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Studies on Nutritional Values of Some Wild Edible Plants from Iran and India

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Abstract: The most important nutrients present in plants are: carbohydrates, such as the starch and free sugars, oils, proteins, minerals, ascorbic acid, and the antioxidant phenols. The Plants *Alocacia indica Sch.,Asparagus officinalis DC., Chlorophytum comosum Linn., Cordia myxa Roxb., Eulophia ochreata Lindl., Momordica dioicia Roxb., Portulaca oleracia Linn.* and *Solanum indicum Linn.* are widely wild in many regions of Iran and India. These are consumed as fruits and vegetables. Therefore, to analyze the nutritional values in them, these plants are selected. Association of the Official Analytical Chemists Methods and Folin-Ciocalteau micro method are used for nutritional analysis of the plants. Results indicated that *Portulaca oleracia Linn.* and *Asparagus officinalis DC* have high amounts of proteins, fats and calorie values. Therefore, these plants are recommended for consumers as vegetables in their diet. The most of the Iranian and Indian people are using these plants in their daily diet.

Kew words: Nutritional values, edible plants, India, Iran

Introduction

Fruits are important sources of minerals, fiber and vitamins, which provides essential nutrients for the human health. In addition, it is known that some fruits have the so-called 'anti-nutritional' factors (e.g. Phytic acid and Tannins) that can diminish the nutrient bioavailability, especially if they are present at high levels (Spiller, (2001), Nevertheless, it has been reported that these anti-nutritional factors could help to prevent and treat several important diseases; remarkably, the anti-carcinogenic activity of Phytic acid has been demonstrated by *in vitro* and *in vivo* assays.

The most important nutrients present in plants are: carbohydrates, such as the starch and free sugars, oils, proteins, minerals, ascorbic acid, and the antioxidant phenols, such as Chlorogenic acid and its polymers. These molecules are involved in pathogen resistance in plants, and the Chlorogenic acid concentration represents about the 90% of the total phenolic compounds in plants (Ekanayake and Nair, 1998).

Protein malnutrition is a major public health problem in the developing world. The major food crops being roots and tubers hence the diets in these parts are predominantly starchy. The trace elements, together with other essential nutrients, are necessary for growth, normal physiological functioning, and maintaining of life; they must be supplied by food, since the body cannot synthesis them. The exact classification of trace versus macro minerals is not clear cut, but traces are often considered as minerals required by the body in amounts less than 100mg daily. While some of them are vitally important for health, the roles of others are unclear. Recommended intakes have been set for some trace elements and their deficiency can lead to disease, but a lack of others does not cause any recognized problems. To decide whether a micro-nutrient is "essential" or not, several criteria are used, such as the presence of the nutrient in healthy tissue, if it appears in the fetus and newborns and if the body maintains homeostatic control over its uptake in the bloodstream or tissue and its excretion (Janab and Thompson, 2002; Reddy, 2002).

Plants, which are sources of Phytochemicals with strong antioxidant activity, have attracted a great deal of attention in recent years. Antioxidants, which inhibit the oxidation of organic molecules, are very important, not only for food preservation, but also for the defense of living systems against oxidative stress (Masuda *et al.*, 2003). Phenolic antioxidants interrupt the propagation of the free radical autoxidation chain by contributing a hydrogen atom from a phenolic hydroxyl group, with the formation of a relatively stable free radical that does not initiate or propagate further oxidation processes (Kaur and Kapoor (2001).

Dietary fiber (DF) plays an important role in decreasing the risks of many disorders such as constipation, diabetes, cardiovascular diseases (CVD), diverticulosis and obesity (Spiller, 2001). Plant foods are the only sources of DF. All the fractions (cellulose, lignin, hemi cellulose, pectin, gums and mucilage) of DF are the major constituents of plant cell wall (Roberfroid and Selvendran, 1984). Dietary fiber is subdivided into Insoluble (IDF) and soluble (SDF) dietary fiber depending on their solubility in water. However, the DF can be grouped into two major types (a) soluble/viscous/fermentable and (b) insoluble/non-viscous/slowly fermentable. Recently, FAO/WHO discussion document on carbohydrates recommended dropping the terms “soluble” and “insoluble” fiber (FAO, 1998). The physiological effects of total dietary fiber (TDF), in the forms of insoluble and soluble fractions of foods, have a significant role in human nutrition.

