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Evaluation of primary metabolites from selected medicinal plants

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ABSTRACT

The developing countries mostly rely on traditional medicines. The traditional medicines involve the use of different plant extracts or the bioactive constituents. This type of studies provides health applications at affordable costs. Biochemical studies of the individual plant parts is a necessary prerequisite in order to evaluate their importance in the over all metabolism of the plant. In the present study various plant parts of selected medicinal plants were evaluated, separately for their metabolite content. Maximum amount of total soluble sugars and lipids were present in leaves of *Rumex vesicarius*, starch in stem of *Sisymbrium irio*. The leaves of *Rumex vesicarius* showed more content of metabolites as compared to the other plant parts.

Introduction

Biochemical studies of the individual plant parts is a necessary prerequisite in order to evaluate their importance in the over all metabolism of the plant, as well as the role of specific substances that may be produced as direct or indirect products of metabolism in same physiological processes. Metabolism comprises coordinate series of coupled enzymatic conversions in living organisms. Hence, carbohydrates, proteins, amino acids, chlorophyll, vitamins, hormones, phenols etc are basic building blocks of plant without which the plant life is hampered.

There are hundreds of medicinal plants that have a long history of curative properties against various diseases and aliments. Plants have formed the basis of sophisticated traditional medicine systems among which are Ayurvedic, Unani, and Chinese. These systems of medicine have given rise to some important drugs which are still in use [Ramchandra and Ravishankar, 2002]. Primary metabolites are substances widely distributed in nature, occurring in one form or another in virtually all organisms. In plants such compounds are often concentrated in seeds and vegetative storage organs and are needed for physiological development because of their role in basic cell metabolism [Sagwan et al., 2011]. The studies of primary metabolites have been carried out in some plants in the past such as *Nerium indicum, Gloriosa superba, Ricinus communis, Euphorbia hirta, Pongamia pinnata, Digera muricata.*[Khandelwal et al., 2011]

Phytochemicals are naturally occurring biochemical in plants that give plants their color, flavor, smell and texture. Preliminary phytochemical screening of medicinal plants is a useful method for qualitatively determination of different metabolite in crude sample. Many primary metabolites lie in their impact as precursors or pharmacologically active metabolites in pharmaceutical compounds such as antipsychotic drugs [Sanchez and Demain, 2008].

Rumex vesicarius L. is a wild edible plant used as a sorrel and collected in spring time and eaten fresh , or cooked. *Rumex vesicarius* L. has many important medicinal uses such as treatment of tumors, hepatic diseases, bad digestion, constipation, calcules, heart troubles, pains, diseases of the spleen, hiccough, flatulence, asthma, bronchitis, dyspepsia, piles, scabies, leucoderma, toothache and nausea. The plant also used as cooling, laxative, stomachic, tonic, analgesic, appetizer, diuretic, astringent, purgative, antispasmodic and antibacterial agents [Mostafa et al., 2011].

The seeds of *Sisymbrium irio* L. (Brassicaceae) are attributed with varied medicinal properties in the Unani system of medicine. These are used for the treatment of inflammatory conditions. Crude extracts of the seeds were tested for antipyretic, analgesic and antimicrobial effects. Ethanolic extract of seeds exhibited marked antibacterial action, and also elicited antipyretic and analgesic effects. [Sener, 1988].

Materials and Methods

Experimental Plants

Plant material was collected from the hills of Jaipur. *Rumex vesicarius* (RUBL 21074) was authenticated by Herbarium, Department of Botany, Rajasthan University, Jaipur, Rajasthan, India and *Sisymbrium irio* (BSI/AZC/I.12012/TECH/2011-12/708) was authenticated by Botanical Survey of India, Jodhpur, Rajasthan, India.

