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REVIEW ARTICLE

Nutritive Value and Potential Uses of *Leucaena Leucocephala* as Biofuel – A Mini Review

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ABSTRACT

Leucaena leucocephala is a small tree originated in Mexico and escaped as a weed in tropical and warm temperate region of other countries. In India, it is mostly cultivated for its fodder and other important uses like hedge plant, green manure, food for animal, timber and as a bio energy crop. The plant is also used in phytoremediation. The plant has high nutritive contents like protein, carbohydrates and fat as that of alfalfa. As a timber, it is used as a raw material for making agricultural implements and the seed oil could be used as a biofuel by blending with the conventional diesel. In the present study, the nutritive value and potential uses of this plant were collected and discussed.

Keywords: *Leucaena leucocephala*, Conflict tree, Mimosine, Forage, Biofuel, bio inhibitor.

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INTRODUCTION

Leucaena leucocephala is a medium sized fast growing tree belongs to the family Fabaceae. It is native to Southern Mexico and Northern Central America [1] and now it has naturalized in many tropical and sub-tropical locations [2]. The specific name 'leucocephala' comes from 'leu' meaning white and 'cephala', meaning head, referring to the flowers. It is commonly known as White Lead tree, White Popinac, Jumbay and Wild Tamarind. In India, it is popularly known as kubabul or subabul [3]. During the 1970s and 1980s it was promoted as a "miracle tree" due to its multiple uses [4]. It has also been described as a "conflict tree" because it has been promoted for its forage production and naturally spreads like a weed. It grows up to 20m height. Leaves are looking like that of tamarind having white flowers tinged with yellow, and having long flattened pods. Seeds are dark brown with hard shining seed coat. The tree has multifarious uses like firewood, timber, greens, fodder, green manure, provide shade, controls soil erosion [5-8]. The kernel of seeds contains more than 20% oil and it can be used as a bio energy crop. The seeds may also be used as concentrates for dairy animals, as manure [9-10], as a protein source [11], as an oil seed [12] and as a potential source of commercial gum [12, 13].



Fig 1: Habit of the plant

L. leucocephala is a legume and in the symbiosis with Rhizobia bacteria the tree is able to fix about 500 kg nitrogen per ha annually. The nitrogen fixing nodules are found on the small lateral roots near the soil surface [12].

Chemical composition and nutritive value:

Leucaena leucocephala leaves and seeds contain lipids, crude protein and carbohydrates. The seeds contain tannin and oxalic acid [14, 15]. The kernel contains oil content of about 17 -20 % [16]. The leaves and seeds also contain a toxic and non protein substance known as mimosine. The details are given in table- 1 and 2

Table- 1. The chemical constituents of *L.leucocephala* leaves and seeds [17-19]

Sl. No	Chemical constituents	Leaves	Seeds
1.	Crude Protein (%)	25.9	46
2.	Carbohydrate (%)	40	45
3.	Tannin (%)	4	1.2
4.	Mimosin (%)	7.19	10
5.	Total ash (%)	11	3.79
6	Total N (%)	4.2	-
7	Crude protein (%)	25.9	8.4
8	Calcium (%)	2.36	4.4
9	Phosphorus (%)	0.23	0.189
10	b-carotene (mg/kg)	536.0	-
11	Gross energy (kJ/g)	20.1	-
12	Tannin (mg/g)	10.15	-

Table- 2. The chemical constituents of *L.leucocephala* seeds [20]

Sl.No	Chemical constituents	Seeds
1.	K	137.3
2.	N	338.0
3.	Mg	44.6
4.	Ca	44.4
5.	Na	12.6
6	Mn	52.6
7	Fe	642.4
8	Cu	55.0
9	Zn	125.1
10	Fatty acid (%)	15
11	Saponification value	108.74
12	Iodine value	4.90
13	Acid value	1.08

Medicinal uses

The seeds of leucocephala have great medicinal properties and are used to control stomachache, as contraception and abortifacient. The seed gum used as a binder in tablet formulation [21, 22]. Sulfated glycosylated form of polysaccharides from the seeds was reported to possess significant cancer chemo-preventive and anti-proliferative activities [23]. The extracts of the seeds has reported as anthelmintic, antidiabetic and has a broad spectrum antibacterial activity [24 – 26]. Recently, the seed oil was used in engineering as a novel bio-device useful in biomembrane modeling in lipophilicity determination of drugs and xenobiotics [27]. The plant is reported to be a worm repellent.

Human food

Leucaena is consumed by humans in Central America, Indonesia and Thailand. It can be eaten in processed and unprocessed forms. In Java, the seeds are fermented and are eaten as sprouts or bean cake. In the Philippine Islands, the young pods are cooked as a vegetable and roasted seeds are used as a substitute for coffee. The young dry seeds are popped like popcorn [28]. In Indonesia, Thailand, Mexico and Central America people also eat the young leaves, flowers, and young pods made in to soups and salads. Seeds are being considered as non-conventional sources of protein, together with other leguminous seeds [12].