Indian diets predominantly consist of a variety of plant foods such as cereals, pulses, green leafy vegetables (GLV), roots, tubers, other vegetables, fruits, oil seeds, spices and condiments. Fruits are consumed in various forms like fresh, dried, frozen or canned. The polysaccharides comprising a major part of DF in fruits and vegetables are beneficial to healthy human volunteers, since the consumption of fiber lowers plasma cholesterol levels (Holland *et al.,* 1998; Gillman *et al.,* 1995). reported protective effect of fruits and vegetables against the development of stroke in men. Addition of fruits and vegetables to the regular diet of infracted survivors resulted in a decreased mortality and subsequent infarctions. Therefore, the dietary fiber may play a major role in determining the health and disease conditions of different population groups.

Inositol hexakisphosphate ($InsP_6$), commonly known as phytate, is a major component of plant storage organs such as seeds, roots and tubers, where it serves as a phosphate source for germination and growth (Reddy, 2002). Due to its ability to chelate and precipitate minerals, phytate can decrease the bioavailability of critical nutrients such as zinc, iron, calcium and magnesium in foods such as whole grains, nuts and legumes (Weaver and Kannan, 2002), At the same time, phytate may have beneficial roles as an antioxidant, ant carcinogen and more (Janab and Thompson, 2002).

Materials and Methods

Sample preparation: Selected wild edible plants were collected from various localities of Maharashtra (India) and Iran. Three wild edible plants were collected from India viz *Alocacia indica, Momordica dioica and Eulophia ochreata* in September 2006. Five wild edible plants were collected from Iran viz *Asparagus officinalis, Chlorophytum comosum, Codia myxa, Portulaca oleracia and Solanum indicum* were collected from Iran in October 2006 and April 2007. Efforts made to collect these plants in flowering and fruiting conditions for the correct botanical identification. Healthy and disease free edible plant part/s selected and dried them under shade so as to prevent the decomposition of chemical compounds present in them. All the dried material powdered in blander for further study.

Proximate composition: Ash and fat contents were assayed by the Association of the Official Analytical Chemists (AOAC, 1984) Methods 14004, 14009 and 14006, respectively. Nitrogen was determined using the Kjeldahl method (Matissek *et al.*, 1989) The quantity of protein was calculated as 6.25×N (method 7015, AOAC, 1984).

Mineral content: Mineral content was analyzed with a Perkin-Elmer (optima) 3000 DV analyzer with induction coupled plasma atomic emission spectroscopy (ICPAES) (Eknayake and Nair, 1998). The sample (2g) was digested with 20ml concentrated nitric acid (BDH-Aristar) until a transparent solution was obtained. The instrument was calibrated with known standards and samples analyzed at corresponding wavelengths. Five-point standard curves were made for all analyzed minerals using reference materials. Linear regression analysis of the standard curves indicated they were linear with correlation coefficients in the range of 0.997–0.999. Selenium was determined as hydride using a hydride generator (VGA-76). The samples digested in HNO_3 were mixed with concentrated HCl and heated to 70 to90°C for 10min and cooled before injection into hydride generator followed by NaBH4.

Determination of phytate content: The phytate content was determined by the method of (Wheeler, and Ferrel (1971), based on the ability of standard ferric chloride to precipitate phytate in dilute HCl extracts of the vegetables.

Determination of total phenolic compounds: Total phenols were extracted by heating a weighed portion (50–500mg) of dried sample with 5ml of 1.2M HCl in 50% aqueous methanol for 2h at 90°C and analyzed by Folin-Ciocalteau micro method (Slinkard, and Singleton, 1977), Results were expressed as mg of Gallic acid per 100g of dried plant material.

