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Full Length Research Paper

Proximate and nutrient analysis of selected medicinal plants of Tank and South Waziristan area of Pakistan

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Inhabitants of Tank and South Waziristan area of Pakistan are facing acute shortage of medicines and food. The purpose of this study was to evaluate the medicinal plants of the area for their nutrient and medicinal values and to recommend their preservation/propagation for medicinal and/or food purposes. The plants investigated were *Alhagi maurorum* Medik, *Datura alba* Ness, *Chenopodium album* L. *Tecomella undulata* (Sm.), *Withania coagulans* Dunal, *Berberis lycium* Royle. Proximate parameters like protein, fat, fiber, carbohydrates, moisture contents, ash, and energy values were obtained using Association of Official Analytical Chemists (AOAC) methods. Macronutrients (Ca, Mg, Na, and K) and micronutrients (Fe, Cu, Zn, Cr, Cd, Pb, and Ni) were analyzed by employing atomic absorption spectrophotometer. The study showed that *Datura album* has higher nutrient value than *Withania coagulans* and there exist a significant correlation among the results. Further, the plants were found to be useful for medicine and food purpose.

Key words: Proximate analysis, protein, fiber, macro- and micro-nutrients, medicinal plants, Tank, South Waziristan area.

INTRODUCTION

Market is full of synthetic drugs having high prices, severe side effects and affecting the environment whereas medicinal plants and the drugs derived from them are cheaper in cost, have lesser side effects and hence popular among the people (Alfawaz et al., 2006). According to a survey, 75 to 80% of the world's population relies over such plants (Atta et al., 2004) as they are famous for healing several diseases and are considered as a healthy source for life (Ndubani et al., 1999; Verpoorte, 2000; Harvey et al., 2000). Though, Pakistan has biodiversity in climate and in geographical situation and has valuable medicinal plants heritage (Newman et al., 2000), but its flora is neither properly explored for medicinal point of view nor for food value (Shinwari et al., 2000); in spite of the facts that medicinal plants are considered to be mostly rich in nutrients (Farnsworth, 1994). On the other hand, the dwellers are victim of malnutrition and facing tremendous problems due to economic position of people (Siddiqui et al., 2000), non-availability of standard drugs and food stuff in the area (Pandey et al., 2006; Pieroni et al., 2000).

The prevailing situation has provoked us to analyze the bioactive plants with reference to micro and macronutrients and their food values (Shinwari et al., 2004; Hussain et al., 2010). The following plants were selected for analysis based on their utility by natives as medicines and their reported bioactivity. *Chenopodium album* is antipyretic (Dai et al., 2002), antinociceptic (Kumar et al., 2007), sperm immobilizing agent (Gohar et

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Table 1. Species collected for study with local name and families.

Species name	Family name	Local name	Parts used	Status
A. maurorum	Fabaceae	Thanda	Whole plant	Wild
D. alba	Solanaccae	Badalbangae	Seed/Whole plant	Cultivated
C. album	Amaranthaceous	Batoo	Seed/Leaves	Cultivated/Wild
T. undulate	Bigoniaceae	Rohida	Seed/Bark	Wild
W. coagulans	Solanaceae	Paniry poda	Seed/Whole PLANT	Cultivated/Wild
B. lyceum	Berberidaceae	Kashmal/Ishkeen	Fruit/Roots bark	Wild