The stem, leaf and flowers of *Rumex vesicarius* and *Sisymbrium irio* washed using distilled water and were shade dried for 24 hours in a drying chamber at 40-50^{o}C and powdered using a mechanical blender (Chase *et al.*, 1949). The resultant was then subjected for successive extraction with petroleum ether, benzeze, chloroform, acetone, alcohol, and water with soxhlet apparatus. The extracts were then concentrated in vacuum under reduced pressure using rotary flash evaporator and dried in desiccators. The extractive values were deduced using following formula:

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Yield (%) = Dry weight of extract/Dry weight of plant powder×*100*

These extracts were then subjected to preliminary phytochemical screening for the detection of various plant constituents. Each of these extracts was processed further to evaluate the presence of carbohydrates, proteins, tannins and flavonoids following the established protocols (Kokoshi *et al*., 1949).

Analysis of primary metabolites of selected medicinal plants

The quantitative estimation of primary metabolites was carried out using different protocols. The powdered plant parts used for analysis of carbohydrate (Dubois et al., 1951), protein (Lowry et al., 1951), lipids (Jayaraman, 1981), starch (Dubois et al., 1951) and phenol (Bray and Thorpe, 1954), chlorophyll (Holden, 1960), ascorbic acid (Roe and Kuenthar, 1943), carotenoids (Kirk and Allen, 1965) and DNA and RNA (Jensen,1956) respectively. All experiments were repeated in triplicate and means (±SD) were calculated.

Results

The shade dried plant material subjected to sequential extraction in petroleum ether, benzeze, chloroform, acetone, alcohol, and water . Maximum yield were found in water extract (3.089%) and Alcohol(9.89%) in *R. vesicarius* and *S. irio* respectively. Total extractive values are shown in **Table 1 and 2.**

Preliminary phytochemical investigation revealed that aqueous extract of *S. irio* contains carbohydrates and proteins, alcoholic extract of *S. irio* contains tannin and flavonoids and Maximum intensity of carbohydrates and proteins present in aqueous extract and tannin and flavonoids in alcoholic extract of *R. vesicarius.*

The various plant parts of the experimental plants exhibited variation in total levels of various metabolites **(Table 3)**

In the present investigation maximum starch was observed in stem of *S. irio* and minimum in flowers of *Rumex* while soluble sugars were found to be maximum in leaves of *R. vesicarius* and minimum in stem of *S. irio*. Ascorbic acid and Protein were found to be maximum in leaves of *R. vesicarius* and minimum in stem of *S. irio*. Lipids were maximum in leaves of *S. irio* and minimum in stem of *R. vesicarius.* Leaves of *R. vesicarius* had maximum phenols while minimum in stem of *S. irio*. Total amount of various nucleic acid which are backbone of building material in plants were found o be maximum in leaves of *R. vesicarius* and minimum in flowers of *S. irio* and stem of *R. vesicarius* respectively. Overall leaves of *R. vesicarius* had maximum content of total level of primary metabolites and minimum were in stem of *S. irio*

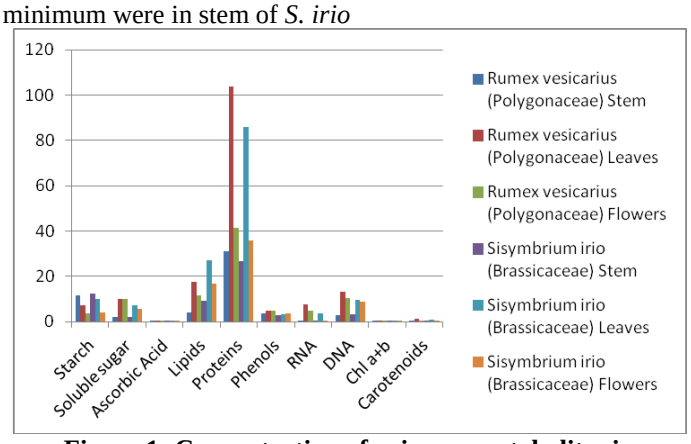

Figure 1: Concentration of primary metabolites in *R.vesicarius* and *S.irio* (mg/gdw)