Determination of calorie: The first total sugars content will be calculate, then total calorie value will be calculate. total calorie value is equal with fat calorie + protein calorie + sugars calorie. Each gram fat give 9 kcal, each gram protein give 4kcal and each gram sugar give 4kcal.

Results and Discussion

Many studies have been done by various research workers all over the world by selecting one or more plants particularly leaves, fruits, roots, stem, food plants and so on but rarely by selecting a particular family. In this investigation works pertaining to seven different families (Araceae, Liliaceae, Boraginaceae, Orchidaceae, Cucurbitaceae, Portulacaceae and Solanaceae) are selected.

Sodium values of eight samples in this study in order to mg/g were obtained 4.4, 1.84, 3.95, 1.62, 1.62, 1.51, 7.17 and 1.51 respectively (Fig. 1).

Calcium values of eight samples in order to mg/g were obtained 0.88, 0.67, 13.14, 0.46, 7.37, 0.46, 18.17 and 4.48 respectively (Fig.1).

Potassium values of eight samples in this research in order to mg/g were obtained 3.4, 10.94, 4.29, 7.83, 4.63, 8.25, 14.71and 8.32 respectively (Fig.1).

Iron values of eight samples in this research in order to

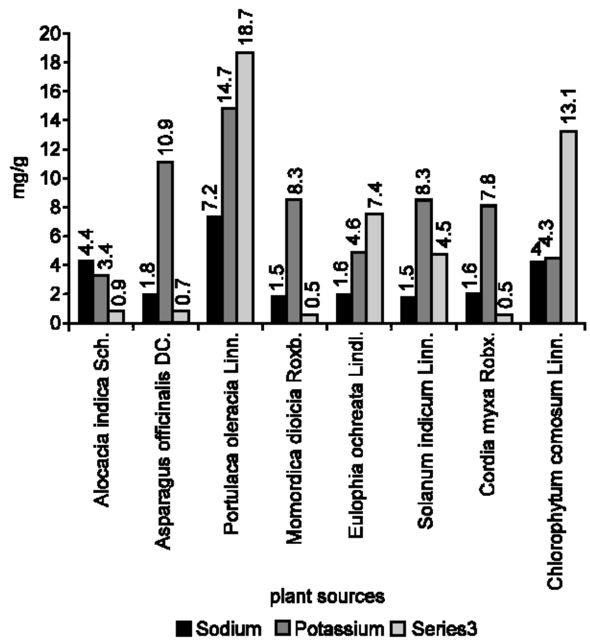

Fig. 1: Amounts of macro elements of edible plants.

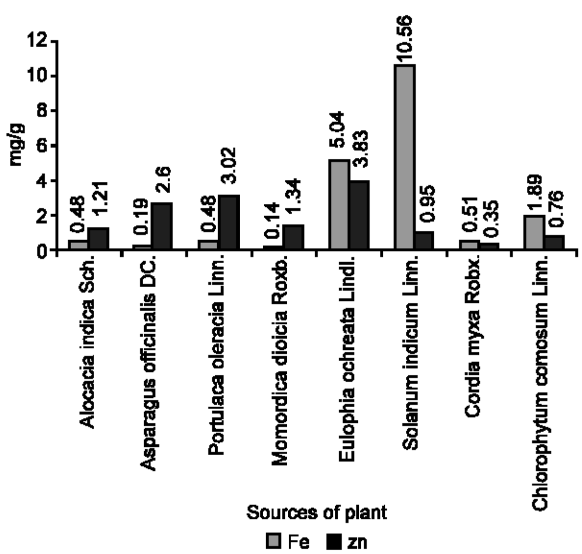

Fig. 2: Amounts of micro elements of edible plants.

mg/g were obtained 0.48, 0.19, 1.89, 0.51, 5.04, 0.14, 0.48 and 1.56 respectively (Fig. 2).

Zinc values of the eight samples in this study in order to mg/g were obtained 1.21, 2.60, 0.76, 0.35, 3.83, 1.34, 3.02 and 0.95 respectively (Fig. 2).

