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Determination of Some Elements in Seeds of Rose Species by WDXRF Spectrometry

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The metals content in seeds of six rose species (*Rosa canina* L., *Rosa dumalis* subsp. *boissieri* L., *Rosa dumalis* subsp. *antalyensis* L., *Rosa villosa* subsp. *villosa* L., *Rosa pisiformis* (Christ) D. Sosn and *Rosa pulverulanta* Bieb.) which found in same collection orchard in Agricultural Faculty of Ataturk University were determined semi quantitatively by using Wave-dispersive X-ray fluorescence spectrometer (WDXRF). A qualitative analysis of spectral peaks showed that there were differences among species in terms of percentage of P, K, Ca, Mg, S, Ba and Sr in its seeds.

Key Words: Rose hip, Dogroses, Elemental analysis, Wave dispersive X-ray fluorescence spectrometer.

INTRODUCTION

The genus *Rosa* contains approximately 100 species that are widely distributed in Europe, Asia, the Middle East and North America. The Anatolia region of Turkey is one of the major genetic diversity centers of *Rosa* species[1] and most of the rose species growing in this area have arisen from seed. Twenty-five rose species have been reported in Turkey[2]. These 25 species are distributed over more than half the country and the Eastern and Middle Anatolia region has the largest native rose population[2]. In most parts of Anatolia, wild roses have been gathered for their fruits from scattered sites since ancient times. Flowers of some rose species, such as *Rosa gallica* and *Rosa damascena*, have been used for rose oil and rose water production in Anatolia for a long time. Fruits (rose hip) of some other species have economic value and are also used for medicinal purposes[2].

The fruit of the wild rose, the rose hip, is extremely favoured, has been gathered by peasants for a long time in Turkey and is an excellent source of vitamins A, B3, C, D and E, as well as bioflavonoids, citric acid, flavonoids, fructose, malic acid, tannins and zinc[3]. The fruits are commonly used to make jam, marmalade, fruit juice *etc.*[4], while the dried fruits and roots are excellent for making tea[5].

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The fruits (rose hip) include average 40 seeds per fruit. Approximately 30-35 % of fruit made up of seed while the remaining 65-70 % is pericarp[6]. The seeds of rose hips are also considered a low-value by-product that may used in animal feeds as an energy source in diets in particular eastern part of Turkey where roses were abundant. Some villages in this region, during processing, seeds of rose hips are crushed and used for animal nutrition or burned. Rose hip seeds contain 6.9-8.6 % oil (mainly unsaturated fatty acids), 6.9-8.6 % protein and 0.22-0.44 mg of ascorbic acid/per 100 g seed[7].

The osmotic, structural and biochemical functions of elements are very important in the livestocks, because the elements contribute formation of osmotic balance in their tissues and cells. They have a role in the formation of important biomolecules as protein, nucleic acid and lipid as well. They also participate in the formation of several enzymes by binding to specific proteins as prosthetic group (cofactor) and in the formation of NADP and ATP, which have important roles in energy metabolism and redox reactions[8].

The advent of commercially available wave dispersive spectrometers for X-ray fluorescence (XRF) measurements provide an economical and powerful tool for environmental, clinical, chemical, geological and industrial analysis. XRF is a non-destructive, fast, multi-element technique for analyzing the surface layer and determining major, as well as minor some trace elements in thin and thick samples of all sizes and forms. Although XRF spectrometry measurement is simple for a quantitative study, accurate quantitative measurements often depend on matrix correction procedures which require a large number of standards. One of the major problems posed by geological materials is the sample preparation. Since the beginning of the application of XRF technique as an analytical tool, a great deal of research has been done in mineralogical and biological materials by different workers[9-23].

The purpose of present investigations is to determine and compare the metals from a typical waste material: Rose hip seed.

EXPERIMENTAL

The following instrumental contents were used: a sieve (RETSCH); a digital scale (OHAUS TS 120); a hydraulic press (SPEX $P_{max} = 3.5 \times 10^7$ kg/m^2); a wavelength dispersive spectrometer (Rigaku ZSX-100e with Rhodium target X-ray controlled by a Software ZSX computer).

Rose species: *Rosa canina* L., *Rosa dumalis* subsp. *boissieri* L., *Rosa dumalis* subsp. *antalyensis* L., *Rosa villosa* subsp. *villosa* L., *Rosa pisiformis* (Christ) D. Sosn and *Rosa pulverulanta* Bieb.

At first, the sample was dried in porcelain crucibles at 50 ºC for 1-2 h. To obtain a XRF-pellet, a small metallic sample holder made of aluminium with a diameter of about 3.0 cm was used. The pellets were pressed at 3.5×10^7 kg/m^2 in a Spex hydraulic press for 30-50 s.

WDXRF Spectrometry was employed for analysis of rose hip seed samples by using the semi-quantitative method[12]. The measurements were performed using a ZSX 100e sequential spectrometer equipped with Rh X-ray tube operated. Working conditions of the apparatus are shown in Table-1.

TABLE-1
EXPERIMENTAL CONDITIONS FOR EACH CHEMICAL ELEMENT

Element	Line	Crystal	Attenuator	Slit	Detector	V (kV)	I (mA)	Angle 2θ
P	Kα	GE	1—1	STD.	Flow	30	120	141.065
K	Kα	LIF1	1—1	STD.	Flow	40	90	136.675
Ca	Kα	LIF1	1—1	STD.	Flow	40	90	113.125
Mg	Kα	TAP	1—1	STD.	Flow	30	120	45.275
S	Kα	GE	1—1	STD.	Flow	30	120	110.820
Ba	Kα	LiF1	1—1	STD.	Scintillate	50	72	10.848
Sr	Kα	LiF1	1—1	STD.	Scintillate	50	72	24.987

Quantitative determination of elements is an important task in industrial, chemical, environmental, mineralogical, physical, medical and other fields. Among the methods of elemental analysis are atomic absorption spectrometry, neutron activation analysis and XRF.

