

Chemical Characteristics, and Nutritional Value of *Strychnos nux-vomica* L. Seeds.

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I. ABSTRACT

Strychnos nux-vomica L. commonly known as 'Nux-Vomica, Poison nut and Strychnine tree in English is a medium sized deciduous tree which belongs to the family Loganiaceae. *Strychnos nux-vomica* L. traditionally has been used for treatment of various ailment since generations. These seeds have been found to be rich in protein and possess high calorific value. Proximate and Ultimate analysis of seed reveals Moisture – 5.21%, Ash – 11.72%, Volatile Matter – 80.22%, Fixed carbon – 2.85%, N – 0.82%, C – 51.05%, H – 9.433%, S – 0.10%. The *Strychnos nux-vomica* L. seeds are enriched in mineral and nutrient content which are rich source of K and Ca ions. Quantitatively, the amino acid profile by HPLC result shows essential amino acids such as methionine, threonine, leucine, isoleucine, lysine, phenylalanine, histidine (EAA - 29.1 %) and non-essential amino acids such as glutamate followed by serine, glycine, tyrosine, aspartate, proline, cystine, arginine (NEAA - 62.68%).

Key Words: Chemical characteristics, Proximate-Ultimate Analysis, AAS, Amino Acid, HPLC, Seed.

II. INTRODUCTION

Strychnos nux-vomica L. [1] commonly known as nux-vomica/ poison nut/ strychnine tree/ quaker button in English. Throughout India it is well known in various states and languages. It Hindi its known as Kucchla. Vishmushti / Kapilu in Sanskrit; Mushidi in Telugu; Kancirai in Tamil and Kuchila in Odia Kuchila in Bengali, Kajra in Marathi. It belongs to family 'Lognaiaceae' [2]. *Strychnos nux-vomica* L. is a medium sized deciduous tree and is found in sub-tropical and tropical biome. The ancient origins of employing the desiccated, mature fruit of *Strychnos nux-vomica* L. as a potent arrow toxin (curare) are well-documented. Alkaloid strychnine mainly exhibits the medicinal and toxicological properties. Commercially, Strychnine is obtained from the seeds of the *Strychnos ignatii* (Saint-Ignatius bean) and from the *Strychnos nuxvomica* (Nux-vomica). For the poisonous principles of Strychnine and Brucine, Nux-vomica as a drug plant is well known in many ancient and traditional medicine systems such as Ayurveda in India and outside India as well for example Unani, Chinese, Tibetan, and Homeopathy. Fruit is round, soft, fleshy, white, jelly pulp containing 1-5 seeds. One side of the seed is convex and the other concave with a small depression in the centre [3]. This species has been included in the list of rare endangered tree (RET) as it is rarely observed in the forests in some states like Chhattisgarh [4]. The plant has various biological activities, despite of inadequate scientific evidence in each activity. Therefore, more research is necessary for this medicinal plant with high potential in various medicinal and other industrial use opportunity.

Medicinal Properties

The Ayurvedic Pharmacopodia of India recommends detoxified seeds for ailment of paralysis, facial paralysis, sciatica, and impotency. The root bark is useful in cholera and intermittent fever. The leaves are known to be useful for treatment of chronic wounds and ulcers and are applied as poultice. Pulp of the ripe fruit is used in treating paralytic affection of palms and foot. The seeds which are bitter in taste are used as anti-periodic, aphrodisiac, appetizer, digestive, stimulant, and purgative. They are applied in the treatment of various ailments like malarial fever, skin itching and disease, anaemia, bronchitis, lumbago, asthma, constipation, muscle

weakness, emphysema, colic, diabetes, paralysis, insomnia, nervous debility, dyspepsia, diarrhoea, hysteria, mental emotions, chronic constipation, chronic rheumatism, epilepsy, gout, hydrophobia and spermatorrhoea [5,6]. Pharmacologically the drug plant has been tested on animals for its action as antifungal, antibacterial, antioxidant, anti-inflammation, anticancerous, antidiabetic, neuropharmacological properties as well as for the specific actions on gastrointestinal, bone cells and cardiovascular systems. Apart from medicinal use *Strychnos nux-vomica* L. have also been used as rodenticide, avicide, insecticide, Nematicide and Piscicide [7].

Phyto-chemical Constituents

Almost all part of this tree contains alkaloids of medicinal importance, but seed is official in many pharmacopeias. It is rich in alkaloids, flavonoids, tannins and triterpenoids, glycosides, lignins and steroids [8]. More than 90 chemical compounds have been isolated from different parts of *Strychnos nux-vomica* L. but strychnine and brucine are the principal toxic alkaloids. They occur not only in the seeds but also in roots, wood, bark, fruit pulp and hard fruit shells [9]. Seeds contain 2.6 to 3.0% of total alkaloids, out of this alkaloids 1.25 to 2.5% is strychnine and 1.5 to 1.7% is brucine. The seeds additionally contain chlorogenic acid, a glycoside (loganin), and 3.0% of fixed oil [10].

