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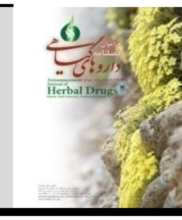

Investigation of mineral composition of some wild Sumac (*Rhus coriaria* L.)

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ABSTRACT

Background & Aim: *Rhus coriaria* L. (sumac) is usually a wild plant and classified in Anacardiaceae family. The fruits are used as a medicine for curing fever, diarrhea, stomachache, dermatitis disease and some other important disease like cancer, stroke, diabetes and liver disease. In this study, some Iranian wild sumac ecotypes were investigated in terms of mineral compositions. Detecting medicinal plants chemical composition is useful for phytochemical scientific source.

Experimental: Mature and ripe fruits were collected and dried in laboratory condition, and then the minerals content like Ca, Cu, Fe, Mg, Mn, Na, P, K, and Zn were determined by atomic absorption spectrophotometer.

Results: In Yahya-Abad samples, potassium, sodium, zinc, phosphorous and manganes were the most abundant minerals. The amount of calcium in Yahya-Abad samples and Firizhand samples was the highest. In Firizhand samples the amount of copper and magnesium were higher than other ecotypes and in Malmir samples, iron was significantly higher than other ecotypes. Also, results from this study indicated that all samples are significantly different from each other in terms of mineral elements. The samples from Yahya-Abad was found to contain appreciable amounts of different minerals.

Recommended applications/industries: Minerals are vital chemical elements for the human health and must be in the diet. These findings would be useful for food scientists and nutritionists interested in the nutritive value of plants.

1. Introduction

Rhus coriaria L., usually known as sumac, belongs to Anacardiaceae family and grows wild in the Mediterranean bordering countries, Iran and Afghanistan (Raynead and Mazza, 2007; Ozcan and Haciseferogullari, 2004). This plant is growing in marginal agricultural areas in temperate and tropical regions (Nasar-Abbas and Halkman, 2004). *Rhus coriaria* L. is a shrub or small tree with small oval leaflets and white flowers. The fruits are red when ripe (Unver and Ozcan, 2011).

Medicinal plants are one of the main rich source of genetic diversity and are really valuable in all countries (Ghasemi, 2011). Sumac is a kind of medicinal plant that also has been used in traditional food as a seasoning spice for a long time (Ali-Shtayeh, 2008). From all parts of this plant (leaves, bark, roots, fruits and branches) various medicinal and nutritional metabolites (tannins, anthocyanins, essential oils, fatty acids and minerals) were identified (Shabir, 2012). The fruits are used as a medicine for curing fever, diarrhea, stomachache, dermatitis disease and some other important disease like cancer, stroke, diabetes and liver disease (Brunke *et al*., 1993; Fazeli *et al*., 2007).

Minerals are vital chemical elements for the human health and must be in the diet (McDowell, 2003). Minerals like potassium, calcium and magnesium were detected in sumac (Kizil and Turk, 2010).

The aim of this study is to determine the chemical compositions of six ecotypes of sumac in Iran for using in food and medicine industry.

2. Materials and Methods

2.1. Sample collection

Mature and ripe fruits were collected in October and November, 2016, from central parts of Iran (Pashandegan, Baghestan, Yahya- Abad, Torgh, Firizhand in Isfahan province, and Malmir in Markazi province). In each region, 20 sumac trees were randomly selected and the fruit clusters (bobs) were collected and held at room temperature. This study was carried out at the laboratory of agriculture Faculty, Khorasgan University, Isfahan, Iran.

2.2. Minerals content analysis

Samples were dried at 105°C in a forced air oven, and ground into a powder. One-gram of each sample was used for mineral analysis. Contents of Ca, Cu, Fe, Mg, Zn and Mn were determined by atomic absorption spectrophotometer (model 3400, Perkin Elmer, Wellesley, Mass) according to AOAC methods (1990) and expressed as dry weight (% DW) basis. Potassium was measured in the emission mode of the spectrometer. Phosphorus content was determined by the spectrophotometric method (Jeffery *et al*., 1989).

