THE NUTRITIONAL AND PHYTOCHEMICAL COMPOSITION OF MOLDAVIAN PUMPKIN

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Abstract

This paper presents the results of analyzing of chemical composition and some bioactive components such as phenols, carotenoids, carbohydrates and minerals in one of a product of plant origin, namely, in pumpkin. High amount of carbohydrates, vitamins and minerals in pumpkin makes it an important source of bioactive ingredients. Pumpkin is rich in beta-carotene, and lycopene. In accordance with current research, the edible part of pumpkin grown industrially in Republic of Moldova presented the following nutritional potential: total phenols – 260,3 mg GAE/100 g, total carotenoids – 8,38 mg/100 g, carbohydrates – 10,5%, minerals as iron, calcium, potassium, phosphorus, the most abundant mineral was potassium – 210 mg/100 g. The acidity was of 0,23 %, expressed as malic acid, and pH value of 5,2. The knowledge and effective use of this valuable agro-food product can be useful in the development of different healthy diets and in the treatment of pathologies with nutritional impact.

Key words: *pumpkin pulp, phenolic compounds, carotenoids, carbohydrates, minerals*

INTRODUCTION

Pumpkin (Cucurbita spp.), is one of the most popular vegetables consumed in the world, moreover it has been recently recognized as a functional food is due to anti-diabetic, anti-carcinogenic, anti-inflammatory effects, also as a good hypolipidemic agent [1].

The volume of pumpkin cultivation in Republic of Moldova is constantly growing and reaches 32.6…44.3 thousand tons per year. Traditionally, in Moldovan cuisine, pumpkin is used in the preparation of pastries, confectionary products or as a gastronomic garnish in dishes.

The edible part of the pumpkin usually makes up 75% of the total mass, and the seeds are about 10-15%. Pumpkin pulp is a good source of potential bio-accessible phenols and other antioxidant promotors [2].

Pumpkin seeds also represent a rich source of food, especially in the form of oil or seed flour [3].

MATERIAL AND METHOD

Specimens of pumpkins of Cucurbita Moscato species with a mass of 1.5...2.5 kg and pyramidal form were purchased from a local market. Sample preparation included cleaning from the skin and seeds of the pumpkin, cutting of the edible part, combined thermal drying of it, in the microwave, followed by the oven at 55 ºC and crushing to obtain dry pumpkin powder.

Extraction of soluble compounds from dry powder was performed with different solvents – water, methanol, ethanol. For clarification of samples the double filtration method was used, supplemented by centrifugation (20 min., 6000 rpm). The ratio of solvent to dry product was 20:1 (ml/g

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DM). The extraction conditions were as follows: time 240 min., temperature 20 ºC.

UV-VIS molecular absorption spectra were recorded in the 190-800 nm range with a Lange DR-5000 spectrophotometer (Germany). Total phenolic content (TPC) was expressed as milligrams of gallic acid equivalent per 100 g of pulp (mg GAE/100 g pulp, FW). The assay involved the reduction of Folin Ciocalteu's reagent, and then the absorbance was measured at 760 nm using a molecular spectrophotometer [4].

In parallel, the profile of individual compounds was determined by using data of molecular absorbance and value of absorption coefficient, for gallic acid at 270 nm, caffeic acid at 273 nm, chlorogenic acid at 325 nm and neochlorogenic acid at 217 nm [5, 6].

For the individual quantification of carotenoids, data related to the specific wavelength and the value of the absorption coefficient were used [7].

For spectrophotometric determinations, the clarified pumpkin juice was diluted 1 to 10.

To calculate the individual carotenoid concentration (mol/L), the following equation was used:

$$C\left(\frac{mol}{L}\right) = \frac{A_\lambda \cdot F \cdot d}{\varepsilon} \qquad (d = 1\ cm)$$

with $A_\lambda$being the mean absorbance maxim, and F a dilution factor adjusting for extractions, drying, and reconstitution processes. Results can also be expressed as milligrams per 100 grams of edible part (mg/100 g).

Acidity and minerals were determined by standard analytical methods.

All of these analyses were performed in triplicates and mean values were calculated.

RESULTS

In the prezent work spectrophotometric data (fig. 1) served as the source for estimation of the values of four polyphenols - gallic, caffeic, chlorogenic, neochlorogenic acids were estimated. By using the molar extinction coefficient of each individual component, the concentration of the sample was reached, and with the use of the extraction factor - the amount of acid in the researched product. Phenolic acids are optimally determined when the extraction solvent is water or dilute solutions of methanol (e.g. 10%) [8, 9].