III. METHODS AND MATERIAL REQUIRED

A. Seed selection and sampling

Strychnos nux-vomica L. seeds were collected between December and February month from Eastern Chhattisgarh. Removed the seeds from fleshy pericarp. Dried the seeds in shade at room temperature, crushed it by using mortar-pestle and cut the seeds by sharp-edged scissor and then stored in airtight bottles at 4°C. After crushing of seeds, Extraction and Proximate – Ultimate analysis was performed from original and defatted seed.

B. Extraction

Oil from the shade dried seeds powder of *Strychnos nux-vomica* L. was extracted by using Soxhlet Apparatus. The seeds of *Strychnos nux-vomica* L. were exhausted with petroleum ether (Boiling point 60-80°C). [11,12,13] A brown-yellow colour oil is obtained in 1% yield. The chemicals used are AR grade and of Sigma chemical company.

C. Proximate and Ultimate Analysis

Proximate chemical composition of the seed and physico-chemical characteristics of the extracted oil were determined by standard methods. Calorie contents were determined using Julius and Peter's Bomb calorimeter.

- 1) Proximate Analysis – The proximate analysis determines only the Fix Carbon, Volatile matter, Moisture, Ash percentage, Crude Protein, Fibre etc. [14,15]
- 2) Ultimate Analysis – The ultimate analysis determines all seed components elements like C, H, N, S. [14,15]

D. Mineral nutrient content of seed flour

To determine the mineral nutrient content of seed flour, a 5.0 gm sample was incinerated in a furnace at 550°C and the residues (ash) were dissolved in 50 mL of 0.5 M HNO₃ solution. The concentrations of Mg, Fe, Co, Ni, Cu, Zn, and Pb were determined using atomic spectrophotometer (Make Thermo Scientific and iCE 3000 SERIES) absorption, following the method of J. T. Ouilly et al. [16] A calibration curve was prepared using standard metal solutions.

E. Amino acid Analysis

Seed flour amino acids (method 982.30) were determined using official methods of the Association of Official Analytical Chemists [17]. According to the FAO/WHO/UNU reference amino acid pattern, the essential amino acid score was calculated as below:

$$\text{Amino Acid score} = (\text{Test Amino Acid} / \text{Reference Amino Acid}) \times 100$$

IV. RESULT AND DISCUSSION

A. Physico-chemical properties.

The physico-chemical properties of *Strychnos nux-vomica* L. seeds oil in Table 1 shows the qualitative property of seed oil. The moisture content of seeds was 5.21% which is low and therefore beneficial for prolonging the shelf life of the seeds.

Table 1: Characteristics of *Strychnos nux-vomica* L. seed. [18,19,20]

Sl No	Sample	Properties	Value
1	Seed	Moisture % in seeds	5.21
2		Oil %	1
3		Protein %	5.125
4		Ash %	11.72
5		VM %	80.22
6		FC %	2.85
7		Calorie content calorie/gm	3580.20 cal/gm

The seeds contained significant amounts of volatile matter - 80.22%, fixed carbon- 2.85, protein – 5.125%, ash – 11.72%. Image of *Strychnos nux-vomica* L. is given in Fig.



Fig.1: Image of *Strychnos nux-vomica* L. fruit and seeds

B. Ultimate Analysis of seed and seed ash

The Ultimate analysis was carried for both original and defatted *Strychnos nux-vomica* L. seeds using standard method. The result of these analysis is tabulated in Table 2.

Table 2: Ultimate analysis of *Strychnos nux-vomica* L. seeds (%)

Carbon	Hydrogen	Nitrogen	Sulphur
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Original seeds	51.05	9.433	0.82	0.10
Defatted seeds	44.85	10.399	1.00	0.10

C. Atomic Absorption Spectroscopy

The ash of the seeds was subjected to analysis [20] of mineral nutrients present in them using flame photometer for Na, K, Ca ions and atomic absorption spectrophotometer for other mineral nutrients. Evaluation of mineral nutrients of *Strychnos nux-vomica* L. seeds ash by using AAS. tabulated in Tables 3.

Table 3: Determination of mineral nutrients of *Urena lobata* seeds ash by using AAS.

No.	Test Parameter	Measurement Unit	Test Method	Test Result
I.	Chemical Testing			
	Metals			
1	Sodium (as Na)	mg/kg	Flame Photometer	395.42
2	Potassium (as K)	mg/kg	Flame Photometer	2541.83
3	Calcium (as Ca)	mg/kg	Flame Photometer	1388.44
4	Magnesium (as Mg)	mg/kg	AAS	616.53
5	Iron (as Fe)	mg/kg	AAS	56.77
6	Cobalt (as Co)	mg/kg	AAS	0.99
7	Nickel (as Ni)	mg/kg	AAS	40.84
8	Copper (as Cu)	mg/kg	AAS	9.96
9	Zinc (as Zn)	mg/kg	AAS	51.79
10	Lead (as Pb)	mg/kg	AAS	0.99

Strychnos nux-vomica L. seeds also contained significant amounts of minerals. The most abundant was K followed by Ca, Mg, Na, Fe, Zn, Ni, Cu, Co, and Pb (Both Co and Pb were in same quantity). By Ultimate analysis H is in highest % followed by C, N, S. These elements except Pb and Ni are required in very small amounts (in micrograms) by the human body and animal. However, Pb and Ni cause toxic effects.

