Phenolic Content of Selected Sumac Fruits from Iran, Extracted With Different Solvents

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Abstract: In this study, the phenolic content of three sumac (R. coriaria L.) samples were evaluated including, brown sumac fruit, brown sumac powder and red sumac. Methanol, ethanol, mixture of methanol-ethanol and distilled water were used for extraction. Phenolic content was determined by Folin–Ciocalteau procedure. The efficiency of the extraction varied considerably. The phenolic content of brown sumac powder, brown sumac fruit and red sumac powder were 2.906-2.997, 2.438- 2.529, 2.172- 2.263 gallic acid equivalents/100 g (GAE/100 g), respectively. According to the results, ethanol shows the best results and sumac had highest phenolic content as compared to other extracts.

Keywords: phenolic compounds, solvent extraction, sumac

INTRODUCTION

Lipid oxidation is a highly deteriorative process in foods, as it leads to unacceptable properties for the customer and a loss in nutritional value. In addition, oxidation leads to health disorders such as atherosclerosis and cancer genesis, hence the presence of antioxidants in foods is essential for their quality, retention and safety. Koleva et al., (2003) Antioxidants are often added to foods to prevent the radical chain reactions of oxidation, and they act by inhibiting the initiation and propagation step leading to the termination of the reaction and delay the oxidation process. Shahidi et al. (1992). On the other hand, the commonly used synthetic antioxidants such as butylatedhydroxyanisole (BHA) and butylatedhydroxytoluene (BHT) are restricted by legislative rules because of doubts over their toxic and carcinogenic effects [6]. Therefore, there has been a considerable interest in the food industry to find natural antioxidants to replace synthetic compounds in food applications, and a growing trend in consumer preferences for natural antioxidants, all of which has given more impetus to explore natural sources of antioxidants.

Many herbs and spices have been shown to impart antioxidant effects in food; the active principles are phenolics [4,5]. A wide variety of phenolic substances derived from herbs and spices possess potent antioxidant, anti-inflammatory, antimutagenic, anticarcinogenic and anti-tumor activities, which contribute to their chemopreventive potential [4,5].

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Selected sumac fruits (Rhuscoriaria L. Anacardiaceae) with brown color and ground sumac with red color were bought in bulk from local market in Shahreza, Iran. Brown sumac fruits were cleaned and dried in a hot air oven at 50 °C for 2 hours. The dried plant materials were
The stems were powdered and passed through a 60 mesh sieve. All samples were kept in air tight containers at -18 °C until further use. Solvents, chemical reagents and standard phenolic compounds were purchased from Sigma–Aldrich Canada Ltd. (Oakville, ON, Canada).

**Extraction of polyphenols**

Brown sumac fruit, its powder and ground red sumac were extracted with organic solvents and distilled water, using Reflux method. Extraction was done at 40 °C for 2 h. After extraction, the mixture was filtered and the obtained extract was concentrated with a rotary evaporator under reduced pressure in a water bath at 40 °C. The crude extracts were collected after 3 h and stored at -18 °C in the dark. The extraction process was carried out in triplicate, using three different samples each time. Four different extraction systems were used (methanol, ethanol, mixture of ethanol and methanol and 100% distilled water). Solvent to sumac ratio was 10:1 mL/g.

**Determination of total phenolic content**

Total phenolics content of sumac fractions was determined according to the Folin–Ciocalteau procedure [15]. All samples and Gallic acid were dissolved in 50% (v/v) of specific solvent. Samples (0.5 mL) were placed into test tubes and then 2.5 mL Folin–Ciocalteau reagent (10%, v/v, in water) solution and 7.5 mL sodium carbonate (20%, w/v, in water) solution were added. The tube contents were mixed and allowed to stand for 2 h at room temperature. Absorbance was measured at 750 nm and the total phenolic content was expressed as gallic acid equivalents (GAE) in mg per g dry material.

**STATISTICAL ANALYSIS**

Data were analyzed using SPSS software. Analysis of variance (ANOVA) and Duncan’s multiple range method were used to compare any significant differences between solvents and samples. Values were expressed as means ± standard deviations. Differences were considered significant at P < 0.05. All the analyses were carried out in triplicates.

