Health Benefits of Pumpkin Seed and Nutrition Profile of 35 Pumpkin Accessions

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Introduction

Pumpkin seed (*Cucurbita pepo* L.) is high in oil, protein, and total unsaturated fatty acids (TUFA) and provides an important source of nutrition and income globally. Use of pumpkin seed in the snacking and vegetable oil industry in the US is expected to rise as the market for healthy foods increases. Pumpkin seed is a popular ingredient in snacks sold in retail stores across the country, such as trail mixes with various nuts, seeds, and dried fruit, and is also used as an ingredient in breakfast cereal and bread (Baxter et al. 2012; Loy 2004). In addition, pumpkin seed oil can be purchased by the bottle for use in salads, or as formulated capsules in health food stores (Stevenson et al. 2007). This article will discuss the health benefits, production, processing, and nutritional profile of pumpkin seed.

Currently, most of the pumpkin seed consumed in the US is imported, hence the need to breed high-yielding and nutritious accessions (cultivars) that are locally adapted to various agro-ecological zones in the country. To meet the current and projected demand for pumpkin seed in the US, it is critical for growers to have access to pumpkin cultivars with optimized seed yield, seed size, and seed nutrition. Pumpkin cultivars without seed coat (naked seed) are preferred for snacking and oil production because they eliminate the need for manual de-hulling prior to use. In addition, they are generally higher in oil content than the hulled cultivars. The naked seed trait is conferred by a single recessive mutation that leads to significant reduction in the amounts of lignin and cellulose in the hypodermis, sclerenchyma, and parenchyma tissues of the seed coat (Fruhwirth and Hermetter 2007). Depending on the level of lignification or cellulose in the seed coat, several types of seed phenotypes may form (Figure 1).

![Figure 1. Various *Cucurbita pepo* seed phenotypes, where A) represents hulled seeds, B) represents semi-hulled seeds, C) represents thin layered seeds, and D) represents ‘naked’ seeds. Credit: Geoffrey Meru](image)

Health Benefits of Pumpkin Seed

Pumpkin seed is a nutritious food with a high oil (50% w/w) and protein (35%) content that varies depending on cultivar (Fruhwirth and Hermetter 2007). Palmitic (≤ 15%), stearic (≤ 8%), oleic (≤ 47%), and linoleic (≤ 61%) fatty acids are the main components of the oil (Bavec et al. 2007), while albumins and globulins make up approximately 60% of the crude protein. The oil content and fatty acid com-position of pumpkin seed is comparable to that of soybean (*Glycine max*) (Panthee et al. 2005), sunflower (*Helianthus*...


**Production and Processing of Seed Pumpkins**

Growers should follow guidelines used in conventional pumpkin production (Bavec et al. 2007). Direct seeding is the most cost-effective system, but it requires seeding equipment and optimum germination conditions. A pneumatic corn seeder can be used for mechanical planting of pumpkin seeds (Bavec et al. 2007). Transplants on raised beds may be used in areas where low temperatures can hamper seed germination. Plant density affects total fruit yield, fruit size, number of fruit per plant, and seed yield (Napier 2009) and is dependent upon the growth habit (vigious, bush, or semi-bush) of the pumpkin cultivar grown. Management of diseases (fungal/fungal-like, bacteria, viruses, and nematodes) should be done conventionally. Harvesting of fruit should be done at maturity to achieve maximum seed oil content (Bavec et al. 2007). Separation of flesh and seed can be achieved manually or mechanically. For oil production, harvested pumpkin seeds should be dried to a 5–7% moisture content and ground. To form soft pulp, water and salt should be added and the pulp roasted for up to 60 min at temperatures around 100°C to allow coagulation of the protein fraction and convenient separation of the lipid fraction by pressing. Pressing should be carried out under isothermal conditions at pressures between 300 and 600 bar. The obtained seed oil should be stored in dark bottles to avoid light-induced deterioration (Fruhwirth and Hermetter 2007). Alternatively, pumpkin seed oil can be extracted through the cold press method, meaning seeds are ground in a screw press at temperatures less than 49°C, causing the oil to be expelled under pressure. Although the latter method produces more pristine oil, extraction efficiency is reduced and some of the oil remains in the seed pulp. After oil extraction, the remnant pressing cake contains a significant level of nutritious components (>60% proteins) and can be used as an animal feed (Fruhwirth and Hermetter 2007; Lelley et al. 2009).

