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Analysis of nutrients and minerals of some wild edible plants

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Abstract

This study was carried out to assess the nutritional and mineral composition of selected vegetables, which are commonly used as food in Pakistan. *Amaranthus thunbergii*, *Caralluma edulis*, *Allium astrosanguineum*, *Rumex patientia* and *Portulacca oleracea* were collected from the arid region of South Waziristan Agency (FATA), Pakistan and subjected to nutrient analysis. Nutrient analysis (total proteins, fats, carbohydrates, ash, energy value and moisture contents) of vegetable species were determined according to AOAC methods. Minerals viz. Calcium (Ca), magnesium (Mg), iron (Fe), zinc (Zn) and manganese (Mn) elements were analyzed using Atomic Absorption Spectrometric method. The range of crude protein, fat, Ash, Moisture (dry matter), Carbohydrate and fiber was observed in the range of 17.18-24.44%, 5.98-6.84%, 22.45-30.53%, 3.19-5.32%, 18-34.7% and 9.8-17.11% respectively. The level of Fe, Zn, Cu, Ca, Mg and Mn was in the same 2.31-5.84 µg/100g, 0.062-0.694 µg/100g, 0.55-0.936 µg/100g, 5.296-11.63 µg/100g, 5.162-5.74 µg/100g and 0.86-1.91 µg/100g respectively. The results indicate that all these vegetables have the potential to provide essential nutrients to the human beings. *Amaranthus thunbergii*, *Caralluma edulis* and *Portulacca oleracea* were found to be a good source of proteins, fats, carbohydrates, hence capable of providing energy to the consumer. These species were found significantly useful in terms of mineral sources, particularly Fe, Ca, Zn, Cu and Mg.

Keywords: analysis, nutrients, minerals, wild edible plants, South Waziristan agency, Pakistan

Introduction

Wild edible plants are the plants which are neither cultivated nor domesticated, but are available from their natural habitat and are used as a part of a food [1]. Plants are considered as the best source of essential nutrients carbohydrates, fats and crude proteins that form the basic source of diet for the human community, and are the good source of energy. Other than these biomolecules, some plant species are considered to play important role in making human body healthy. Micro and Macro elements and heavy metals have certain risks [2]. The potential biomolecules in the combination of both organic and inorganic are present in wild plant species. Plants are also considered essential, cheap and remunerative source of proximate nutrients, minerals, vitamins as well as antioxidants for many economical suffered community. However, the same ranges of these anti-nutritional factors are reported by several researchers in many traditional and conventional plants. The presence of these biomolecules in wild plants, people should aware of the use of these plants as a source of food [3].

The present study documented five wild edible plants that are used routinely for food purposes collected from the arid region of South Waziristan Agency (FATA) Pakistan. These are considered the common, expensive and sometime scarcely available traditional plant based foods. Due to their high nutritional value, the low-income peoples depend on such plants, both for cash and survival and can be exploited. Thus, it is necessary to investigate the range of these compounds in the plants that are used widely in common routine. In general, knowledge about wild plants on their edibility properties is limited, but data on their proximate nutrients and elements is negligible [4-5].

Due to the dramatic loss of traditional knowledge regarding wild edible plants our objective is to determine and evaluate the indigenous knowledge about chemical analysis (the nutrient composition of which has not been reported in literature from this area) of these plant species: *Portulaca oleracea*, *Rumex patientia*, *Amaranthus thunbergi*, *Caralluma edulis* and *Allium astrosanguineum* grown in and around South Waziristan Agency (FATA), Pakistan. The plant of geographical area has never been fully investigated in the past.

The present studies were initiated to examine, the nutritional composition (proximate analysis of nutrients and minerals) of five wild edible plants: *Portulacca oleracea*, *Rumex patientia*, *Amaranthus thunbergii*, *Caralluma edulis* and *Allium astrosanguineum*.

Materials and Methods

The trial on Analysis of Nutritional composition and Biological activities of selected wild edible plants (Table.1) from South Waziristan Agency (FATA), Pakistan was conducted in the different laboratories viz. Biochemistry lab (Hazara University), Animal Nutrition, Human Nutrition, Soil Science and plant pathology Department at The University of Agriculture, Peshawar, Pakistan from November, 2014 to March, 2015.

