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Assessment of nutritional and phytochemical properties of *Sesbania grandiflora* flower and leaves

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Abstract

Sesbania grandiflora is a multipurpose tree with edible flowers and leaves has unique medicinal properties and used as a herbal drug for its antibiotic, anthelmintic and anti-tumor properties. In view of the medicinal and therapeutic importance the nutritional and phytochemical properties of *S. grandiflora* flower and leaves was analysed. In present investigation efforts have made to analyse morphological, nutritional, minerals, vitamins and phytochemical content such as the total polyphenol, total flavonoid, total carotenoid. The nutritional analysis revealed that *S. grandiflora* flower contain good amount of protein (1.18%), carbohydrate (5.75%), ash (1.10%), fiber (1.60%) and also high level of calcium (62mg), potassium (180mg), iron (0.80mg), phosphorus(28mg), magnesium (22mg), zinc (0.30mg) and selenium (20.40 µg) per100g. The leaves are rich in protein (8.25%), carbohydrate (6.30%), ash (3.15%), fiber (2.90%) and also adequate source of calcium (702 mg), potassium (574mg), iron (2.45mg), phosphorus (48.30mg), magnesium (80.56 mg), zinc (0.44 mg) and selenium (30µg) per100g. The flower and leaves was good source of vitamin A, contain 89µg RE and 65 µg RE respectively. The considerable amount of vitamin B₉ in flower 80 µg and leaves 105 µg per 100g was observed. The phytochemical analysis demonstrated that flower contain higher amount of total phenolic (105 mg/100g), total flavonoid (32.25 mg/100g), total carotenoid (420 µg /100g), The leaves contain little but less total phenolic (81.20 mg/100g), total flavonoid (13.42 mg /100g) but more carotenoid (3120 µg /100g) than flower. It can be concluded from present investigation that as *Sesbania grandiflora* is appreciable source of many vital nutrients and phytochemicals could be utilised in development of value added products for enriching human diet.

Keywords: *Sesbania grandiflora*, medicinal properties, morphological, nutritional phytochemical

1. Introduction

Plants have been one of the important sources of medicines since the beginning of human civilization. There is a growing demand for plant based medicines, health products, pharmaceuticals, food supplements and cosmetics. *Sesbania grandiflora* is a multipurpose tree with edible flowers and is a source of one of the medicinal products. *S. grandiflora* has unique medicinal properties and used as a herbal drug for its antibiotic, anthelmintic and anti-tumor properties (Neethu S. Kumar and Dhanyaraj F.S., 2016) [19].

Edible flowers are rich in a great variety of natural antioxidants including flavonoids, and many other phenolic compounds (Youwei Z., 2008) [27]. Some specific health benefits of flowers are that they nearly calorie free, source of anti-oxidants, some edible flowers are anti-inflammatory. Edible flowers exerted potent activities against cancers of the liver, bladder, prostate, breast, and colon. (Gupta Y. C. 2018) [11]. Epidemiological data have shown that a diet rich in antioxidants could prevent chronic diseases such as type 2 diabetes, cancer, and cardiovascular and neurodegenerative disorders (Willcox, J., 2004) [25].

Sesbania grandiflora is plant cultivated in all over India for its edible flowers. It has synonym *Agati grandiflora* and commonly known as Hummingbird Tree, Butterfly Tree. It is small ornamental tree with a straight trunk produces white flowers like little birds. Bark, leaves, gums, and flowers have medicinal potential. Dried bark powder is used in cosmetics (Dethe U. L. et al., 2014) [8]. It is also cultivated in south or west India in the ganga valley and in Bengal. The plant contains rich in tanins, flavonoides, coumarins, steroids and triterpens. The plant used in colic disorder, jaundice, poisoning condition, small-pox, eruptive fever, epilepsy etc. (Suresh Kashyap and Sanjay Mishra, 2012) [24].

As one of the rare trees where flowers and leaves can be eaten as vegetables, the nutrients of *Sesbania* leaves and pods are easily absorbed and no allergy has been reported. (Noviany Hasan et al. 2012) [20].

According previous studies of *S. grandiflora* exhibited the antioxidant activity and antiurolithiatic activity (Doddola *et al.*, 2008) [9], anticancer and chemo preventive activity (Laladhas *et al.* 2009) [16].

The earlier research on *S. grandiflora* was done with respect to pharmacology study and very little data on processing was available. In view of the medicinal and therapeutic importance the nutritional and phytochemical properties of *S. grandiflora* flower and leaves was analysed. In present investigation efforts have made to analyse morphological, nutritional quality such as proximate, minerals and vitamin content of it. Also flower and leaves evaluated for their phytochemical content such as the total polyphenol, total flavonoid, total carotenoid. The results of this study would be helpful for further research work on processing and value addition of *S. grandiflora* flowers and leaves.

