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NUTRITIONAL AND ELEMENTAL ANALYSES OF SOME SELECTED MEDICINAL PLANTS OF THE FAMILY POLYGONACEAE

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Abstract

Proximate composition of proteins, crude fibers, fats & oils, moistures, ash contents and carbohydrates and different elements like C, O, Na, Mg, Al, Si, S, P, Cl, K, Ca, Ti, Fe and Br in some medicinal plants viz., *Rumex hastatus, Rumex dentatus, Rumex nepalensis, Rheum australe, Persicaria maculosa* and *Polygonum plebejum* of the family Polygonaceae is presented.

Introduction

The nutrients essential for life are proteins, fat and carbohydrates, all contribute to caloric content of the dietary, minerals including trace elements, vitamins and water. Numerous studies including same in man have demonstrated clearly that life may be sustained by nutrient mixtures in which every component is definable chemically and soluble in water (Underwood, 1994). The quality and quantity of protein in the seed are basic factors important in the selection of plants for nutritive value, systematic classification and plant improvement programs (Siddique, 1998).

Most of the countries of the world are facing malnutrition problems. The deficiency of protein in human food and animal feed is well recognized. The need of the good quality of proteins has been increasing due to rapid growth of population. It has been reported that in Pakistan the protein gap would continue to increase unless well-planned measures are adopted to tackle the situation. It is therefore imperative to increase protein production by utilizing all the available ways and means. In addition to increase in conventional production, much work has been done in recent years in developing new chemical and biological methods for the production of protein foods and feeds (Shah & Khalil, 1988).

When the deficiency is prevented or cured, some 20 or 30 trace elements which do not meet these exacting requirements occur more or less constantly in highly variable concentration in living tissues. They include Al, Sb, Hg, Cd, Ge, V, Si, Rb, Ag, Au, Pb, Bi, Ti and others. Such elements are believed to be acquired by the animal body as environmental contaminants and to reflect the contact of the organism with its environment (Goodwin & Mercer, 1998).

In recognition of the important role that major and trace elements play in health and disease of human body, in the building up and restoration phenomenon, it was observed that during the last 20 years remarkable progress has occurred in this area of health sciences. Elements research has definitely been part of this explosion of scientific knowledge (Said *et al*. 1996). Impressive developments in the field of mineral elements have taken place in the chemical, biochemical and immunological areas of research. Deficiency of trace elements in human subjects can occur under the most practical dietary conditions and in many diseased statuses. In recent years, scientists and nutritionalists have started believing in the therapeutic role of metals in human health (Udayakumar & Begum, 2004).

Trace elements play both curative and preventive role in combating diseases. There is a vast scope to exploit the preventive medicinal aspects of various trace elements such as Cu, Cr, etc. Medicinal plants play the most important role in the traditional medicines. In most developing countries most of the flora remain virtually unexplored from the point of view of the medicinal utilizing through traditional Eastern system of medicines strongly upholds the use of these elements for curing many diseases (Kaneez *et al*.. 1998). Mineral elements though usually form a small portion of total composition of most plant materials and of total body weight; they are nevertheless of great physiological importance particularly in the body metabolism. Their effects are related to concentration and recorded observation range from a deficiency state, to role as biological essential component to imbalance created when excess of one interferes with the function of another, to pharmacological activities (Bamiro, 1995).