Discussion

Niranjan and Katiyar (1979) evaluated the range of crude proteins (22-31%), total carbohydrates (9.68-11.80%) and total lipids (1.61-3.91%) in selected leguminous plants. Stem, leaves and seeds of *M.sativa* contained total soluble sugars and protein, which were found to be higher than those reported by (Duke, 1981a, 1982b). Aerial plant parts and seeds of *T. foenumgraecum (fenugreek)* also showed higher amount of total carbohydrates and protein compared to the amount reported earlier by Duke & Ayensu, (1985). Many primary metabolites lie in their impact as precursors or pharmacologically active metabolites in pharmaceutical compounds. Plant synthesizes primary metabolites (lipid, protein, starch, sugars, phenol etc.) for the normal growth and development of itself. Many polysaccharides purified from Chinese medicinal herbs and phenols are bioactive and possess immuno-modulating, anti-tumor and antibacterial activities. In addition, the results confirm the use of the plant in traditional medicine. The plant parts varied in composition of their primary metabolites. The quantitative estimation of the primary metabolites yields of chemical constituents of the plants studies showed that the leaves and stems were rich in soluble sugar, starch, protein, lipid and phenol. The investigation can be subjected to the therapeutic uses and carry out further pharmacological evaluation.

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Table 1 : Physico-chemical tests of *Sisymbrium irio*:

	EXTRACTIVES					
	Petroleum ether	**Benzene**	**Chloroform**	**Acetone**	**Alcohol**	**Aqueous**
Total % by weight	1.890	0.768	0.456	0.501	2.432	3.089
Carbohydrates	-	+	++	+	++	+++
Proteins	-	-	+	-	+	+++
Tannins	-	+	-	-	++	-
Flavonoids	-	-	-	-	++	+

Plant material in g/dry wt. = 50 g

Total % of extractives = 17.78; Total % of ash values = 7.87; Relative intensity of the test = +/++/+++

Table 2 : Physico-chemical tests in *Rumex vesicarius*:

	Extractives					
	Petroleum ether	**Benzene**	**Chloroform**	**Acetone**	**Alcohol**	**Aqueous**
Total % by weight	1.089	0.998	1.012	0.453	9.89	3.11
Carbohydrates	-	+	++	+	+++	+++
Protein	-	-	-	-	++	++
Tannins	-	-	-	-	++	-
Flavonoids	-	-	+	+	+	++

Plant material in g/dry wt. = 50 g

Total % of extractives 18.987; Total % of ash values = 4.765; Relative intensity of the test = +/++/+++

Table 3. Total of various primary metabolites in selected plants

Plant Species	***Rumex vesicarius* (Polygonaceae)**			***Sisymbrium irio* (Brassicaceae)**		
Primary metabolites (in mg/gdw)	Stem	Leaves	Flowers	Stem	Leaves	Flowers
Starch	11.6±0.21	7.1±0.6	3.54±0.98	12.3±0.48	9.84±0.11	4.08±0.9
Soluble sugar	2.03±0.09	10.08±0.44	9.98±0.37	1.89±0.62	7.39±0.22	5.78±0.18
Ascorbic Acid	0.41±0.04	0.64±0.30	0.48±0.69	0.05±0.03	0.11±0.09	0.03±0.95
Lipids	4.07±0.10	17.75±0.3	11.71±0.53	9.4±0.03	27.21±0.56	16.8±0.52
Proteins	31.09±0.34	103.67±1.76	41.33±0.82	26.6±0.91	85.89±1.07	35.7±0.45
Phenols	3.56±0.56	4.97±0.94	4.77±0.67	2.9±0.16	3.07±0.83	3.56±0.23
RNA	0.56±0.90	7.57±0.37	4.89±0.41	0.27±0.17	3.56±0.23	0.12±0.63
DNA	2.78±0.45	13.25±0.16	10.34±0.38	3.44±0.07	9.78±0.14	8.71±0.62
Chl a+b	0.19±0.11	0.211±0.09	0.092±0.81	0.27±0.05	0.657±0.34	0.18±0.81
Carotenoids	0.34±0.07	1.077±0.22	0.49±0.76	0.29±0.24	0.89±0.17	0.34±0.76

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