

Research Article

Proximate nutritional, elemental and phytochemical analysis of selected wild edible plants of District Malakand, Pakistan

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Abstract

The objective of this survey was to examine the nutritional, elemental and phytochemical analyses of selected wild edible species of District Malakand Khyber Pakhtunkhwa, Pakistan. The selected wild edible species *Ammaranthus viridis*, *Chenopodium album*, *Malva neglecta*, *Nasturtium officinale* and *Rumex dentatus* were collected from the study site and were subjected to nutritional, elemental and phytochemical analysis. The results of the present nutritional analysis of these selected wild edible species disclosed that these plants possess proteins, fats, fibers, carbohydrates and caloric energy. The Energy Dispersive X-Rays Analysis (EDX) analysis of powdered plants sample showed that these plants also possess the much needed and fundamental elements of human diet like carbon, oxygen, nitrogen, magnesium, sulfur, potassium, phosphorus, aluminium, calcium, silicon, copper, iron and chlorine. Through the qualitative phytochemical screening, it was noticed that, important phytochemical substances such as steroids, saponins, flavonoids, phenols, alkaloids, glycosides and tannins were there in the methanolic extract of the plants. The study demonstrated that such wild edible plants are the inexpensive and rich source of essential and fundamental nutrients, elements and phytochemicals.

Keywords: Elemental analysis; Nutritional analysis; Pakistan; Wild edible plants

Introduction

The plants which grow on their own in natural habitats and are used as a food are called wild edible plants (WEPs) [1]. From prehistoric period, human beings are using these WEPs to fulfill their own dietary and dietetic necessities and to gratify their hunger. The consumption of such edible species for nutrition and diet are considered

fundamental and central chunk of the values and traditions of the local folks throughout the globe [2]. These wild edible species not only offer chief and complementary nutrients but are also a source of income for the local communities, thus guaranteeing food security. The native people, from their own experiences, have knowledge about the significance and role of such plants in their

daily diet but are also conscious about the probable well-being and ecological threats [3]. These plants are well acknowledged for their indispensable biochemical and nutritional position as these plants contain a reasonable amount of fibers, fats, proteins, carbohydrates, minerals and vitamins [4, 5]. From traditional and cultural point of view wild native plants were dynamic sources of minerals and vitamins and always played an important role in times of food scarcity, and were also used as herbal remedies [6]. It was supposed and confirmed about these WEPs that they possess useful elements and its uses have always been a good influence on human health. For this reason, commonly used WEPs were assessed and tested for their nutritional and elemental values [7, 8]. WEPs are generally known as “Chemical Goldmines” which means that these plants possess phytochemicals which have a favorable impact on human health [9]. Phytochemicals such as carbohydrates, proteins, glycosides, alkaloids, flavonoids, tannins, saponins, phenols, and steroids are known to possess healing properties as well as show physiological activity. Plants are of great importance to the health and food of individuals and communities [10].

Materials and Methods

$$\text{Moisture content \%} = \frac{\text{Weight of sample} - \text{Weight of oven dried sample}}{\text{Weight of sample}} \times 100$$

Determination of crude protein

Micro kjeldahl method was used to determine the crude proteins in plant samples [14]. The percentage of nitrogen was determined by formula mentioned below:

$$N \% = \frac{(S-B) \times N \times 0.014 \times D}{\text{Weight of sample}} \times 100$$

Where, D= Dilution factor

T= Titration value (S – B)

W= Weight of sample

0.014= Constant value

$$\text{Crude protein \%} = N \times 6.25 \text{ (factor)}$$

Plant species collection

The collection of WEPs was done from different sites of District Malakand (34.5030⁰ N, 71.9283⁰ E) during March 2018 to February 2020, and properly identified according to flora of Pakistan and relevant literature [11].

Preparation of samples

The collected plant materials were thoroughly cleaned with water and then shade dried under shade at 25-30°C except for moisture analysis where fresh plant parts were used. The dried samples of different plants were grinded into fine powder in a grind mixer and kept in air tight plastic bottles for further nutritional, elemental and phytochemical analyses [12, 13].

Nutritional analysis

The proximate nutritional analysis of dried, powdered plants samples were carried out according to official methods of analysis (AOAC, 2005) in the laboratory of Agriculture Chemistry, Agriculture University Peshawar, Pakistan [14].