Rumex hastatus juice is astringent and is used in bloody dysentery. The fresh tuber is chewed to relieve throat aches. Root is laxative, alternative, tonic, antirheumatic and is used in skin disease (Manandhar, 2002). The leaves and shoots of *Rumex hastatus* and *Rumex dentatus* are diuretic, refrigerant and used as cooling agent (Islam *et al*., 2006; Hussain *et al*., 2006). The root of *Rumex dentatus* is used as an astringent and in cutaneous disorders (Chopra *et al*., 1986). The root of *Rumex nepalensis* is purgative (Chopra *et al*., 1986; Manandhar, 2002). It is used as a substitute for *Rheum* spp., (Chopra *et al*., 1986). A strong decoction is applied to dislocated bones. Root paste is applied externally to relieve headaches. Plant decoction is used to alleviate body pain (Manandhar, 2002). The leaves of *Persicaria maculosa* are astringent, rubefacient and vermifuge (Foster & Duke, 1990). An infusion has been used for gravel and stomach pains. Plant decoction is mixed with flour, has been used as a poultice to relieve pain and for rheumatism. The dried leaves are rubbed on poison ivy rash (Moermann, 1998). The roots of *Polygonum plebejum* are used in bowel complaints. The dried plant powder is taken internally in pneumonia (Baquar, 1989; Arshad & Rao, 1998). The root of Indian rhubarb is darker, inferior in aroma, is a well known stomachic, bitter and cathartic and used all over the world (Thakur *et al*., 1989). Adetuyi and Akpambang (2006) reported moisture, ash, crude fat, crude fiber, protein and carbohydrate in *Sorghum bicolor*. Alfawaz (2006) reported protein value 17.1–20.1 g/100 g, moisture 87.8–93.5 g/100 g, ash 14.6–19.6 g/100 g and lipids 3.1–3.8 g/100 g in *Rumex vesicarius*. Protein was highest in leaves and lowest in stems. Dastagir & Pervez (2004) reported C, O, Mg, Al, Si, K, Ca, Fe, S, Na, Cl, B, P and Zn in different parts of *Alstonia scholaris*. Bibi *et al*., (2006) reported C, O, Na, Mg, Al, Si, Cl, K, Ca and Fe in different parts of *Viola odorata*. Naseem *et al*., (2006) reported carbohydrates 7.16%, crude fibers 27.2%, moisture 63.10%, ash 5.67% and crude fats 6.36%.

Materials and Methods

Sources of plant materials: *Persicaria maculosa* S.F. Gay., Linn., *Rumex hastatus* D. Don, *Rumex dentatus* Linn., *Rumex nepalensis* Spreng, *Polygonum plebejum* R. Br were collected from Peshawar University Campus and *Rheum australe* D. Don was collected from Gharam Chasma (Chitral) in March – November 2005. These plants were identified with the help of Flora of Pakistan (Ali & Qaiser, 2007). These plants were shade dried at temperature (28–30^{o}C) for 14 days.

Nutritional analysis: Ash contents, moisture contents, crude protein by Macrokjeldahl method, fats or ether extracts, crude fibers and carbohydrates were determined by standard methods following AOAC (Anon., 2000).

Elemental analysis: The elemental analysis was done at Centralized Resource Lab., University of Peshawar, using Energy Depressive X-Rays Spectrometer (EDX), Model (Inca, 200), Company Oxford instruments made in U.K. The EDX was attached to the Scanning Electron Microscope (SEM) and used for analysis. For analysis powdered specimen was transferred to a metallic stub using a double-sided cello tape and coated with gold by using (JEE-420) Model Vacuum Evaporator (JEOL). Finally, the examination was carried out on EDX used for analysis, attached to electron microscope (J.S.M. 5910). The elemental analysis was done for roots, stems, leaves, petioles and flowers of all the 6 species.

Results

Nutritional analysis: The ash content in *Persicaria maculosa* was 14.98% in roots, 11.24% in flowers, 12.50% in stems, and 14.88% in leaves, 14.22% in fruits and 13.20% in seeds (Table 1). The moisture was 7.40% in roots, 5.40% in stems, 6.53% in leaves, 4.80% in fruits, 6.57% in flowers, and 7.30% in seeds. Fat was 2.62% in stems, 3.18% in roots, 2.13% in flowers, 4.50% in leaves, 5.10% in fruits and 6.10% in seeds. Protein was 10.48% in roots, 6.50% in fruits, 7.70% in stems, 8.58% in leaves, 10.09% in flowers and 9.50% in seed. The crude fiber in roots and stems were 11.89% and 13.75%. Leaf contained 15.11% crude fiber. Flowers, fruits and seeds contained 15.50%, 10.73% and 12.19% fiber, respectively. Carbohydrate was 52.06% in root while in stems it was 57.95%. Leaves, flowers and fruits contained 50.40%, 54.50% and 58.64% carbohydrates, respectively. Seeds contained 51.66% carbohydrate.