If protein, Fat, and calorie values of eight samples in this research are compared, it is observed that *Asparagus* (32.69%) and *Portulaca* (23.47%) have the highest of protein values respectively; *Chlorophytum* (4.54%), *Eulophia* (5.44%) and *Alocacia* (5.7%) have the least of protein values. *Momordica* (19.38%) have medium protein value (Fig. 3).

If total phenolic compounds of eight plants in this research are compared together, it is observed that *Solanum indicum Linn.* with 7.02mg/g has maximum the phenolic compounds value and then *Portulaca oleracia Linn.* with 5.86mg/g have high phenolic compounds. *Alocacia indica Sch.* with 0.87mg/g has minimum phenolic compounds value. *Cordia Myxa Roxb* with 4.02mg/g and *Momordica dioicia Roxb.* with 3.69mg/g and *Asparagus officinalis DC.* with 3.17mg/g have medium phenolic compounds value (Fig. 4).

If Phytic acid content of eight plants are compared in this research, it is reveal that *Portulaca oleracia Linn.* with 823.6mg/100g has maximum value and then Solanum indicum with 695.8 mg/100 g has high value and Eulophia with 255.6 mg/100g has minimum value and the others plants have less than medium values(Fig. 4).

Total Ash values of eight samples of *Alocacia indica Sch., Asparagus officinalis DC Chlorophytum comosum Linn. Cordia myxa Roxb., Eulophia ochreata Lindl., Momordica dioicia Roxb., Portulaca oleracia Linn. and Solanum indicum Linn.* were obtained as 7.3%, 10.7%,10.38%, 6.7%, 9.1%, 6.7%, 22.6% and 11.0% respectively (Fig..5).

The maximum ash values and the minimum ash values were for *Portulaca oleracia Linn.* and *Momodica dioicia Roxb. or Cordia myxa Roxb.* respectively. The medium ash value was obtained in *Eulophia ochreata Lindl.* (9.1%). If each plant contain ash or minerals high amounts, the sample nutritional value will be good, because these minerals are involved in human body structure and the edible plants are suitable for consumption by human .

Sodium amount of *Portulaca oleracia Linn.* was maximum and sodium amounts of *Momordica dioicia Roxb.* or *Solanum indicum Linn.* were minimum. Sodium amount of *Alocacia indica Sch.* was medium.

Potassium amount of *Portulaca oleracia Linn.* was maximum and potassium amount of *Alocacia indica Sch.* was minimum. Potassium amount of *Cordia Myxa Roxb.* was medium.

Calcium amount of *Portulaca oleracia Linn.* was maximum and Calcium amounts *Momordica dioicia Roxb.* or *Cordia myxa Roxb.* were minimum. Calcium amount of *Eulophia ochreata Lindl.* was medium.

Iron *amount* of *Eulophia ochreata Lind*l. was maximum and Iron amount of *Momordica dioicia Roxb* was minimum. Iron amount of *Chlorophytum comosum Linn.* was medium.

Zinc amount of *Eulophia ochreata Lindl.* was maximum and Zinc amount of *Cordia myxa Roxb.* was minimum. Zinc amount of *Asparagus officinalis DC.* was medium. *Portulaca oleracia Linn* has high nutritional value from view of point of macro-elements because, the plant contains the macro-elements high amounts such as sodium, potassium, calcium and especially ash high amount in comparison with others plants. The *Eulophia*

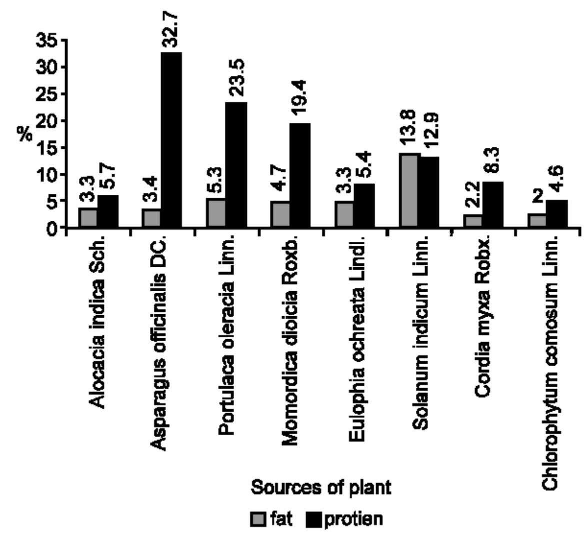

Fig. 3: Values of protein and fat of edible plants.

