Influence of Roasting on Quality of Pumpkin (Cucurbita L.) Oil

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Pumpkin (Cucurbita L.) seeds has received considerable attention because of the nutritional and health protective value. They are normally discarded during processing. They can be utilized to process into value-added product via roasting. Pumpkin seeds were roasted in different time and temperature (120/4.5, 125/4.0, 130/3.5, 135/3.0, 140/2.5, °C/min). There were significant differences between roasted and unroasted samples. Total phenolic content and scavenging activity were higher in roasted pumpkin seeds than unroasted ones. The highest content of total phenolic and the highest free radical-scavenging activity were noticed at the roasted pumpkin seed by roasting at 130/3.5 (°C/min). Oxidative stability in pumpkin seed oil was also evaluated on both roasted and unroasted samples at accelerated storage. The roasted pumpkin seed oil showed lower peroxide value (PV) and thiobarbituric acid (TBA) value than the oxidative values in the unroasted samples during heating at 55°C for 28 days.

Keywords: Pumpkin seed, oil, roasting, total phenolic, free radical-scavenging activity, peroxide value thiobarbituric acid

INTRODUCTION

Pumpkin (Cucurbita L.) seeds is an important source of vegetable oil with complex carbohydrates and a high percentage of dietary fibers, vitamins, minerals, unsaturated fatty acids and numerous bioactive compounds (Al-Shahwani et al, 2008; Bahramsultany et al, 2017; Montesano et al, 2018; Mohammed and Munther, 2019). The predominant fatty acids in pumpkin seed oil were oleic, linoleic and palmitic acids (Tuan and Huong, 2019). Many available literatures mentioned to the antioxidative potential of pumpkin seeds and oils (Nawirska-Olszanska et al., 2013; Saavedra et al., 2015; Can-Cauich et al., 2019). Pumpkin seeds have hypoglycaemic effect as well as antioxidant, anticancer and anti-inflammatory effects (Veronezi and Jorge, 2012; Prevc et al., 2013; Rabrenovic et al., 2014). Health promoting impacts of pumpkin seeds on the level of blood glucose, cholesterol, immunity, liver functioning, gallbladder, disabilities of leaning, prostate gland, depression, inflammation, cancer management and inhibition of parasites were established (Qamar et al., 2019). There was a large quantity of pumpkin seeds as underutilized products (Saavedra et al., 2015). They are commonly consumed as snacks in raw or salt-roasted form (El-Adawy and Taha, 2001; Prevc et al., 2013). Pumpkin seed and oil are also utilized as ingredient in baked products and salads (Juranovic et al., 2003; Nawirska-Olszanska et al., 2013).

There were several outstanding literatures mentioned to the roasting of pumpkin seeds. The pumpkin seed oils used were obtained from roasted and unroasted seeds. Wet salting and roasting process maintained the quality criteria and antioxidant characteristics of the oil (Nesimi et al., 2018). The effect of roasting temperature on pumpkin seed oil tocopherols and phenolics was investigated. Pumpkin seeds were roasted at temperatures from 90 to 200°C. As roasting
temperatures increased, polyphenol concentrations decreased (Tanja et al. 2018). Tuan and Huong (2019) evaluated the thermal pre-treatments including microwave heating and roasting on the oil yield and quality properties from pumpkin seeds. The dried pumpkin seeds were heated under microwave for 2 minutes or roasted for 45 minutes at temperature of 90 - 130°C and subjected to oil extraction. Objective of our research focused on the effectiveness of roasting to total phenolic content, free radical-scavenging activity, peroxide value, thiobarbituric acid of the roasted pumpkin seed and oil.

MATERIALS AND METHODS

2.1 Material
Pumpkin seeds as by-products were obtained from local market in SocTrang province, Vietnam. All solvents and chemicals were of analytical grade.

2.2 Researching method
Pumpkin seeds were roasted in an oven at different conditions: 120/4.5, 125/4.0, 130/3.5, 135/3.0, 140/2.5 (°C/min). After removal from the oven, roasted samples were cooled to ambient temperature, stored in sealed commercial zipper bags. The roasted and unroasted samples were analyzed the total phenolic content, free radical-scavenging activity. The roasted and unroasted samples were also extracted to collect oil. Oil collected from these samples were subjected to accelerated oxidation in the dark in an oven at 55°C for 28 days. Oil was withdrawn periodically every 7 days to determine oxidative stability (peroxide value and thiobarbituric acid value).

2.3 Chemical analysis
Total phenolic content (mg GAE/100g) was determined using Folin-Ciociculceu reagent (Hassan and Bakar, 2013). Free radical-scavenging activity or DPPH (%) was evaluated according to Bakar et al. (2017). Peroxide value or PV (meqO₂/kg oil) examined according to AOAC (2005). Thiobarbituric acid value or TBA value (mg malonaldehyde/kg oil) was verified according to Allen and Hamilton (1989).

2.4 Statistical analysis
The experiments were run in triplicate with three different lots of samples. The data were presented as mean ± standard deviation. Statistical analysis was performed by the Statgraphics Centurion version XVI.

