Comparison Of Nutritional Value And Antioxidant Compounds Of Some Winter Pumpkin (Cucurbita Sp) Species Fruits In Iran

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ABSTRACT

Winter pumpkin is a seasonal crop that has been implicated in providing health benefits. Therefore, the aim of this work was to investigate nutrition value and sensory characteristics of some different winter pumpkin genotypes. The genotypes chosen were: ‘Astaneh Ashrafiyeh’, ‘Ziaber’, ‘Langrood’ and ‘Tallesh’ that were grown in different regions of Guilan Province, Iran. Some quality attributes including total soluble solids, fresh weight, dry matter, antioxidant capacity (with DPPH method), total flavonoid and total phenolics content were evaluated. The results showed a significant difference for nutritional quality in investigated genotypes. Ziaber genotype had the highest fresh weight, dry matter, antioxidant capacity, total flavonoid and total phenolics content as compared to the other genotypes. Furthermore, a significant relationship was found between antioxidant capacity, total flavonoid and total phenolics content of fruits. Therefore, we found that Ziaber pumpkin genotype is the most valuable from nutritional and sensory points of view.

Key words: dry matter, squash, total flavonoid, total phenolics content, total soluble solids.

Introduction

Pumpkin is one of the seasonal vegetables that meet the requirements of healthy nutrition. Pumpkins are widespread, because they can grow under different climate conditions. The name ‘pumpkin’ is commonly used for cucurbits of some species, similar in botanical characteristics. In general pumpkins belonged to Cucurbita pepo L. (Called also ‘squash’), Cucurbita maxima Duch. (Called ‘winter squash’) and Cucurbita moschata Duch [14]. Fruit quality is significantly influenced by the conditions of growing, fertilization and other factors such as genotypes [25]. When growing pumpkins, it is very important to select the suitable cultivars, which genotype influences taste properties. Pumpkins suitable for using should be completely ripen, with hard skin and, with the exception of several striped species, of uniform external colour. Moreover, the flesh of the pumpkins, which are of good quality, is brightly yellow or orange with excellent juicy structure.

Pumpkin varieties, especially winter squash, are tasty and promising sources of carotenoids, ascorbic acid and polysaccharides, mineral compounds (K, Ca, Mg and Fe), starch (1.5–20 %), pectin (4.8–12.8 %) and cellular tissue (0.7–0.95 %) and much dry soluble [6,13,21]. Because of a low tendency to accumulate heavy metals, winter squash can be recommended for baby food products [19]. Depending on regional customs and resources, pumpkin and winter squash are eaten cooked, baked, roasted, stewed or microwaved, and as components of salads, jams, cakes, pies or soups [32,24]. Since pumpkin species and cultivars differ in nutritional and technological value of fruits, breeders and scientists seek genotypes of the highest suitability for human nutrition. Moreover, winter squash has been reported for their use as traditional medicine with anti-diabetic, antihypertensive, antitumor, immunomodulation, antibacterial, anti-hypercholesterolemia and anti-inflammation activities [12].

In recent years, consumer’s interest in the health enhancement role of specific foods or physically active food components, so-called nutraceuticals or functional foods, has exploded [16]. The quality of fruits and vegetables consists of some properties, which can be evaluated using physical and chemical methods [1]. One of important quality traits of food is biological activity of a product, and especially its antioxidative activity. Antioxidants are compounds

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that protect cells against the damaging effects of reactive oxygen species. Phenolic compounds are widely distributed in plant foods and therefore are important constituents of the human diet. Phenolic compounds may act as an antioxidant and protect foods from oxidative deterioration. In recent years, the numbers of studies which are conducted to determine antioxidant activity of phenolic compounds have increased due to the possible role of reactive oxygen species in the pathogenesis of degenerative diseases such as atherosclerosis, cancer and chronic inflammation [16].

Flavonoids are the most common group of poly phenolic compounds in the human diet and are found ubiquitously in plants. These compounds have been intensively investigated during the past years due to their possible protective effects against chronic diseases. Moreover, flavonoids might induce mechanisms that affect cancer cells and inhibit tumor invasion [9]. Consumers and food manufacturers have become interested in flavonoids for their possible medicinal properties, especially their putative role in inhibiting cancer or cardiovascular disease. Taking into consideration the high antioxidant activity and nutritional properties of Cucurbita, any activities leading to the launching of new attractive products based on this species are advisable [4].

For the effective utilization of pumpkin fruit and its parts as a functional food component or medicinal herb, qualitative and quantitative information on the nutritional is essential. Therefore, the aim of this study was to determine nutritional and technological properties of Cucurbita, any activities leading to the launching of new attractive products based on this species are advisable [4].

