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# Identification and characterization of chemical composition of *Rhus coriaria* L. fruit from Hamadan, Western Iran

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## ABSTRACT

**Background & Aim:** Identification, characterization and detection of medicinal plants chemical composition are very important for phytochemical scientific source. Sumac is one of the medicinal plants in the world that uses for industrial and pharmacological application. In this study, chemical composition of *Rhus coriaria* has been investigated.
**Experimental:** Chemical composition of the mature and ripe fruit of *Rhus coriaria* cultivated in Hamedan (Iran) climatic conditions has been analyzed by high performance liquid chromatography–electrospray ionization mass spectrometry (HPLC-MS).
**Results & Discussion:** In total 191 compounds were identified in sumac fruit including, 78 hydrolysable tannins (Gallic acid), 59 flavonoid such as, Apigenin, 40 other compounds such as Butein, 9 anthocyanins such as Cyanidin.
**Industrial and practical recommendations:** The results indicated that this plant is one of the extensive sources of bioactive phytochemical, phenolic compounds and as a source of functional ingredients in chemical, pharmaceutical industries, traditional medicine and herbal drugs as widespread uses in the world.

## 1. Introduction

The common name for the genus *Rhus* is Sumac, which contains over 250 individual species in the family Anacardiaceae. *Rhus coriaria* L. is a wild medicinal plant growing in the Mediterranean region, has long been used as a flavoring foods and medicinal plant (Ali-Shtayeh *et al.*, 2008). In folk medicine and traditional Iranian herbal medicine, sumac has been used in the treatment of hypertension, cancer, stroke, diabetes, atherosclerosis, smallpox, liver disease, aconuresis, headaches, liver disease and dermatitis (Fazeli *et al.*, 2007). In addition, *R. coriaria* has antiseptic, antifungal, antibacterial, antioxidant, anti-ischaemic, hypouricemic,

hypoglycaemic, and hepato-protective effects, which support its use in traditional medicine (Anwer *et al.*, 2013). The scientific source lacks detailed good information on *R. coriaria* chemical composition. Previous works have reported sumac to contain phenolic compounds, such as hydrolysable tannins, anthocyanins and also organic acids such as malic and citric acids (Kosar *et al*., 2007a; Kossah *et al*., 2009; Tsankova *et al.*, 1993). This plant contains flavonoid compounds and the extracts, have been shown to have antioxidative properties. The acidic and styptic flavor may be due to inherent tannins and organic acids. Many compounds have been identified from different tissue of sumac, such as phenolics, organic acids, proteins, fibre, essential oils, minerals, fatty acids and vitamins (Mavlyanov *et al.*, 1997). The phenolic compounds of sumac fruit's remains defectively investigated. Thus, identification and characterization of the phytochemicals in sumac fruits by high sensitive tools is required. In addition, mass spectrometry coupled to high-performance liquid chromatography (HPLC–MS) has been increasingly used in the structural characterization of phytochemical and phenolic compounds in plants. Only a few researches have been carried out on the chemical composition of Rhus species, therefore, in this study we analyzed phytochemical compounds of hydro-methanolic extracts of *R. coriaria* fruits cultivated in Hamedan (Iran), by using HPLC with mass spectrometry (HPLC-MS) as a powerful analytical method.

## 2. Materials and methods

Mature and ripe fruit of *R. coriaria* was collected on 2013 autumn from Hamedan province (Iran) and dried in oven in 70° C for 72 hours. The dried and ground Sumac fruit (0.5 g) were extracted using methanol (80% v/v) and sonicated for 30 min at room temperature, then, centrifuged for 20 min at 3800 g and the supernatant was collected into a round-bottom flask (Madsen *et al*., 2000). The extraction process was repeated four times by 80% methanol, the supernatant was mixed twice with 5 mL of *n*-hexane to purify of the non-polar fraction. The solvent was vaporization using a rotary under vacuum at 40 °C. Finally, the extract was centrifuged again and the supernatant was filtered through a 0.2 syringe filter and stored at 20°C until analysis time. Separation and analysis of phenolic compounds from sumac extract was conducted with a series 1100 HPLC (Hewlett–Packard, Waldbronn, Germany) equipped with ChemStation software, a model G1322A degasser, a model G1312A binary gradient pump, a model G1329/1330A thermoautosampler, a model G1316A column oven, and a model G1315A diode-array detector. Acetic acid 0.5% and acetonitrile were used as mobile phases A and B, respectively. The gradient was programmed as follows: 0 min, 0% B; 20 min, 20% B; 30 min, 30% B; 40 min, 50% B; 50 min, 75% B; 60 min, 100% B; 62 min 0% B, and for re-equilibration initial conditions were held for 10 min. The flow rate was set at 0.8 mL/min throughout the gradient. Monitoring was performed at 520 nm and the diode-array detector was set at an acquisition range from 200 nm to 600 nm at a spectral acquisition rate of 1.25 scans s−1 (peak width 0.2 min). The flow from the HPLC system into the ESI-Q-TOF-MS detector was 0.2 mL/min. The injection volume was 10 µL and the column temperature was retained at 25 °C.