The ash content in *Polygonum plebejum* was 11.88% in stems, 7.00% in flowers, 7.36% in roots, 8.18% in leaves, 10.54% in fruits and 9.15% in seeds. The moisture content was 14.88% in roots, 5.50 % in stems, 6.50% in leaves, 4.91% in fruits, 6.56% in flowers, and 7.14% in seeds. Fat in stems was 4.76%, 6.32% in roots, 15.36% in flowers, 6.02% in leaves, 11.33% in fruits and seed have 11.33% and 11.96% fat respectively. Protein in roots was 17.50% and in fruits 10.10%. Stem contained 14.52% protein and leaves contained 14.35% protein. Protein found in flower was 14.55% while in seed it was 15.00%. The crude fiber in root and stem was 6.86% and 18.93%. Leaf contained 8.13% crude fiber. Flower, fruit and seed contained 10.81%, 5.32% and 7.14% fiber, respectively. Carbohydrate was 47.08% in root while 44.50% in stem. Leaves, flowers and fruits contained 56.84%, 45.70% and 57.77% carbohydrate, respectively. Seed contained 49.60% carbohydrate.

The ash in *Rheum australe* was 10.25% in fruits, 8.65% in stems, 7.45% in leaves, in rhizomes it was 9.47%, in flowers it was 9.98% and in seeds it was 8.98%. The moisture content was in seed 9.86%, in flowers 6.28%, in stems 9.62%, in leaves 8.14%, in fruit 7.48% and in rhizomes 9.61%. Fat was 32.98% in stems, while it was 35.29% in rhizomes, 36.48% in flowers, leaves contained 31.45% fat, fruits and seeds have 35.95% and 32.96% fat, respectively. Protein in rhizomes was 6.40% and in fruits 2.96%. Stems contained 5.48% protein and leaves 5.32% protein. Protein found in flowers was 6.25% while in seeds it was 5.96%. The crude fiber in roots and stems was 13.85 % reported and 14.98% reported. Leaves contained 12.45% crude fiber. Flowers, fruits and seeds contained 17.94%, 15.93% and 17.18% fiber, respectively. Carbohydrate was 25.36% in rhizomes while in stems it was 28.26%. Leaves, flowers and fruits contained 35.16%, 23.04% and 27.40% carbohydrates, respectively. Seeds contained 25.02% carbohydrate.

Table 1. Nutritional analysis of the different parts of some members of the Polygonaceae.

Plant name	Part	Moisture	Ash	Protein	Fat & oil	Crude fiber	Carbohydrate
Persicaria maculosa S.F.Gay	Root	7.40	14.98	10.48	3.18	11.89	52.06
	Stem	5.40	12.50	7.70	2.62	13.75	57.95
	Leaf	6.53	14.88	8.58	4.50	15.11	50.40
	Flower	6.57	11.24	10.09	2.13	15.50	54.50
	Fruit	4.80	14.22	6.50	5.10	10.73	58.64
	Seed	7.30	13.20	9.50	6.10	12.19	51.76
Polygonum plebejum R. Br	Root	14.88	7.36	17.50	6.32	6.86	47.08
	Stem	5.50	11.88	14.52	4.76	18.93	44.50
	Leaf	6.50	8.18	14.35	6.02	8.13	56.84
	Flower	6.56	7.00	14.55	15.36	10.81	45.70
	Fruit	4.91	10.54	10.10	11.33	5.32	57.77
	Seed	7.14	9.15	15.00	11.96	7.14	49.60
Rheum australe D. Don	Rhizome	9.61	9.47	6.40	35.29	13.85	25.36
	Stem	9.62	8.65	5.48	32.98	14.98	28.26
	Leaf	8.14	7.45	5.32	31.45	12.45	35.16
	Flower	6.28	9.98	6.25	36.49	17.94	23.04
	Fruit	7.48	10.25	2.96	35.95	15.93	27.40
	Seed	9.86	8.98	5.96	32.96	17.18	25.02
Rumex hastatus D. Don	Root	20.22	5.25	13.65	2.54	19.37	39.04
	Stem	26.80	6.23	6.05	4.50	19.36	36.19
	Leaf	22.56	18.58	14.00	5.84	14.57	24.50
	Flower	20.50	8.66	9.50	3.54	18.65	39.24
	Fruit	24.01	9.73	13.59	4.57	15.06	33.04
	Seed	23.05	15.50	12.01	4.56	16.06	28.88
Rumex dentatus Linn	Root	9.33	8.37	10.58	14.66	10.65	46.40
	Stem	6.33	7.95	15.72	11.44	8.76	50.25
	Leaf	4.05	8.65	13.75	12.50	9.03	52.05
	Flower	5.86	7.50	14.76	13.00	10.88	40.00
	Fruit	6.23	6.99	10.50	11.80	11.67	52.84
	Seed	4.91	8.44	12.12	11.12	9.00	54.40
Rumex nepalensis Spreng	Root	4.79	6.40	11.12	15.57	13.50	48.62
	Stem	5.30	9.73	15.30	.18.69	10.78	40.20
	Leaf	3.50	8.11	13.95	17.54	15.38	41.52
	Flower	4.82	8.77	9.88	19.10	9.00	48.43
	Fruit	3.00	4.95	14.84	11.78	14.60	50.83
	Seed	3.40	5.47	18.53	13.80	17.40	41.40

