



# Proximate and Mineral Analysis of *Delonix regia* Leaves and Roots

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## Abstract

Medicinal plants serve as therapeutic agents as well as raw materials for the manufacture of modern medicines due to the presence of bioactive chemicals (phytochemicals) and nutrients (protein, carbohydrates, fats, amino acids etc.). Among the potential medicinal plants is *Delonix regia*, therefore this study was carried out to determine the proximate and mineral composition in the plant (leaf and root). The result on proximate analysis of *Delonix regia* Leaf (DRL) showed that it contained moisture (8.10%), dry matter (91.90%), crude protein (18.77%), crude fibre (9.85%), ether extract (1.33%), ash (5.21%), nitrogen free extract (56.74%), carbohydrates (78.54%) and energy (1703.5 kJ/100 g) while *Delonix regia* Root (DSR) contained moisture, dry matter, crude protein, crude fibre, ether extract, ash, nitrogen free extract, carbohydrates and energy at 9.60%, 90.40%, 10.63%, 7.44%, 2.71%, 9.30%, 60.32%, 90.18% and 1814 kJ/100 g respectively. Mineral analysis showed that DSR contained higher concentrations of calcium, phosphorus, potassium, zinc, magnesium, sodium, copper, iron and cobalt at 95.43 mg/100 g, 40.77 mg/100 g, 100.4 mg/100 g, 7.21 mg/100 g, 14.21 mg/100 g, 41.22 mg/100 g, 10.2 mg/100 g, 1.10 mg/100 g and 0.05 mg/100 g relative to calcium (77.31 mg/100 g), phosphorus (40.35 mg/100 g), potassium (51.60 mg/100 g), zinc (3.21 mg/100 g), magnesium (10.35 mg/100 g), sodium (33.18 mg/100 g), copper (7.35 mg/100 g) and iron (1.89 mg/100 g) established in DRL. It was concluded that DRL and DSR contain various nutrients and phytochemicals that produce definite physiological action on the body of animals.

**Keywords:** *Delonix regia*; Minerals; Phytochemicals; Proximate analysis

## Introduction

Medicinal plants contain phytochemical constituents which are used for the treatment of various human and livestock health disorders all over the world from ancient times to the present day [1,2]. WHO [3] reported that there are over 250,000 species of medicinal plants and more than 80% of people from developing countries rely on herbal medicines for better health. Medicinal plants have also been reported to be relatively cheap, efficient and safe [4]. Phytochemical constituents possess important pharmacological properties like antimicrobial, anti-inflammatory, antifungal, antiviral, antioxidant, anti-nociceptive, antithrombotic, hepatoprotective, antidiabetic, chemopreventive and cytotoxic effects [5-7].

*Delonix regia* is a leguminous plant belonging to the family *Caesalpinaceae*. It is found in mostly tropical countries like India, Pakistan, Afghanistan, Brazil, Mexico, China, Nigeria, Senegal, Ghana, South Africa, Cameroon, Togo, Congo, Sudan, Kenya, Tanzania, Rwanda and Madagascar [8]. The tree can grow up to a height of 9.1 to 18.0 meters with wide spreading umbrella like canopy, the leaves are characterized by long stalks with numerous flowers of about 12 mm long, pods are flat, woody, dark brown, 61 cm long and about 5.1 cm wide [9-12]. The plant is rich in phytochemicals such as: Saponins, alkaloids, carotene, hydrocarbons, phytotoxins, flavonoids, tannins, steroids, carotenoids, galactomannan, lupeol,  $\beta$ -sitosterol, terpenoids, glycosides and carbohydrates, essential minerals, fatty acids and amino acids in leaves, flowers, bark and roots [13,14]. Traditionally, the leaves and stem bark are used for the prevention and treatment of fever, constipation, inflammation, arthritis, hemiplegia, piles, boils, pyorrhea, scorpion bite, bronchitis, asthma and dysmenorrhoea [11,15,16].

In view of these abundant potentials, a study was carried out to examine the proximate and mineral analysis in *Delonix regia* leaf and roots.

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## Materials and Methods

### Site of experiment

The experiment was carried out at Sumitra Research Institute, Gujarat, India in the month of September to December, 2019.

### Plant collection and preparation

*Delonix regia* leaves and roots were collected from Sumitra Research Farm, Gujarat, India. It was identified and authenticated by a crop taxonomist (Singh. Ram), washed with clean running tap water to remove dirt's, cut differently into pieces and allowed to dry under shade to retain the bioactive chemicals in the samples. The dried samples were individually crushed into powder using a pulverizer and stored in a well labeled air tight container for further analysis. *Delonix regia* leaf, stem bark and root were abbreviated as DRL and DSR respectively.