RESULTS AND DISCUSSION

3.1 Effect of roasting to total phenolic content and free radical scavenging activity of pumpkin seed
Phenolic elements are the most effective antioxidants in plants because of their ability to donate hydrogen and stable radical intermediates. Antioxidants affect human health by inhibiting the activity of reactive oxygen species. Therefore they limit their harmful effect and reduce the risk of cardiovascular, cancer, and neurodegenerative disease (Bartosz et al. 2020). Pumpkin seed oil has been recognized as a great source of phenolic components (Mirjana et al. 2010). In our research, there was a significant difference in total phenolic content (TPC) and free radical-scavenging activity (DPPH) scavenging at the between roasted and unroasted pumpkin seeds (see table 1). Roasting resulted in phenol complexes being created from the Millard reaction, contributing to higher absorbance values (Yu et al. 2005). Our results were similar to finding in another report. Elsorady and Ali showed that total phenolic content and scavenging activity were higher in roasted peanut skin than unroasted peanut skin. El-Shourbagy and El-Zahar (2014) mentioned that total phenolic content was higher in roasted peanut than unroasted one. Davis et al. (2010) reported that roasting over 77 min decreased phenolic content by degradation of phenolics. Roasted kernel flour had higher TPC compared to that of raw kernel (Win et al. 2011). The kernels were roasted at 170°C for 10 min had higher phenol contents than unroasted samples (Talcott et al., 2005). During roasting, pyroles and furans were formed to build up phenolic content of roasted samples (Yanagimoto et al. 2002).

3.2 Oxidative stability in pumpkin seed oil in accelerated storage
Pumpkin seed oil is a rich source of mono and polyunsaturated fatty acids, vitamins, minerals, phytosterols, pigments, pyrazine derivatives and phenolic compounds (Xanthopoulou et al. 2009; Kim et al. 2012; Veronezi and Jorge, 2012). Pumpkin seed oil is traditionally obtained by pressing the roasted pumpkin seeds (Nesimi et al. 2018). It is a dichromatic viscous oil having strong antioxidant activity beneficial to human health in treatment for benign prostatic hyperplasia, which inhibits the growth and size reduction of the prostate (Siano, 2016; Shaban and Sahu, 2017).
Table 1: Effect of roasting to total phenolic and free radical scavenging activity in pumpkin seed

<table>
<thead>
<tr>
<th>Roasting (°C/min)</th>
<th>Unroasted</th>
<th>120/4.5</th>
<th>125/4.0</th>
<th>130/3.5</th>
<th>135/3.0</th>
<th>140/2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TPC (mg GAE/ 100g)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unroasted</td>
<td>19.63±0.02d</td>
<td>32.29±0.00c</td>
<td>36.47±0.01b</td>
<td>43.71±0.00a</td>
<td>40.32±0.01ab</td>
<td>34.68±0.00bc</td>
</tr>
<tr>
<td>% DPPH</td>
<td>42.11±0.01d</td>
<td>63.49±0.03c</td>
<td>69.50±0.02b</td>
<td>76.23±0.03a</td>
<td>73.54±0.02ab</td>
<td>66.12±0.01bc</td>
</tr>
</tbody>
</table>

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 2: Oxidative stability of pumpkin seed oil in accelerated storage

<table>
<thead>
<tr>
<th>Storage (days)</th>
<th>PV (meqO₂/kg oil) in unroasted samples</th>
<th>0</th>
<th>7</th>
<th>14</th>
<th>21</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unroasted</td>
<td></td>
<td>1.23±0.02c</td>
<td>3.72±0.01bc</td>
<td>5.73±0.03b</td>
<td>7.51±0.00ab</td>
<td>8.94±0.01a</td>
</tr>
<tr>
<td>PV (meqO₂/kg oil) in roasted samples at 130/3.5 (°C/min)</td>
<td>0.11±0.01c</td>
<td>0.68±0.00bc</td>
<td>1.33±0.02a</td>
<td>1.71±0.01ab</td>
<td>2.03±0.02a</td>
<td></td>
</tr>
<tr>
<td>TBA (mg malonaldehyde/kg oil) in unroasted samples</td>
<td>0.06±0.00c</td>
<td>0.17±0.02bc</td>
<td>0.29±0.01b</td>
<td>0.47±0.02ab</td>
<td>0.64±0.03a</td>
<td></td>
</tr>
<tr>
<td>TBA (mg malonaldehyde/kg oil) in roasted samples at 130/3.5 (°C/min)</td>
<td>0.02±0.00c</td>
<td>0.05±0.01bc</td>
<td>0.11±0.03b</td>
<td>0.20±0.00ab</td>
<td>0.29±0.01a</td>
<td></td>
</tr>
</tbody>
</table>

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

The peroxide value (PV) and thiobarbituric acid (TBA) are key indicators evaluate the oxidative stability of pumpkin seed oil. During heating at 55°C for 28 days, peroxide value (PV) and thiobarbituric acid (TBA) in oil of roasted samples were lower than those of unroasted ones (see table 2). It means that roasting raw material contributed to the low oxidative changes in oil during accelerated storage. Taha et al. (2012) proved that roasted peanut skin extracts can be utilized effectively in the edible oil to limit its oxidation. Tuan and Huong (2019) concluded that the PV increased with roasting times. Roasting at high temperature or prolong roasting may cause the increase of PV in oil (Nederal, 2012).

CONCLUSION

Pumpkin seeds are a rich source of bioactive antioxidants beneficial to human health. They are important by-product of the pumpkin processing. Pumpkin seed oil is not only an edible oil but also a potential nutraceutical oil. In this research, we have successfully demonstrated that total phenolic content and free radical-scavenging activity were higher in roasted pumpkin seeds than unroasted ones. Roasting would be a useful thermal treatment in retarding oxidation process in pumpkin seed oil during accelerated storage.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

ACKNOWLEDGEMENT

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AUTHOR CONTRIBUTIONS

Nguyen Phuoc Minh arranged the experiments and also wrote the manuscript.

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