The ash content in *Rumex hastatus* was 18.58% in leaves, 5.25% in roots, in6.23% stems and 8.66% in flowers. The ash content in fruits and seeds was 9.73 % and 15.50%. The moisture was 26.80 in stems 20.22% in roots, and in leaves 22.56% and 20.50% in flowers. The moisture content in fruits and seeds was 24.01% and 23.05%, respectively. The fat was 4.57% in fruits, 4.50% in stem and in root it was 2.54%. The fat present in flowers was 3.54% and in leaves 5.84%, while in seeds it was 4.56%. The protein was in leaves 14.00%, in roots 13.65%, and 6.05% in stems and 9.50 % in flowers. The protein in fruits and seeds was 13.59% and 12.01%. Crude fiber in roots was 19.37%, in leaves it was 14.57% and in stems it was 19.26%. The crude fiber in flowers was 18.65% and in fruits it was 15.06%. The seeds contained crude fiber 16.06%. Carbohydrate in fruits was 39.24%, 39.04% in roots and 24.50 % in stems. Leaves contained 24.50% carbohydrate. Flowers and seeds contained 33.04% and 28.88 %.

The ash content in *Rumex dentatus* in leaves was 8.65%, in roots it was 8.37 % and 7.59% in stems. The flowers contained 7.50% while the fruits contained 6.99% and in seed it was 8.44%. The moisture in roots was 9.33%, 6.23% in stems and 4.05% in leaves. Flowers and fruits contained 5.86% and 6.23 % moisture, respectively. It was

4.91% in seeds. The protein in stems was 15.72%, 10.58% in roots. 13.75% in leaves, 14.76% in flowers, 10.50% in fruits and 12.12% in seeds. The fat 14.66% in roots was and 11.44% in stems. 12.50% in leaves was Flowers and fruits contained 13.00% and 11.80%, respectively. Fat in seeds was 11.12%. Crude fiber in fruit was 11.67% in roots, stems and leaves it was 10.65%, 8.76% and 9.03 %, respectively. Crude fiber in flowers and seeds was 10.88% and 9.00%. Carbohydrate in seeds was 54.40% and 46.40 % in roots. Carbohydrate found in stems, leaves and flowers was 50.25%, 52.05% and 40.00%, respectively. It was 52.84% in fruits.

The ash content in *Rumex nepalensis* in stems was 9.73% and 6.40% in roots. Leaves contained 8.11% ash. Flowers, fruits and seeds contained 8.77%, 4.95% and 5.47%, respectively. The moisture was 5.30% in stems. In roots it was 4.79% and 3.50% in leaves. Flowers contain 4.82% moisture. Fruits and seeds contained 3.00% and 3.40%, respectively. The protein was 15.30% in stems, 11.12% in roots while in leaves it was 13.95 %. Flowers and fruits contained 9.88% and 14.84%. Seeds contained 18.53% protein. The fat was 19.10% in flowers, 15.57% in roots and in stems it was 18.69%, in leaves 17.54% and 11.78% in fruits. Seeds contained 13.80% fat. Crude fiber was 17.40% in seeds, 13.50% in roots while 10.78% in stems and 15.38% leaves. 9.00% in flowers and fruits and 14.60% in fruits. Carbohydrate was 50.83% in fruits, 48.62% in roots. Carbohydrates present in stems, leaves, flowers and seeds was 40.20%, 41.52%, 48.43% and 41.40% respectively (Table 1).

