Research Article

Proximate and Mineral Composition of Leaf, Stem, Flower and Seed of *Cassia sophera* Linn.

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ABSTRACT

Cassia sophera Linn is an important medicinal plant. The whole part of the plant used as traditional folk medicine and has reported to possess analgesic, anticonvulsant, antioxidant, anti-inflammatory, hepatoprotective and antiasthmatic activity due to its chemical constituents. During present study, various parts (leaf, stem, flower, seed) of *Cassia sophera* used to investigate their proximate and mineral composition. Standard protocol were used for the proximate analysis and the quantitative analysis. Atomic absorption spectrophotometer was used for quantitative analysis of various elements. From proximate analysis, leaf part showed high crude fiber and ash content than the other parts. Total 13 important elements were analyzed from different parts of the plant indicated that the plant is enriched in some micro and macro nutrients like Fe, Ca, Na, K, Zn, which are very important for biological metabolic system as well as human health. Among the elements, Na, Fe, Al, Cu and Ni concentration was found higher in flower part than other parts. Whereas, leaf part showed high concentration of K, Ca, Mg, Zn, Pb and Mn than the rest parts.

Keywords: *Cassia sophera* (*C.sophera*) Proximate analysis, Atomic Absorption Spectrophotometer, mineral compositions.

INTRODUCTION

Plant plays a key role in world health as they are important source of medicines.[1] Almost all cultures from ancient times to today plants have been used as medicine. Approximately 85% of traditional preparations involve the uses of plants or plant extracts.[2,3] Herbal remedies are gaining their revival as many sufferers shifting from modern drugs and embracing complementary medicine. Most clinical useful prescription drugs are of plant origin world wide[4]. In Bangladesh nature has bestowed on us a very rich botanical wealth and a large number of diverse types of plants grown in different parts of the country [5]. There has been a gradual revival of interest in the uses of medicinal plants in developing countries because herbal medicines have been reported safe and without any adverse side effect especially when compared with synthetic drugs, in recent years. Thus a search for new drugs with better and cheaper substitutes from plant origin are a nature choice[6].

C. sophera is one of the important medicinal plants in tropical and subtropical region in Asia especially in India, Sri Lanka, Pakistan, Malaysia, Myanmar and in Bangladesh belongs to the family of Caesalpiniaceae. It grows abundantly in the plain land, hilly areas of Chittagong Hill Tracks, Sylhet and patches throughout Bangladesh[7]. In Ayrveda and Unani [8,9,10], it has number of traditional and medicinal uses. *C. sophera* described in unani literature to be repulsive of morbid humors, resolvent, blood purifier, carminative, purgative, digestive, diaphoretic and reported to be useful in epilepsy, ascites, dyscrasia of liver, skin disorders, piles, jaundice, fever, articylar pain and palpitation. In ethanobotanical literature this plant is mentioned to be effective of pityriasis, psoriasis, asthma, acute bronchitis, cough, diabetes and convulsions of children[11]. Although in traditional medicine for the treatment of skin diseases [12] *C. sophera* have been well known for their laxative and purgative properties, there is now an increasing body of scientific evidence demonstrating that the plants possess many other beneficial properties [13]. The bark, leaves and seeds are used as a cathartic and juice of the leaves is specific for ring-worm, especially when made into plaster in combination with sandal-wood. The root is administrated internally with black pepper for snake bite [14]. The essence of dried *C. sophera* with same amount of mint into water used to cure apositia [15]. The flowers of this important medicinal plant is prescribed as a tonic, astringent, febrifuge and strong purgative and useful in fever, heart diseases, joint pain, migraine and blood dysentery [16]. The seeds of this plant are used as a traditional medicine in Japan, Korea and China for the treatment of eye in Aammation, phytophobia and lacrimination, dysentery, headache as well as dizziness [17,18]. The plant *C. sophera* revealed the presence of ascorbic acid, dehydroascorbic acid, ß-sitosterol, glycosides and a rich source of flavanoids and anthraquinones [11].