Table 1: Wild edible plants, status and pattern of their local use

| Plant Name | Family Name | Local Name | Parts used | Status |
|-------------------------------|-----------------------|------------|-------------|--------|
| <i>Amaranthus thunbergii</i> | <i>Amaranthaceae</i> | Ranzakka | Arial Parts | Wild |
| <i>Caralluma edulis</i> | <i>Asclepiadaceae</i> | Pamankai | Arial Parts | Wild |
| <i>Allium astrosanguineum</i> | <i>Alliaceae</i> | Shezyee | Arial Parts | Wild |
| <i>Rumex patientia</i> | <i>Polygonaceae</i> | Zundaa | Arial Parts | Wild |
| <i>Portulacca oleracea</i> | <i>Potulacaceae</i> | Terwikai | Arial Parts | Wild |

Proximate Analysis

By using the standard methods of the Association of the Analytical Chemists (AOAC), determination of moisture, ash, and crude fibers (on dry basis) was carried out [6]. The determination of proteins in terms of nitrogen was done by the micro Kjeldahl method. The nitrogen value was converted to protein by multiplying to a factor of 6.25. The lipid content of the samples was done using the Soxhlet type of the direct solvent extraction method. The solvent used to be petroleum ether (boiling range 40-60°C) [6-7]. The crude fiber was also determined by the method described by [8]. The energy values (kcal/100 g) were determined by multiplying the values of carbohydrates, lipids and proteins by a factor of 4.3, 9.1, and 4.3 respectively, and taking the sum, expressed in kilocalories [9-10]. The total carbohydrates were determined by the difference method [100 - (proteins + fats + moisture + ash in percentage)] [11-12]. All the proximate values were reported in percentage.

Statistical Analysis

The data recorded triplicates for each treatment were subjected to the One-way analysis of variance (ANOVA) technique and reported the \pm SE of the triplicate measurement and the significance difference ($P < 0.05$) or ($P > 0.05$) by using MSTATC software and the data means were separated by Fischer's Least Significance Difference (LSD) test [13].

Minerals Analysis

Accurately weighed sample (0.5 g) in labeled digestion tubes and 10ml Nitric acid (HNO₃) added to each sample. The solution was placed over night for 24 hours. After 24 hours, 4ml of perchloric acid (HClO₄) was added to each one and placed in a digestion flask for digestion till the solution becomes clear or colorless. After cooling in a desiccator, the solution was filtered and diluted up to 100 mL with distilled water. The solution was analyzed for Ca, Mg, Fe, Cu, Zn and Mn by using Atomic Absorption Spectrophotometer (AAS-Perkin Elmer, Model analyst 800). The results were obtained while using a working standard of 1000 ppm for each of the

Collection and Identification of Plant Material

The selected wild edible plants were collected from South Waziristan Agency (FATA), Pakistan in October 2014. The healthy and disease free edible plants having fully matured leaves were collected. The identification of selected wild edible plants was confirmed with the help of local people and technically from the department of weed science in the University of Agriculture, Peshawar. The details of each plant species, with respect to their local names, parts used and status are elaborated in Table 1.

The collected samples of plants were shaded dried at room temperature and ground into fine powder by using Thomas-Wiley laboratory Mill model-104. The powder placed temporarily in airtight polythene bags until further analysis.

species.

Mg/100g = Instrumental Reading \times 100/ Sample weight

Results and Discussions

It has been reported that the wild plants are the most abundant and cheapest source of food for human community. The present study was designed to document the edibility of the wild plants and promoting the awareness of the local community of the selected area. The selected wild edible plants were investigated for their nutritional importance. It was found that these selected wild plants are a rich source of essential biomolecules and minerals. The result showed that these plants provide food either used raw or cooked. The general purposes of plants include dietary diversification, food supply, flavoring agent or spices, increase nutraceutical potential of diet. Results of our study revealed that *Amaranthus thunbergii*, *Caralluma edulis*, *Allium astrosanguineum*, *Rumex patientia* and *Portulacca oleracea* are important as food supplement for local communities.

