8	1.47	58.8	0.71	62.8	2.50
methionine }	1.28		trace		0.86		
threonine	3.64	107.1	3.85	113.2	4.01	117.9	3.40
phenylalanine }	3.85	136.7	4.20	123.5	5.11	142.9	6.30
tyrosine }	4.76		3.58		3.89		
isoleucine	4.12	147.1	5.16	184.3	5.57	198.9	2.80
leucine	7.85	118.9	5.08	77.0	4.80	72.7	6.60
histidine	3.14		2.76		3.80		
lysine	6.60	113.8	5.72	98.6	6.03	104.0	5.80
tryptophan	1.35	122.7	1.25	113.6	0.81	73.6	1.10
proline	ND[a]		ND		ND		

[a] ND, not determined.

Table 3. Fatty Acid Composition of *Mucuna pruriens* Seed Lipids (% of Total Fatty Acid)

fatty acid	
palmitic acid (C16:0)	20.16
palmitoleic acid (C16:1)	1.72
stearic acid (C18:0)	3.84
oleic acid (C18:1)	28.71
linoleic acid (C18:2)	37.14
linolenic acid (C18:3)	3.28
arachidic acid (C20:0)	1.80
behenic acid (C22:0)	0.73
unidentified	2.62
saturated fatty acids	26.53
unsaturated fatty acids	70.85
essential fatty acids	40.40

the present study. When the seeds of *M. pruriens* are properly cooked/roasted before consumption, total free phenolics get reduced markedly. This enables improvement in protein digestion and utilization among the tribals.

Hydrogen cyanide (HCN) is known to cause acute or chronic cyanide toxicity. Although the level of HCN is higher in raw seeds, it is significantly reduced during dry heat treatment (67%) and autoclaving (68%). Hence, HCN-related ill effects can be nullified during consumption of cooked seeds.

Phytic acid has the antinutritional properties due to its ability to lower the bioavailability of minerals and form a complex with proteins and inhibits the enzymatic digestion of ingested protein (Nolan and Duffin, 1987). Significant reduction in the content of phytic acid has been noticed in *M. pruriens* subjected to both dry heat treatment (36%) and autoclaving (47%) in the present study.

Consumption of improperly boiled seeds by the tribal sect Kanikkars in Kerala State, India, is known to cause ill effects like and increase in body temperature and skin eruptions. Shankaranarayan (1978) has attributed the aforesaid ill effects to the presence of L-DOPA, which is pharmacologically active, and is also known to cure Parkinson's disease. Subsequently, by repeated boiling and decanting of the seeds for seven times with water, a substantial reduction in the quantity of L-DOPA has been shown. Consumption of such seeds has been shown to be safe to the consuming tribals (Janardhanan, 1982). In the present study, L-DOPA content (7.7 g kg^{-1}) seems to be higher as compared to earlier reports (Daxenbichler, 1972; Mary Josephine and Janardhanan, 1992; Vijayakumari, 1994). Dry heat treatment has been shown to be more effective in reducing the L-DOPA content in the present report. The possible reduction of L-DOPA content may be attributed to its racemization under roasting. Studies of Hayase et al. (1975) have revealed that amino acid residues in proteins and in synthetic peptides can racemize under roasting conditions.

The antinutritional properties of various protease inhibitors, α-amylase inhibitors, and lectins have been well documented (Liener, 1994). In the present study, a significant reduction of TI activity has been achieved by dry heat treatment (93%) and autoclaving (96%). Since trypsin inhibitors are known to be heat labile, their structural disintegration under heat treatment may explain the destructive effect on diminished trypsin inhibitor activity.

The seeds of *M. pruriens* are known to contain relatively high levels of α-amylase inhibitor activity (Table 4) as compared to different varieties of chickpea (Mulimani et al., 1994). Complete elimination of α-amylase inhibitor activity has been observed under autoclaving (Table 4). In general, a significant reduction of hemagglutinating activity (lectin) has been noticed among all the blood groups (A, B, and O) when the seeds were subjected to both dry heat treatment and autoclaving (Table 4). The presence of similar residual activity has also been reported after heat treatment in *Phaseolus vulgaris* (Almeida et al., 1991).

In addition to chemical analysis, rat feeding trials of protein provide useful information with regard to its overall quality. The PER and FER of raw, dry-heated, and autoclaved seed samples of *M. pruriens* along with casein (control) are given in Table 5. The food as well as protein intake of rats fed heat-treated seed diets are found to be higher as compared to raw seed diet, and thus the rats register a substantial increase in body weight. However, autoclaved seed samples exhibit a relatively high level of PER over raw seeds.