Elemental analysis: Elemental analysis showed that C, O and K were present in all parts of the *P. plebejum* while rests of the elements vary in different parts of the *P. plebejum.* Na was present in leaves. Mg, Al, Si, S, Cl, Ca and Fe were found in roots, stems and leaves. P was present in stems and leaves. Ti was only found in stems of *P. plebejum*. C, O, Si and K were present in all parts of the *Persicaria maculosa* while rests of the elements vary in different parts of the *Persicaria maculosa*. Na was found in roots. Mg was found in leaves and petioles. Al was absent in roots and flowers and but present in stems, leaves and petioles. Cl was present in roots, leaves and petioles. Ca was found in roots, stems, leaves and flowers and remained absent in petioles. Br was found only in flowers. C, O, Si and C were present in all parts of *Rumex hastatus* while rests of the elements varied in different parts of the *Rumex hastatus*. Na, P, S, Cl and Fe were present in roots, stems and leaves and was absent in petioles and flowers. Mg was absent only in petioles and was present in rest of the plant parts. Al and K were present in all parts of the plants except flowers. In *Rumex dentatus* C, O and K were present in all parts of the plant while rests of the elements vary in different parts of the plant. Si was absent only in petioles. Mg was present only in leaves. Ca was present in leaves and petioles and absent in roots, stems and flowers. Cl was absent in roots and leaves. In *Rumex nepalensis* C, O, Si and K were present in all parts of the plants. Na was present in stems and leaves and was absent in roots, petioles and flowers. Mg was present in petioles and flowers and remained absent in other parts of the plant. Al was absent in roots and flowers. S was only present in stems. Cl was present in stems, leaves, petioles and flowers. Ca was present in roots, petioles and flowers and was absent in stems and leaves. Fe was only present in petioles and remained absent in other parts of the plant. C, O, K and Ca were present in all parts of *Rheum australe* while rests of the elements vary in different parts of the *Rheum australe*. Si, Mg, Cl and Al were present in some and were absent in other plant parts. Si was present in all plant parts except stem. Mg and Cl were found in stems and were absent in other parts of the plant. Al was found in leaves and flowers and was absent from roots, stems and petioles (Table 2).

Table 2. Elemental analysis of the different parts some members of the Polygonaceae.