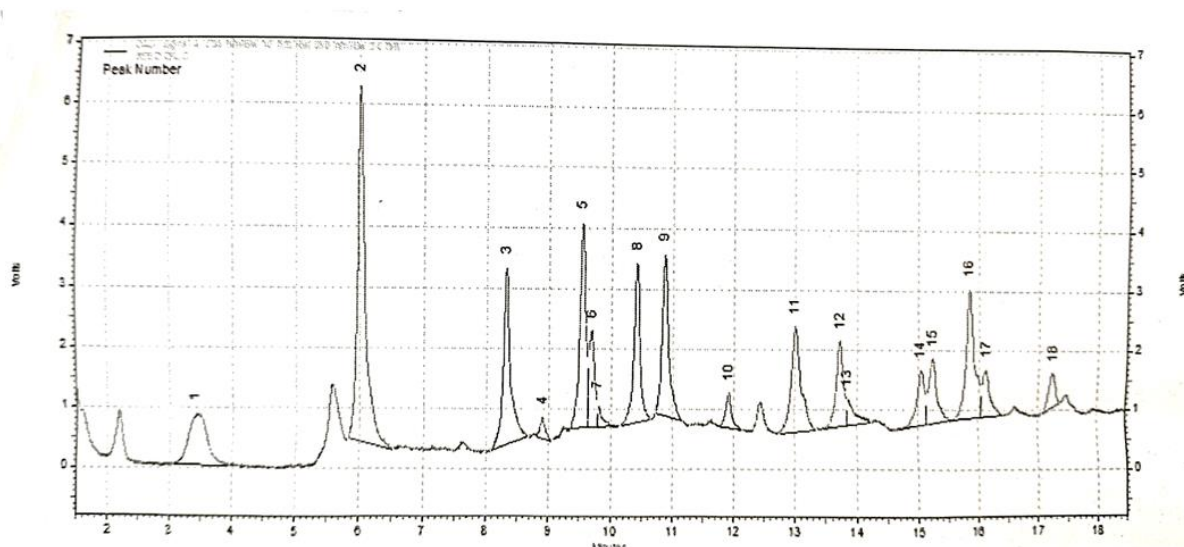


Fig 3: Chromatogram of amino acid of *Strychnos nux-vomica* L. seeds.

Table 5: Amino acids content of *Strychnos nux-vomica* L. seeds.

DAD: Signal A, 338nm/Bw:10 nm Ref 390, nm/Bw:20 nm Results				
Peak Number	Name	Retention Time	Area	Area %
1	Aspartate	3.433	35954	6.64
2	Glutamate	6.010	104090	19.22
3	Serine	8.315	49292	9.10
4	Histidine	8.907	4005	0.74
5	Glycine	9.538	47012	8.68
6	Threonine	9.687	23266	4.30
7	Arginine	9.793	3239	0.60
8	Alanine	10.415	39485	7.29
9	Tyrosine	10.868	42170	7.79
10	Cystine	11.920	8353	1.54
11	Valine	12.998	41829	7.72
12	Methionine	13.720	25413	4.69
13	Phenylalanine	13.843	8933	1.65
14	Isoleucine	15.047	17103	3.16
15	Leucine	15.242	21668	4.00
16	Unknown	15.838	44452	8.21
17	Lysine	16.107	15391	2.84
18	Proline	17.217	9842	1.82
Totals			541497	100.00

Table 5 depicts the amino acid composition of *Strychnos nux-vomica* L. seed flour. The results indicated that the essential amino acids EAA formed 29.1% of the total amino acid and most were at higher levels than in requirements recommended by FAO/WHO/UNU. [21] Valine had the highest amino acid score, followed by methionine, threonine, leucine, isoleucine, lysine, phenylalanine, histidine. Non-essential amino acids NEAA represent 62.68% of the total amino acid content. The highest levels were recorded for glutamate followed by

serine, glycine, tyrosine, aspartate, proline, cystine, arginine. The total amino acid composition of *Strychnos nux-vomica* L. seed flour is very higher than the of seeds of Sunflower seeds [22]. *Strychnos nux-vomica* L. seed flour is rich in both essential and nonessential amino acids. It constitutes a potential source of protein for livestock fodder and human food.

V. CONCLUSION

The phytochemical study on the chemical composition, physicochemical properties, and nutritional value of *Strychnos nux-vomica* L. seeds suggests that these seeds could be considered as an alternative source of protein, and micronutrients. The essential amino acid (29.1% of total amino acid) of *Strychnos nux-vomica* L. is higher than the seeds of Sunflower seeds [22]. *Strychnos nux-vomica* L. seeds have the potential phytochemical constituents which could be used as food supplement and pharmaceutical industries.

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