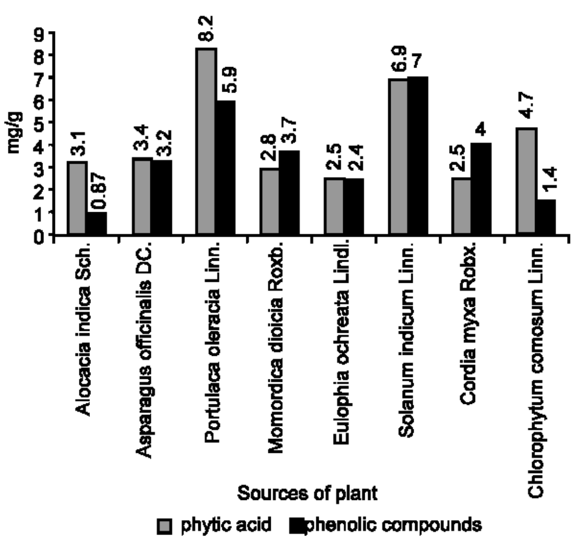

Fig. 4: Values of Total phytic acids and Total phenolic compounds of edible plants.

has high nutritional value from view of point of trace(micro)elements, because it has micro-elements maximum amounts such as iron and zinc in comparison with others plants. *Momordica dioicia Roxb. or Cordia myxa Roxb* have the minimum nutritional value, because they have ash minimum amounts, *Momordica dioicia Roxb*. have minimum values of sodium and calcium, but *Cordia myxa Roxb*. has minimum value of zinc. *Alocacia indica Sch., Asparagus officinalis DC., Chlorophytum comosum Linn., Cordia Myxa Roxb., Eulophia Ochreata Lindl.* have medium nutritional values, from view of point of each element.

Minerals in the diet are required for proper growth and good health. Those needed in macro, or major quantities are calcium, phosphorus, magnesium, potassium, sulfur, sodium, and chlorine, and those needed in micro(trace) amounts are iron, iodine, copper, cobalt, chromium, manganese, selenium, zinc, fluorine, and molybdenum. The cruciferous and many other vegetables are excellent sources of minerals, particularly of calcium, phosphorus, magnesium, potassium, iron, sodium, and most of these minerals are present in the available form. The trace mineral content of fruits and vegetables depends on the amount present in the soil in which the plant was grown. The diverse geographical sources of fruits and vegetables and modern systems of transporting produce to market reduce the chance of a low intake. Calcium intake from fruits and vegetables is small compared to that from the milk group but will assume more importance if milk intake is low. Vitamins and minerals present in the diet are necessary for normal growth and metabolism and influence the utilization of other nutrients such as protein. The deficiency of essential vitamins or minerals leads to several physiological disorders and diseases, slowed growth, and lack of deposition of proteins in tissues. An adequate supply of B- complex vitamins is necessary for critical protein utilization. The deficiency of minerals such as potassium, phosphorus, sodium, calcium, and magnesium also influences the capacity of the body to utilize amino acids and proteins (Ekanayake and Nair, 1998),

Portulaca oleracia Linn. and *Asparagus officinalis DC* plants have high proteins, therefore, they have high enzymatic activity and also high metabolic products. In addition, *Portulaca* plant has high hormones, so that these components control genetic activity in plant and therefore, amino acids amounts and proteins will be increased. Therefore, we can conclude that plants that have high proteins amount, these proteins will increase nutritional values directly and indirectly.