Animal feed, poultry and fish diets

L. leucocephala is one the highest quality and most palatable fodder trees of the tropics, often being described as the 'alfalfa of the tropics'. It was developed as forage in Hawaii. *Leucaena* provides nutritious and high protein forage for ruminants such as cattle, water buffalo, sheep and goats which increases milk production and is a protein supplements fed for dairy cows [29]. *L. leucocephala* leaves have been used in feeds for non-ruminants like pig, and its processed seeds are also used as feed ingredient. It is reported to have a very good effect on the performance of growing - fattening pigs [30]. The leaf-meal is used as poultry diets has been reported [31]. The effect of different levels of *L. leucocephala* supplementation on egg production and egg quality in laying hens was reported.[32] Fish, rodents and poultry may also be raised on diets supplemented with *L. leucocephala* leaves [33,34] offers a good potential, cheaper plant protein source with high nutritive value.

Timber

L. leucocephala wood is pale yellow sapwood and light reddish-brown heartwood. The wood has medium density, medium textured, close grained and easily workable for a wide variety of carpentry purposes like sawn timber, mine props, furniture and parquet flooring [20]. *L.leucocephala* pulp is used in paper and rayon industries [35]

Gum or resin

Gum arises from *Leucaena* stems is used as gum and has a potential commercial value. Seeds also yield about 25 percent gum and is highly viscous solutions at low solute concentrations [36-38].

Dyes

Red, brown and black dyes are extracted from the pods, leaves and bark of *L.leucocephala*. It contain tannin and is used as a natural dye in leather and cotton industries [39].

Avenue tree



Leucocephala is grown in the garden as a avenue tree for cocoa, coffee and tea plantation instead of silver oak trees. It is planted as a living fence around the garden as ornamental, firebreak and wind break. It also used as supporting tree for vines such as pepper, vanilla, tubers and passion fruit.

Agricultural Purpose

The leaves of leucocephala used as a green manure in organic farming [40, 41]. Since it is having large number of roots with root nodules aids to help fix the atmospheric nitrogen in a great level [12]. The planting of trees in the foot-hills and loamy and sandy soils prevents the natural soil erosion by wind and water. The hard wood is used to make major agricultural implements like spade, pick-axe, ploughing tools and making shelves for rearing honey bees [42]. Since the tree blooms throughout the year its yield nectar for honey bees.

Bio Fuel

L. leucocephala is an excellent firewood species with a specific gravity and high calorific value [43]. Wood burns steadily with little smoke, few sparks and produces less than 1% ash. The tree makes excellent charcoal. L. leucocephala seed oil is used as a bio fuel in diesel engines was found to involve no harmful agents.

The kernel contains 15- 20% % of fatty acid [20, 44]. The oil extracted from the kernel is used as a bio-fuel. It can be directly blend with the fossil fuel at the maximum of 20%. The seed oil can also be converted into biodiesel by transesterification method. The fatty acid of this leucaena seeds has a great potential source for inhibiting the bio-corrosion of mild steel and copper alloys. Studies are on progress to evaluate the leucaena oil as a potential source for biodiesel and bio inhibitor in our centre. The oil cake obtained after the extraction of oil can be used as a bio manure, biocide and biofertilizer.

CONCLUSION

Leucaena leucocephala is a small tree commonly cultivated in garden as a ornamental, avenue and forage crop in India. The various parts of this plant like root, the leaves, stem bark, wood and seeds are highly useful to the human beings and animals. The stem has high timber value. The leaves are used as an animal feed because of its high nutritional value. The plant has the property of fixing atmospheric nitrogen in the root nodules. The seed oil could be used as a potential bio inhibitor for corrosion of mild steel and copper. The product obtained from the plant is natural and eco-friendly. So it is very apt to call as miracle tree.

