ANTHOCYANINS EXTRACTION FROM PURPLE POTATO (GĂLĂNEŞTI BLUE-VIOLET VARIETY)

Florentina DAMŞA[1], Alexandru WOINAROSCHY[2], Carmen Liliana BĂDĂRĂU[3]

Varieties of pigmented potato (Solanum tuberosum L.) are an important source of anthocyanins. The aim of this work is to establish the optimal conditions for purple potato anthocyanins extraction. The anthocyanins were extracted from Gălăneşti blue-violet variety using the soaking in ethanol and 1% acidified ethanol. The highest yield (178.25mg/100g FW) of anthocyanins was reached at the temperature of 60°C, extraction time 60 min. in absolute ethanol.

Keywords: anthocyanins extraction, purple potato

1. Introduction

The interest for natural antioxidants, especially from fruits and vegetables, has increased in recent years. Epidemiological studies indicated that a high level of natural antioxidants (ascorbic acids, vitamin E, carotenoids and phenolics) in human everyday diet can protect against cardiovascular diseases, cataract, cancer and aging-related disorders [1].

Potato (*Solanum tuberosum L.*) is one of the principal food crops in the world and the tubers are a good source of carbohydrates (starch), proteins and vitamin C. As a product of plant origin they also contain secondary metabolites (phytochemicals) [2, 3, and 4]. Polyphenolic compounds are a large group of phytochemicals and depending on their chemical structure they can be divided into the following classes: flavonoids, phenolic acids, tanins, stilbenes and lignans [5]. Anthocyanins (classified as flavonoids) are responsible for the color found in the pigmented potatoes.

Considering that anthocyanins possess anti-oxidant, anti-microbial and interesting dye properties, these compounds are used in the food industry as a "natural" food additive. Several researchers have studied the anthocyanin contents

[1] Department of Chemical and Biochemical Engineering, University POLITEHNICA of Bucharest, National Institute of Research and Development for Potato and Sugar Beet, Brasov, Romania

[2] Department of Chemical and Biochemicalp Engineering, University POLITEHNICA of Bucharest, Romania, e-mail: a_woinaroschy@chim.upb.ro

[3] Department of Chemical and Biochemical Engineering, University POLITEHNICA of Bucharest, University Transilvania of Brasov, Faculty of Food and Tourism, Romania

of colored potato tubers. The pigments have been identified as anthocyanin derivatives [6, 7]. In fact, the first anthocyanin in a colored potato, malvidin-3-(p-coumaroryl-rutinoside)-5-glucose, was identified by Chmielewska (1936) still the year 1930. [8]

The aim of this study was to investigate the effect of temperature (30 – 60^{o}C) extractions time (20 – 40 min) and solvent type (ethanol and 1% acidified ethanol) on anthocyanins extraction from purple potato (Gălăneşti blue-violet variety).

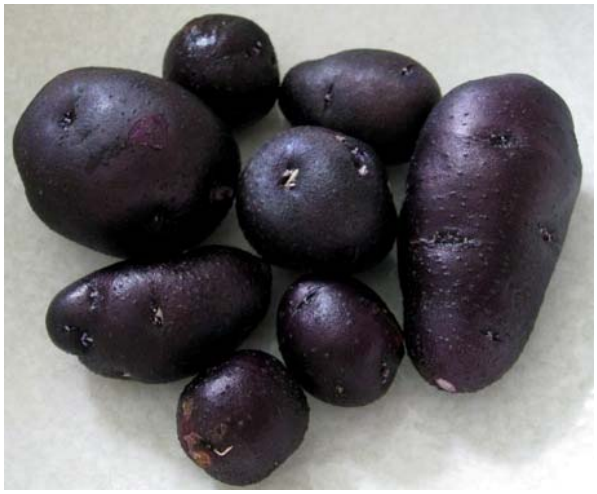

Fig. 1. Purple potato

2. Experimental

2.1. Anthocyanins extraction

Purple potato (Fig. 1) in amount of 5 g was homogenized in ethanol and 1% acidified ethanol (according with conditions presented in Table 1).

Table 1

Conditions for anthocyanins extraction from Purple Potato (Galanesti blue-violet variety)

Sample no.	Sample mass, g	Solvent	Time, min	Temperature, ^{o}C
P1	5	Ethanol	20	30
P2	5	Ethanol	20	45
P3	5	Ethanol	20	60
P4	5	Ethanol	40	30
P5	5	Ethanol	40	45

P6	5	Ethanol	40	60
P7	5	Ethanol	60	30
P8	5	Ethanol	60	45
P9	5	Ethanol	60	60
P10	5	1% acidified ethanol	60	30
P11	5	1% acidified ethanol	60	45
P12	5	1% acidified ethanol	60	60

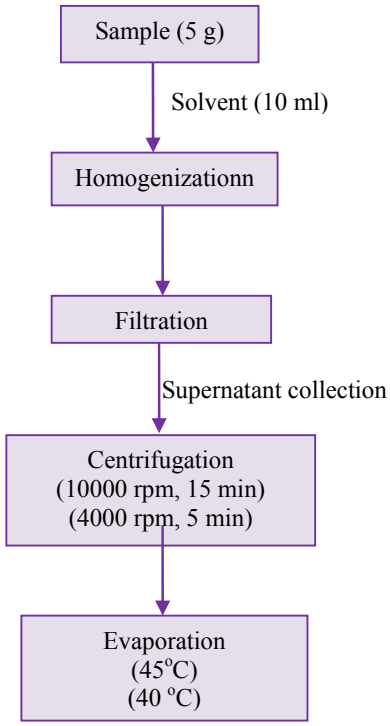

Fig. 2 Extraction procedure applied for anthocyanins

Extracts were centrifuged (10 000 rpm, 15 min) and concentrated at 45°C. The extraction procedure of anthocyanin pigments from Purple Potato is schematically presented in Fig. 2.