Solanum (13.76%) has the highest of Fat value and *Chlorophytum* (2%) has the least of Fat value. *Portulaca* (5.26%) Fat value was medium approximately and the others samples have low fat values.

Momordica (4125/83Kcal/Kg) and *Cordia* (4067/94 Kcal/Kg) have maximum Calorie values and *Portulaca* (2913/82 Kcal/Kg) has minimum Calorie value and the others samples have medium Calorie values (3514/4Kcal/Kg to 3647/23Kcal/Kg). (Fig..6). Therefore, *Asparagus* and *Portulaca* have maximum nutritional value from standpoint of proteins values.

Plants such as vegetables and fruits have satisfactory edible proteins with high quality so that we can use them in food industries and as nutrition. Total proteins and nitrogen is related to Albumins, globulins, free Amino acids, enzymes, hormones, peptides and other nitrogen components. The proteins that contain essential amino acids have high nutritional values therefore they are suitable for consumption because body cells need such proteins.

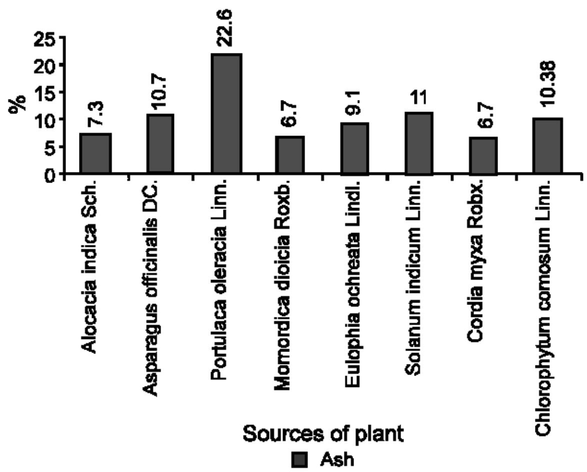

Fig. 5: Amounts of Total Ash of edible plants.

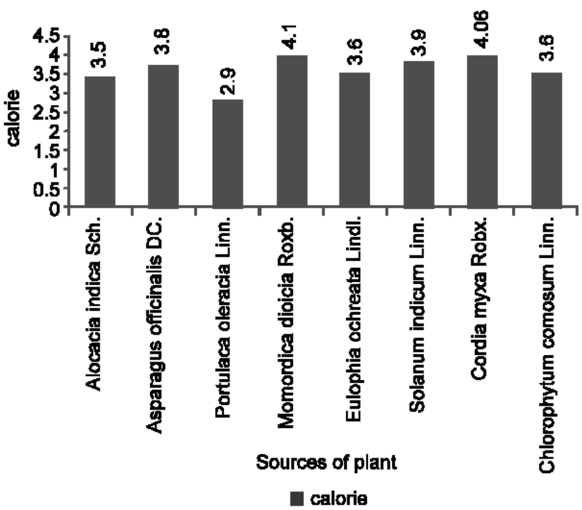

Fig. 6: Values of Calories of edible plants.

Therefore, *Portulaca* and *Asparagus* have maximum enzymatic activity and also high amount of metabolic products. In addition, *Asparagus* and *Portulaca* plants have high hormones, so that these components control genetic activity in plant and therefore, amino acids amounts and proteins will be increased. We can conclude because protein amount of the plants were high, therefore their nutritional values will be increased directly or indirectly.

Solanum indicum has the maximum nutritional value from view of point of fat. Quality of plant oil is better than animal oil, because plants oils have essential fatty acids such as linoleic and linolenic acids and ω-3 and ω-6 fatty acids, therefore, they are useful for body tissues. *Solanum indicum* has maximum nutritional values from view of point of oil, in comparison with other plants, because the plant has the best oil (fat) from view of point of quality and quantity.