2. Material and Method

2.1 Material

The raw material required for present investigation such as *Sesbania grandiflora* leaves and flower will be procured from local market of Parbhani, Maharashtra. The other ingredients such as wheat flour, spices and additives etc. were also procured from the local market of Parbhani.

2.2 Methods

2.2.1 Morphological properties of *Sesbania grandiflora* flower and leaves

The Morphological character of *Sesbania grandiflora* flower and leaves such as weight, length, width, colour, per cent edible index and waste index was determined. The weight of 10 flowers, calyx and petals was taken individually on an electronic weighing balance. Then average weight of flowers, calyx and petals was calculated and expressed in grams. Similarly the weight of 10 leaves, leaflet and twig was taken and average was calculated and expressed in grams. Physical properties such as length and width were determined in centimeter with the help of a vernier caliper. According to established standards and procedure (Oriola and Raji, 2013) [21]. Length and breadth of ten (10) specimens of flower were measured with the use of a (0.01 mm precision) vernier caliper (Mitutoyo, digital calliper, mm). Similarly the length and breadth of 10 leaves, leaflet was measured and average

expressed in centimetres. The per cent edible index was determined as a ratio of edible part of flower / leaves to total weight of flower / leaves multiplied by 100. The per cent waste index was determined using formula ie waste part of flower / leaves to the total weight of flower /leaves multiplied by 100 and expressed in percentage.

2.2.2 Proximate, mineral and vitamin analysis

Sesbania grandiflora leaves and flower was analysed for proximate composition including moisture, fat, protein, total carbohydrate, crude fiber, ash, vitamin and mineral content. The moisture, fat, protein, carbohydrate, ash was estimated by method of AOAC (2005) [4] and fiber was determined by AACC (2000) [1]. The minerals such as calcium, potassium, phosphorus, magnesium, iron and selenium content of *Sesbania grandiflora* was evaluated by method described in AOAC (2016) [5]. Also vitamin A, C and B₉ (folic acid) were determined. Vitamin A and C content was estimated as per the method given by Ranganna (2010) [23]. Whereas vitamin B₉ (Folic acid) is extracted from the sample using pcreatin and L-ascorbic acid and quantified by reversed-phase liquid chromatography (RP-HPLC) with UV detection (Mahato A *et al.*, 2020) [17].

2.2.3 Phytochemical analysis

Phytochemical content of *Sesbania grandiflora* flower and leaf such as the total polyphenol, total flavonoid, total carotenoid was analysed. Total polyphenol content and total flavonoid content was determined according to method of Pinelo *et al.*, (2005) [22] and Kale, A *et al.* (2010) [13]. Total carotenoid was determined using method of AOAC (2000) [3].

3. Results and Discussion

3.1 Morphological characteristics of *Sesbania grandiflora* flower and leaves

The results pertaining to morphological characteristics of *Sesbania grandiflora* flower and leaves are presented in Table 1. Morphological characteristics are of prime importance as it defines feasibility of raw material for processing. The properties such as length, breadth, weight, edible index and waste index of *Sesbania grandiflora* flower and leaves was determined.

Table 1: Morphological characteristics of *Sesbania grandiflora* flowers and leaves

Parameter	Observation for flower	Parameter	Observation for leaves
Length of flower (cm)	7.5	Length of leaflet (cm)	28
Width of flower (cm)	3.0	Width of leaflet (cm)	4
Weight of flower (g)	7.684	Weight of one leaflet (g)	3.11
Weight of calyx (g)	2.764	Weight of only leaves of leaflet (g)	2.37
Weight of petals (g)	4.884	Weight of twig(waste) (g)	0.714
Edible index (%)	64.629	Edible index (%)	77.086
Waste index (%)	35.970	Waste index (%)	22.913
Colour	Yellowish white	Colour	green

The length of *Sesbania grandiflora* flower is 7.5 cm and width 3 cm. The length of *Sesbania grandiflora* leaves is 28 cm and width 4 cm. The weight of flower, calyx and petals was 7.684, 2.764 and 4.884 respectively. The weight of one leaflet, Weight of only leaves of leaflet and twig was 3.11, 2.37 and 0.714 g respectively. The colour of flower was yellowish white and leaves of green colour. The similar

results were obtained with with respect to morphological characteristics of *Sesbania grandiflora* flower and leaves. (Karmakar *et al.*, 2016) [19]. The edible index of flower was 64.629 and leaves 77.086 percent. The waste index of flower was 35.970 and of leaves 22.913 percent. It shows that leaves had higher edible index and less waste index than flower which will effect on final yield of powder.