The molecular absorption profile of pumpkin. extracts in water and ethanol (fig. 1, 2) confirms peaks and maximum absorption values in the range of 250-300 nm waves, which are specific for polyphenols [6]. Thus, after testing and analysis, we found that the species of pumpkin Cucurbita Moschata presented maximum values for caffeic acid of 13.7 and gallic acid of 82.6 mg/100 g. Low values had chlorogenic and neochlorogenic acid - respectively of 5,4 and 9,2 mg /100 g. The total polyphenols determined by the method of reference to the presence of gallic acid had a value of 260.3 mg GAE/100g.pumpkin.

The polyphenols present in the pumpkin pulp have good reductant qualities, which ensure visible antioxidant and anti-stress effects [4, 10].

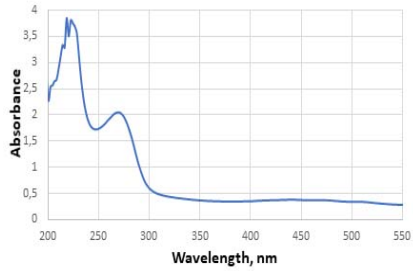

Fig. 1. UV-ViS spectra of aqueous solution of pumpkin

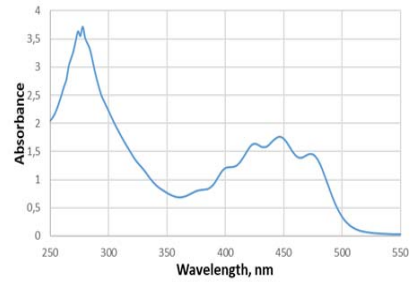

Fig. 2. UV-ViS spectra of ethanol solution of pumpkin

The carotenoid family is large and is represented in pumpkin by several compounds - α-carotene, β-carotene, ζ-carotene, β-carotene 5,6-epoxide, β-cryptoxanthin, licopene, lutein, taraxanthin, zeaxanthin, luteoxanthin and auroxanthin [11]. In the current research 6 types of carotenoids were detected. The maximum presence was recorded for lycopene and β-cryptoxanthin, respectively of 1.56 and 1.46 mg/100 g. β- carotene which is a precursor of vitamin A showed a level of 1.28 mg/100 g (tab. 1). The total amount of carotenoids in pumpkin pulp was 8.36 mg/100 g. Other researchers reported an amount of 7.47 mg/100 g [1] or 3.52 mg/100g [8] for total carotenoids.

The differences in content obtained can be interpreted as caused by the versatility of the pumpkin's composition. In the same way, they largely depend on the solvent used in the extraction stage - ethanol, metanol, hexane or acetone [7].

Table 1. Profile of carotenoids in pumpkin pulp

Individual carotenoids	λ, nm	Absorbance	Absorption coefficient ε, L/mol	Molar mass, g/mol	Content, mg/100 g
α-carotene	452	1,682	141970	536.9	1,27
β-carotene	452	1,682	140663	536.9	1,28
Lutein	445	1,753	144900	568.9	1,38
Lycopene	448	1,756	120600	536.9	1,56
β-cryptoxanthin	449	1,743	131915	552.9	1,46
Zeaxantine	452	1,682	133118	568.9	1,43

The pumpkin pulp had an active acidity of pH= 5.2 and titratable acidity of 2.23 ml NaOH, 0.1N/100 g. Acidity of pumpkin fruits is not too high and is mainly due to the presence of organic acids - citric, malic and fumaric [12].

The amount of accumulated carbohydrates depends on the species, the degree of physiological maturity and the growing conditions of the plant. In this research, the profile of water-soluble simple sugars was studied.

Pumpkin contains as the most macro elements K and P, potassium is the absolute record holder, amounting to 340 mg/100 g of product [2]. The other minerals that are present in the pumpkin pulp are – iron, calcium, magnesium, sodium [13].

