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Nutritional evaluation of *Canavalia ensiformis* (Jack bean) cultivated in North East region of India

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Abstract
Canavalia ensiformis is a legume, mainly used for nutrition, especially in North-East India, South East Asian countries and South American countries. It is also a rich source of Concanavalin A and can also be used as an animal fodder. In North-east India this plant is cultivated mainly for domestic consumption. The aim of the present study was to evaluate the nutritional composition of pods of *Canavalia ensiformis* (Jack bean) with the help of proximate analysis. The proximate composition were determined in the form of moisture content (83.3%), reducing sugar (2.21%), total sugar (3.41%), acidity (0.19), vitamin C (8.087 mg/100g), protein (10.85 g/100g), fat (1.59 g/100g), carbohydrates (12.15 g/100g) and crude fiber (3.98 g/100g). Based on the result of this study, the pods of *Canavalia ensiformis* was found to be a potential source of protein, vitamin and energy supplements.

Keywords: *Canavalia ensiformis*, North-East India, proximate analysis, vitamin, protein

Introduction
North-East India comprising of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Tripura & Nagaland, and the Himalayan state of Sikkim has huge physiographical variations. This region is one of the richest reservoir of various kinds of fruits, vegetables, spices, medicinal & aromatic plants including ornamental plants. *Canavalia ensiformis* (Jack bean) is a legume crop, belonging to the family Fabaceae and is cultivated in North Eastern region of India (CSIR 1950) [5]. It is widely distributed in India, Argentina, China and United States and is mainly used for animal fodder and for human nutrition in a limited scale. The seeds of *Canavalia ensiformis* (Jack bean) are consumed in different parts of India (Mittre, 1991) [9]. It is a twining type of plant whose height may go upto 10 feet in North-East India. Moreover, its height may vary to some extent from region to region depending upon the topography and the climatic condition of the region. It is highly drought resistant and its roots penetrate deep into the soil. It can spread *via* long runners and its flowers are pink-purple in colour. The average length of the pod is 32 cm with large white seeds. This legume is used as a cover crop and the roasted seeds are ground to prepare drink like coffee in western countries (Bressani *et al.,* 1987) [4]. Its cultivation is easy and produces high yields in low-altitude regions with high temperature and relative humidity. The environment of different locality plays an important role in the determination of quantity and quality of seed proteins. Locality effect is relatively more crucial than that of cultivar of plant in terms of protein content (Dodd *et al.,* 1980) [7]. Hence the objectives of present study are to evaluate the nutritional status through proximate analysis of *Canavalia ensiformis* cultivated in the hot and humid climate of North-East India.

Material and Methods
Mature pods of *Canavalia ensiformis* were harvested during post-monsoon season from the Agricultural Experimental Field of Defence Research Laboratory (DRL), DRDO, Tezpur, Assam which is located at 26° 38'N, 92° 48'E. The proximate analyses of pods were done at Defence Food Research Laboratory (DFRL), DRDO, Mysore, Karnataka.

Classification of *Canavalia ensiformis* (Figure 1)

Kingdom	: Plantae
Class	: Magnoliopsida
Order	: Fabales
Family	: Fabaceae
Genus	: *Canavalia*
Species	: *ensiformis*
Scientific Name	: *Canavalia ensiformis*
Common Name	: Jack Bean
Local Name (Manipuri)	: Tekpi

Fig 1: Plant of Jack Bean *(Canavalia ensiformis)*

Fig 2: Mature pod and mature seed of *Canavalia ensiformis*

Fig 3: Seeds of *Canavalia ensiformis* (Top and Lateral View)

Characteristics of Pods and Processing

The dimensions of pods were recorded and seeds were evaluated with the help of proximate analysis.

Proximate Analysis

Moisture Content (Hot Air Oven Method)

Moisture content is determined using AOAC (1984) [2] procedure. The sample is dried in an oven and the moisture content is calculated from the weight loss due to the evaporation of moisture. Moisture content was determined by using the following formula:

(Moisture content of sample (% mc)
=Initial weight-Final weight x 100/weight of sample)

Ash Content (Muffle Furnace)

Ash content of prepared sample was determined following AOAC (2000) [3] method. Ash is the mineral matter found after the ignition of oils (or) fats. Ash content of food stuff represents the inorganic residue remaining after the destruction of organic matter.10g of sample was weighed in a dish. The weight of empty dish was noted. The weight of the sample and dish was also noted. The dish was placed in a sand bath, and then holds in a plate. It was gently heated to a point of ignition and allowed to burn spontaneously. Thereafter, It was gently ignited as a carbon residue was obtained. It was again placed in a muffle furnace at a temperature of 550 °C – 600 °C. This was done till carbon residue disappeared. It was allowed to cool and finally weighed. Ash content was determined by using the following formula.