## 3. Results and discussion

This study indicated that the 191 compounds in *R. coriaria* identified by HPLC-MS with their retention times ($t_R$) detected by mass detector (ionization modes either negative and/or positive, molecular formula, error in ppm). In this study, a qualitative analysis of the phenolic composition has been carried out by using HPLC-MS in negative and positive ionization modes from the hydro-methanol extract of *R. coriaria* fruits. This method was used to identified and characterize 191 phytochemical compounds (Matuszewski *et al*., 2003). Totally 78 hydrolysable tannins, 59 flavonoid, 9 anthocyanin, 2 isoflavonoid, 2 terpenoid, 1 diterpene and 38 other compounds identified in the fruit of *R. coriaria*. The most chemical composition group in *Rhus* species is hydrolysable tannins derivatives, flavonoid derivatives and other compounds (Bursal and Köksal, 2011; Kosar *et al*., 2007b; Zalacain *et al*., 2003). In totally, 40.83% of total allocated to hydrolysable tannins, 30.89% of total is flavonoid, 19.89% is other compound, 4.71% is anthocyanin, isoflavonoid, terpenoid and unknown compound is 1.04% and 0.52% allocated to diterpene (Fig. 1)

## 4. Conclusions

By using this HPLC-MS, a total of 191 chemical compounds were identified and characterized in *R. coriaria*. To our knowledge, this research was presented on of the first comprehensive study of the phytochemical

and phenolic components from *R. coriaria* extract. The obtained results showed that, *R. coriaria* is one of the extensive sources in phenolic, bioactive phytochemical compound and as a source of functional ingredients in chemical and pharmaceutical industries, has widespread uses.

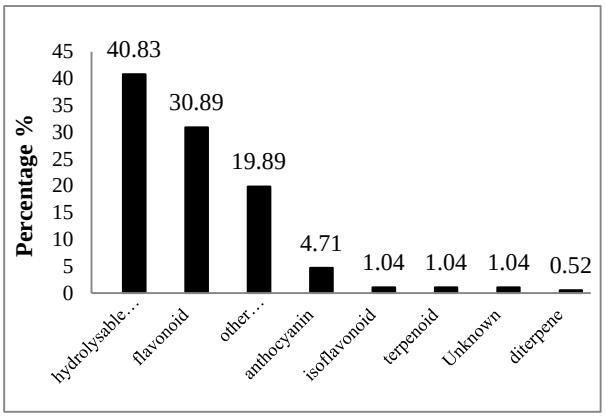


**Fig 1.** Classification of chemical components in *R. coriaria*.

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## 6. References

Ali-Shtayeh, M.S., Jamous, R.M., Al-Shafie, J.H., Elgharabah, W.A., Kherfan, F.A., Qarariah, K.H., Isra'S, K., Soos, I.M., Musleh, A.A., Isa, B.A. 2008. Traditional knowledge of wild edible plants used in Palestine (Northern West Bank): a comparative study. *Journal of Ethnobiology and Ethnomedicine*., 4, 13.

Anwer, T., Sharma, M., Khan, G., Iqbal, M., Ali, M.S., Alam, M.S., Safhi, M.M., Gupta, N. 2013. Rhus coriaria ameliorates insulin resistance in non-insulin-dependent diabetes mellitus (NIDDM) rats. *Acta Pol Pharm*., 70, 861-867.

Bursal, E., Köksal, E. 2011. Evaluation of reducing power and radical scavenging activities of water and ethanol extracts from sumac (*Rhus coriaria* L.). *Food Research International*., 44, 2217-2221.

Fazeli, M.R., Amin, G., Attari, M.M.A., Ashtiani, H., Jamalifar, H., Samadi, N., 2007. Antimicrobial activities of Iranian sumac and avishan-e shirazi (*Zataria multiflora*) against some food-borne bacteria. *Food Control*., 18, 646-649.

Kosar, M., Bozan, B., Temelli, F., Baser, K. 2007a. Antioxidant activity and phenolic composition of sumac (*Rhus coriaria* L.) extracts. *Food Chemistry.*, 103, 952-959.

Kosar, M., Bozan, B., Temelli, F., Baser, K. 2007b. Antioxidant activity and phenolic composition of sumac (*Rhus coriaria* L.) extracts. *Food Chemistry*., 103, 952-959.

Kossah, R., Nsabimana, C., Zhao, J., Chen, H., Tian, F., Zhang, H., Chen, W. 2009. Comparative study on the chemical composition of Syrian sumac (*Rhus coriaria* L.) and Chinese sumac (*Rhus typhina* L.) fruits. *Pakistan Journal of Nutrition*., 8, 1570-1574.

Madsen, A.D., Goessler, W., Pedersen, S.N., Francesconi, K.A. 2000. Characterization of an algal extract by HPLC-ICP-MS and LC-electrospray MS for use in arsenosugar speciation studies. *Journal of Analytical Atomic Spectrometry.*, 15, 657-662.

Matuszewski, B., Constanzer, M., Chavez-Eng, C. 2003. Strategies for the assessment of matrix effect in quantitative bioanalytical methods based on HPLC-MS/MS. *Analytical Chemistry*., 75, 3019-3030.

Mavlyanov, S., Islambekov, S.Y., Karimdzhanov, A., Ismaikov, A. 1997. Anthocyans and organic acids of the fruits of some species of sumac. *Chemistry of Natural Compounds*., 33, 209-209.

Tsankova, E.T., Dyulgerov, A.S., Milenkov, B.K. 1993. Chemical composition of the Bulgarian sumac oil. *Journal of Essential Oil Research*., 5, 205-207.

Zalacain, A., Prodanov, M., Carmona, M., Alonso, G. 2003. Optimisation of extraction and identification of gallotannins from sumac leaves. *Biosystems Engineering*., 84, 211-216.