## Measurements

### Proximate analysis

Crude fibre, crude protein, moisture, ether extract and moisture content were determined according with the official methods of the association of official analytical chemist [17] and all samples were evaluated in triplicates.

Dry Matter (DM) = 100 - moisture content

Energy value (KJ/100 g) was calculated using the equation below:

Energy = (37 × Ether extract) + (17 × carbohydrate) + (17 × crude protein)

% NFE = % DM - (% EE + % CP + % ash + % CF)

Where, NFE: Nitrogen Free Extract; EE: Ether Extract; CP: Crude Protein; CF: Crude Fiber

### Mineral analysis

Analysis of calcium, phosphorus, potassium, magnesium, zinc, sodium, copper, cobalt, selenium and iron were determined using Atomic Absorption Spectrophotometer (Model NF-123D, Punjab, India) according to Association of Official Analytical Chemist (AOAC, 1999).

### Statistical analysis

The analyses were done in triplicates and the data obtained were expressed as mean ± standard error of the means (mean ± S.E.M). The data were subjected to one way Analysis of Variance (ANOVA) and differences between samples were determined Duncan multiple range test (Duncan, 1955). Significant was declared if  $P \leq 0.05$ .

## Results and Discussion

### Proximate composition of DRL and DSR

Table 1 reveals the proximate composition of *Delonix Regia* Leaf (DRL) and root (DSR). DRL contained moisture, dry matter, crude protein, crude fibre, ether extract, ash, nitrogen free extract, carbohydrates and energy at 8.10%, 91.90%, 18.77%, 9.85%, 1.33%, 5.21%, 56.74%, 78.54% and 1703.5 (Kj/100 g) respectively. DSR contained dry matter (90.40%), moisture (9.60%), crude protein (10.63%), crude fibre (7.44%), ether extract (2.71%), nitrogen free extract (60.32%), ash (9.30%), carbohydrates (90.18%) and energy (1814.1 Kj/100 g). The moisture values obtained in DRL and DSR is higher than the values reported for *Daniellia oliveri* stem bark (6.25%), *Piliostigma thonngii* root (8.34%), *Urena lobata* leaf (7.21%),

**Table 1:** Proximate composition of DRL and DSR.

| Parameters        | DRL                       | DSR                       |
|-------------------|---------------------------|---------------------------|
| Moisture (%)      | 8.10 ± 0.01               | 9.60 ± 0.01               |
| Dry matter (%)    | 91.90 ± 2.56              | 90.40 ± 1.22              |
| Crude protein (%) | 18.77 ± 1.01              | 10.63 ± 0.03              |
| Crude fibre (%)   | 9.85 ± 0.05 <sup>a</sup>  | 7.44 ± 0.01 <sup>b</sup>  |
| Ether extract (%) | 1.33 ± 0.02               | 2.71 ± 0.00               |
| Ash (%)           | 5.21 ± 0.00 <sup>b</sup>  | 9.30 ± 0.01 <sup>a</sup>  |
| NFE (%)           | 56.74 ± 4.22              | 60.32 ± 4.08              |
| Carbohydrates (%) | 78.54 ± 2.11 <sup>b</sup> | 90.18 ± 2.56 <sup>a</sup> |
| Energy (Kj/100 g) | 1703.5 ± 43.08            | 1814.1 ± 35.61            |

Values expressed as mean ± SEM (n=3)

Means in the same row with different superscripts differ significantly ( $P < 0.05$ )

**Table 2:** Mineral composition of DRL and DSR.

| Parameters | DRL (mg/100 g)             | DSR (mg/100 g)            |
|------------|----------------------------|---------------------------|
| Calcium    | 77.31 ± 0.01               | 95.43 ± 0.00              |
| Phosphorus | 40.35 ± 0.00               | 40.77 ± 0.02              |
| Potassium  | 51.60 ± 0.02 <sup>b</sup>  | 100.4 ± 0.03 <sup>a</sup> |
| Zinc       | 3.21 ± 0.00 <sup>b</sup>   | 7.21 ± 0.00 <sup>a</sup>  |
| Magnesium  | 10.35 ± 0.00               | 14.21 ± 0.01              |
| Sodium     | 33.18 ± 0.03 <sup>ab</sup> | 41.22 ± 0.02 <sup>a</sup> |
| Copper     | 7.35 ± 0.08                | 10.2 ± 0.05               |
| Iron       | 1.89 ± 0.00                | 1.10 ± 0.00               |
| Cobalt     | 0.07 ± 0.00                | 0.05 ± 0.00               |
| Selenium   | 0.09 ± 0.00                | 0.04 ± 0.00               |

Values expressed as mean ± SEM (n=3)

Means in the same row with different superscripts differ significantly ( $P < 0.05$ )