Depending on the number of traditional and medicinal uses of this important medicinal plant *C. sophera* creates sufficient interest to carry out research on proximate analysis and mineral compositions of the different parts of the plant, since no work has been reported about proximate analysis and mineral compositions of leaf, stem, flower and seed part of the plant so far. The purpose of this investigation is therefore to determine the proximate analysis and to estimate the mineral composition on leaf, stem, flower and seed part of the plant, *C. sophera* to justify its uses in traditional and ayurvedic medicinal system.

MATERIALS AND METHODS

Collection of plant material

From Sylhet, Bangladesh fully matured fresh leaves, stems, flowers and seeds of *C. sophera* were collected from in the month of June 2015 and identified by the taxonomist of Bangladesh national Herbarium, Dhaka where a voucher specimen number (No.43734) has been deposited. Different parts of the plant, leaves, stems, flowers and seeds were separately air dried. These dried samples of leaves, stems, flowers and seeds were powdered using a grinder and then used for subsequent analysis.

Proximate analysis

Standard protocols were used for proximate analysis of various parts of the plant *C. sophera* (leaf, stem, flower and seed).The proximate analysis including moisture, organic matter, ash, acid insoluble ash, water soluble ash, crude fibre, carbohydrate, food energy were determined by the method as described in " A manual of Laboratory Techniques."

Mineral Compositions

Chemicals

Chemical used here for the digestion of plant samples such as Nitric acid (69%, Merck India) and Percholoric acid (70%, Merck India). For standard calibration of respective elements Na, K, Ca, Mg, Cr, Fe, Zn, Al, Ni, Cd, Mn standard solution (100mg/ml) were purchased from Hach (Germany). The respective desired standard from the stock solution were prepared using double distilled water.

Ashing and digestion of plant parts

Plant samples were taken separately in a porcelain crucible and heated to about 650̊C and cooled and was weighed. In each case 2.0g of sample was used. The crucible was placed in the Bunsen burner (at low flow rate gas) until the smoke ceased. Then it is placed in a muffle furnace at 525̊C for about 8-10 hours to get carbon free white ash. It was then cooled in desiccators and weighed. This procedure was repeated till the color of the ash was changed to almost white as well as constant weight was obtained . About 1.0g ash sample for leaves, stems, flowers and seeds were taken separately in 50 ml volumetric flask and then 15ml 1M HNO_3 acid was added. Then the flask was placed on magnetic stirrer heater in fume hood for four hours at 250̊C.When the color of the solution was changed to milky solutions, it was cooled for 10 minutes and then 7.5ml concentrated perchloric acid ($HClO_4$) was added. Then it was heated until colorless solution was obtained. The sample was filtered through 0.45 micron filter paper. The pH of the sample for all cases was maintained and verified to be less than 2.0 prior to analysis. The standard working solution of interest was prepared to make the standard calibration curve. Absorption for a sample solution used the calibration curve to determine the concentration of particular element in that sample.

Analytical procedure

Among all elements only Sodium (Na) and Potassium (K) were estimated by using flame photometer (Model AnA-135, OSK, Japan). Most of the elements like Calcium, Magnesium, Chromium [19], Iron(Fe), Zinc (Zn), Aluminum (Al),Copper (20), Nickel (Ni), Lead (Pb), Cadmium (Cd) and Manganese [20] in leaves and seeds were analyzed by using Atomic Absorption Spectrophotometer (Varian, AA 240FS, Australia) which was equipped with flame and graphite furnace. For the experiment, air acetylene flame mode were used. The condition fixed with acetylene 1.8 l/min and air 15 l/min, argon gas flow for inert atmosphere. The instrumental default temperature parameters were automatically fixed for each element analysis.

RESULTS AND DISCUSSION

Proximate composition of leaves, stems, flowers and seeds of *C. sophera* were recorded and the results are presented in Table 1.

The leaves of *C. sophera* have high crude fiber (28.44%) and high ash content (10.96%) than stems, flowers and seeds. The present result found that in the case of leaves enrich with high mineral content due to its high ash content. The moisture content in all the parts of the plant (leaves, stems, flowers and seeds) was determined on the fresh weight basis whereas the organic content was calculated on the dry weight basis. Acid insoluble ash is an indication of silicate impurity and water soluble ash indicates the content of soluble minerals[21]. In both cases leaves of the plant showed the higher values than stems, flowers and seeds. Also in the current studies, the amount of acid insoluble ash was found low compare to water soluble ash in all cases.