3.2 Proximate composition of fresh *Sesbania grandiflora* flower and leaves

Proximate composition approximates nutrients present in the raw material and can be used to estimate the nutritional quality of food products for which they will be used. Moreover, some components correlate with functional properties. Protein content, for example, influences the baking properties of flours. In addition, moisture and crude fat content are determinants of storage stability of the flours; high amounts lead to microbial growth and rancidity, respectively. The data presented in Table No. 6 revealed that, the *Sesbania grandiflora* flower contain moisture (90.20%), protein (1.18%), fat (0.10%), carbohydrate (5.75%), ash (1.10%) and fiber (1.60%). Moisture in food determines the rate of food absorption and the keeping quality of food. The presence of high moisture (90.20%) in flower make them available for microbial growth and development resulting in spoilage, hence shelf life of this get reduced. Drying of commodity results in decreasing moisture content to large extent thereby making them unavailable for microbial growth and hence shelf life of dried products is get increased.

The results of proximate analysis revealed that the *Sesbania grandiflora* flower are an good source of nutrition and natural energy for human around the world who lack in many nutritional supplements. The carbohydrate content is very valuable as a main source of energy for human body. The *Sesbania grandiflora* flowers was rich in carbohydrates and has great calorific value that can contribute to the caloric requirements of the body. Carbohydrates are an essential part of a healthy diet and should make up 50% of our daily calorie intake. Ash in food determines largely the extent of mineral matters likely to be found in food substance, the reported value of ash (1.10%) indicated that *Sesbania grandiflora* flower are a good source of minerals. It was also a good source of fiber (1.60%) that might be taken as a part of diet to clean the digestive tract by removing potential carcinogens from the body and hence prevents the absorption of excess cholesterol. The similar results mentioned by Duke (1983)^[10] for proximate composition of *Sesbania grandiflora* flower.

The data presented in Table 2 revealed that, the *Sesbania grandiflora* leaves contain moisture (76.8%), protein (8.25%), fat (1.25%), carbohydrate (6.30%), ash (3.15%) and fiber (2.90%). Moisture in leaves was less compared to flower, which helps drying process required. The proximate analysis of *Sesbania grandiflora* leaves revealed that the leaves are an excellent source of nutrition with special reference to protein and natural energy for human diet. It is however important to stress that high protein content emphasis on its nutritional potential that could find application in food ingredient, infant formula, food supplement and food formulation. The leaves contain a low fat content (1.25%) which is desirable. Ash content is an indication of the level of minerals present in food material. The results indicate that the leaves have high deposits of mineral elements, this suggests that leaves can help in boosting the mineral content of prepared value added product from it. The fiber content of leaves also good which is beneficial in human diet. Findings of present investigation with slight difference in conformity with the values reported in earlier literature of Gopalan c. et al. (2007)^[12].

Table 2: Proximate composition of fresh *Sesbania grandiflora* flower and leaves

Parameter	Flower	leaves
Moisture (%)	90.20	76.8
Protein (%)	1.18	8.25
Carbohydrate (%)	5.75	6.30
Fat (%)	0.10	1.25
Ash (%)	1.10	3.15
Fiber (%)	1.60	2.90

3.3 Mineral content of *Sesbania grandiflora* flower and leaves

The *Sesbania grandiflora* flower and leaves mineral concentrations might become one of the important sources of essential elements for human body. Mineral contents of *Sesbania grandiflora* flower and leaves revealed that they were rich source of many vital nutrients (Table 3). *Sesbania grandiflora* flower contained a high level of calcium (62mg), potassium (180mg), iron (0.80mg), phosphorus(28mg), magnesium (22mg), zinc (0.30mg)and selenium (20.40 µg) per100g. *Sesbania grandiflora* leaves was also rich source of calcium (702 mg), potassium (574mg), iron (2.45mg), phosphorus (48.30mg), magnesium (80.56 mg), zinc (0.44 mg) and selenium (30µg) per100g. Leaves was very good source of calcium that very useful for bones and teeth development. Calcium is also needed for normal blood clotting and proper nervous function. The high potassium in both flower and leaves helps to control body weight and improve water and electrolyte balance in the blood and tissues also works to lowering the blood pressure. The adequate level of iron in flower (0.80mg) and leaves (2.45mg) was very important element as a nucleus of hemoglobin that forms red blood cells in the body.

Iron functions as a oxygen transport with haemoglobin in blood stream an one of the main constituent of succinate dehydrogenase as well as a part of the heme of haemoglobin (Hb), myoglobin and the cytochromes (Chandra, 1990)^[6]. The Phosphorus helps in bone formation, energy metabolism and metabolism of nucleic acid (Murray et al., 2003)^[18]. Magnesium level in leaves was (80.56 mg/100g) that is extremely vital to health by stimulating gastric motility and intestinal function, a considerable content of phosphorus is an important to serve as the main regulator of energy metabolism in cells. Zinc can support the immune system and useful for normal growth and development during pregnancy. These obtained results for mineral content of *Sesbania grandiflora* flower and leaves are in accordance with the results of Gopalan c. et al. (2007)^[12] and Duke (1983)^[10] respectively.