The average results of the concentration determination of elements in the seeds of six rose species are shown in Table-2. As a test of the sample homogeneity, sets of measurements were made for all samples at different mixing times. Each sample was analyzed and it appeared that all the results are in good agreement. Based on these results, it is assumed that the samples are homogeneous.

RESULTS AND DISCUSSION

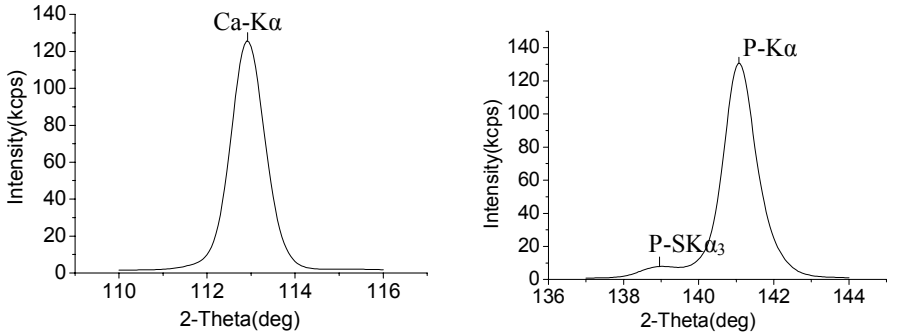
There are differences between species in terms of per cent of element content in its seeds. Among six rose species, with similar ecological conditions and soils, phosphorus, potassium and calcium values, which are very important for animal diet, varied from 10.24 % (*Rosa villosa* subsp. *villosa*) to 12.33 % (*Rosa dumalis* subsp. *boissieri*); 21.52 % (*Rosa dumalis* subsp. *antalyensis*) to 32.41 % (*Rosa dumalis* subsp. *boissieri*) and 29.69 % (*Rosa villosa* subsp. *villosa*) to 43.04 % (*Rosa dumalis* subsp. *antalyensis*), respectively (Table-2 and Fig. 1). *Rosa dumalis* subsp. *antalyensis* seeds accumulated more magnessium (10.94 %) in its seeds than the other species (Table-2). Thus this species is completely consequence of better magnesium accumulating capability than the other species.

As well known carbon is the main element in all kind of plant tissues with *ca.* 60 %. The other percentage comprises with P, K, Ca, Mg and the other elements. In this study, we ignored the C, H, O and elements in rose species because some elements present in rose species are in minor portion. Finally, we have been able to prepare a table apparently including minor elements with relatively higher percentage.

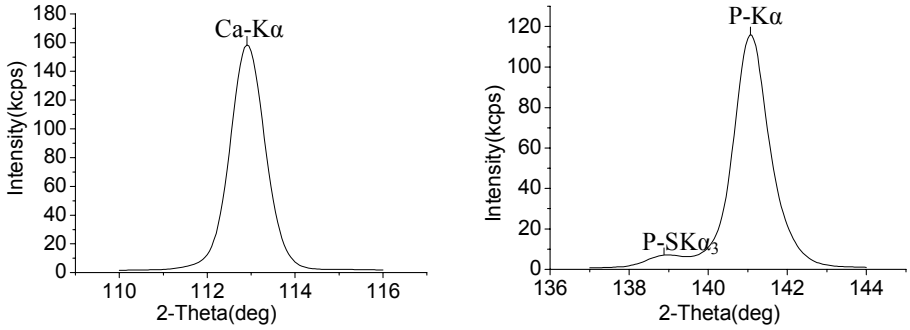
TABLE-2
WEIGHT CONCENTRATION OF ELEMENTS IN SEEDS OF DIFFERENT ROSE SPECIES

Species	Concentration (%)						
	P	K	Ca	Mg	S	Sr	Ba
R. canina	11.20	20.39	31.19	7.10	7.38	0.16	ND
R. dumalis boissieri	12.33	32.41	35.69	8.59	7.47	0.17	ND
R. dumalis Antalyensis	12.06	21.52	43.04	10.94	7.81	0.24	0.67
R. villosa subsp.villosa	10.24	26.01	29.69	6.29	7.82	0.13	ND
R. pisiformis	12.16	25.34	40.22	9.52	8.44	0.17	ND
R. pulverulanta	11.16	25.72	42.11	8.18	8.47	0.21	ND

ND = Not determined.



(a)



(b)

Fig. 1. Kα X-ray peaks of Ca and P in the (a) *Rosa dumalis* subsp. *boissieri* L, (b) *Rosa pulverulanta* Bieb. by using WDXRF spectrometry

In present study 6 different rose species found same ecological conditions. Therefore, the effects of ecology on elements content are highly eleminated. The differences of element contents of different rose species belonging to the same genus living in the same habitat could be explain due to genetic origin. Therefore,

by using in particular Ca, K and Mg values, WDXRF analysis may be helpful in the comparison of different rose species for element content. As a conclusion, the seed of rose hip fruit is a typical waste material obtained annually in large amounts as by-products of the canning factory. The present results showed that rose hip seeds is not waste material and have notable nutritient elements. Therefore farmers should use *Rosa dumalis* subsp. *antalyensis*, *Rosa pulverulanta* and *Rosa pisiformis* to obtain higher calcium and use *Rosa dumalis* subsp. antalyensis to obtain higher magnesium in rose hip seeds to add it livestocks diet for feeding. Because calcium is responsible for bone development and magnesium involves enzyme formation is very important essential elements in diet for livestocks.

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