Studying Physicochemical Properties of Sardasht Red Grape Skin Encapsulated Extract and Stability Evaluation of These Compounds in Yoghurt

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Received: 2017.04.13; Accepted: 2018.01.31

Abstract
Sardasht’s red grape (Vitis Viniferae cv. Rash) skin is one of the most abundant wastes found in juice factories annually and is a rich source of bioactive compounds. In this research after preparing the extract with ethanol-chloride-acid solution from the skin of Sardasht’s red grape, the bioactive compounds were determined using high performance liquid chromatography (HPLC). The results showed the highest amount of phenolic compounds were for gallic acid then catechin, salicylic acid and vanillic acid. The highest levels of anthocyanins were Petunidin 3-o-glucopyranoside and Peonidin 3-o-glucoside chloride. Microencapsulation of the skin of Sardasht’s red grape extracted is done by maltodextrins and Arabic gum with ratios of 50-50, 75-25. The experiments were carried out, including moisture content, water activity, solubility, anthocyanin, phenolic compounds and antioxidant activity. According to the results, The powder obtained from the microencapsulation of the sample with maltodextrin and Arabic gum (50-50) with the highest phenolic compounds and antioxidant activity were selected and used in yoghurt (0.3-0.6) with tannic acid (1% by weight). Phenolic compounds, anthocyanins, antioxidant activity level of our samples during the 21 days of storage were investigated. The results showed that the most amounts of anthocyanin and phenolic compounds and antioxidant activity were observed in yoghurt with 0.6% powder with tannic acid. Significant increase in phenolic compounds, anthocyanins and antioxidant activity of yogurt containing encapsulated powder were observed compared to control yogurt. The results showed that red grape’s skin extract and powder can be used in functional food formulations.

Keywords: Arabic gum, HPLC, Maltodextrine, Microencapsulation, Sardasht’s red grape

Introduction
Grape pomace is a lignocellulose waste and the solid remains of grape juice processing. 20% of wet grape pomace is composed of grape pomace (Mahdavi et al., 2004). Grape pomace contains polyphenols (mainly anthocyanins, flavonols, flavanols, phenolic acids and Resveratrol)
Research and Innovation in Food Science and Technology 7 (2018), 3

and citric acid (Pourali et al., 2014). In this research, after producing the extract of Sardasht red grape flesh, the bioactive compounds were identified, and after microcapsulation and powder production by spray drying, the usability and durability potential of microcapsulated powder in yogurt were measured.

Material and methods
First, Sardasht red grapes (Vitis Vintiferae cv. Rash) were obtained from Urmia Pakdis juicer Factory. After washing, the grape was dried with vacuum oven and grinded then mixed with ethanol- hydrochloric acid, was sonicated at temperature 55 °C and times 15 min in an ultrasonic bath, the working frequency was fixed at 35 kHz (Rajaei et al., 2010). Total phenolic contents of this extract were determined using the Folin–Ciocalteau method (Shahidi & Naczk, 2004). Evaluating the antioxidant activity of the extract by DPPH was monitored according to the method explained by (Galvez et al., 2007). Measurement of anthocyanin by pH differential method introduced by Fuleki & Fransis (1968). Identification of major bioactive compounds was carried by High Performance Liquid Chromatography (Barreca et al., 2016).

Finally to micro-encapsulation of the bioactive compounds of Sardasht red grape extract with various amounts of maltodextrin and Arabic gum, ratios of 50-50, 75 to 25 w/w were done according to the results of other investigations and according to the preliminary tests (Sharifi et al., 2015). The characteristics of micro-coating powder including moisture content (AOAC, 1990), water activity and solubility (AOAC, 1990) were investigated.

Production of yogurt containing extracts and microencapsulated powder of Sardasht red grape was done according to the proposed method of Tamime & Robinson (1999). Concentrated extract of red grapes with brix 27 and microencapsulated powder of Sardasht red grape were added to 0.3% and 0.6% w/w to production yogurt. Tannic acid was used as a 1 wt% for anthocyanin stability in the yogurt (Bordignon et al., 2006). The samples were kept 21 days for evaluation some physicochemical properties, determination of anthocyanin content (Fuleki & Fransis, 1968), total phenolics content (Shahidi & Naczk, 2004), antioxidant activity (Galvez et al., 2007) and synersis that was done according to Zainoldin & Baba (2009) method.

Statistical analysis was performed by SAS software and Duncan’s comparison was done at the level of 5% to compare mean scores and charts were drawn using Excel 2007 software.

Results and discussion
Identification of phenolic and anthocyanin compounds of red Sardasht grape extract with high performance liquid chromatography
At optimal extraction with ultrasound at 55 °C and time of 15 min, the anthocyanin content of the extract was 121.65 mg/mL, phenolic compounds 115.14 mgGAL/100mL, and the antioxidant activity of extract was 64.88%. Table (1) displays the phenolic and anthocyanin compounds found in the extract of Sardasht red grape flesh.