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REFERENCES

- [1] Hill GD. *Herbae Abstracts* 1971; 4: 111-19.
- [2] Hughes, Colin E. *Systematic botany monograph* 1998; pp. 55.
- [3] Chandrasekhara Rao T, Lakshminarayana G, Prasad NBL, Sagan Mohan Rao S, Azeemoddin G, Atchynta Ramayya D, Thirumala Rao SD. *J Am Oil Chem Soc* 1984; 61: 1472-3.
- [4] Gutteridge, Ross C, and H Max Shelton. *Tropical Grassland Society of Australia, Inc.,* 1998; 2: 1.
- [5] Dijkmann DJ. *Economic Botany* 1950; 4: 337-349.
- [6] Gutteridge and H Shelton. *Forage Tree Legumes in Tropical Agriculture* 1st Ed CAB, International, Wallingford, Oxon, UK 1994
- [7] Shelton H and J Brewbaker. *Leucaena leucocephala*-the Most Widely used Forage Tree Legume. In: *Forage Tree Legumes in Tropical Agriculture*, Gutteridge C and H Shelton (Eds.) CAB International, UK 1994; Chap 2.1, pp: 15-30.
- [8] Gardezi AK, ID Barcelo-Quintal VM Cetina-Alcala, AL Bussy and MA Borja Salin. *Studies of phytoremediation by Leucaena leucocephala in association with arbuscular endomycorrhiza and Rhizobium in soil polluted by Cu.* *Proceedings of 8th World conference on Systemics, Cybernetics and Informatics, Orlando Florida, USA, 2004;* pp: 33-39.
- [9] Catchpole DW, Blair Gal. *Aust J Agric Res* 1990; 41: 539-47.
- [10] Sandhu J, Sinha M, Ambasht RS. *Soil Biol Biochem* 1990; 22: 859-63.
- [11] Jagan Mohan Rao S, Azeemoddin G. *J Oil Technol Assoc India* 1988; 20: 12.16-7.
- [12] Azeemoddin G, Jagan Mohan Rao S, Thirumala Rao SD. *J Food Sci Technol* 1988; 25: 158.
- [13] Buckeridge MS, Dietrich SMC, Maluf AM. *Rev Brasil Bot* 1987; 10: 25-7.
- [14] Azeemoddin G, Jagan Mohan Rao S, Thirumala Rao SD. *J Food Sci Technol* 1988; 25: 158.
- [15] Padmavathy P, Shobha SJ. *Food Sci Technol* 1987; 24: 180-2.
- [16] Hossain MA, Alam M, Huq MS. *Studies on the composition of ipil-ipil (Leucaena leucocephala) seed oil.* *Dhaka Univ. Stud., Part B* 1998; 36: 163-9.
- [17] Ojo OA and Fagade OE. *African Journal of Biotechnology* 2002; 1 (1): 23-27.
- [18] Anonymous. *Leucaena leucocephala - the Most Widely Used Forage Tree Legume".* FAO.
- [19] Orwa. *Leucaena leucocephala.* *Agroforestry Database.* World Agroforestry Centre. 2009
- [20] Alabi DA and Alausa AA. *World Journal of Agricultural Sciences* 2006; 2 (1): 115-118,
- [21] Deodhar UP, Paradkar AR, Purohit AP. *Drug Dev Ind Pharm* 1998; 24 (6): 577-582.
- [22] Verma PRP, Balkishen R. *Journal of Scientific and Industrial Research* 2007; 66: 550-557.
- [23] Gamal-Eldeen AM, Amer H, Helmy WA, Ragab HM, Talaat RM. *Indian J Pharm Sci* 2007; 69: 805-11.
- [24] Irene MV, Robert MTG, Rosette CG. *Phytotherapy Research* 1997; 11 (8): 615-617.
- [25] Ademola IO, Akanbi AI, Idowu SO. *Pharmaceutical Biology* 2005; 43(7): 599-604.

- [26] Syamsudin RS, Partomuan S. European Journal of Scientific Research 2010; 43 (3): 384-391.
- [27] Idowu SO, Adeyemo MA, Ogbonna UI. Journal of Biological Engineering 2009; 3: 14.
- [28] Hegarty MP, Schinckel PG, Court RD. Aust J Agric Res 1964; 15: 1 53-67.
- [29] Ter Meulen U, Struck S, Schulke E, El-Harith EA. Trop Anim Prod 1979; 4: 113-26.
- [30] Lee PK, Yang YF, Lee MC. J Agric Assoc China 1983; 01 (118): 62-71
- [31] DMello JPE and Taplin DE. World Review of Animal Production 1978; 24: 41-47.
- [32] Atawodi SE, Mari D, Atawodi JC and Yahaya Y. African Journal of Biotechnology, 2008; 7 (3): 317-321.
- [33] Ekpeyong TE. Nutr Rept Int 1986; 31(12): 345-350.
- [34] Wee KL, Shun-sen W. Aquaculture 1987; 62(2): 97-108.
- [35] Dutt, Dharm, Tyagi CH, Malik R S. Indian Journal of Chemical Technology 2007; 14: 626-634
- [36] Unrau AM. J Org Chem 1961; 26: 3097-101.
- [37] Morimoto JY, Unrau ICJ, Unrau AM. J Agric Food Chem 1962; 10: 134-7.
- [38] Raval DK, Patel RG, Patel VS. Starch 1988; 40: 214-8.
- [39] Shrivastava VS. International Journal of Chem Tech Research 2012; 4(3): 1038-1043
- [40] Gangwar KS, Sharma SK, Tomar OK. Indian Journal of Agronomy, 2004; 49(2): 84-88.
- [41] Mathuva MN, Rao MR, Smithson R. Field Crops Research 1998; 55: 57-72.
- [42] Abedin MZ, and Quddus MA. Household fuel availability and homegarden in selected locations of Bangladesh, FAO/Regional wood development program in Asia, Bangkok, Thailand, 1990, p-66.
- [43] Whitesell CD. *Leucaena leucocephala*, leucaena.. In: Schopmeyer CS, tech. coord. Seeds of woody plants in the United States. USDA Forest Service. Handbook. 450. Washington, DC: 1974
- [44] Felker P, Bandurski RS. J Sci Food Agric 1977; 28: 791-7.