Plant name	Part	C	O	Na	Mg	Al	Si	S	P	Cl	K	Ca	Ti	Fe	Br
Polygonum plebejum	Root	41.65	41.85	-	0.68	0.54	1.68	0.37	-	0.46	4.45	7.68	-	0.65	-
	Stem	43.20	42.09	-	0.79	1.29	4.18	0.58	0.26	0.65	3.15	2.19	0.20	1.43	-
	Leaf	38.61	49.90	0.32	0.91	1.58	5.44	0.78	0.26	0.76	3.92	4.22	-	2.29	-
	Flower	38.71	56.02	-	-	-	-	-	-	-	4.97	-	-	-	-
Persicaria maculosa	Root	42.35	45.99	1.72	-	-	2.36	-	-	2.94	3.57	1.07	-	-	-
	Stem	40.99	48.03	-	-	0.95	1.60	-	-	-	4.94	3.49	-	-	-
	Leaf	45.45	46.60	-	0.99	1.00	1.95	-	-	0.86	1.23	1.93	-	-	-
	Petiole	39.58	37.49	-	0.71	13.78	1.09	-	-	0.79	6.57	-	-	-	-
	Flower	49.09	45.36	-	-	-	0.96	-	-	-	1.36	1.49	-	-	1.78
Rumex hastatus	Root	44.78	44.78	0.38	0.55	0.44	1.20	0.33	0.27	0.95	3.21	2.77	-	0.52	-
	Stem	42.48	42.48	0.59	0.46	0.29	1.32	0.45	0.27	1.61	6.10	1.51	-	0.58	-
	Leaf	38.32	41.82	0.26	1.43	1.24	4.26	0.47	0.39	0.68	6.09	3.28	-	1.65	-
	Petiole	36.11	50.34	-	-	2.12	4.56	-	-	-	3.17	3.70	-	-	-
	Flower	47.57	48.00	-	0.77	-	0.79	-	-	-	-	2.87	-	-	-
Rumex dentatus	Root	47.48	48.98	-	-	-	0.70	-	-	-	2.84	-	-	-	-
	Stem	40.58	49.05	-	-	-	1.38	-	-	1.30	7.70	-	-	-	-
	Leaf	48.60	43.68	-	1.23	-	3.95	-	-	-	1.04	1.51	-	-	-
	Petiole	42.13	51.19	-	-	-	-	-	-	1.64	2.40	2.63	-	-	-
	Flower	45.81	48.18	-	-	-	1.38	-	-	0.50	4.13	-	-	-	-
Rumex nepalensis	Root	46.71	46.02	-	-	-	1.17	-	-	-	3.46	2.64	-	-	-
	Stem	42.19	34.12	-	-	17.07	1.46	0.50	-	1.67	2.11	-	-	-	-
	Leaf	44.58	46.55	0.89	-	0.74	1.14	-	-	2.54	3.02	-	-	-	-
	Petiole	43.40	45.24	1.43	1.08	0.88	2.60	-	-	0.91	3.34	1.43	-	1.11	-
	Flower	40.57	48.20	-	0.75	-	1.22	-	-	1.65	4.80	2.81	-	-	-
Rheum australe	Rhizome	49.23	47.74	-	-	-	1.25	-	-	-	0.79	0.99	-	-	-
	Stem	43.14	49.59	-	0.94	-	-	-	-	0.80	4.37	1.16	-	-	-
	Leaf	50.22	44.41	-	-	0.72	1.39	-	-	-	1.26	2.00	-	-	-
	Petiole	40.50	46.95	-	-	-	1.20	-	-	-	6.11	5.24	-	-	-
	Flower	46.26	46.45	-	-	2.06	1.81	-	-	-	1.70	1.72	-	-	-

Discussion

Nutritional analysis: The ash content in *P. maculosa* was highest in roots and lowest in flowers. The moisture was highest in roots and lowest in fruits. Branvo (1967) reported water, protein, fat, carbohydrate, fiber and ash in *Polygonum aviculare*. Fat was lowest in flowers and highest in seeds. Protein was highest in roots and lowest in fruits. Irvine (1952) reported carbohydrate, fat and ash in *Polygonum hydropiper*. The crude fiber was lowest in fruits and highest in flowers. Carbohydrate was highest in fruits and was lowest in leaves (Table 1). Read (1946) reported fat, tannin, sugar, pectin and cellulose in *Persicaria maculosa*.

The ash content in *P. plebejum* was highest in stems and lowest in flowers. The moisture content was highest in roots and lowest in fruits. Hooper (1904) reported water, fat, albumenoids, carbohydrate, fiber and ash in *Polygonum stagninum*. Fat was lowest in stems and highest in flowers. Protein was highest in roots and lowest in fruits. Adetuyi & Akpambang (2006) reported moisture, ash, crude fat, crude fiber, protein and carbohydrate in *Sorghum bicolor*. Saxena (1979) reported ash and albumenoids in *Calligonum polygonoides*. The crude fiber was highest in stems and lowest in fruits. Carbohydrate was highest in leaves and lowest in stems (Table 1). Duke & Ayensu (1985) reported water, protein, fat, carbohydrate, fiber and ash in *Polygonum bistorta*.

The ash content in *R. australe* was highest in fruits and lowest in leaves. The moisture was highest in seeds and lowest in flowers. Liu *et al*., (1998) reported oils from *Rheum wittrochii*. Fat was highest in flowers and lowest in leaves. Protein was highest in rhizomes and lowest in fruits. Lin *et al*., (1998) reported 18 amino acids from *Rheum wittrochii*. The crude fiber was highest in flowers and lowest in leaves. Carbohydrate was highest in leaves and lowest in flowers (Table 1). Irvine (1952) reported carbohydrate, fat and ash in *Polygonum hydropiper*. Naseem *et al*., (2006) reported carbohydrates 7.16% crude fibers 27.2%, moisture 63.10%, ash 5.67% and crude fats 6.36%.