Moisture content in plant is a potential source of water and is necessary as it is considered that around 20% of the total water consumption must come from food moisture [15]. The proximate nutrient analyses of five selected wild edible plants were carried out on dry matter basis. The analysis of the species shows that Moisture and Ash content were nearly identical in all the plants and the values ranged from 3.20 % - 5.33 % and 30 % - 24.59 % respectively. Among the tested plants, *Portulacca oleracea* shows the maximum value of Ash content 30.53% followed by 24.59% in *Amaranthus thunbergii* while *Allium astrosanguineum* shows the minimum value of Ash content 22.45% followed by 23.79% in *Caralluma edulis* and 24.28% in *Rumex patientia* as shown in Table: 2. These results are in line with other wild edible plants such as *Amaranthus Virdis*, *Chenopodium murate*, *Nastrium officinale* and *Scandex pectin- veneris* having Ash value 88.90%, 89.50%, 90.54% and 81.31% respectively reported by [16]. Furthermore, these studies indicated that *Portulacca oleracea* could be a good source of essential mineral elements. Our finding of ash content are higher than

those reported by other researchers [17-19]. In the analysis of Moisture, *Allium astrosanguineum* (5.33%) and *Portulacca oleracea* (4.71%) observed the higher value while *Rumex patientia* (3.20%) and *Amaranthus thunbergii* (3.94%) indicated the lower value Table: 2. Other studies also found the same value in *Portulacca oleracea* (5.5%) and in the leaf of some *Rumex species*, 4.05% in *Rumex dentatus*, 3.5% *Rumex nepalensis* of moisture content reported by [18-20]. Like the moisture content, ash content is also very important from a biochemical point of view, ash contains all the important nutritional ingredients, especially minerals, both micro and macro nutrients which are very important for the physiological function of the body.

Protein is considered to be one of the major ingredients of human diet. Protein not only supports growth, but is also responsible for maintaining and repairing of body tissues. Among the tested wild plants, the highest value of crude protein was found in *Rumex patientia* (24.4%) followed by 24.18% in *Portulacca oleracea*. *Rumex patientia* is a good source of crude protein Table: 2. The protein content found in *Rumex hastatus* (14%) reported by [18] is less than our tested, value, whereas *Portulacca oleracea* has almost same value 26% that were documented by [21]. The lowest value of crude protein were found in *Amaranthus thunbergii* and *Caralluma edulis* 17.18% and 17.34% respectively as shown in Table (2). The plants having high crude protein value may encourage

their use as high protein sources in some food formulations. [22] Reported that protein-calories malnutrition is a major factor responsible for nutritional pathology. Food taken from a plant that gives more than 12% of its energy value from protein are considered a good source of protein [23]. The total intake of protein on a daily basis is depending on the need for growth and desirable weight of an individual. According to the WHO recommended dietary allowance (RDA) of protein, for children, an adult male and adult female is 28, 63 and 50 g, respectively, while in Pakistan the average protein intake is 43.4 g/day [24]. The results of our proximate analysis showed that the mentioned wild edible plant is a rich source of protein and are good diet for human beings.

In the proximate analysis of the selected plants, the *Caralluma edulis* 6.85% and *Portulacca oleracea* 6.45% may be considered as a good source of fat Table (2). *Caralluma adscenders* and *Caralluma pauciflora* contained 10.06% and 11.22% fat, respectively, as reported by [25]. While in *Portulacca oleracea* the fat value were observed as 5.26% by [26] in their studies. The difference in the values is due to certain conditions like plant maturity, growth, environmental condition and methods of analysis. The lower value 5.98% fat has been seen in *Allium astrosanguineum* followed by 6.07%, 6.07% in *Amaranthus thunbergii* and *Rumex patientia* respectively (Table: 2).