Investigation of microcapsulated powder of Sardasht red grape extract characteristics
The moisture content of two samples of microcapsulated powder of Sardasht red grape extract

<table>
<thead>
<tr>
<th>Phenolic compounds</th>
<th>ppm rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galic acid</td>
<td>150.1±0.06</td>
</tr>
<tr>
<td>Catechin</td>
<td>42.2±0.04</td>
</tr>
<tr>
<td>Vanillic acid</td>
<td>5±0.01</td>
</tr>
<tr>
<td>Salicylic acid</td>
<td>10±0.02</td>
</tr>
<tr>
<td>Petunidin 3-o glucopyranoside</td>
<td>94.23±0.06</td>
</tr>
<tr>
<td>Peonidin 3-o-glucoside chloride</td>
<td>696±0.02</td>
</tr>
</tbody>
</table>

Investigation of microcapsulated powder of Sardasht red grape extract characteristics
The moisture content of two samples of microcapsulated powder of Sardasht red grape extract
was compared, there was no significant difference between two samples \( (P \geq 0.05) \). The highest solubility was observed in the sample 50:50 maltodextrin and gum arabic (85\%) that has statistically significant difference with the sample 25:75 (80\%) \( (P \leq 0.05) \). The results of antioxidant activity changes showed that there was no significant difference between the two samples \( (P \geq 0.05) \). The ratio of maltodextrin and Arabic gum had no significant effect on the content of phenolic compounds of the two studied samples. The microcapsulated sample with a maltodextrin-to- gum arabic ratio of 50:50 showed more phenolic compounds (102.89 mgGAL/100mL) compared to 25:75 (96.11 mgGAL/100mL). The evaluation results of the total anthocyanins content of the two tested samples revealed that the maximum amount of anthocyanins in the microcapsulated sample with a maltodextrin-to-gum arabic ratio of 50:50 was observed to be 109.89 mg/mL, which has significant difference \( (P \leq 0.05) \) with the microcapsulated sample with a maltodextrin-to-gum arabic ratio of 75:25, (98.73 mg/mL). In this study, microcapsulated sample with a maltodextrin-to-gum arabic ratio of 50:50 had a higher water activity (0.156) compared to the other sample (0.123) \( (P \leq 0.05) \).

**Investigation of physicochemical characteristics of yogurt containing extract and microcapsulated powder of Sardasht red grape extract**

The results showed that the application of microcapsulated powder in retention of anthocyanin content was effective. The highest amount of anthocyanins was observed in samples containing microcapsulated powder, which showed a statistically significant difference with yoghurt containing the extract \( (P \leq 0.05) \). The content of anthocyanins during the storage of yoghurt samples was significantly decreased \( (P \leq 0.05) \). The highest amount was observed in yoghurt samples containing 0.6\% of microcapsulated powder with tannic acid at the first day of product (8.94 mg/mL).

The highest and lowest content of phenolic compounds was observed in yoghurt samples containing 0.6\% tannic acid microcapsulted powder on 7th day (35.25 mgGAL/100mL) and control yoghurt samples respectively. Yogurt samples containing 0.3\% extract of Sardasht red grape (13.28 GAL/100mL) on 21st day of storage after the control sample contained the lowest amount of phenolic compounds. All samples had statistically significant difference in terms of phenolic compounds \( (P \leq 0.05) \). The effectiveness of the microcapsulation process as well as the use of tannic acid in retention of phenolic compounds during yogurt storage period was confirmed with these results. The amount of phenolic compounds decreased with the increase in yogurt storage time and the lowest amount was observed on 21st day of storage.

Yogurt samples containing 0.6\% of the microcapsulated powder with tannic acid on 7th day contained the highest levels of antioxidant activity (47.26\%) in compared with yoghurt containing 0.6\% of microcapsulated powder had no significant difference, but had a statistically significant difference with other treatments \( (P \leq 0.05) \). The lowest level of antioxidant activity was observed in the control sample.

The control sample had the highest rate of syneresis \( (P \leq 0.05) \). The lowest rate of syneresis was observed in yoghurt samples containing 0.6\% microcapsulated powder with tannic acid. Probably the increase in the amount of the solid content has been effective in decreasing of syneresis \( (P \leq 0.05) \). Over time, the amount of syneresis was significantly increased, and the highest amount of syneresis was observed on 21st day of storage. The lowest amount of syneresis was observed in yogurt samples containing 0.6\% microcapsulated powder with tannic acid on the first day of storage, and the highest amount was observed in the control sample on the 21st day of storage.

**Conclusion**

Results showed the highest amount of phenolic compounds were for gallic acid then catechin, salicylic acid and vanillic acid. The highest levels of anthocyanins were Petunidin 3-
oglucopyranoside and Peonidin 3-o-glucoside chloride. The microcapsulation results revealed that the produced powder samples with the equal ratio of maltodextrin to Arabic gum contained the most bioactive compounds. The results of stability of the extract bioactive compounds in yogurt indicated that the most amounts of anthocyanin, phenolic compounds and antioxidant activity are observed in yoghurt with 0.6% powder with tannic acid. Significant increase in phenolic compounds, anthocyanins and antioxidant activity of yogurt containing encapsulated powder were observed compared to control yogurt. Results showed that we can use red grape skin extract and powder in functional food formulations.

References


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