Determination of moisture content

Moisture percentage of fresh plants was calculated by oven-dry method. The plant samples were kept in an oven at 102 ± 2°C. The weight loss recorded represents the moisture %.

Determination of fats

The fat content was calculated by AOAC Soxhlet extraction technique [14]. The fat contents present in plants can be extracted by petroleum ether at a temperature of 40-60°C. Formula for fat content is:

$$\text{Crude fat (\%)} = \frac{\text{weight of fat in sample}}{\text{weight of sample}} \times 100$$

Determination of ash content

Muffle furnace was used to calculate ash content in plants. The sample was kept at

600°C for 8 hours in furnace according to methods of AOAC [14].

$$\text{Ash (\%)} = \frac{\text{weight of Ash}}{\text{weight of sample}} \times 100$$

Determination of crude fiber: Dried plant sample was mixed with acetone ethanol mix and then AOAC methods were carried out to calculate fibers [14].

$$\text{Carbohydrates \%} = 100 - (\text{Ash\%} + \text{Fibers\%} + \text{Proteins\%} + \text{Crude fats \%})$$

Determination of caloric energy

Caloric energy value in a plant sample was calculated when the sum total of carbohydrates and proteins are multiplied by

$$\text{Total energy (Kcal/100g)} = (\text{Crude proteins} \times 4) + (\text{Carbohydrates} \times 4) + (\text{Crude fats} \times 9)$$

Elemental analysis

The Energy Dispersive X- Rays Analysis (EDX) of powdered plant samples were carried out at Central Resource Laboratory, University of Peshawar Pakistan. About 2 grams of powdered sample was transferred to a metal pellet using (JEE 420) cello tape and coated with gold by using Vacuum Evaporator (JEOL). The EDX (Inca, 200 Model Oxford Company UK) was attached to Scanning Electron Microscope (SEM) [15].

Phytochemical analysis

Qualitative analyses of selected plants were carried out to examine various phytochemicals like, glycosides, saponins, tannins phenols, alkaloids and steroids present in the methanolic extract. This was done by using standard methods [16, 17].

Statistical analysis

The proximate nutritional and elemental analysis data was made in triplicates and the values are reported as means \pm standard deviation [18]. The statistical computations were made using Microsoft Excel (version 2016).

$$\text{Fiber(\%)} = \frac{\text{weight of residue} - \text{weight of ash}}{\text{weight of sample}} \times 100$$

Determination of carbohydrates

Difference method was used to calculate carbohydrates. The total of ash%, fibers%, proteins% and fats% were subtracted from 100 % according to AOAC methods [14]. The formula used is as follow.

a factor 4 and that of crude fats by a factor 9 according to official methods of analysis [14].

Results and Discussion

Moisture content, ash content, and nutritional analyses of WEPs are represented in (Table 1). Moisture in *Nasturtium officinale* was (90.20%) and the lowest moisture content was found in *Amaranthus viridis* (81.24%). The dry matter content was maximum in *Amaranthus viridis* (18.76%) and lowest in *Nasturtium officinale* (9.80%). The Ash content was found maximum in *Chenopodium album* (18.90%) and was found minimum in *Rumex dentatus* (16.45%). The highest value of fibers was observed in *Malva neglecta* (16.50%) and lowest value was observed in *Rumex dentatus* (12.40%). The value of crude fats was found maximum in *Nasturtium officinale* (3.96%) and minimum value was found in *Malva neglecta* (2.25%). The crude proteins were found maximum in *Rumex dentatus* (11.95%) and minimum in *Nasturtium officinale* (6.18%). The highest value of Carbohydrates was observed in *Nasturtium officinale* (58.24%) and lowest in *Malva neglecta* (52.82%). The result obtained from the caloric value was highest for *Rumex dentatus*

(298.75%) and lowest for *Malva neglecta* (271.13%).