Table 2: Proximate analysis of selected vegetables of South Waziristan Agency

| Plants Name | Plants Name | Moisture | Ash | Protein | Fat | Fiber | Carbohydrate | Energy value |
|------------------------|-------------|----------|-------|---------|------|-------|--------------|--------------|
| Amaranthus Thunbergii | | 3.94 | 24.59 | 17.19 | 6.07 | 13.51 | 34.70 | 278.41 |
| Caralluma edulis | | 4.11 | 23.79 | 17.34 | 6.85 | 15.08 | 32.83 | 277.7 |
| Allium astrosanguineum | | 5.33 | 22.45 | 17.53 | 5.98 | 15.12 | 33.58 | 276.16 |
| Rumex patientia | | 3.20 | 24.28 | 24.44 | 6.08 | 9.80 | 32.22 | 299.59 |
| Portulacca oleracea | 4.71 | 4.71 | 30.53 | 24.19 | 6.46 | 17.11 | 18.00 | 240.3 |

Fiber in diet helps to decrease serum cholesterol level, the risk of cardiovascular diseases, colon and breast cancer and hypertension. The high level of fiber in the diet can cause intestinal irritation, lower digestibility, difficult absorption of minerals found in plants and overall decrease nutrients utilization [16]. Fiber value in the wild edible plants varied among the tested species. *Amaranthus thunbergii* (34.70%) and *Allium astrosanguineum* (33.58%) contain higher values of crude fiber while *Caralluma edulis* (32.83%), *Rumex patientia* (32.22%) and *Portulacca oleracea* (18.00%) have the lower value Fig (2). [20] has reported that *Portulacca oleracea* contains 17.7% fiber. Crude fibers of this treatment of plants varied from 9.8- 17.11% which are found higher in *Portulacca oleracea* 17.11% while lowest observed in *Rumex patientia* 9.8%. Similar value 17.7% of fiber in *Portulacca oleracea* reported by [18-26] WHO also reported 14.5%, 9.03% and 15.38% in *Rumex hastatus*, *Rumex dentatus* and *Rumex nepalensis* respectively in their studies. The American Dietetic Association recommended intakes of 20-30 gm of fiber in the diet are necessary for digestion and for effective elimination of wastes reported by [27].

Carbohydrate is the principle and indispensable source of energy. The RDA for carbohydrate is 130gm reported by [28] while in Pakistan 349gm of carbohydrate intake is reported by [29]. Due to carbohydrate content sample plants can be a good food source. The total carbohydrates found in the selected plants are in the decreasing order of *Amaranthus thunbergii* 34.70%, *Allium astrosanguineum* (33.58%), *Caralluma edulis*

(32.83%), *Rumex patientia* (32.21%) and *Portulacca oleracea* (18%). The lowest value was found in *Portulacca oleracea* and the highest in *Amaranthus thunbergii*. Whereas the lower value 5.98% is recorded in *Allium astrosanguineum* followed by 6.07%, 6.07% in *Amaranthus thunbergii* and *Rumex patientia* respectively (Table: 2).

The energy content of the total plants varied in the decreasing order of *Rumex patientia* (299.59%), *Amaranthus thunbergii* (278.41 Kcal/100g), *Caralluma edulis* (277.70 Kcal/100g), *Allium astrosanguineum* (276.16 Kcal/100g) and *Portulacca oleracea* (240.30 Kcal/100g). The first three plants have an almost similar energy level with a small difference whereas *Portulacca oleracea* showed the lowest energy value. [30] also reported the similar energy value for *Allium cepa*, *Brassica oleracea*, *Spinacia oleracea* and *Coraindrum sativum* that were 319.77 Kcal/100g, 281.27 Kcal/100g, 257.51 Kcal/100g and 284.87 Kcal/100g respectively (Table 2).

Elemental Composition

The mineral analysis of the plants on dry weight basis is given in Table: 3. The results show that these are good sources of Ca, Mg, Zn, Fe, Cu, and Mn. These selected plants were considered as a major source of essential elements and can be used as one of the potential sources of the essential minerals in the diet. Among the tested elements, Fe (5.84mg/100g) was observed in greater amount in *Allium astrosanguineum*, while *Caralluma edulis* contained lesser amount (2.31mg/100g) of Fe. Iron play an important role in many bioreactions in the