Materials and Methods

Plant material:

In this study, the fruits of four major genotypes of winter squash (Cucurbita sp) which grown in different regions of Guilan province, Iran (Astaneh Ashrafiyeh, Langrood, Ziaber and Tallesh) were harvested at the similar stage of physiological maturity, at the beginning of October 2010. Blemished, damaged or diseased fruits were discarded carefully. For each genotype, three replicates were prepared, each consisting of the pulp and the peel of three fruits of similar size. Then, fruits were transferred to the laboratory for evaluation. The characteristics of fruits were evaluated after one-month storage at 4°C and 70±5% relative humidity.

Total soluble solid (TSS), fresh weight and dry matter:

Total soluble solid (TSS) contents were determined by a desktop digital refractometer (CETI-Belgium) for 3-6 juice for each genotype. Fruits were weighed and then dry matter content was determined using the standard mention the AOAC 2001.12 [3]. The method entails drying at defined pressure and temperature until the sample attains a constant mass.

Antioxidant capacity:

The antioxidant capacity was measured by the scavenging of 2, 2-diphenyl-2-picrylhydrazyl hydrate (DPPH) radicals according to Ghasemnezhad et al. [15] with minor modifications. Two ml of a 0.15 mM of DPPH solved in methanol was added to 1 ml of pumpkins extracts and then mixed well. Absorbance of the mixture was measured at 517 nm after 30 minutes. Inhibition percentage for each sample was calculated as follows and expressed as antioxidant capacity:

% inhibition = [(Acont– Asamp) / Acont] × 100

Where Acont is the absorbance of the control, and Asamp is the absorbance of the sample.

Total phenolic content (TPC):

Total phenolic content (TPC) were determined using Folin – Cicalteau method as described by Shiri et al. [28], with minor modifications. Polyphenols extraction was carried out by 10 mL acidic methanol added to one gram fine powder of specimen and kept in 4°C then filtered through ordinary filter paper. One hundred fifty μL of this extract was diluted with 350 μL of distilled water. 2.5 mL of Folin–Cicalteau reagent and 2 mL of 7.5% sodium carbonate were added to the mixture. This reaction solution was shaken in a shaker and kept in dark for 2 hours. The absorbance of samples was measured at 765 nm in UV/VIS spectrophotometer (model PG Instrument +80, Leicester, United Kingdom). Gallic acid was used as standard for getting calibration curve. Data were expressed as milligram gallic acid equivalent (mg GAE) per one gram of fruit fresh weight.

Total flavonoids:

The total flavonoids contents were determined according to the aluminium chloride colourimetric method described by Bor et al. [7]. Briefly, 50 μL of fruit pulp extract were mixed with 10 μL aluminum chloride (10%), 10 μL potassium acetate (1 M), and deionized water (280 μL). Samples vortexes vigorously and then incubated at room temperature for 40 min at 25°C. The absorbance of the reaction mixture was measured at 415 nm against a deionized water blank using an UV/VIS spectrophotometer. The total flavonoid content was quantified according to the standard curve using a six point’s concentration (0.016-0.5 mg mL⁻¹) of quercetin. The
data were expressed as mg quercetin equivalents (QE) per one gram of fruit fresh weight.

Statistical analyses:

Results of the experiment were statistically evaluated with ANOVA (Statgraphics Plus software), using single-factor variance analysis. Tukey’s HSD test was used to show which values differ significantly at $P = 0.01$.

Results and Discussion

TSS, fresh weight and dry matter:

The total amounts of TSS, fresh weight and dry matter of four winter squash genotypes are given in Table 1. As the table 1 showed, there is no significant different among genotypes for TSS ($P \leq 0.01$). TSS determined in this study was 7.0-8.7°Brix are in agreement with founding of Noseworthy and Loy [23].

The highest fresh weight and dry matter was observed in Ziaber species. As the table 1 showed, the highest and the lowest proportion of dry matter were measured in the species with 11.67 grams and 7.21 grams by Ziaber and Tallesh genotypes, respectively.

TSS, fresh weight and dry matter are important technological indices of pumpkin fruits [8]. The results which are a continuation of previous studies [29,13,27] which showed pumpkin cultivars differed greatly in respect of physical, chemical and sensory attributes.

Table 1: Fresh weight, dry matter and TSS content of four different winter pumpkin genotypes.

