



Oil pumpkins – Important source of antioxidants

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Abstract

The objective of the two years study was to investigate the content of the antioxidants in oil pumpkin fruits and seeds of different cultivars (Golosemiannaja, Herakles and Miranda). Samples of pumpkin seeds were extracted and analyzed for vitamin E (high-performance liquid chromatography assay), vitamin C (titration method of 2,6-dichlorophenol-indophenol), β -carotene and lutein (Shimadzu HPLC 10A system analysis), zinc and selenium (by mass spectrometry). Specimens of pumpkin flesh were analysed for total carotenoids (UV-VIS spectrophotometer assay) and vitamin C. The seeds of 'Miranda' accumulated the highest amount of vitamin E (402.93 $\mu\text{g g}^{-1}$ d.m.). The content of vitamin C in oil pumpkin flesh ranged from 3.06 to 3.87 mg g^{-1} fresh mass, in seeds 7.04–8.43 mg g^{-1} fresh mass. Total carotenoid quantity in flesh of all pumpkin cultivars was significantly different and ranged from 0.01 to 1.74 mg g^{-1} fresh mass. The content of lutein in oil pumpkin seeds varied from 25.26 to 162.70 $\mu\text{g g}^{-1}$ d.m. as well the content of β -carotene from 4.16 to 5.15 $\mu\text{g g}^{-1}$ d.m. The highest amount of zinc was found in 'Golosemiannaja' (65.45 mg kg^{-1} d.m.), and the highest amount of selenium in 'Miranda' (0.09 mg kg^{-1} d.m.) seeds. Summarising our results, we could to maintain that 'Golosemiannaja' seeds are especially rich in antioxidants lutein and zinc. The flesh and seeds of 'Miranda' are valuable due to high total carotenoid content and vitamin E. The seeds of all tested oil pumpkin cultivars accumulated significantly higher amount of vitamin C compared to flesh.

Key words: Oil pumpkin, vitamins, minerals.

Introduction

Antioxidants of plants have recently attracted growing consumers' interest. It can be explained with their positive influence on human's health. A diet rich in fruits and vegetables helps in diminishing the risk of cardiovascular disease, some tumor types and it can protect against other diseases⁷. Therefore, it is important to encourage consumers to choose products abundant in natural antioxidants, e. g. oil pumpkins. These pumpkins can be used as a food and in medicine, seeds are perfect material for oil production. Many people use pumpkin oil as a healthy and tasty food additive. This oil is rich in vitamin E, which was discovered in 1922 as a compound necessary to sustain reproductive ability in rodents. Evans and Bishop determined that rodents fed diets containing rancid fat produced offspring that were mostly sterile in the first generation and completely sterile in the second generation. They concluded that fetal resorption occurred despite the presence of normal ovarian structure and function⁵. Nowadays the most well known biological function of vitamin E is a chain-breaking antioxidant that prevents the propagation of lipid peroxidation⁴. Vitamin E has been found to "outcompete" the propagation reactions so that a single vitamin E molecule is able to protect about 1000 lipid molecules from the chain-reaction propagation step². Many investigations have shown that vitamin E can ameliorate the risk of developing chronic diseases, particularly heart disease, certain cancers, and Alzheimer's disease^{5,16,22}.

Oil pumpkins flesh and seeds are source of vitamin C, which is a required nutrient for humans. Vitamin C has strong reducing

properties due to its enediol structure, which is conjugated with the carbonyl group in a lactone ring²³. Vitamin C is required for collagen formation, prevention of scurvy, degenerative conditions, including cancer, heart disease, cataracts, and stimulation of the immune system²³.

This vegetable is also rich in carotenoids. In the human body carotenoids keep such chemical reactivity as in plants by catching free radicals and active atomic oxygen. This is particularly important for heavily working peoples, record-seeking sportsmen and people being in the situation of the prolonged stress. The diet rich in carotenoids diminishes coronary disease, tumours of the lungs, urinary diseases and skin problems^{10,12,13}.

Mineral components delivered along with the food realize important matter in the behavior of the human body acid-alkaline equilibrium. Zinc and selenium have been found to have nutraceutical potential. Their nutraceutical potential is usually discussed in relation to antioxidation²³. The objective of the two years study was to investigate the content of the antioxidants in oil pumpkin fruits and seeds of different cultivars.

Materials and Methods

The study material consisted of oil pumpkin (*Cucurbita pepo* L. var. *styriaca*) fruits of three different cultivars: 'Golosemiannaja', 'Herakles' and 'Miranda'. The research work was carried out in 2010–2011 at the Experimental Station of the Aleksandras Stulginskis University in Kaunas. The field was not fertilized.

Vitamin E amounts in pumpkin seeds were determined using high-performance liquid chromatography (HPLC)¹⁷. Vitamin C in flesh and seeds of pumpkins was quantified by titration method of 2,6-dichlorophenol-indophenol. Total carotenoids content in flesh was measured using UV-VIS spectrophotometer. Analyses of β -carotene and lutein contents in seeds were performed with Shimadzu HPLC 10A system^{9,12}. Zinc and selenium quantities in seeds of oil pumpkins were determined using a mass spectrometer (Thermo Finnigan MAT, Bremen, Germany).

Statistical analysis was performed using one-way ANOVA (STATISTICA software). Statistical significance was considered at $p < 0.05$. Data presented in figures and tables are mean values of the two years of study. Vertical bars in figures indicate standard deviation.