2.3. Statistical analysis

Results were subjected to the analysis of variance (ANOVA) using the SAS system for windows, version 8.0. Duncan's multiple-range test was used to compare means at a significant level of 5%.

3. Results and discussion

In this study, significant differences were observed among all ecotypes based on mineral elements. The contents of minerals in sumac collected from different ecotypes are shown in Table 1.

Table 1. Mineral contents of sumac fruits.

Ecotypes/minerals	Pashandegan	Baghestan	Torgh	Yahya-Abad	Firizhand	Malmir
Fe (mg/kg)	0.3^{c}±138.2	130.5±0.2^{d}	106.5±0.3^{e}	224.6±0.3^{b}	106.2±0.4^{e}	314.9±0.4^{a}
Cu (mg/kg)	16.45±0.02^{c}	16.78±0.1^{c}	17.45±0.03^{bc}	18.26±0.02^{b}	21.65±0.03^{a}	15.06±1.7^{d}
Zn (mg/kg)	6.3±0.3^{d}	9.16±0.03^{b}	6.92±0.04^{c}	10.84±0.03^{a}	9.38±0.03^{b}	6.95±0.03^{c}
Na (mg/kg)	203.1±0.3^{f}	264.4±0.3^{d}	302.6±0.3^{b}	512±0.03^{a}	258.5±0.4^{c}	211.9±0.4^{e}
P (%)	400±100^{c}	533.33±152.7^{c}	566.66±152.7^{c}	1183.33±100^{a}	800±100^{b}	400±100^{c}
K (mg/kg)	8185.33±3^{d}	10100±100^{c}	6304.66±3.5^{e}	18366.66±152.7^{a}	15233.33±208.1^{b}	5367.67±3.5^{f}
Ca (mg/kg)	7972.33±3.2^{b}	7905.66±3^{b}	3104.67±4^{c}	15600±200^{a}	15700±200^{a}	7885.66±3^{b}
Mg (mg/kg)	308.4±0.2^{e}	408.2±0.3^{c}	305.7±0.2$_{f}$	542.3±0.3^{b}	548.2±0.4^{a}	365.4±0.3^{d}
Mn (mg/kg)	8.06±0.02^{c}	5.84±0.1^{f}	6.14±0.03^{e}	15.45±0.04^{a}	7.31±0.03^{d}	8.32±0.04^{b}
Moisture (%)	7.13±0.01^{d}	7.9±0.01^{b}	7.62±0.01^{c}	7.08±0.01^{e}	9.62±0.01^{a}	5.84±0.01^{f}
Ash (%)	4.02±0.01^{f}	5.29±0.01^{c}	4.2±0.01^{e}	8.32±0.01^{a}	4.42±0.01^{d}	5.51±0.01^{b}

Values in rows followed by the same letter are not significantly different, P ≤0.05, Duncan multiplerange test.

In Yahya-Abad samples, potassium, sodium, zinc, phosphorous, and manganese were the most abundant minerals. The amount of calcium in Yahya-Abad and Firizhand samples was the highest. The amount of copper and magnesium in Firizhand samples and iron content in Malmir samples were significantly higher than other ecotypes (P<0.05).

Sumac samples from Yahya-Abad was found to contain appreciable amounts of minerals. Minerals play many different and vital roles in human nature, and they can be found in fluids and tissues of our body (Soetan *et al*., 2010).

Results showed that sumac fruits in Yahya-Abad, Firizhand and Malmir maybe used in the human diet for supplying the required mineral elements. These sumac ecotypes can be considered as good sources of additive and ingredients for the food industry. Therefore, these findings would be useful for food scientists and nutritionists interested in the nutritive value of plants. The reasons of this wide variations between these ecotypes are not clear and further work needs but environment and soil composition can affect the minerals contents of plants (Mohammadi and

Asadi-Gharneh, 2018; Javanmard *et al*., 2017; Rupasinghe and Clegg, 2007).

There are about 20 minerals that they are vital for humans and when they are not sufficient in the body, deficiency symptoms may arise (Bender *et al*., 2003).