Table 3: Mineral content of fresh *Sesbania grandiflora* flower and leaves

Mineral	Flower	Leaves
Calcium (mg/100g)	62	702
Potassium (mg/100g)	180	574
Iron (mg/100g)	0.80	2.45
Phosphorus (mg/100g)	28	48.30
Magnesium (mg/100g)	22	80.56
Zinc (mg/100g)	0.30	0.44
Selenium (µg /100g)	20.40	30

3.4 Vitamin content of fresh *Sesbania grandiflora* flower and leaves

Sesbania grandiflora flower and leaves contained a reasonable concentrations of both fat soluble vitamin A and water soluble vitamins such a Vitamin B₉ (Folic acid) and Vitamin C (Table 4). These vitamins could play an important role in improving human health. *Sesbania grandiflora* flower and leaves was rich source of vitamin A contain 89µg RE and 65 µg RE respectively. Vitamin A is a natural antioxidant to inhibit free radicals, very important for improving the immune system, vision, inflammatory systems, cell growth and development (W H Foods, 2017) [26]. They were good source vitamin C, the flower contain 60 mg and leaves 140 mg vitamin C. It is very important for cardiovascular health and reducing free radicals in the cells which increases iron absorption in the body.

The flower and leaves contain considerable amount of vitamin B₉(folic acid). The leaves had (105 µg/100g) maximum vitamin B₉ than flower (80 µg/100g). Folic acid is important for production of red blood cells and its deficiency along with deficiency of copper, iron, vitamin B₆ and vitamin B₁₂ can spoil the production of red blood cells. Well-known role of folic acid is to support the brain health. Messengers molecules are produced which are used by nerves to send the signals in whole body. Folic acid support the cardiovascular system and nervous system in human (Crider *et al.*, 2011) [7]. The data in Table 4 indicated that *Sesbania grandiflora* flower and leaves had good source of some vital vitamin in human diet.

Table 4: Vitamins content of fresh *Sesbania grandiflora* flower and leaves

Vitamins	Flower	Leaves
Vitamin A(µg RE/100g)	89	65
Vitamin C (mg/100g)	60	140
Vitamin B ₉ (µg/100g)	80	105

3.5 Phytochemical content of fresh *Sesbania grandiflora* flower and leaves

The finding on phytochemical content of fresh *Sesbania grandiflora* flower and leaves depicted Table 5. Phenolic compounds and flavonoids are very important constituents that have antioxidant activity by scavenging free radicals and occurred in several kinds of plants. In the scientific and medical communities, antioxidants are considered to have the ability to scavenge free radicals and reduce oxidative damage. L. Yu *et al.* (2002) [15]. Epidemiological data have shown that a diet rich in antioxidants could prevent chronic diseases such as type 2 diabetes, cancer, and cardiovascular and neurodegenerative disorders. During metabolism reactive oxygen species (ROS) and other free radicals are generated. These radicals are normally inactivated by endogenous antioxidant system. However, in particular conditions such as consequences of lifestyle or pathological situations, these free radicals can accumulate, generating oxidative stress (Willcox, J. K., 2004) [25]. The total phenolic content determination revealed that the *Sesbania grandiflora* flower contain higher amount of total phenolic 105 mg/100g and total flavonoid 32.25 mg/100g. The leaves contain little beat less total phenolic 81.20 and total flavonoid 13.42 mg /100g than flower. It revealed from data that the amount of total carotenoids in leaves (3120 µg/100g) was higher than and flower (420 µg /100g). Carotenoids have been found to play an important role in the human body, e.g., α- and β-carotene

have a primary function in the biosynthesis of vitamin A, an essential factor in visual functions, embryo and fetus development. Therefore, carotenoids should be included in the human diet to promote health. (Zile M. H. 1998) [28]. The phenolic compounds, flavonoids and antioxidants might be involved in human body protection against free radicals causing the damage to the body over time. These results confirmed that *Sesbania grandiflora* flower and leaves might be a potent source of natural antioxidants with a high human health benefits.

Table 5: Phytochemical content of fresh *Sesbania grandiflora* flower and leaves

Phytochemical	Flower	Leaves
Total phenolics (mg/100g)	105	81.20
Total flavonoids (mg/100g)	32.25	13.42
Total carotenoids (µg /100g)	420	3120

4. Conclusion

It can concluded from present investigation that *Sesbania grandiflora* flower and leaves have immense nutritional value attributes that rich in nutrients such as proteins, ash, fiber, vitamins, minerals, and phytochemicals. So, the flowers and leaves could be utilised in development of value added products for enriching human diet.

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