Flavonoids and other Polyphenolic compounds have powerful antioxidant effects *in vitro* in many test systems, but can act as pro-oxidants in some others. Whether pro-oxidant, antioxidant, or any of the many other biological effects potentially exerted by flavonoids account for or contribute to the health benefits of diets rich in plant-derived foods and beverages is uncertain. Phenolic compounds may help to protect the gastrointestinal tract against damage by reactive species present in foods or generated within the stomach and intestines. The overall health benefit of flavonoids is uncertain, and consumption of large quantities of them in fortified foods or supplements should not yet be encouraged (Kaur and Kapoor, 2001; Slinkard and Singleton, 1977).

Because nutrients of Solanum *indicum Linn.*, *Cordia Myxa Roxb*, *Momordica dioicia Roxb*. and *Asparagus officinalis DC.* wouldn't destroyed in stages of post-harvesting and harvesting therefore, them nutritional values were high. *Portulaca oleracia Linn.* and *Asparagus officinalis DC.* have maximum nutritional values and therefore, these edible vegetables are recommended for consumption, because they have proteins, fat high amounts and calorie high values. The most of Iranian and Indian peoples consume the plants in daily diet.

Duke and Ayensu (1985) reported that *Asparagus officinalis* Stem (Fresh weight) contain 26 calories per 100g, water: 91.7%, Protein: 2.5g; Fat: 0.2 g; Carbohydrates: 5g; Fibre: 0.7g; Ash: 0.6g; Calcium: 22mg; Iron: 1mg; Sodium: 2mg; Potassium: 278mg; Zinc: 0mg. protein and Zinc amounts in our study are more than obtained results by Duke and Ayensu (1985). Difference between two results depends on other condition such as plants growth places and analysis methods. They also reported *Portulaca oleracia* Analysis: Leaves (Dry weight) of *Portulaca oleracia*. In gram per 100g weight of food: Water: 0 Calories: 270 Protein: 26 Fat: 4 Carbohydrate: 50 Fibre: 11.5 Ash: 20 In mg per 100g weight of food: Calcium: 1500; Iron: 29; Sodium: 55; Potassium: 1800. Fat and Ash amounts in our study are more than obtained results by Duke and Ayensu (1985). Difference between two results depends on plants growth places. Studies on Analysis of other edible plants has not been reported by other researchers yet.

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Captions

Macro elements (sodium, potassium and calcium) levels (mg/g) of plant sources such as *Alocacia indica Sch., Asparagus officinalis DC., Portulaca oleracia Linn., Momordica dioicia Roxb., Eulophia Ochreata Lindl., Solanum indicum Linn., Cordia Myxa Roxb. and Chlorophytum comosum Linn.*

Micro elements (Iron and Zinc) levels(mg/g) of plant sources such as *Alocacia indica Sch., Asparagus officinalis DC., Portulaca oleracia Linn., Momordica dioicia Roxb., Eulophia Ochreata Lindl., Solanum indicum Linn., Cordia Myxa Roxb.* and *Chlorophytum comosum Linn.*

Protein levels (%) of plant sources such as *Alocacia indica Sch., Asparagus officinalis DC., Portulaca oleracia Linn., Momordica dioicia Roxb., Eulophia Ochreata Lindl., Solanum indicum Linn., Cordia Myxa Roxb.* and *Chlorophytum comosum Linn.*

Total phytic acids and Total phenolic compounds(mg/g) of edible plants such as *Alocacia indica Sch.,Asparagus officinalis DC., Portulaca oleracia Linn., Momordica dioicia Roxb., Eulophia Ochreata Lindl., Solanum indicum Linn., Cordia Myxa Roxb.* and *Chlorophytum comosum Linn.*

Amounts of Total Ash (%) of edible plants such as *Alocacia indica Sch., Asparagus officinalis DC., Portulaca oleracia Linn., Momordica dioicia Roxb., Eulophia Ochreata Lindl., Solanum indicum Linn., Cordia Myxa Roxb.* and *Chlorophytum comosum Linn.*

Calories values of edible plants such as *Alocacia indica Sch., Asparagus officinalis DC., Portulaca oleracia Linn., Momordica dioicia* Roxb., *Eulophia Ochreata* Lindl., *Solanum indicum* Linn., *Cordia Myxa* Roxb. and *Chlorophytum comosum* Linn.