Results and Discussion

The chemical composition of oil pumpkins flesh and seeds depends on the soil, climate conditions and genetic characteristics^{3,15,18}. The results showed that the content of vitamin E in seeds of oil pumpkin cultivars ranged from 296.75 to 402.93 $\mu\text{g g}^{-1}$ (Fig. 1). 'Herakles' seeds accumulated the lowest amount of vitamin E (296.75 $\mu\text{g g}^{-1}$) and 'Miranda' seeds the highest amount of vitamin E (402.93 $\mu\text{g g}^{-1}$).

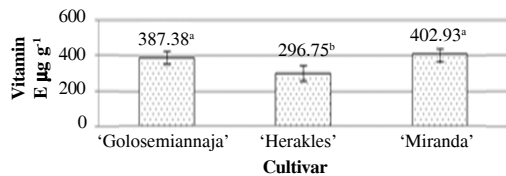


Figure 1. The amount of vitamin E in oil pumpkin seeds ($\mu\text{g g}^{-1}$).

The same letters show no significant differences between means ($p < 0.05$)

According to Pandey *et al.*²⁰, the content of vitamin C in fresh pumpkin flesh ranged from 1.53 to 6.74 mg g^{-1} . Our results are in agreement with these results. The fruits of all tested oil pumpkin cultivars accumulated in flesh similarly contents of vitamin C, 3.06–3.87 mg g^{-1} (Fig. 2). The amount of this vitamin in pumpkin seeds, 7.04–8.43 mg g^{-1} , was significantly higher than in flesh.

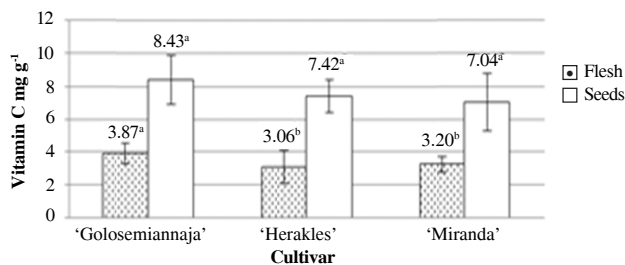


Figure 2. The amount of vitamin C in oil pumpkin flesh and seeds (mg g^{-1}).

The same letters show no significant differences between means ($p < 0.05$).

In the human body carotenoids accomplish functions of antioxidants, and some are converted to vitamin A. According to literature data, total carotenoid content in flesh of oil pumpkins fruits is 0.03–0.17 mg g^{-1} ¹⁰. Our results showed that the significantly highest amount of total carotenoids was in 'Miranda' (1.74 mg g^{-1}) and significantly smallest in 'Herakles' (0.01 mg g^{-1}) pumpkin flesh (Table 1).

Some studies have indicated that in seeds of oil pumpkins lutein composed 71% and β -carotene only 12% of all carotenoid content⁶. The amount of lutein in tested pumpkins seeds ranged from 25.26 to 162.70 $\mu\text{g g}^{-1}$ (Table 2).

Table 1. Total carotenoids contents in oil pumpkin cvs. (mg g^{-1}).

Cultivars	Total carotenoids mg g^{-1}
'Golosemiannaja'	0.82 \pm 0.1527b
'Herakles'	0.01 \pm 0.0001c
'Miranda'	1.74 \pm 0.1533a

The same letters show no significant differences between means ($p < 0.05$), \pm STDEV = Standard deviation.

Table 2. Lutein and β -carotene contents in oil pumpkin cvs. seeds ($\mu\text{g g}^{-1}$).

Cultivars	Lutein	β -carotene
'Golosemiannaja'	162.70 \pm 2.69a	5.15 \pm 0.87a
'Herakles'	64.06 \pm 4.89b	4.91 \pm 0.59a
'Miranda'	25.26 \pm 0.86c	4.16 \pm 0.17a

The same letters in the same column show no significant differences between means ($p < 0.05$), \pm STDEV = Standard deviation.

The highest amount of lutein was in oil pumpkin seeds of 'Golosemiannaja' (162,70 $\mu\text{g g}^{-1}$). The contents of β -carotene in tested seeds was similar 4.16–5.15 $\mu\text{g g}^{-1}$.

According to the literature, pumpkin seeds accumulated zinc 15–100 mg kg^{-1} ²⁰ and of selenium 0.023–0.037 mg kg^{-1} ¹⁵. Zinc has antiviral and anticancer effect, increases the body's resistance and activates about 80 enzymes. Selenium is also an important antioxidant, that protects cell membranes and the formation of free radicals, resulting in reduced risk of cancer, heart and vascular diseases. The richest in zinc was 'Golosemiannaja' (65.45 mg kg^{-1} d.m.) and in selenium 'Miranda' (0.09 mg kg^{-1} d.m.) seeds (Table 3).

Table 3. Zinc and selenium contents in oil pumpkin cvs. seeds (mg kg^{-1} d.m.).

Cultivars	Zn	Se
'Golosemiannaja'	65.45 \pm 2.70a	0.04 \pm 0.01b
'Herakles'	64.42 \pm 0.91b	0.01 \pm 0.00c
'Miranda'	54.81 \pm 3.27c	0.09 \pm 0.01a

The same letters in the same column show no significant differences between means ($p < 0.05$), \pm STDEV = Standard deviation.

Conclusions

The biggest quantities of antioxidants lutein and zinc have been found in cv. 'Golosemiannaja' seeds. The flesh and seeds of cv. 'Miranda' are valuable due high total carotenoid content and vitamin E. The seeds of all tested oil pumpkin cultivars accumulated significantly higher amount of vitamin C compared to flesh.

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