**RESULTS AND DISCUSSION**

**Polyphenol content**

Table 1 shows the total phenolic content (TP) of the samples extracts measured using Folin-Ciocalteau’s colorimetric method. TP of the samples ranged from 2.453 GAE/100 g to 3.277 GAE/100 g for brown sumac powder, while it ranged from 2.318 GAE/100 g to 3.277 GAE/100 g for brown sumac fruit and from 0.811 GAE/100 g to 3.188 GAE/100 g for red sumac powder. Therefore, brown sumac powder extracts had higher polyphenol contents when compared with the other samples.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Solvent</th>
<th>Mean</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown Sumac fruit</td>
<td>ethanol</td>
<td>2.454</td>
<td>0.044</td>
<td>2.364</td>
<td>2.545</td>
</tr>
<tr>
<td></td>
<td>methanol</td>
<td>2.637</td>
<td>0.044</td>
<td>2.546</td>
<td>2.728</td>
</tr>
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<td>ethanol-methanol</td>
<td>2.524</td>
<td>0.044</td>
<td>2.433</td>
<td>2.615</td>
</tr>
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<td></td>
<td>water</td>
<td>2.318</td>
<td>0.044</td>
<td>2.227</td>
<td>2.408</td>
</tr>
<tr>
<td></td>
<td>ethanol</td>
<td>3.157</td>
<td>0.044</td>
<td>3.066</td>
<td>3.248</td>
</tr>
<tr>
<td>Brown Sumac powder</td>
<td>methanol</td>
<td>2.918</td>
<td>0.044</td>
<td>2.827</td>
<td>3.009</td>
</tr>
<tr>
<td></td>
<td>ethanol-methanol</td>
<td>3.277</td>
<td>0.044</td>
<td>3.186</td>
<td>3.367</td>
</tr>
<tr>
<td></td>
<td>water</td>
<td>2.453</td>
<td>0.044</td>
<td>2.362</td>
<td>2.544</td>
</tr>
<tr>
<td></td>
<td>ethanol</td>
<td>3.188</td>
<td>0.044</td>
<td>3.097</td>
<td>3.279</td>
</tr>
<tr>
<td>Red Sumac powder</td>
<td>methanol</td>
<td>2.093</td>
<td>0.044</td>
<td>2.002</td>
<td>2.184</td>
</tr>
<tr>
<td></td>
<td>ethanol-methanol</td>
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<td>0.044</td>
<td>2.688</td>
<td>2.870</td>
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<tr>
<td></td>
<td>water</td>
<td>0.811</td>
<td>0.044</td>
<td>0.720</td>
<td>0.902</td>
</tr>
</tbody>
</table>

**Effect of solvent system**

Earlier, solvents, such as methanol, ethanol, acetone, propanol, thyl acetate and dimethylformamide, have been commonly used for the extraction of phenolics from fresh produce at different concentrations in water. [19,18]. The recovery of polyphenols from plant materials is influenced by the solubility of the phenolic compounds in the solvent used for the extraction process. Furthermore, solvent polarity will play a key role in increasing phenolic solubility [2, 10, 21]. Therefore, it is hard to develop a suitable standard extraction procedure for the extraction of all plant phenols. The least polar solvents are usually considered to be suitable for the extraction of lipophilic phenols unless very high pressure is used. From the results shown in Table 1, it is evident that the recovery of phenolic compounds was dependent on the solvent used and its polarity (for all three
samples). For brown sumac fruit extracts, methanol gave the highest yield of TP. Mixture of ethanol and methanol could recover the highest yield of TP (3.277 GAE/100 g) in brown sumac powder with significant difference when compared with all other used solvent systems. The highest yield of red sumac powder TP was obtained using ethanol.

CONCLUSIONS
The extraction of the sumac (R. coriaria L.) was carried out with water, ethanol, methanol and mixture of ethanol and methanol separately. The present study indicated that phenolic content of ethanol extract was significantly higher than other extracts. Also amounts of total phenolic contents of brown sumac powder were higher than other samples. Therefore, it is hard to develop a suitable standard extraction procedure for the extraction of all plant phenols. The least polar solvents are usually considered to be suitable for the extraction of lipophilic phenols unless very high pressure is used.

REFERENCES
antimicrobial studies of cinnamon leaf and bark volatile oils, oleoresins and their constituents, J. Food and Chemical Toxicology, Volume 45, Pages 1650-1661.