al., 1997), and hypertensive and is rich in iron contents (Yadav et al., 2002). *Datura alba* used in asthma, muscle spasm, whooping cough, hemorrhoids, skin ulcer, anesthetic for setting bones, bruises and menstruation (Chithra et al., 1998; Satyavati et al., 1976). *Tecomella undulata* has antifungal (Azam et al., 1999), antitermite (Ahmad et al., 1994), analgesic and anti-inflammatory property (Budhiraja et al., 1984). It is used for the cure of syphilis, eczema and relaxant, cardio tonic and chloretic activities (Batanouny, 1999). Its leaves have oleanolic acid, ursolic acid and betulinic acid, compounds that are strong in prohibiting HIV (Dushyent et al., 2000). Traditionally, *Alhagi maurorum* is used for gastrointestinal disorders, gastric ulcer and rheumatism (Khushbaktovaet al., 1992). *Withania coagulans* is used for the treatment of diabetes mellitus (Abouzid et al., 2010) and have antibacterial, antifungal (Hemalatha et al., 2008), anti-inflammatory (Choudhary et al., 1995), antitumor cardio-vascular activity (Gaind et al., 1967; Khan et al., 1993). *Berberis lyceum* is well known for its anti-inflammatory and immune-potentiating property (Gupta et al., 2008). The berbamine inhibits hepato-carcinogenesis and possesses anticancer activity (Gilani et al., 1992).

The current study has been desined to analyze proximate composition and mineral profile of *Alhagi maurorum, Datura alba, Chenopodium album, Tecomella undulata, Withania coagulans and Berberis lyceum*.

MATERIALS AND METHODS

Plants collection

The plants were collected from Tank and South Waziristan region of Khyber Pukhtoon Khawa province, Pakistan from March to May, 2008 and were identified by Prof. Dr. Muqarab Shah, Chairman, Department of Botany Hazara University, Mansehra. Specimen of each plant was deposited in the Herbarium of Botany Department, Peshawar University, Peshawar, KPK Pakistan. The collected plant species, their family, botanical and local names are listed as shown in Table 1.

Proximate and chemical analysis

Each collected plant sample was dried under the shade and was finely ground using an electric grinding machine (Model MX 491N, National) to raw flour separately. The analysis was then made using standard techniques provided by Association of Official Analytical Chemists (AOAC, 1990).

The moisture contents were determined by drying the sample at 105°C in the oven up to constant weight. The crude protein value of the sample was assessed by determining the total organic nitrogen using Micro-Kjeldahl's apparatus (Komel et al., 2000). The crude lipids were extracted in petroleum ether at 40 to 60°C, using Sox-let apparatus, and then evaporating the solvent up to dryness using evaporator (Pandey et al., 2006). For the estimation of the fiber contents, the dry outcome of lipid estimation was ignited and the ash contents were determined and taken as equivalent to fiber contents (Hussain et al., 2010). Carbohydrate contents of each sample were calculated using the difference method as follows:

Carbohydrate (%) = 100 - (moisture (%) + protein percentage (%) + lipid (%) + ash contents (%))

Whereas, the energy values of each sample were determined using the following formula.

K calories/100 g = 9 (crude fats (%)) + 4 (carbohydrates (%) + proteins (%)).

Elemental analysis

The plant was ignited to ash and the ash was dissolved in HCl to bring the ash in solution form. The macro- and micronutrients were then determined using single beam atomic absorption spectrometer provided by Perkin Elmer, USA (Bibi et al., 2006).

Statistical analysis

Proximate and elemental analysis of each plant sample was carried out thrice for each parameter and the mean, standard deviation and standard error were calculated. Inter-element correlation was performed using Statistical Package for Social Sciences (SPSS V.14).

RESULTS AND DISCUSSION

The proximate compositions and calorific values calculated over dry weight of the samples are displayed in Table 2. The moisture contents of the samples were 5.55% in *B. lycium* and 14.22 % in *D. alba.* Carbohydrates contents were the highest among all the investigated parameters and were from 32.35 (*W. coagulans*) to 92.65% (*C. album*) (Table 2). The low concentration of crude fat and ash was recorded in *T. undulata* and in *W. coagulans*; while the high contents were in *D. alba* and *C. album* (Table 2). High value of protein and fiber were

Table 2. Nutritional values of selected medicinal plant species*.