In plants crude fiber refers the presence of indigestible carbohydrate component. Also fiber is characterized by low or no nutritional value but because of its effect on the digestive system, it is thought to help with such problems in diabetes and high levels of blood cholesterol [22]. In the present study the crude fiber content for leaves (28.44%) and for seeds (25.17%) showed good values.

Plants require energy in chemical form so they can grow and carry out basic life functions like all living organisms. Plants produce, store and burn carbohydrates in the form of sugar to provide themselves with energy [23]. The present study showed the presence of carbohydrate content in the case of leaves is 32.47% and in the case of flowers is 40.82%. The Table 1 also presented the food energy in the case of leaves and seeds of this plant are 290.23 cal/g and 320.08 cal/g, respectively.

A total of 13 elements i.e. Na, K, Ca, Mg, Cr, Fe, Zn, Al, Cu, Pb, Cd, Mn and Ni were analyzed from leaves, stems, flowers and seeds of *C. sophera* by AAS which are accountable for curing various diseases. The result of the analyses is presented in the Table 2 and Figure 1 & 2 respectively. It may be noted each result is an average of at least three independent measurements. For the formation of secondary metabolites which are responsible for pharmacological actions these elements play a vital role, present in different parts of the plant.

Table 1: Proximate composition leaves, stems, flowers and seeds of *C. sophera*

Test parameters	Leaves	Stems	Flowers	Seeds
	Percent (%) Composition			
Moisture	11.876 ±0.23	11.17±0.22	14.5	9.46±0.02
Organic matter	89.04±0.23	89.86±0.20	91.22±0.23	94.56±0.20
Ash	10.96±0.10	10.14±0.10	8.78±0.10	5.44±0.30
Acid Insoluble ash	4.56±0.02	2.34±0.05	3.43±0.05	2.08±0.05
Water soluble ash	94.82±0.02	94.41±0.02	92.86±0.01	94.26±0.02
Crude fiber	7.05±0.50	35.27±0.50	5.01±0.50	3.94±0.01
Carbohydrate	72.45±0.30	45.0±0.30	73.24±0.05	66.41±0.05
Food energy	334.06±.02cal/g	220.80±.02cal/g	353.69±.02cal/g	377.90±.02cal/g

Data are expressed as Mean ± SD (n=3)

Table 2: Mineral compositions (mg/g) of different parts of *C. sophera*

Elements	Leaves (dry weight basis, mg/g)	Stems (dry weight basis, mg/g)	Flowers (dry weight basis, mg/g)	Seeds (dry weight basis, mg/g)
Na	72.27±8.23	53.34±6.08	74.59±8.50	12.03±1.37
K	432.01±93.31	215.38±46.52	328.44±70.94	55.85±12.06
Ca	182.95±15.36	25.62±0.052	43.07±3.61	13.07±0.089
Mg	100.51±5.22	0.023±0.001	38.17±1.98	0.712±0.003
Zn	17.92±2.07	0.009±0.001	2.86±0.33	0.071±0.002
Fe	2.98±0.24	ND	11.28±0.90	ND
Mn	0.67±0.001	0.0007±<0.001	0.34±<0.001	0.0007±.009
Al	1.67±0.200	ND	6.20±0.744	ND
Cu	0.140±0.01	ND	0.30±0.021	0.0008±<0.001
Ni	0.0006±<0.001	ND	0.0005±<0.001	ND
Cr	0.0029±0.004	0.001±<0.001	0.002±0.001	ND
Pb	0.46±<0.001	0.006±<0.001	0.222±<0.001	0.0008± <0.001
Cd	0.0013±<0.001	0.001±<0.001	0.001±<0.001	0.001± <0.001