The ash content in *Rumex hastatus* D. Don was highest in leaves and lowest in roots. The moisture content was highest in stem and lowest in roots. Alfawaz (2006) reported protein value 17.1–20.1 g/100 g, moisture 87.8–93.5 g/100 g, ash 14.6–19.6 g/100 g and lipids 3.1–3.8 g/100 g in *Rumex vesicarius*. Protein was highest in leaves and lowest in stems. The fat was highest in leaves and lowest in roots. Gupta (1962) reported water, fat, albumenoids, carbohydrates, fibers and ash in *Alternanthera sessilis*. Crude fiber was highest in roots and lowest in leaves. Carbohydrate was highest in flowers and lowest in leaves (Table 1). Duke & Ayensu (1985) reported fats, carbohydrates, water, protein, ash and fiber in *Rumex crispus*.

The ash content in *R. dentatus* was highest in leaves and lowest in fruits. The moisture is highest in roots and lowest in leaves. Read (1946) reported protein, fat, carbohydrate and ash in *Amaranthus blitum*. The protein was highest in stems and lowest in fruits. Kononov *et al*., (2005) reported that the highest dry weight yield (8.8 t/ha) was achieved using *Medicago falcata*; the highest crude protein yield (1.58 t/ha) was obtained for *Rumex acetosa*. The authors state that crops such as *Melilotus*, *Amaranthus*, *Raphanus sativus* var. *oleifera*, *Glycine hispida [Glycine max]*, *Rumex tianschanicus*, *M. falcata*, *Isatis tinctoria* and *Sida* can give a crude protein yield of 0.5-1.5 t/ha and can be cultivated in the region alongside the more common peas and lucerne. The fat was highest in roots and lowest in seeds. Crude fiber was highest in fruits and lowest in stems. Crude fiber was in highest fruits and lowest in stems. Carbohydrate was highest 54.40%

in seeds and 46.40% in roots. Carbohydrate was highest in seeds and lowest in leaves (Table 1). Liu *et al*., (1998) reported oils from *Rheum wittrochii* Lundstr.

The ash content in *R. nepalensis* was highest in stems and lowest in fruits. The moisture was highest in stems and lowest in fruits. The protein was highest in seeds and lowest in flowers. Khodzhaeva *et al*., (2002) reported the content and composition of lipids, proteins, flavonoids and carbohydrates in the aerial part of the *Rumex confertus* (*Rumex K-I*). The fat is highest in flowers and lowest in fruits. Gupta (1962) reported protein, fat, carbohydrate, ash and water in *Chenopodium album*. Crude fiber was highest in seeds and lowest in flowers. Carbohydrate was highest in fruits and lowest in stems (Table 1).