(Ash content (gm) = (M2-M1) * 100 /M)

Estimation of fat content

Fat content in foods, in terms of free lipid or petroleum ether extractable lipids, are estimated by using Soxhlet extractor (Gerhardt, Germany) with continuous refluxing for 14 - 16 hrs described by AOAC (1984) [2]. Fat content was determined by using the following formula.

Fat % = wt. of ether extract X 100 /wt. of sample

Estimation of Crude Fiber (Fibretherm, Gerhardt, Germany)

Crude fibre is lost on ignition of dried residue remaining after sequential digestion of sample with 1.25 % H_2SO_4 & 1.25% NaOH solution specific conditions.

Preparation of Gooch Crucible

Cleaned and dried Gooch crucible was filled to 3/4th of its column with dried asbestos powder and was fixed on to the filtration device. It was washed with distilled water. While adding distilled water suction was applied to facilitate the asbestos to settle tightly at the bottom of Gooch crucible. The packed volume should not be more than 1/8th of the total volume of the Gooch. If required, the surface of the asbestos may be levelled by pressing with a glass rod having a flat end. The packed Gooch Crucible was washed under suction, by distilled water until the washings were clear. It was then dried in a hot air oven at 120 °C for one hour and stored in a desiccator until further use.

Preparation of sample

The given sample was homogenized in a warring Blender. The moisture content of the homogenized material was determined by a suitable method. The fat was also determined in the dried residue, obtained after estimation of moisture, by Soxhlet extraction. The residue obtained after estimation of fat was finely ground, preferably to pass through 100 mesh sieve and used for determination of crude fibre.

Procedure

2g of the prepared sample was weighed and placed in a wide mouthed conical flask. Approximately 2g of dried asbestos powder and bumping chips were added. 200 ml of 1.25 % H2SO4 was added and the condenser was fitted**.** The hot mixture was refluxed through a wetted muslin cloth spread over a Buchner funnel fitted to the suction unit. The residue was washed several times with hot distilled water until the filtrate is neutral. The residue was transferred quantitatively over the muslin cloth back into the same conical flask, with the help of 200 ml of 1.25 % NaOH. The mixture was again refluxed for 30 min. The digested material was filtered, under suction, through the prepared Gooch crucible. It was taken care to see that every part of the residue in the conical flask is transferred on to the Gooch crucible. It was washed 3-4 times with hot distilled water. It was again washed with 10-15 ml 95 % alcohol followed by 10-15 ml of solvent ether. The Gooch containing the residue was dried overnight in a hot air oven at 95±5 °C. Thereafter it was cooled in a dessicator and weighed (W1). The Gooch was transferred into a Muffle furnace and was ignited at 550 ± 5 °C for 3-4 hrs. Now it was cooled in desiccators and weighed (W2). Crude fibre was determined by using the following formula:
Crude fibre % = 100 - (moisture + fat) X wt of fibre/wt of sample taken

Estimation of protein by micro Kjeldahl method (PELICAN-Kelplus-KES06INL & Kelplus Classic DXVA, India)

Protein in foods is generally estimated by the nitrogen content. Nitrogen content is estimated which is based on the determination of the amount of reduced nitrogen. The various nitrogenous compounds are converted into ammonium sulphate by boiling with concentrated sulphuric acid. The ammonium sulphate formed is decomposed with a strong alkali (NaOH) and the ammonia liberated is absorbed in excess of neutral boric acid solution and then titrated with standard H.

$$\text{Sample} + H_2SO_4 \longrightarrow (NH_4)_2SO_4$$
$$(NH_4)_2SO_4 + NaOH \longrightarrow NH_3\ Na_2SO_4 + H_2O$$

Procedure

Digestion

0.5gm of sample was weighed into a digestion flask.1 gm of digestion mixture was added. Concentrated H_2SO_4 was added. The sample was digested in mantle or any other heating system in a fume chamber. At the initial stage proper care was taken to prevent spoilage due to frothing. To avoid any food material left undigested proper care was also taken. Heating was continued until the colour of the digested sample is pale green or colourless. It was left for cooling and 30- 40 ml of distilled water was added slowly through the sides of the flask. It was mixed properly and left for cooling. The solution was transferred to a 100 ml volumetric flask. The flask was rinsed with distilled water and transferred in to the same volumetric flask. The volume was make up.