Measured values are mean ± Standard Deviation (24) of three replicate analysis

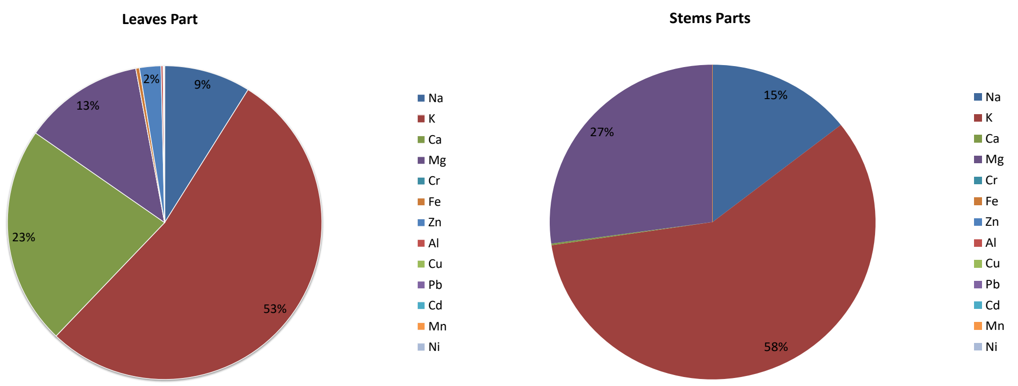
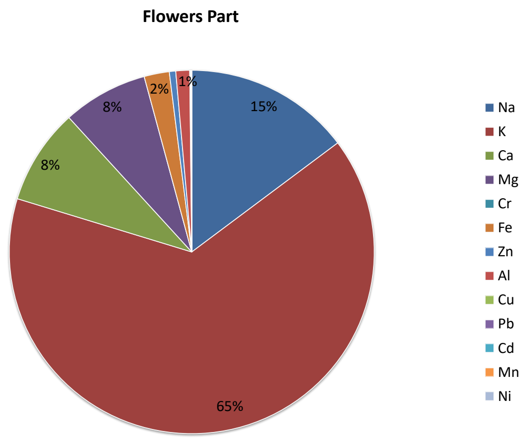


Figure 1: Mineral compositions (mg/g) of leaves and Stems of *Cassia sophera*



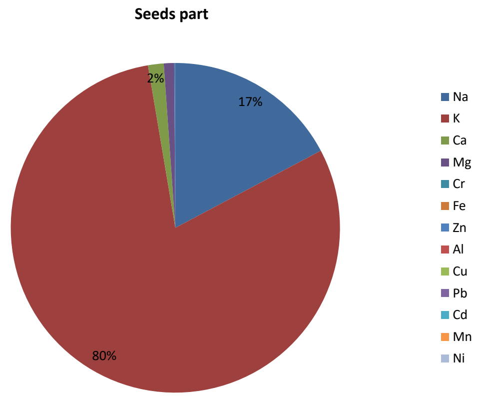


Figure 2: Mineral compositions (mg/g) of Flowers and Seeds of *Cassia sophera.*

From the present study it was observed that flowers of *C. sophera* showed high concentration of Na, Fe, Al, Cu and Ni compared to other part of the plant. But leaf part showed high concentration of K, Ca, Mg, Zn, Pb and Mn.

Sodium (Na) concerned with the conduction of nervous impulses, muscle contractility and control of heart muscle conduction. It is also maintains the osmotic equilibrium between the extra cellular fluid and the tissue cells and maintains the pH of blood within normal limit (21). The average concentration of Na was 74.59 mg/g for flowers, 72.27 mg/g for leaves 53.34 mg/g for stem and for seeds 12.03 mg/g in the present study.

Potassium (K) plays a vital role in reducing hypertension and maintaining cardiac rhythm. In the human body, Potassium helpful in many physiological reactions and its deficiency or excess can affect human health[22]. The average concentration of K was 432.01 mg/g for leaves, 328.44 mg/g for flowers, 215.38 mg/g for stem and for seeds 55.85 mg/g in the present study.

Calcium overcomes high blood pressure problems, heart attack, pre-menstrual syndrome, colon cancer and keeping the bones strong and reduces the risks of osteoporosis in old age [23,24,25]. The average concentration of Ca was 182.95 mg/g for leaves, 43.07 mg/g for flowers, 25.62 mg/g for stem and for seeds 13.07 mg/g in the present study.

Magnesium plays a key role to improve insulin sensitivity, protects against diabetes and its complications and reduces blood pressure[26]. Also Mg involves in many enzymatic reactions of oxidative metabolism of nutrients and cell constituents synthesis, transmission of nerve impulses, body temperature regulation, detoxification, energy production and the formation of health bones and teeth [27]. The average concentration of Mg was 100.51 mg/g for leaves, 38.17 mg/g for flowers, 0.71 mg/g for seeds and for stems 0.023 mg/g in the present study.