**Nutrition Profile of 35 Pumpkin Seed Accessions**

Availability of highly nutritious pumpkin seed products is of utmost importance to the consumer. Generally, consumers prefer large-seeded accessions for snacking, but seed size does not matter for consumers of pumpkin seed oil. In addition, pumpkin seed for snacking may be bred for either high protein or high oil value, but for oil production, the latter is a necessity. Pumpkin cultivars can vary greatly in seed oil and protein content, fatty acid composition, and seed size. It is therefore important for consumers/growers to have information on the nutrition profile of pumpkin accessions, so that they can choose those that meet their needs. To generate this information, the Cucurbit Research Program at the University of Florida Tropical Research and Education Center examined key nutrition traits among 35 pumpkin seed accessions. Seed oil and protein content was determined using nuclear magnetic resonance, while fatty acid composition was determined using gas chromatography. Data for the 35 pumpkin seed accessions is presented in Table 1. In general, naked pumpkin accessions were higher in seed oil content and seed size than hulled accessions (Table 2). On the contrary, the reverse was true for seed protein content. Styrian pumpkin and PI 379309 had the highest seed oil content among the naked seed and hulled accessions, respectively. In comparison to major oil crops, the level of healthy fats (unsaturated fatty acids: oleic and linoleic acid) in the current study (78.6%–86.1%) was similar to that of soybean (84.4%) and sunflower (88.6%) (Baboli and Kordi 2010). As mentioned before, unsaturated fatty acids contribute towards reduced risk of arteriosclerosis and heart-related ailments. However, high linoleic acid content in pumpkin seed oil lowers the heat stability of the derived oil, making it unsuitable for cooking. This challenge may be alleviated by developing high-oleic acid, low-linoleic acid pumpkin seed cultivars suitable for production of cooking oil; development of these cultivars will be a focus in our breeding program.

**References**


Table 1. Seed phenotype, seed oil percentage, seed protein percentage, fatty acid composition, and seed size (seed weight, seed length, and seed width) for 35 Cucurbita pepo accessions.

<table>
<thead>
<tr>
<th>Accession</th>
<th>Seed phenotype</th>
<th>Seed oil (%)</th>
<th>Seed protein (%)</th>
<th>Palmitic acid (%)</th>
<th>Stearic acid (%)</th>
<th>Oleic acid (%)</th>
<th>Linoleic acid (%)</th>
<th>10 Seed weight (g)</th>
<th>Seed length (mm)</th>
<th>Seed width (mm)</th>
</tr>
</thead>
</table>
Table 2. Means for seed oil percentage, seed protein percentage, palmitic acid, stearic acid, oleic acid, linoleic acid, and seed size (seed weight, seed length and seed width) among 35 *Cucurbita pepo* accessions with hulled, semi-hulled, thin layer, and ‘naked’ seed phenotypes. Means within column followed by the same letter are not significantly different (P < 0.05).

<table>
<thead>
<tr>
<th>Seed type</th>
<th>Seed oil (%)</th>
<th>Seed protein (%)</th>
<th>Palmitic acid (%)</th>
<th>Stearic acid (%)</th>
<th>Oleic acid (%)</th>
<th>Linoleic acid (%)</th>
<th>Seed weight (g)</th>
<th>Seed length (mm)</th>
<th>Seed width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hulled (n= 9)</td>
<td>35.91b</td>
<td>25.81ab</td>
<td>8.25b</td>
<td>4.87a</td>
<td>31.41a</td>
<td>52.79a</td>
<td>0.86c</td>
<td>11.92b</td>
<td>7.56p</td>
</tr>
<tr>
<td>Semi-hulled (n= 7)</td>
<td>42.91a</td>
<td>26.13a</td>
<td>9.80a</td>
<td>6.14a</td>
<td>29.56a</td>
<td>52.22a</td>
<td>1.55ab</td>
<td>16.50a</td>
<td>8.82a</td>
</tr>
<tr>
<td>Thin layer (n= 10)</td>
<td>43.97a</td>
<td>24.30ab</td>
<td>10.25a</td>
<td>5.67a</td>
<td>29.45a</td>
<td>51.82a</td>
<td>1.26bc</td>
<td>15.08a</td>
<td>8.06p</td>
</tr>
<tr>
<td>Naked (n= 9)</td>
<td>44.60a</td>
<td>22.63b</td>
<td>11.04a</td>
<td>5.96a</td>
<td>32.54a</td>
<td>48.12a</td>
<td>1.97a</td>
<td>17.01a</td>
<td>9.04a</td>
</tr>
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