The elemental analysis of the selected WEPs are shown (Table 2). The results showed that these wild edible species contain essential elements. These plants are therefore, thought to be a major source of essential elements and can be used as one of the potential and cheap source of essential elements in the human diet. The highest value of carbon was found in *Chenopodium album* (58.56%) and lowest value was found in *Amaranthus viridis* (49.54%). The oxygen was found maximum in *Nasturtium officinale* (36.13%) and minimum value was found in *Chenopodium album* (29.24%). The value of nitrogen was observed maximum in *Amaranthus viridis* (6.51%) and minimum in *Nasturtium officinale* (4.72%). The value of potassium was highest in *Chenopodium album* (9.37%) and lowest in *Nasturtium officinale* (2.62%). Magnesium was found maximum in *Amaranthus viridis* (1.14%) and minimum in *Chenopodium album* (0.33%). The other elements such as aluminium, silicon, phosphorus, sulfur, calcium, chloride, iron and copper were present in small quantity in these WEPs.

Results of the present nutritional and elemental composition of these WEPs are compatible and in line with the studies of earlier workers available in literature. However, some disparities are there which are accredited to prevalent ecological and soil situations in the study area, plants age, period and season for plants collection and uptake of

nutrients by the plants from the soil. The results of the nutritional and elemental analysis of *Amaranthus viridis* are in proximity to the results of Sharma *et al.* [19], those of *Chenopodium album* are similar to that of Vinita *et al.* [20], *Malva neglecta* to that of Ozer & Aksoy [21], *Nasturtium officinale* to that of Shad *et al.* [22] and the results of *Rumex dentatus* are similar to the results of Mushtaq *et al.* [23].

Qualitative analysis of phytochemicals in the selected WEPs are represented in (Table 3). The study showed that these plants also contain important phytochemicals which possess therapeutic activities. The study showed that *Malva neglecta* contain all the tested plants chemicals like saponins, glycosides, alkaloids, steroids, flavonoids, phenols and tannins. The *Amaranthus viridis* do not contain glycosides and steroids. *Chenopodium album* have no glycosides and *Nasturtium officinale* do not contain glycosides, saponins, tannins and steroids. *Rumex dentatus* have no steroids in its methanolic extract. The results of the qualitative phytochemical analysis of *Amaranthus viridis* are similar to the study of Kumari *et al.* [24], those of *Chenopodium album* are similar to the study of Pandey & Gupta [25]. The results of *Malva neglecta* are compatible with Saleem *et al.* [26], those of *Nasturtium officinale* are similar to Mazandarani *et al.* [27] and the results of *Rumex dentatus* are compatible with the phytochemical study of Nisa *et al.* [28].

Table 1. Nutritional analysis of selected wild edible plants

Plants Name	MC (%)	DM (%)	Ash%	Fib (%)	CF (%)	CP (%)	Carb (%)	EV (Kcal/100g)
<i>Ammaranthus viridis</i>	81.24±0.2	18.76±0.2	16.64±0.01	15.25±0.5	2.60±0.01	7.94±0.01	57.57±0.2	285.44±0.3
<i>Chenopodium album</i>	85.32±0.6	14.68±0.4	18.90±0.1	13.42±0.2	3.23±0.01	9.72±0.04	54.73±0.5	291.87±0.5
<i>Malva neglecta</i> Wallr	82.40±0.2	17.60±0.1	18.53±0.03	16.50±0.05	2.25±0.4	9.90±0.1	52.82±0.3	271.13±0.1
<i>Nasturtium officinale</i> W.T. Aiton	90.20±0.5	9.80±0.05	16.90±0.1	14.72±0.6	3.96±0.06	6.18±0.03	58.24±0.02	293.32±0.3
<i>Rumex dentatus</i> L.	88.30±0.2	11.70±0.03	16.45±0.2	12.40±0.3	2.83±0.2	11.95±0.02	56.37±0.8	298.75±0.4
Mean	85.492	14.508	17.484	14.458	2.974	9.138	55.946	288.102
Median	85.32	14.68	16.9	14.72	2.83	9.72	56.37	291.87
Standard Deviation	3.798	3.798	1.142	1.595	0.656	2.180	2.198	10.605
Standard Error	1.698	1.698	0.510	0.713	0.293	0.974	0.983	4.743
Kurtosis	-2.166	-2.166	-2.877	-0.879	0.386	-0.164	-0.915	1.565
Skewness	0.152	-0.152	0.580	-0.082	0.797	0.190	-0.624	-1.224

