

# Leucaena leucocephala as Protein Source

Subjects: **Biology**

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White leadtree or Leucaena (Leucaena leucocephala) (), also known as ipil-ipil, is native to Central America and has spread and/or naturalized all over the World at a latitude between 30° N and 30° S due to a shrub variety used as a shade tree for coffee, cocoa, hemp plantations, pepper, vanilla, and other essences.

animal nutrition

chemical composition

leadtree

Ipil-Ipil

Mediterranean areas

SWOT analysis

fodder

mimosine

anti-nutritional factors

## 1. Introduction

White leadtree or Leucaena ( Leucaena leucocephala ) ( **Figure 1** ), also known as ipil-ipil, is native to Central America and has spread and/or naturalized all over the World at a latitude between 30° N and 30° S due to a shrub variety used as a shade tree for coffee, cocoa, hemp plantations, pepper, vanilla, and other essences <sup>[1][2]</sup>.



**Figure 1.** *Leucaena leucocephala* (Lam.) de Wit: (A) leaves; (B) flowers and ripened fruits; (C) honey bee foraging on *Leucaena* flowers; (D) pod and seeds (pictures kindly provided by Dr. Dipasquale D).

The *Leucaena* genus includes only 24 native species (19 diploid and five tetraploid species) [3], even though several researchers [4][5][6] refer to about 50 species of shrubs and trees found in the tropical and subtropical regions of North and South America, Africa, and the South Pacific and more than 800 cultivars, grouped in three main types: (1) the common type, with small and shrubby varieties that grow up to 5 m in height; (2) the giant type, including varieties up to 20 m tall, with larger leaves, pods, and seeds, and a larger trunk poorly branched; and (3) the “Peru” type with medium-sized varieties that grow up to 10 m in height, with lots of branches from the bottom of the trunk, and producing abundant forage with frequent pruning [1]. Undoubtedly, the morphological and ecophysiological diversities within the genus combined with the high crossability among species provide ample opportunities for genetic improvement, via traditional breeding approaches and notably via interspecific artificial hybridization, to develop genetically improved seed lines [3].

Interspecific hybridization enables plant breeders to combine superior traits from different species to form the basis of populations for the further selection and genetic improvement. Hybridization programs have been undertaken to

develop new cultivars of *Leucaena* with the following characteristics: low mimosine forage, acid soil tolerance, psyllid resistance, cold tolerance, wood/biomass/pulp production, and sterility [7].

The optimal growth of *Leucaena* occurs in areas that receive an average annual precipitation of 1500 mm, with a dry season of 4 months [2] and with an average annual temperature between 25 and 30 °C [4]. It tolerates a wide variety of soil conditions [8], and the best growth occurs under direct sunlight in well-drained soils, from moderately alkaline (pH 7.5) to slightly acidic (pH 6.0), with a salinity less than 20 mmhos/cm [9].

## 2. SWOT Analysis

In the following sections, pros and cons of using the *Leucaena* as protein source are assessed by a detailed analysis of literature data on the topic according to a four-box analysis framework approach: strengths, weakness, opportunities, and threats, known as SWOT analysis [10], as already performed by the authors elsewhere [11][12].

Heifers fed with *L. leucocephala* incorporated into the ration from 20% to 80% DM had no effect on dry matter and organic matter intake and digestibility, but energy losses in the form of methane emission were reduced to 61% (with *Leucaena* forage included at 80% DM level), in comparison to the no-*Leucaena* diet, even though the energy losses in the urine increased linearly with the increased inclusion of *Leucaena* in the diet [13]. The optimum level of inclusion of *L. leucocephala* in cattle rations as a source of condensed tannins lies in the range of 20–40% of ration dry matter [13].

Using leaf meal as a supplement for broilers, a daily growth of 100–110 g per week can be determined; in addition, in quantities not exceeding 5% of the diet, leaf meal could be used with other xanthophyll sources to give a satisfactory color to the carcass [14]. Adult chickens fed with *Leucaena* leaf meal up to 7% of the diet showed an increase in the use of crude protein and metabolizable energy [15]. Dumorné [16] found positive effects on weight gain, body weight, and feed intake of laying hens with inclusion of *Leucaena* leaves meal from 6 up to 12 g/bird/day, in comparison with the control diet without *Leucaena*. Feeding broiler chicken with boiled *L. leucocephala* meal (10% of the diet) was recommended since it furnished high carcass and meat attributes of broiler chicken [17]. In research conducted on laying hens, a consistent increase in the yolk color, with inclusions equal to 16% of the diet [18], was found.

On growing pigs, the use of *Leucaena* leaves did not produce significant increases in average weight, but a 47% increase in food conversion [19]. Ekpenyong [20] claimed that it may be possible to use *Leucaena* leaf meal as a means of meeting the amino acid requirements of pigs fed in the tropics.

## 3. Conclusions

Among the vegetable sources, *L. leucocephala* seems to be suitable to fill the deficiencies of other sources, especially from a protein and amino acid point of view, representing, moreover, an economically sustainable nutritional source. Being highly productive and having a medium-high protein content, it can be used as feedstuff,

especially in those areas where the problem of finding alternative protein sources arises, such as the inland areas of the Mediterranean countries. *Leucaena* forage can be a valid food both for ruminants and for non-ruminants as well. Its limited use can be due to the presence of antinutritional factors, especially tannins and mimosine, but the research proved that these constraints can be overcome in several ways, not least the search of low anti-nutritional genotypes. *Leucaena* is also a plant worthy of interest for the reduction of methane production by ruminants when fed with *Leucaena* due to the presence of tannins.