Distillation and Titration

5 ml of the sample was transferred into the distillation unit. It was rinsed with 5 ml of distilled water. Thereafter, 10 ml of sodium hydroxide solution was added. 10 ml of boric acid was transferred into a 100 ml conical flask; 3-4 drops of mixed indicator was added. The flask was kept under the condenser. Now steam was passed into the distillation unit where sample and alkali were present. The liberated ammonia condensed into the boric acid. Distillation was continued for 5 minutes. Then distillation was stopped and the distillate was titrated against standard 0.01 N HCL.

Calculation

This calculation is based on the fact that 1000 ml of 1N HCL = 14 g of Nitrogen.

Hence % Nitrogen value of the sample =

$$\frac{\text{Titration value x N x 14 x 100 x 100}}{\text{Wt of the sample x volume taken x 1000 for distillation}} = \%\ N_2 \text{ in g}$$

Nitrogen obtained is multiplied by the factor 6.25
I.e. N x 6.25 given protein % in gm.
Factor 6.25 is based on the assumption that plant protein contains 16 % nitrogen.

Estimation of reducing, total and non reducing sugars by fehling's method

Estimation of reducing sugars

5 ml of Fehling's solution A & B were taken in a conical flask and contents were boiled using Bunsen burner. Methylene blue indicator was added when it started boiling. The contents were titrated against the filtrate in the burette and the end point was observed till blue to brick red colour was obtained and it was confirmed by adding a drop of indicator into the flask. The titration was repeated in triplicates.

Estimation of total sugars

20 ml of the filtrate were taken in a 100 ml volumetric flask and 10 ml of concentrated hydrochloric acid were added and kept for overnight for acid hydrolysis. After that a drop of phenolphthalein indicator was added and drop of saturated alkali were added to neutralize the acid where a pale pink color is obtained and volume was made up to the mark using distilled water. 5ml of Fehling's A & B were pipette out into conical flask. Contents were boiled and indicator is added and this is titrated against filtrate and finally end point brick red color standardization of Fehling's solution is done. Calculation of reducing sugar, total sugar and non reducing sugar was determined by using the following formula:

- % of reducing sugar= factor X 100 X 100/titre value X weight of sample
- % of total sugar= factor X 100 X 100 X 100/titre value X 20 X wt of sample
- % of non-reducing sugar= total sugar - reducing sugar

Standardization of Fehling's solution

Calculation

100 ml of glucose solution= 100 mg of glucose
100 ml of glucose solution= 1000/100=10 mg of glucose
10 ml of fehling's solution= x ml of glucose X 10 mg = titre value X 10 mg (factor)

Result and Discussion

North Eastern region of India, being rich in plant diversity, has a very huge amount of non-traditional or underutilized horticultural crops and also have a large group of underutilized food plants from Leguminosae family. Jack bean (*Canavalia ensiformis*) of Fabaceae family is also cultivated on limited scale in the North Eastern region (CSIR, 1950) [5] whose potential until now remains untapped. Unless the collection accessories of plant genetic resources from different region have been properly evaluated and their attributes become known to breeder they will have only a little practical use. Therefore in the present study, *Canavalia ensiformis* (Jack bean) were harvested and collected during post-monsoon season from the study area. After collection we observed that the structure of seed is oval in shape and its colour is white (Fig. 2 and 3). The physical characteristics like average number of fruits per branch, average number of seeds per pod, average weight of per seed in gm, average height of plant in metre were evaluated which are mentioned in Table 1. Proximate chemical analysis, *viz*, anti-oxidant activity, water activity, pH, TSS, moisture (%), reducing sugar, total sugar, acidity, vitamin C, protein, fats, carbohydrates, crude fiber, calorific value were evaluated and result were shown in Table 2. The number of fruits was found to be 4-6/bunch, number of seed ranged from 12-16/pod, weight of seed ranged from 1.80-2.06 gm/seed, length of pod ranged from 28-36 cm and height of *Canavalia ensiformis* plant was found to be ranged from 3.54-3.94 meter (Table 1). We found high content of vitamin C i.e, 8.087 mg/100 g in *Canavalia ensiformis* (Table 2).