Species	M (%)	A (%)	P (%)	F (%)	F (%)	C (%)	EV (Kcal/100 g)
A. maurorum	8.76 ±0.01	12.66±0.02	6.56±0.02	4.88±0.01	3.33±0.01	56.52±0.12	330.51±0.01
D. alba	14.22±0.02	6.58±0.00	12.10±0.19	16.49±0.01	9.21±0.09	65.64±0.06	290.40±0.21
C. album	9.13±0.31	21.15±0.03	15.21±0.00	3.92±0.02	7.58±0.07	92.65±0.02	420.92±0.30
T. undulate	7.73± 0.01	4.52±0.03	9.44±0.06	2.52±0.11	18.3±0.01	74.08±0.06	380.39±0.01
W. coagulans	6.82 ±0.09	2.32±0.01	4.51±0.02	8.24±0.00	8.85±0.02	32.35±0.03	261.33±0.19
B. lycium	5.55± 0.00	7.75±0.01	7.67±0.03	5.32±0.01	13.5±0.20	46.99±0.23	485.70±0.35

*Values are the mean ± standard deviations of triplicate determination: M=Moisture, A=Ash, P=Protein, F=Fat, C=Carbohydrate, EV=Energy values.

Table 3. Correlation matrix of proximate parameters.

Parameter	Correlation coefficient	P-value (extent of interdependency)	Status
Moisture vs. ash	0.13	0.81 (>0.05)	Non-significant
Moisture vs. protein	0.54	0.26 (>0.05)	Non-significant
Moisture vs. fat	0.76	0.07 (>0.05)	Strongly positively correlated
Moisture vs. fiber	-0.29	0.57 (>0.05)	Non-significant
Moisture vs. carbohydrates	0.39	0.44 (>0.05)	Non-significant
Moisture vs. energy value	-0.46	0.35 (>0.05)	Non-significant
Ash vs. protein	0.67	0.15 (>0.05)	Non-significant
Ash vs. fat	-0.31	0.55 (>0.05)	Weakly negatively correlated
Ash vs. fiber	-0.49	0.35 (>0.05)	Non-significant
Ash vs. carbohydrates	0.70	0.11 (>0.05)	Non-significant
Ash vs. energy value	0.42	0.40 (>0.05)	Non-significant
Protein vs. fat	0.15	0.84 (>0.05)	Non-significant
Protein vs. fiber	0.03	0.96 (>0.05)	Weakly positively correlated
Protein vs. carbohydrate	0.91*	0.01 (<0.05)	Significant
Protein vs. energy value	0.32	0.54 (>0.05)	Non-significant
Fat vs. fiber	-0.23	0.66 (>0.05)	Non-significant
Fat vs. carbohydrate	-0.21	0.66 (>0.05)	Non-significant
Fat vs. energy value	-0.59	0.24 (>0.05)	Moderately negatively correlated
Fiber vs. carbohydrate	0.08	0.89 (>0.05)	Non-significant
Fiber vs. energy value	0.32	0.45 (>0.05)	Non-significant
Carbohydrate vs. energy value	0.35	0.50 (>0.05)	Non-significant

found in *T. undulata* (18.32%) and *C. album* (15.21%), while the low contents were found in *W. coagulans* (4.51%) in *A. maurorum* (3.33%). The highest calorific value was recorded in *B. lyceum* (485.70 Kcal/100 g) followed by *C. album* (420.92 Kcal/100 g) and *W. coagulans* (261.33 Kcal/100 g) (Figure 2). The samples were found to be a good source of carbohydrates and to some extent of protein. The values obtained for all investigated parameters are in agreement with the values recorded in Microsoft Encarta Premium DVD 2009. Similar studies have also reported previously by (Irvine 1992, Naseem et al, 2006, Zia-Ul-Haq et al., 2007, 2011, 2012; and Nisar et al, 2009). The results obtained of protein, fat, fiber, carbohydrates, moisture contents, ash, and energy values for Withania coagulans (Hussain et al., 2010) Datura alba (Hussain et al., 2011) quite different from the present result obtained. This is may be due to environmental condition. The other species nutritionally evaluated for the first time.