Key: Percent (%), Moisture content (MC), Dry matter (DM), Fibers (Fib), Crude fats (CF), Crude proteins (CP), Carbohydrates (Carb), EV (Energy value)

Table 2. Elemental analyses of selected wild edible plants

Plants Name	C%	O%	N%	Mg%	Al%	Si%	P%	S%	K%	Ca%	Cl%	Fe%	Cu%
<i>Amaranthus viridis</i> L	49.54	31.87	6.51	1.14	0.26	1.01	0.64	0.43	4.89	1.97	0.70	0.29	0.76
<i>Chenopodium album</i>	58.56	29.26	-	0.33	0.27	0.94	-	0.29	9.37	0.28	0.51	0.18	-
<i>Malva neglecta</i> Wallr	52.95	34.55	0.68	0.94	0.28	0.72	0.25	0.87	3.01	4.24	0.93	0.30	0.28
<i>Nasturtium officinale</i> W.T.Aiton	51.87	36.13	4.72	0.39	0.22	0.84	0.16	0.63	2.62	0.95	1.47	-	-
<i>Rumex dentatus</i> L.	55.02	32.75	-	0.53	0.29	1.15	0.62	0.34	8.00	0.21	-	0.25	-

Mean	53.58	32.91 2	3.97	0.666	0.264	0.93 2	0.4175	0.51 2	5.578	1.53	0.9025	0.255	0.52
Median	52.95	32.75	4.72	0.53	0.27	0.94	0.435	0.43	4.89	0.95	0.815	0.27	0.52
Standard Deviation	3.410	2.621	3.031	0.356	0.027	0.16 3	0.284	0.23 8	3.002	1.671	0.540	0.123	0.331
Standard Error	1.525	1.172	1.750	0.159	0.0120	0.07 3	0.142	0.10 6	1.342	0.747	0.270	0.061	0.234
Kurtosis	0.251	-0.231	0	-2.17	2.021	-0.34	-5.322	-0.29	-2.44	1.532	0.944	0.605	0
Skewness	0.569	-0.280	-1.05	0.605	-1.338	0.05 0	-0.106	0.94 9	0.393	1.385	1.059	-1.188	0

Key: % (Percentage), C (Carbon), O (Oxygen), N(Nitrogen), Mg (Magnesium), Al (Aluminium), Si (Silicon), P(Phosphorus), S (Sulfur), K (Potassium), Ca (Calcium), Cl (Chlorine), Fe (Iron), Cu (Copper)

Table 3. Qualitative phytochemical analysis of selected wild edible plants

Phytochemicals	<i>Amaranthus viridis</i> <i>L.</i>	<i>Chenopodium</i> <i>album L.</i>	<i>Malva neglecta</i> Wallr	<i>Nasturtium officinale</i> <i>W.T.Aiton</i>	<i>Rumex dentatus L.</i>
Alkaloids	+	+	+	+	+
Flavonoids	+	+	+	+	+
Glycosides	-	-	+	-	+
Phenols	+	+	+	+	+
Saponins	+	+	+	-	+
Tannins	+	+	+	-	+
Steroids	-	+	+	-	-

Key: (+) Presence, (-) Absenc

Conclusion

The recent research work revealed that WEPs possess latent to offer all the essential nutrients to the human beings. *Amaranthus viridis*, *Chenopodium album*, *Malva neglecta*, *Nasturtium officinale* and *Rumex dentatus* were found as excellent basis of fibers, fats, proteins, fats, carbohydrates and energy. These plants were also found to be a useful basis of indispensable elements like as C, O, N, P, K, Mg, S, Al, Si, Cu, Fe, Na and Cl. The phytochemical screening of the extracts of these wild edibles showed the occurrence of important phytochemicals such as phenols, glycosides, saponins, alkaloids, flavonoids, tannins and steroids. Presence of these phytochemicals in WEPs showed that these plants also have high healing potential.

Authors' contributions

Conceived and designed the experiments: M Ibrahim & Sara, Performed the experiments: M Ibrahim & Sara, Analyzed the data: N Akhtar, Contributed materials/ analysis/ tools: H Bahadar, Wrote the paper: M Ibrahim.

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