<table>
<thead>
<tr>
<th></th>
<th>TSS</th>
<th>Fresh weight</th>
<th>Dry matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astaneh Ashrafiyeh</td>
<td>7.32 a</td>
<td>32.62 b</td>
<td>9.82 ab</td>
</tr>
<tr>
<td>Ziaber</td>
<td>6.83 a</td>
<td>42.14 a</td>
<td>11.67 a</td>
</tr>
<tr>
<td>Tallesh</td>
<td>7.53 a</td>
<td>40.18 a</td>
<td>7.21 b</td>
</tr>
<tr>
<td>Langrood</td>
<td>8.47 a</td>
<td>32.95 b</td>
<td>10.76 ab</td>
</tr>
</tbody>
</table>

Means in columns followed by the same letters not significantly differs at $P \leq 0.01$, according to Tukey’s test

Antioxidant capacity:

The antioxidant activities of winter pumpkin genotypes extracts were determined using the DPPH free radical assay. Scavenging activity on DPPH radicals assay provides information about the antiradical activity of extracts. Pumpkin extracts’ radical scavenging activities, expressed as %DPPHsc values, are presented in fig. 1. As it shown, the highest level of antioxidant capacity was found in the Ziaber genotypes (54.41 % DPPHsc).

Yu et al., [31] reported significant effects of growing conditions, including the number of hours exceeding 32 °C, on the antioxidant properties of wheat varieties. The average temperature at growing locations was shown to have effects on the antioxidant properties of strawberries [30]. Moreover, Emmons and Peterson [11] found significant cultivar effects for antioxidant activities in oats.

Antioxidant activity of vegetables is very important quality characteristics from nutritional attitude, so differences in the antioxidant activity among the samples are attributable to the fruits and vegetables varieties used as additives.

Total phenolic content:

The TPC significantly differed depending on winter pumpkin species (Fig. 2). The highest TPC was found in the Ziaber species that had significantly different with others, while the lowest value was measured in the Langrood and Tallesh genotypes respectively. These results are in compatible with those of Emmons and Peterson [11] who’s reported that significant cultivar, location, and interaction effects of cultivar and location for the concentration of total phenolic contents in oats.

It is worth commenting the relationship between the TPC and scavenging activity against DPPH, since phenolics contribute to the antiradical activity. A plot correlating these two characteristics is presented in figure 4. High TPC in Ziaber could be the reason of its high antioxidant activity. The correlation between TPC and antioxidant activity of vegetables are reported in literature [28,18]. The bioactivity of phenolic compounds could be related to their antioxidant capacity, which is attributed to their ability to chelate metals, inhibit lipoxygenase and scavenge free radicals [22]. The mechanism by which phenolic compounds are able to scavenge free radicals is yet to be exactly established. The molecular structure of phenols is important for their antioxidant activity, as this activity is enhanced by the presence of a second hydroxyl or a methoxy group in the ortho- or para-position [20] As reported by Heijnen et al., [17], the aromatic OH groups are the reactive centers; primarily 3’, 4’-dihydroxy catechol group, and their activity can be enhanced by electron donating effects of other substituents.

Total flavonoid:

The content of total flavonoid in winter pumpkin genotypes are shown in Fig. 3. As results of TPC, the highest total flavonoid was found in the Ziaber species. The phenolic and flavonoids content of plants whether organically or conventionally cultivated is influenced by several factors such as variety, seasonal variation, light and climate, degree
of ripeness, and food preparation and processing [2]. Synthesis by plants of phytochemicals is also partly related to insect and microorganism pressures [10]. The differential use of pesticides and fungicides may therefore influence phenolic compound and flavonoid content [10]. As the fig 5 illustrated, there was a positive correlation between total flavonoid content and antioxidant capacity. Interestingly, there was a significant correlation between antioxidant capacity and flavonoids ($R^2 = 0.86$). Beninger and Hosfield [5] were found a positive correlation between antioxidant activity and flavonoids compositions. Flavonoids are also a kind of natural antioxidant substances capable of scavenging free superoxide radicals, thus displaying anti-aging properties and reducing the risk of cancer. Moreover, Pinelo et al., [26] were reported that antioxidant capacity of flavonoid is in agreement with variations in their antiradical activity.

**Fig. 1:** Total phenolics content of four winter pumpkin genotypes. The values are means of three replicates ± standard error (S.E.). The means with the same letter are not significantly different ($P < 0.01$).

**Fig. 2:** Total flavonoid content of four winter pumpkin genotypes. The values are means of three replicates ± standard error (S.E.). The means with the same letter are not significantly different ($P < 0.01$).

**Fig. 3:** Antioxidant capacity of four winter pumpkin genotypes. The values are means of three replicates ± standard error (S.E.). The means with the same letter are not significantly different ($P < 0.01$).
Fig. 4: Relationship between total phenolics content and antioxidant capacity of four winter pumpkin genotypes.

Fig. 5: Relationship between total flavonoid content and antioxidant capacity of four winter pumpkin genotypes.

**Conclusions:**

Chosen winter pumpkin genotypes showed a great variability in nutritional and functional values. The most valuable species was Ziaber, however the high nutritional and functional content (as antioxidant capacity, total flavonoid and total phenolics content) in Ziaber is reason to recommend the production and consumption of this genotypes. Moreover, a positive significantly relationship between antioxidant capacity, total flavonoid and total phenolics content of winter pumpkin species exists.

**References**