The biological evaluation of raw and processed seeds of *M. pruriens* along with casein are presented in Table 6. The raw seeds of *M. pruriens* exhibit low levels of BU, TD, and NPU. When compared with casein, both dry-heated and autoclaved seeds of *M. pruriens* exhibit low levels of TD and NPU. It may be due to the presence of relatively high levels of polyphenols and fiber since the majority of these compounds are concentrated in the seed coat. However, autoclaved seeds significantly improve the protein quality (BV, TD, NPU,

Table 4. Levels of Some Antinutritional Factors Present in Raw and Processed Seeds of *Mucuna pruriens*[a]

antinutrient	raw seeds	dry-heated	autoclaved
total free phenolics (g kg^{-1} DM)	62.3[a]	32.4[b] (48)	24.3[b] (61)
tannins (g kg^{-1} DM)	2.5[a]	1.8[a,b] (28)	0.7[b] (72)
hydrogen cyanide (mg kg^{-1} DM)	37.5[a]	12.4[b] (67)	8.3[b] (78)
phytic acid (g kg^{-1} DM)	7.7[a]	4.9[b] (36)	4.1[b] (47)
L-DOPA (g kg^{-1} DM)	78.1[a]	43.0[b] (45)	58.6[c] (25)
trypsin inhibitor activity (TIU mg^{-1} protein)	78.7[a]	5.3[b] (93)	2.9[b] (96)
α-amylase inhibitor activity (units g^{-1} sample)	86.4[a]	18.2[b] (79)	nil[c] (100)
	hemagglutinating activity (HU mg^{-1} protein)		
phytohemagglutinating activity	raw seeds	dry-heated	autoclaved
erythrocytes from human blood group			
A	164[a]	16[b] (90)	8[b] (95)
B	82[a]	8[b] (90)	4[b] (95)
O	14[a]	nil[b] (100)	nil[b] (100)

[a] Mean of triplicate determinations expressed on dry weight basis. TIU, trypsin inhibitor unit; HU, hemagglutinating unit. Values with the same superscript in each row do not differ significantly from each other ($P < 0.05$). Values in the parentheses indicate the per cent loss from raw seeds.

Table 5. PER and FER of Raw and Processed Seed Samples of *Mucuna pruriens*[a]

	raw seeds	dry-heated	auto-claved	casein (control)
food intake (g)	145.6	180.2	192.4	368.1
protein in diet (%)	10.8	11.2	10.3	10.5
gain in body weight (g)	10.3	22.4	27.6	92.6
PER	0.66[b]	1.12[bc]	1.41[c]	2.43[a]
FER	0.07[b]	0.13[c]	0.15[d]	0.25[a]

[a] Based on five determinations for each treatment. Average initial weight: 40 g. Values with the same superscript in each row do not differ significantly from each other ($P < 0.05$).

Table 6. Biological Evaluation of Raw and Processed Seeds of *Mucuna pruriens*[a]

	raw seeds	dry-heated	auto-claved	casein (control)
biological value (%)	58.7[b]	62.6[b]	74.5[c]	83.2[ac]
true digestibility (%)	48.5[b]	68.5[c]	81.6[d]	92.5[a]
net protein utilization (%)	28.5[b]	42.9[c]	60.8[d]	77.0[a]
utilizable protein (%)	9.0[b]	13.2[b]	18.1[c]	66.5[a]
protein (%)	31.4	30.8	29.7	86.3

[a] Based on five determinations for each treatment. Net protein utilization = (true protein digestibility × biological value)/100. Utilizable protein = (protein × net protein utilization)/100. Protein = N × 6.25 (dry weight basis). Values with the same superscript in each row do not differ significantly from each other ($P < 0.05$).

and UP) of *M. pruriens* as compared to raw and dry-heated seeds. The heat treatment applied to legume foods improves their texture, palatability, and nutritive value by destroying or inactivating heat-labile toxic compounds and other enzyme inhibitors (Khan et al., 1979). The low level of BV in the dry-heated sample might be due to heat treatment which causes considerable nutritional damage to methionine, the most important amino acid in grain legumes (Shemer and Perkins, 1975). A comparative study of dry heat treatment and autoclaving on the protein quality of *M. pruriens* indicates that autoclaving is more beneficial.

An overall report on the nutritional value of the seeds of *M. pruriens* suggests that consumption of properly cooked (autoclaved) seeds of this legume may be used as a food source for consuming tribals. Besides the protein isolates of this little-known pulse might be exploited industrially as a source of food formulation and used as a cereal supplement. The intoxication associated with the overeating of velvet beans is probably related to their L-DOPA content rather than to any other antinutritional factor (Duke, 1981; Afolabi et al., 1985). Cultivar differences are known to exist in the L-DOPA content of mucuna beans (Jayaweera, 1981), and these differences should be exploited to select low L-DOPA lines for human nutrition. Further detailed research on the antinutritional substance in this little-known pulse might also be fruitful.

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