Iron as a necessary element for human body plays an important role in electron and oxygen transfer (Kaya and Incekara, 2000) and the maximum value of this element was found in Malmir and Yahya- Abad, respectively.

Sodium is useful in transmission of nerve impulses (Soetan *et al*., 2010). Calcium is the major element for bones and teeth (Anke *et al*., 1984). Zinc and copper are important for human's diet because of their broad range of biological roles such as participation in enzymatic and redox reactions (McLaughlin *et al*., 1999).

Cu, Fe and Zn are essential elements for human body and their daily requirement for adults are 2-3mg, 18mg and 15mg, respectively (Clydesdale and Francis, 1985). Analysing sumac from Jordan showed the presence of Ti, Cu, Fe, Al, Cl, P, K, Mn, Ca, Zn, Si, Br, S and Sr in different quantities (Barakat *et al*., 2003).

Potassium, Calcium, Magnesium, and Phosphorous were predominant elements in Sumac fruits (Barakat *et al*., 2003; Ozcan and Haciseferogullari, 2004; Ozcan and Akbulut, 2007; Kizil and Turk, 2010). K in sumac fruits is higher than that in most of the other fruits such as terebinth fruit (801.88 ppm)(Ozcan, 2004) and orange varieties (1187 ppm)(Topuz, 2004).

Results of the present study confirmed that the predominant mineral elements in sumac samples were K (10592.9 ppm) and Ca (9694.72 ppm), however, the amount of this two elements in this research were higher than other researches (Kizil and Turk, 2010; Ozcan and Haciseferogullari, 2004; Wang and Zhu, 2017).

The results based on mean values for Mg (413.0ppm), Na (292.0 ppm), Cu (17.6 ppm), Zn (8.25 ppm) and P (647.22 ppm) contents are not compatible with the results of aforementioned researchers and were totally different. However, Fe (170.15 ppm) and Mn (8.52 ppm) contents were approximately similar to values reported by Ozcan and Haciseferogullari (2004) and Wang and Zhu (2017). The mineral elements differences among different researches were shown in Table 2.

Table 2. Minerals contents in sumac fruits in this study compared to some other reports.

researchers\ Mineral elements (ppm)	K	Ca	Mg	Fe	Na	Al	Cu	Zn	Mn	P
Kizil & Turk (2010)	5259.0	1334.7	765.8	144.7	169.6	-	6.5	26.1	-	-
Ozcan& Haciseferogullari (2004)	7963.33661		855.95	144.53	114.06	125.47	3.73	10.93	10.49	1238.7
Wang & Zhu (2017)	7441.25	3155.53	605.74	174.15	101.04		42.68	55.74	10.57	327.70
Present study	10592.9	9694.72	413.0	170.15	292.0		17.6	8.25	8.52	674.22

The moisture and ash contents of the samples ranged from 5.82% to 9.62% and 4.02% to 8.32%, respectively. Ash content in Yahya-Abad samples, was the highest and also these samples had the highest level of minerals except Mg, Cu and Fe. Kizil and Turk(2010) reported that the moisture and ash contents of sumac fruits were 6% and 1.5%, respectively. Compared to the present study, Ozcan and Haciseferogullari (2004) reported higher value for moisture (10.6%) and lower level for ash content (1.8%). Dogan and Akgul (2005) reported that moisture and ash contents of sumac ranged from 6.4% to 8.3% and 2.8% to 3.3%, respectively. Unver and Ozcan (Unver and Ozcan, 2006) reported that moisture was between 2.1% to 8.2%, and ash was from 0.9% to 2.2%.

Generally, the results of this study based on moisture content (5.84%- 9.62%) are comparable with aforementioned researchers but based on ash content (4.02%-8.32%) are considerably higher than the results of other aforementioned researchers.

4. Conclusion

Results showed that sumac fruits can be considered as potential source of essential mineral, which is helpful in daily dietary. So, these ecotypes of sumacs can be good sources of mineral elements especially potassium and iron. Further researches should be carried out to recognize other ecotypes and species characterizations and then introducing these plants for medicinal and food applications.

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