Elemental analysis of the aforementioned six medicinal plants showed significant variation among macro- and micronutrients (Table 4 and Figure 1). In case of macronutrients out of all the six reported species, *D. alba* showed the highest Ca contents (6329 mg/kg), while *T. undulata* (1321 mg/kg) stood lowest. Similarly, the highest concentration of Mg (45460 mg/kg), K (14991 mg/kg) and Na (895 mg/kg) were found to be in *C. album, A. maurorum* and *B. lyceum,* respectively, while the lowest were found in *A. maurorum* (1292 mg/kg), *W. coagulans* (2450 mg/kg) and *T. undulata* (91 mg/kg). The

Table 4. Concentration of macro- and micro-nutrients of selected medicinal plant species.

Species	Ca	Mg	K	Na	Fe	Cu	Zn	Cr	Cd	Pb	Ni
A. maurorum	2234	1292	14991	650	105.4	14.3	8.5	2.5	0.2	0.7	2.5
D. alba	6329	20248	13535	190	80.2	8.3	95.8	4.6	1.5	2.6	1.4
C. album	4242	45460	10455	375	102.8	4.3	0.2	1.8	0.6	0.00	0.3
T. undulata	1321	4021	3840	91	18.2	16.4	6.4	0.7	0.9	0.3	0.00
W. coagulans	9260	35280	2450	125	98.8	2.2	40.2	0.6	1.4	1.9	1.8
B. lyceum	4621	3240	2640	895	76.2	0.6	25.5	2.8	2.1	0.4	2.2

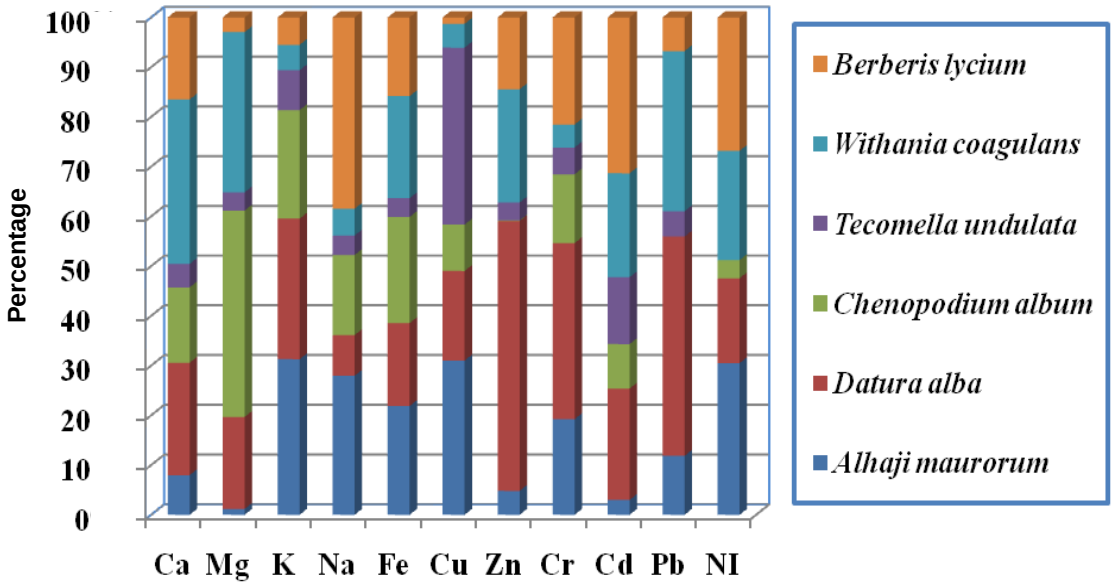

Figure 1. Summary of the macro- and micro-nutrients analysis of the medicinal plants.