In the present study we have found high content of protein in the seeds of *Canavalia ensiformis.* Since moderate intake of these seeds will greatly increase the total dietary protein intake of the consumers these seed material of *Canavalia ensiformis* has promising nutritional significance (Bressani *et al.,* 1987) [4]. In another study, Abitogun and Olasehinde (2012) [1] also observed high content of protein. Leguminous seed have been reported to be superb sources of energy (Oke *et al*., 1984; Del *et al.,* 1981) [6] in animal and human diets. Lots of wild vegetables, even weeds of agricultural crops are highly rich not only in protein but also in vitamins (Olaofe *et al*., 2008) [11] as well. In present study we have also found high content of vitamin C and carbohydrate content in the

pods of *Canavalia ensiformis.* The high carbohydrate content might be a good supplement to scarce cereal grains as sources of energy in feed formulations (Eromosele *et al.,* 1991) [8].

Conclusion

The result shows that the pods of *Canavalia ensiformis* (Jack bean) can be a potential source of edible stuff as well as a source of protein, vitamins, minerals, carbohydrate and energy supplement in livestock feeds. In future, research can also disclose its potential for human utilization.

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Table 1: Physical characteristics of *Canavalia ensiformis* (Jack bean)

S. No.		
1	Date of sowing	23.05.14
2	Date of germination	27.05.14
3	Date of flowering	16.06.14
4	Date of fruit initiation	04.07.14
5	Av. no. of fruits per bunch	5
6	Av. no. of seeds per pod	14
7	Av. wt. of per seed (gm)	1.98
8	Average length of pod:	32 cm
9	Average height of plant:	3.74 m
10	Parts use:	Young Pods
11	Medicinal values:	Anthelmintic or Vermifuge

Table 2: Proximate Chemical Analysis of Tekpi

S. No.	Parameter	Value
1	Anti-oxidant activity	708.44 mcg/ml
2	Water Activity	0.984
3	pH	6.5
4	TSS	5.5
5	Moisture (%)	83.3
6	Reducing Sugar	2.21 %
7	Total Sugar	3.41%
8	Acidity	0.188
9	Vitamin C	8.087 mg/100g
10	Protein	10.85 g/100g
11	Fat	1.59 g/100g
12	Carbohydrates	12.15 g/100g
13	Crude Fiber	3.98 g/100 g
14	Calorific Value	104.59 kcal/100g

References

1. Abitogun AS, Olasehinde EF. Nutritional Evaluation of Seed and Characterization of Crude Jack Bean (Canavalia ensiformis) Oil. IOSR Journal of Applied Chemistry. 2012; (6):36-40.
2. AOAC. Official methods of analysis 14th ed. Washington D.C, USA. 1984.
3. AOAC. Official methods of analysis 30th ed. Washington D.C, USA. 2000.
4. Bressani R, Brenes RS, Garcia A, Elias LG. Chemical Composition, amino acid content and protein quality of canavalia spp. seeds. Journal of Science Food and Agricultural. 1987; 40:17-23.
5. CSIR. The wealth of India, CSIR, New Delhi, 1950; II:56.
6. Del Rosario RR, Lozano Y Noel MJ. The chemical and bio-chemical composition of legume seeds. Philippine Agriculturist, 1981; 64:49-57.
7. Dodd NK Pushpamma. Effect of locate and varieties on protein, amino acid and mineral content of chick pea. Indian Journal of Agricultural Science. 1980; 50:139-144.
8. Eromosele IO, Eromosele CO, Kuzhkuzha DM. Evaluation of mineral elements and ascorbic acid contents in fruits of some wild plants. Plant Hum, 1991; 41:151-154.
9. Mitre V. Wild plant in Indian folk life: a historical perspective. In S.K. Jain (Ed). Contribution to ethnobotany of India. Jodhpur, India. Scientific publishers, 1991, 37-58.
10. OkeDB, Tewe OO, Fatuga BL. The nutritional composition of some Cowpea varieties. Nigeria Journal of Animal Production. 1994; 22(1): 32-36.
11. Olaofe O, Olukitibi BY, Aremu MO. Chemical evaluation of the nutritive value of smooth Luffa (Luffacylindrica) seed'kernel. EJERAF Chemistry. 2008; 7(10):3444-3452.