Zinc, is necessary for the growth and multiplication of cells (enzymes responsible for DNA and RNA synthesis, for skin integrity, bone metabolism and functioning of taste and eyesight [28] as well as important constituent of viable sperm especially human sperm. Zinc (Zn) deficiency may contribute to arrested sexual maturation, growth retardation and hair loss, delayed wound healing and emotional disturbance[23]. The average concentration of Zn was 17.92 mg/g for leaves, 2.86 mg/g for flowers, 0.07 mg/g for seeds and for stems 0.00 9 mg/g in the present study.

Human body needs iron (Fe) for the formation of the oxygen carrying protein haemoglobin and myoglobin. It is an essential mineral to prevent anemia and cough associated with angiotensin-converting enzyme (ACE) inhibitors [29]. Also in the synthesis of neurotransmitters such as dopamine or epinephrine and serotonin, Fe is an essential cofactor [30]. In the present study the average concentration of Fe was found 11.28 mg/g for flowers, 2.89 mg/g for leaves.

Manganese (Mn) helps the diabetic to metabolize carbohydrates and in treating diabetes [31]. Also Mn (10) can help to assist the body in metabolizing protein. The average concentration of Mn was 0.67 mg/g for leaves, 0.34 mg/g for flowers and 0.007 mg/g for stem & seeds in the present study.

Copper (20) has a role in energy production, wound healing, taste sensation, skin and hair color[32]. The average concentration of Cu was 0.14 mg/g for leaves, 0.30 mg/g for flowers in the present study.

The health benefits of nickel (Ni) are optimal growth, healthy skin, bone structure and involved in iron metabolism but it is required in low quantity. Otherwise it may cause toxicity. [23] The average concentration of Ni was 0.006 mg/g for leaves, 0.005mg/g for flowers in the present study.

Lead (Pb) is toxic metal and nonessential element for human body. Pb causes a rise in blood pressure, kidney damage, miscarriage and subtle abortion, brain damage, declined fertility of men through sperm damage, diminished learning abilities of children and disruption of nervous systems[23, 33]. The average concentration of Pb was

0.46 mg/g for leaves, 0.222 mg/g for flowers, 0.008 mg/g for seeds and 0.006 mg/g for stems in the present study.

The value of toxic element Cd for the case of leaf was 0.0013 mg/g and other parts of the plant (stem, flowers and seeds) was 0.001 mg/g respectively. The maximum limit for Cd is 0.3 mg/kg in herbal medicines and products while the dietary intake limit is 10.3 mg/kg which is prescribed by WHO.[34]

Cr showed the value for leaf part 0.005mg/g whereas in the case of seed the value was 0.001 mg/g. In the present experiment all the toxic elements found to be below the prescribed limits. Excessive intake can cause poisoning in human body. Pb and Cd cause acute and chronic poisoning, adverse effects on the kidney, liver, heart vascular and immune system, brain damage, subtle abortion, declined fertility of men through sperm damage, diminished learning abilities of children and disruption of nervous systems.[35-36]

The variation of elemental concentration in different part of the plant due to the environmental factors including atmosphere and pollution, season of collection samples, age of plant and soil condition in which plant grows. These factors may affect the concentration of elements in the plant region to region[26, 21].

CONCLUSION

From the above study (Proximate analysis & elemental analysis) suggested that the plant parts could be an excellent source of investigated minerals and thus could help in maintaining normal physiological functions of human body. Elemental uptake by a plant is influenced by various factors including types of plant, nature of soil, climate and agriculture practices.[36,37] This is the first report of proximate analysis and mineral compositions of different parts (leaves, stems, flowers and seeds) of the plant *C. sophera* and will be helpful in the synthesis of new modern drugs with various combinations of plant parts which can be used in the cure of many diseases ethanomedicinally. Also the different concentration of elements in different parts of *C. sophera* leads to the conclusion that the plant will have different specific roles in the treatment of different diseases. However more detailed analysis of chemical composition of different part of this important medicinal plant is required.

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