results obtained for micronutrients analysis showed that the concentration level of Fe is extremely high in *A. maurorum* as compared to *T. undulate.* In the case of Cu, it was the highest in *T. undulata* followed by *A. maurorum.* Zn contents were the highest in *D. alba* (95.8 mg/kg), followed by *W. coagulans* (40.2 mg/kg) and *Berberis lycium* (25.5 mg/kg), which is in the expected range (25 to 150 mg/kg) (Chopra et al., 1986). The other three species (*A. maurorum, C. album* and *T. undulata*) had below the stated range. The contents of Cr were below the toxic (10 mg/kg) level in all the species, while the contents of Cd, Pb, and Ni were negligible (Dastagir et al., 2004) (Table 4).

Moisture, ash, protein, fat, fiber, carbohydrates contents and energy value have also been determined in the investigated species. We simply calculated the bi-variable correlation co-efficient using the average for a replication of three observations (Table 3), and tried to develop relationship between significance and non-significance value. It has been observed that there exists very strong correlation between carbohydrates and protein with a relationship value of 0.91. It can therefore be strongly concluded that species having high contents of carbohydrate will also have high protein value. On the other hand, moderately negative correlation up to the extent of 0.57 was observed between fat and energy (Table 5).

Conclusions

Six medicinal plants, *A. maurorum, D. alba, C. album, T. undulata, W. coagulans and B. lyceum* were investigated for their proximate analysis. The obtained results showed that *B. lyceum* and *D. alba* had the highest carbohydrates contents among the investigated plants. The low contents of crude fat and ash were in *T. undulata* (2.52%), *W. coagulans* (2.32%), *D. alba* (16.49%) and in *C. album* (21.15%). The high value of protein and fiber were in *C. album* (15.21%) and in *T. undulata* (18.32%) while the low contents were in *W. coagulans* (4.51%) and in *A. maurorum* (3.33%). The highest calorific value was recorded in *B. lyceum* (485.70 Kcal/100 g). These results concluded that the plants are good source of

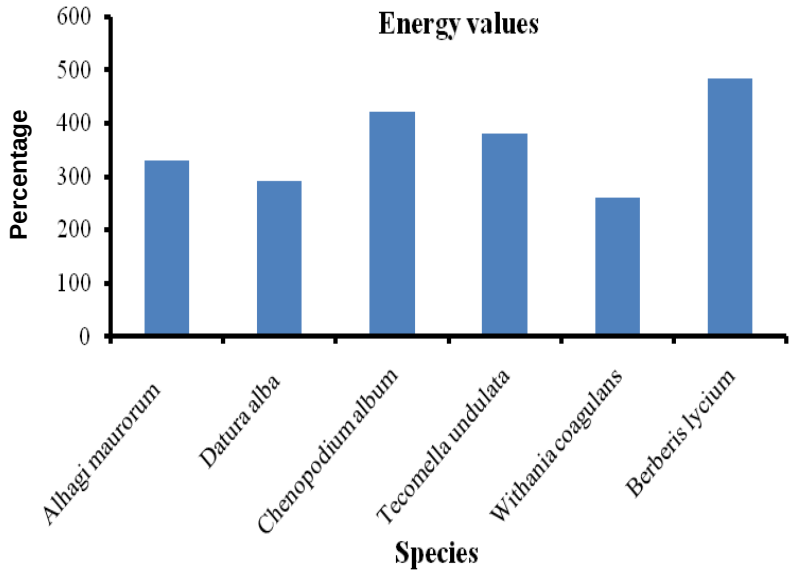

Figure 2. Showing energy value content in different plant species.

Table 5. Descriptive statistics.

Parameter	Mean content	Standard deviation
Moisture	8.71	3.00
Ash	9.16	6.82
Protein	9.25	3.89
Fat	6.89	5.06
Fiber	10.14	5.17
Carbohydrate	61.37	21.12
Energy value	361.50	83.97

carbohydrates and nutrients and up to some extent proteins.

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