Elemental analysis: Elemental analysis showed that C and O were present in all parts of *P. plebejum, P. maculosa, R. hastatus, R. dentatus, R. nepalensis* and *R. australe* while rest of the elements varied in different parts of these plants (Table 2). Na was present in root, stem and leaf of *R. hastatus*; leaf and petiole of *R. nepalensis*; leaf of *P. plebejum* and root of *P. maculosa*. It was absent in petiole and flower of *R. hastatus*; root, stem and flower of *R. nepalensis*; root, stem and flower of *P. plebejum* and stem, leaf, petiole and flower of *P. maculosa*. It is totally absent from *R. dentatus* and *R. australe* (Table 2). Said *et al*., (1996) reported Cu, Mg, Zn, Fe, Cr, and Mn in *R. emodi*. Mg was present in root, stem, leaf and flower of *R. hastatus*; leaf of *R. dentatus*; petiole and flower of *R. nepalensis*; stem of *R. australe*; root, stem and leaf of *P. plebejum* and leaf and petiole of *P. maculosa*. It was absent from petiole of *R. hastatus*; root, stem, petiole and flower of *R. dentatus*; root, stem and leaf of *R. nepalensis*; root, leaf, petiole and flower of *R. australe;* flower of *P. plebejum;* root, stem and flower of *P. maculosa* (Table 2). Garg *et al*., (2007) reported that *Nordostachys jatamansi* (Jatamansi) often used as antibacterial, antipyretic and heart tonic is specially enriched in Co, Cr, Cu, Na, Mn, Fe, Rb and Zn. Al was present in root, stem, leaf and petiole of *R. hastatus*; stem, leaf and petiole of *R. nepalensis*; leaf and flower of *R. australe*; root, stem and leaf of *P. plebejum* and stem, leaf and petiole of *P. maculosa*. It was absent from flower of *R. hastatus*; root and flower of *R. nepalensis*; root, stem and petiole of *R. australe*, flower of *P. plebejum* root and flower of *P. persicaria*. It was totally absent from *R. dentatus* (Table 2). Si was found in all parts of *R. hastatus*, *R. nepalensis* and *P. maculosa*. It was present in all parts except the petiole of *R. dentatus*. It was present in root, stem, leaf and was absent in flower of *P. plebejum*. It was present in all parts except the stem of *R. australe* (Table 2). Gul *et al*., (2006) reported chloride, nitrogen and potassium from *Nicotiana tabacum.* P was found in root, stem and leaf of *R. hastatus* and stem and petiole of *P. plebejum*. It was absent in petiole and flower of *R. hastatus* and root and flower of *P. plebejum.* It was absent from *R. dentatus, R. nepalensis, R. australe* and *P. maculosa*. S was present in root, stem and leaf of *R. hastatus*; stem of *R. nepalensis*; root, stem and leaf of *P. plebejum.* It was absent from petiole and flower of *R. hastatus*; root, leaf, petiole and flower of *R. nepalensis* and flower of *P. plebejum.* It was totally absent from *R. dentatus, R. australe* and *P. maculosa* (Table 2). Blackwell (1990) reported Fe, Mg, Mn and K from rhizomes of *Rheum palmatum*. Cl was present in root, stem and leaf of *R. hastatus*; stem, petiole and flower of *R. dentatus*, stem, leaf, petiole and flower of *R. nepalensis*; stem of *R. australe*; root, stem and leaf of *P. plebejum* and root, leaf and petiole of *P. maculosa*. It was absent from petiole and flower of *R. hastatus*; root and leaf of *R. dentatus*; root of *R. nepalensis*; root, leaf, petiole and flower of *R. australe*; flower of *P. plebejum* and stem

and flower of *P. maculosa* (Table 2). Cheeke (1998) reported Cd and Ca from the petioles of *Rheum rhabarbarum*. K was present in all parts of *R. dentatus*, *R. nepalensis*, *R. australe*, *P. maculosa* and *P. plebejum*. It was present in all parts of *R. hastatus* except flower (Table 2). Bibi *et al*., (2006) reported C, O, Na, Mg, Al, Si, Cl, K, Ca and Fe in different parts of *Viola odorata*. Ca was present in all parts of *R. hastatus* and *R. australe*; leaf and petiole of *R. dentatus*; root, petiole and flower of *R. nepalensis*; root, stem and leaf of *P. plebejum* and root, stem, leaf and flower of *P. maculosa*. It was absent from root, stem and of *R. dentatus*; stem and leaf of *R. nepalensis*; flower of *P. plebejum* and petiole of *P. maculosa* (Table 2). Fe was found in root, stem and leaf of *R. hastatus*; petiole of *R. dentatus* and root, stem and leaf of *P. plebejum*. It was absent from petiole and flower of *R. hastatus*; root, stem, leaf and flower of *R. nepalensis* and flower of *P. plebejum*. It was totally absent from *R. dentatus*, *R. australe* and *P. maculosa*. Ti was only found in stem of *P. plebejum* and was absent in all parts of *P. plebejum*. It was totally absent from other plant parts (Table 2). Dastagir & Pervez (2004) reported C, O, Mg, Al, Si, K, Ca, Fe, S, Na, Cl, B, P and Zn in different parts of *Alstonia scholaris*. Br was present in flower of *P. maculosa* and was absent in other parts of plant. It was totally absent from other plant parts (Table 2).

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