body, including antioxidant defence as an essential component of catalase, protein and energy metabolism, as a respiratory carrier of haem, oxidation–reduction reactions, and in the electron transport system [31]. The range of Zinc (Zn) in *Amaranthus thunbergii*, *Caralluma edulis*, *Allium astrosanguineum*, *Rumex patientia* and *P. oleracea* was 0.694, 0.38, 0.274, 0.062 and 0.07mg/100g respectively (Table: 3). Zn is the second most abundant trace element in mammals and makes a structural component of over three hundred enzymes, where it may also be involved in catalytic and regulatory activity. Zn is helpful in anti-oxidant defence as an integral part of the essential enzymes. It also plays an important role in nucleic acid synthesis, bone metabolism and cell division, sexual development and spermatogenesis; immune function, and appetite control via the central nervous system reported by [32]. The intake of Zinc makes a good effect on the growth of some stunted children and play a positive role in the protection from childhood diseases such as diarrhea. [33] stated that the deficiency of zinc is a significant health problem for the public, especially in developing countries. According to the reported balance food data of FAO, about 20% of the world's population could be at zinc deficiency risk. The average daily intake of Zn is less than 70 µg/day reported by [34]. The amount of Copper in *Caralluma*

edulis was found to be in greater amount (0.936mg/100g) while lesser amount of copper was reported in *Amaranthus thunbergii* (0.55mg/100g). Manganese (Mn) contents of the selected plants were found as 1.912, 1.166, 1.074, 1.068 and 0.86mg/100g for *Caralluma edulis*, *Rumex patientia*, *Portulacca oleracea*, *Amaranthus thunbergii* and *Allium astrosanguineum* respectively (Table: 3). Dairy products supply 50-80% of dietary calcium in most industrialized countries, while foods of plant origin supply about 25%. The Calcium (Ca) amount in *Amaranthus thunbergii* was found the highest (11.63 mg/100g) followed by *Allium astrosanguineum* (5.472mg/100g) among all the plant species, whereas the minimum value was observed in *Caralluma edulis* (5.378mg/100g), *Rumex patientia* (5.314 mg/100g) and *Portulacca oleracea* (5.296 mg/100g). In case of Magnesium (Mg), *Amaranthus thunbergii* has the highest value of 5.74 mg/100g followed by *Portulacca oleracea* (5.566 mg/100g), while *Caralluma edulis*, *Allium astrosanguineum* and *Rumex patientia* was observed lower in Magnesium having value 5.366 mg/100g, 5.184mg/100g and 5.162mg/100g respectively. Magnesium element is helpful in body metabolism as an essential part of enzymes that are involved in bone growth and egg- shell formation and role in reproduction.

Table 3: Composition of minerals elements in selected wild edible plants

| Treatment | Cu (mg/100g) | Fe (mg/100g) | Ca (mg/100g) | Mg (mg/100g) | Mn (mg/100g) | Zn (mg/100g) |
|------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Amaranthus thunbergii | 0.55 | 3.5 | 11.63 | 5.74 | 1.068 | 0.694 |
| Caralluma edulis | 0.936 | 2.31 | 5.378 | 5.366 | 1.912 | 0.38 |
| Allium astrosanguineum | 0.64 | 5.84 | 5.472 | 5.184 | 0.86 | 0.274 |
| Rumex patientia | 0.822 | 3.036 | 5.314 | 5.162 | 1.166 | 0.062 |
| Portulacca oleracea | 0.782 | 4.12 | 5.296 | 5.566 | 1.074 | 0.07 |

Conclusion

The results of the present studies revealed that all these edible plants have the potential to provide essential nutrients to the human beings. *Amaranthus thunbergii*, *Caralluma edulis*, *Rumex patientia*, *Allium astrosanguineum* and *Portulacca oleracea* were envisaged as a good source of crude protein, fats, crude fibers, ash content, moisture content and carbohydrates. These vegetable species were also found significantly useful in terms of elemental resources; particularly Fe, Ca, Mg, Zn, Cu, and Mn levels below the toxicity level.

The results of our study revealed that all these edible plants have the potential to provide essential nutrients to the human beings. *Amaranthus thunbergii*, *Caralluma edulis*, *Rumex patientia*, *Allium astrosanguineum* and *Portulacca oleracea* were envisaged as a good source of Crude Protein, fats, Crude fibers, Ash content, Moisture content and carbohydrates. These vegetable species were also found significantly useful in terms of elemental resources; particularly Fe, Cu, Zn, Ca, Mg and Mn levels, hence, elemental toxicity in the vegetables, lethal for the health is well below than WHO standards.

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