Last but not least, the interest in *L. leucocephala* is linked to its versatility, which makes it a multipurpose plant that can provide several usage options: ornamental, fire break and windbreak, oil extraction and biofuel's production, sources of pharmacological compounds also for veterinary applications, and forage plant for honeybees and other pollinators.

## References

1. National Academy of Sciences. *Leucaena: Promising Forage and Tree Crop for the Tropics*, 2nd ed.; National Academy of Sciences: Washington, DC, USA, 1984; p. 100. Available online: <https://agris.fao.org/agris-search/search.do?recordID=XF2016073798> (accessed on 23 February 2021).
2. Van Den Beldt, R.J.; Brewbaker, J.L. *Leucaena Wood Production and Use*; Nitrogen Fixing Tree Association: Waimanalo, HI, USA, 1985; p. 50.
3. Abair, A.; Hughes, C.E.; Bailey, D. The evolutionary history of *Leucaena*: Recent research, new genomic resources and future directions. *Trop. Grassl.* 2019, 7, 65–73.
4. Allen, O.N.; Allen, E.K. *The Leguminosae: A Sourcebook of Characteristics, Uses and Nodulation*; University of Wisconsin Press: Madison, WI, USA, 1981; p. 812.
5. Brewbaker, J.L. *Giant Leucaena (Koa haole) Energy Tree Farm*; Hawaii Natural Energy Institute: Honolulu, HI, USA, 1980; p. 90.
6. Hutton, E.M.; Gray, S.G. Problems in adapting *Leucaena glauca* as a forage in the Australian tropics. *Emp. J. Experim. Agric.* 1959, 27, 187–196.
7. Dalzell, S.A. *Leucaena cultivars—current releases and future opportunities*. *Trop. Grass.* 2019, 7, 56–64.
8. National Academy of Sciences. *Firewood Crops: Shrub and Tree Species for Energy Production*; National Academy of Sciences: Washington, DC, USA, 1980; p. 237.
9. Tomar, O.S.; Gupta, R.K. Performance of some forest tree species in saline soils under shallow and saline watertable conditions. *Plant Soil.* 1985, 87, 329–335.

10. Leigh, D. SWOT Analysis. In *Handbook of Human Performance Technology. Principles, Practices, and Potential*; Pershing, J.A., Ed.; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2006; p. 1089.
11. Gasco, L.; Acuti, G.; Bani, P.; Dalle Zotte, A.; Danieli, P.P.; De Angelis, A.; Fortina, R.; Marino, R.; Parisi, G.; Piccolo, G.; et al. Insect and fish by-products as sustainable alternatives to conventional animal proteins in animal nutrition. *It. J. Anim. Sci.* 2020, 19, 360–372.
12. Parisi, G.; Tulli, F.; Fortina, R.; Marino, R.; Bani, P.; Dalle Zotte, A.; De Angelis, A.; Piccolo, G.; Pinotti, L.; Schiavone, A.; et al. Protein hunger of the feed sector: The alternatives offered by the plant world. *It. J. Anim. Sci.* 2020, 19, 1204–1225.
13. Piñeiro-Vázquez, A.T.; Jiménez-Ferrer, G.O.; Chay-Canul, A.J.; Casanova-Lugo, F.; Díaz-Echeverría, V.F.; Ayala-Burgos, A.J.; Solorio-Sánchez, F.J.; Aguilar-Pérez, C.F.; Ku-Vera, J.C. Intake, digestibility, nitrogen balance and energy utilization in heifers fed low-quality forage and *Leucaena leucocephala*. *Anim. Feed Sci. Tech.* 2017, 228, 194–201.
14. D'Mello, J.P.F.; Acamovic, T.; Walker, A.G. Evaluation of *Leucaena* leaf meal for broilers growth and pigmentation. *Trop. Agric.* 1987, 64, 33–35.
15. Aissiwe, S.B.; Dieng, A.; Chrysostome, C.; Hornick, J.L.; Missohou, A. Digestibility and metabolic utilization and nutritional value of *Leucaena leucocephala* (Lam.) leaves meal incorporated in diets of indigenous Senegal chickens. *Int. J. Poul. Sci.* 2010, 9, 767–776.
16. Dumorné, K. Effect of dietary inclusion of *Leucaena* (*Leucaena leucocephala*) and banana flour (*Musa cavendishii*) on performance of laying hens. *Rev. Bras. Cien. Avic.* 2018, 20, 725–730.
17. Apata, E.S.; Ogungbesan, A.M.; Abiola-Olagunju, O.; Ogundele, G.J. Studies on carcass and meat quality attributes of broiler chickens fed graded levels of detoxified *Leucaena leucocephala* (Lam.) de wit basal diet. *Trop. Agric.* 2018, 95, 257–264.
18. Ahmed, M.E.; Abdelatik, K.A. Effect of dietary levels of *Leucaena leucocephala* seeds on layers performance, egg quality and blood parameters. *Int. J. Poul. Sci.* 2009, 8, 475–479.
19. Muir, J.P.; Massaete, E.S.; Tsombe, H.N. Effect of *Leucaena leucocephala* and *Brassica napus* on growth of pigs fed wheat bran diets. *Liv. Res. Rural Dev.* 1992, 4, 49–54.
20. Ekpenyong, T.E. *Leucaena Leaf Meal. Non-Traditional Feeds for Use in Swine Production*; CRC Press: Boca Raton, FL, USA, 1990; pp. 225–235.

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