*Carpolobia lutea* leaf (8.84%) but lower than those recorded for *Centella asiatica* (9.96%), *Carpolobia lutea* root (9.55%), *Eugenia caryophyllata* (4.55%) and *Sida cuta* leaves (54.82 %). Low moisture content in a sample improves the shelf life of a sample [18]. The crude protein value of DRL (18.77%) obtained in this study is contrary to the findings of [19], this could be attributed to differences in species, age of plant, method of processing as well as geographical location [20]. Also reported a crude protein value of 12.81% in *Balanites aegyptiaca* root. DRL and DSR Crude Protein (CP) values were lower than the values of *Veronia amygdalina* leaf (30.02%) and *Indigofera tinctoria* leaf (30.53%) reported by [21,22]. The low CP values in DRL and DSR is an indication that the sample cannot be used as a protein supplement in animal feed (NRC, 1994). Crude fibre values reported in this experiment is comparable to those recorded for *Physostigma venenosum* leaves (7.91%) and *Sida acuta* leaves (8.04%) by [23]. Fibre in feed enhances digestion and lowers serum cholesterol level in animals [24,25]. The result showed that DSR contains 9.30% ash compared to DRL with 5.21%, this signifies that DSR contained more minerals [26,27]. According to [28] carbohydrates are responsible in energy provision for metabolism of living organisms and it's produced by plants during photosynthesis. Low level of carbohydrates in diets of animals could lead to hypoglycemia. Fats play a vital role in energy production, aids in structural functioning of cells, transportation of essential vitamins and improves palatability of feeds [29]. Energy value reported in DRL and DSR was higher than the values obtained for *Jatropha curcas* leaf and root (1514.77 kj/100 g) and (602.93 kj/100 g) reported by [30].

## Mineral analysis of DRL and DSR

Mineral composition of DRL and DSR is presented in Table 2. DRL contained calcium (77.31 mg/100 g), phosphorus (40.35 mg/100 g), potassium (51.60 mg/100 g), zinc (3.21 mg/100 g), magnesium (10.35 mg/100 g), sodium (33.18 mg/100 g), copper (7.35 mg/100 g), iron (1.89 mg/100 g), cobalt (0.07 mg/100 g) and selenium (0.09 mg/100 g). *Delonix regia* root (DSR) contained calcium, phosphorus, potassium, zinc, magnesium, sodium, copper, iron, cobalt and selenium at 95.43 mg/100 g, 40.77 mg/100 g, 100.4 mg/100 g, 7.21 mg/100 g, 14.21 mg/100 g, 41.22 mg/100 g, 10.2 mg/100 g, 1.10 mg/100 g, 0.05 mg/100 g and 0.04 mg/100 g. The mineral composition in this study revealed that DSR contained a higher concentration compared to DRL. However, all values were within the World Health Organization guidelines [31]. Calcium value in DRL and DSR higher lower than values reported for *Culcasia scandens* leaf (10.80 mg/100 g), *Albizia lebbek* leaf (16.0 mg/100 g) reported by [32,33]. Calcium provides animal's bone with rigidity and support [34], deficiency of calcium causes tetany. Copper is a powerful pro-oxidant and catalyzes the oxidation of unsaturated fats and oils as well as ascorbic acid. Potassium assists in the regulation of electrolyte, water and acid base in the body and muscle function [35]. Iron is responsible for haemoglobin formation, regulation of the central nervous system and oxidation of protein, fats and carbohydrates. Phosphorus is an essential component of phospholipids, nucleic acids, phosphoproteins (casein), high energy phosphate esters (ATP), hexose phosphates, creatine phosphate, and several key enzymes [36,37]. Zinc is an active component or cofactor for many important enzyme systems zinc plays a vital role in lipid, protein, and carbohydrate metabolism; being particularly active in the synthesis and metabolism of nucleic acids (RNA) and proteins [38]. Magnesium is a key in enzyme activation, magnesium (like calcium) stimulates muscle and nerve irritability (contraction), is involved in the regulation of intracellular acid-base balance, and plays an important role in carbohydrate, protein and lipid metabolism [39]. It has also been suggested that selenium participates in the biosynthesis of ubiquinone (Coenzyme Q; involved in cellular electron transport) and influences the absorption and retention of vitamin E [40]. Sodium plays a fundamental role in the regulation of plasma volume, acid-base balance, nerve action and muscle contraction [41,42]. Cobalt is an integral component of cyanocobalamin (vitamin B12), and as such is essential for red blood cell formation and the maintenance of nerve tissue [43].

## Conclusion

The study was a scientific validation that *Delonix regia* contains essential minerals, nutrients and some chemical substances that produce definite physiological action on the body of human and animals. Medicinal plants are safe, cheap and effective and are could also be used in future to bridge the gap between food safety and production in livestock.

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