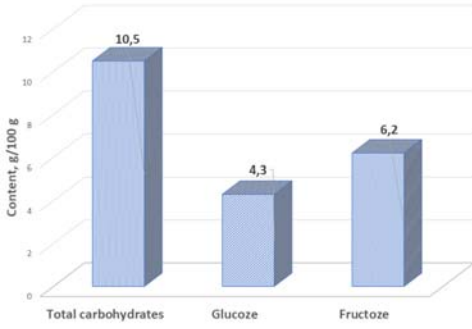

Fig. 3. The carbohydrates content in pumpkin

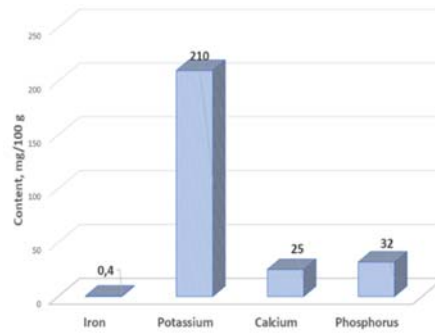

Fig. 4. The mineral content in pumpkin

We obtain the following data for Moldavian pumpkin – 0.4, 210.3, 25.2, 32.2 mg/100 g of presents of iron, potassium, calcium and phosphorus respectively (fig. 4). The mineral content in different batches of pumpkin can differs depending on agricultural practices which affect the ecology and chemistry of the soil in ways that could affect the availability of minerals to plants and hence the mineral content of crops [3].

DISCUSSIONS

To explore the functional ingredients of the pumpkin, it is necessary to elaborate the concept and design of some new culinary recipes, which would include different treatment procedures with minimal impact on the initial nutritional value. The exact knowledge of the phytonutrients present in the pumpkin pulp is a guarantee for the development of innovative culinary products with multiple functional qualities.

CONCLUSIONS

Pumpkin is a good source of bio-active ingredients of various nature. Moldavian pumpkin contains as a secondary metabolites phenols - 206.3 mg GAE/100 g, there gallic acid id dominant. The carotenoid family is mainly represented by lycopene and β-cryptoxanthin and has a value of 8.36 mg/100 g. The nutraceutical value of pumpkin is due to anti-diabetic, anti-inflammatory effects, also it is a good hypolipidemic agent.

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REFERENCES

1. Sharma, S; Rao, RT Nutritional quality characteristics of pumpkin fruit as revealed by its biochemical analysis. *Int. Food Res. J.* **2023**, 20 (5), 2309-2316.
2. Kim, MY et al Comparison of the chemical compositions and nutritive values of various pumpkin (Cucurbitaceae) species and parts. *Nutrition Research*. **2012**, *6 (1),* 21-27.
3. Adubofuor, J; Amoah, I Anti-nutritional factors and mineral composition of pumpkin pulp and functional properties of pumpkin-wheat composite flour for bread preparations. *Int. J. Innov. Food Sci. Technol.* **2018**, *1(1),* 11-19.
4. Busuioc, AC; Botezatu, AV; Furdui, B Comparative Study of the Chemical Compositions and Antioxidant Activities of Fresh Juices from Romanian Cucurbitaceae Varieties. *Molecules*. **2020**, *25(2),* 13-27.
5. Pagano, C; Perioli, L; Balsi, F Optimization of phenol extraction from wine using layered double hydroxides and technological evaluation of the bioactive-rich powder. *Int. J.*

Food Sci. and Technol. **2017**, *52 (12),* 2582-2588.
6. Abebe, BG Spectrophotometric method for the determination of caffeic acid complexation and thermodynamic properties. *International Journal of Biophysics*. **2012**, *2(2),* 60-67.
7. Biehler, E; Mayer, F; Hoffmann, L Comparison of 3 spectrophotometric methods for carotenoid determination in frequently consumed fruits and vegetables. *Journal of Food Science*. **2009**, *75 (1),* 55-61.
8. Hussain, A; Kausav, T; Din, A Determination of total phenolic, flavonoid, carotenoid and mineral contents in peel, flesh and seeds of pumpkin. *J. Food Processing and Preservation.* **2021**, *26 (3),* 17-23.
9. Pinna, N; Salwa, BA; Ianni F Phenolic compounds from pumpkin pulp: Extraction optimization and biological properties. *Food Chemistry*. **2024**, *152 (6),* 256-266.
10. Ruwanthika, KO; Munasinghe, MS Overview of Cucurbita spp. (pumpkin) and development of value-added products emphasizing its nutritional and chemical composition. *World Journal of Advanced Research and Reviews*. **2023**, *18 (02),* 1215-1226.
11. Hidaka, T; Anno, T The composition and vitamin A value of the carotenoids of pumpkins of different colors. *Journal of Food Biochemistry*. **2007**, *11(1),* 59-68.
12. Nawirscka-Olszanska, A; Biesiada, A Characteristics of organic acids in the fruit of different pumpkin species. *Food Chem.* **2013**, *148 (30),* 415-419.
13. Surand, T; Purvando, F The relationship between altitudes and the contents of protein, carbohydrates, lipids of pumpkin. *Agrivita*. **2015**, *37(1),* 59-66.