2.2. Quantification of total anthocyanins

The total anthocyanins content were determined by the differential pH method based on the property of anthocyanin pigments to change the color with pH. Two dilutions of the same sample were prepared, the first one in potassium chloride buffer (0.025 M, pH 1.0), and the second one in sodium acetate buffer (0.4 M, pH 4.5), pH being adjusted with HCl. After equilibration at room temperature for 15 min, the absorbance of two dilutions was read at 510 nm and 700 nm. Total monomeric anthocyanins (mg cyanidin 3-glucoside equivalent/ 100 g Fresh Weight) were calculated as follows:

$$\%\, w/w = \frac{A}{\varepsilon L}\ MW\ \ DF\ \ \frac{V}{W_t}\ 100 \tag{1}$$

$$A = \left(A_{510nm} - A_{700nm}\right)_{pH=1} - \left(A_{510nm} - A_{700nm}\right)_{pH=4.5} \tag{2}$$

The significance of symbols used in these relations are:
%w/w – percentage weight/weight (grams of solute in 100 grams of solution)
A – absorbance
ε – molar extinction coefficient (26900 L/mol cm)
L – path length
MW – molecular weight (449.2 g/mol for cyanidin 3-glucoside)
DF – dilution factor
V – volume
W_t – sample weight

The total anthocyanin content (TAC) of purple potato extract is presented in Table 2.

Table 2

Total anthocyanin content of purple potato extract

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
TAC	47.1 ± 2.43	68.7 ± 3.02	81.1 ± 2.72	44.41 ± 2.95	55.10 ± 3.61	115.43 ± 3.42	86.0 ± 3.15	139.5 ± 3.80	178.25 ± 4.23	59.08 ± 3.24	73.32 ± 3.61	150. 73± 2.68

The influences of temperature, time and solvent on anthocyanins extraction are presented in Fig. 3-5.

Fig. 3 shows the influence of contact time between solvent and sample on anthocyanins extraction. The contact time has a positive influence on the content of total anthocyanin pigments (for a contact time of 20 min was obtained 81.1 ± 2.72 mg cyanidin 3-glucoside equivalent/ 100 g Fresh Weight and for 60 min was obtained 178.25 ± 4.23 mg cyanidin 3-glucoside equivalent/ 100 g Fresh Weight).

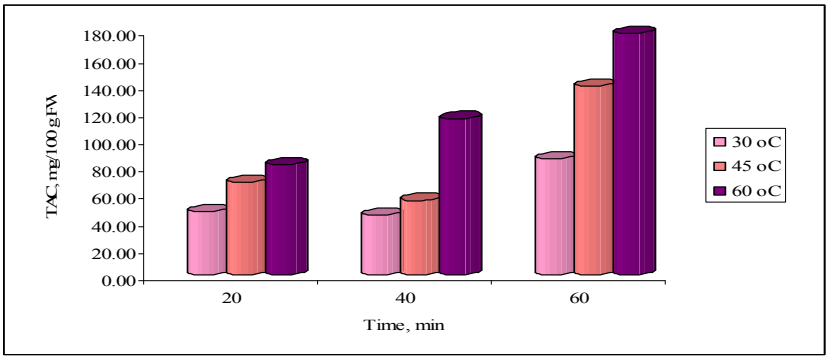

Fig. 3. Influence of contact time between solvent and sample on anthocyanins extraction

Fig. 4 shows the influence of temperature on anthocyanins extraction. The temperature has a positive influence on the total anthocyanins content (for a temperature of 30°C was obtained 86.0±3.15 mg cyanidin 3-glucoside equivalent/ 100 g Fresh Weight and for 60°C was obtained 178.25±4.23 mg cyanidin 3-glucoside equivalent/ 100 g Fresh Weight).

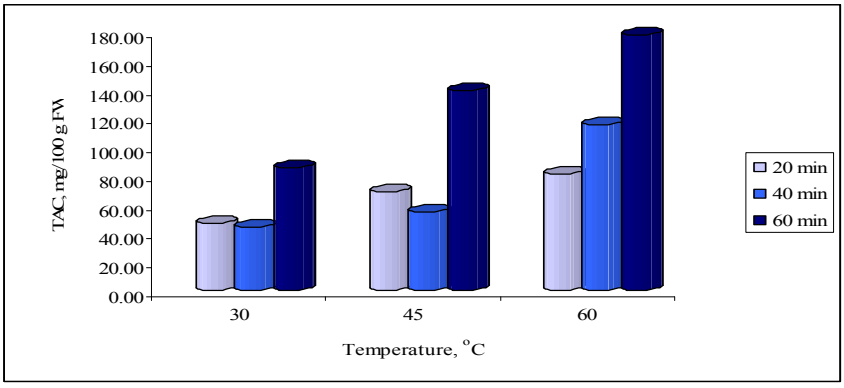

Fig. 4. Influence of temperature on anthocyanins extraction

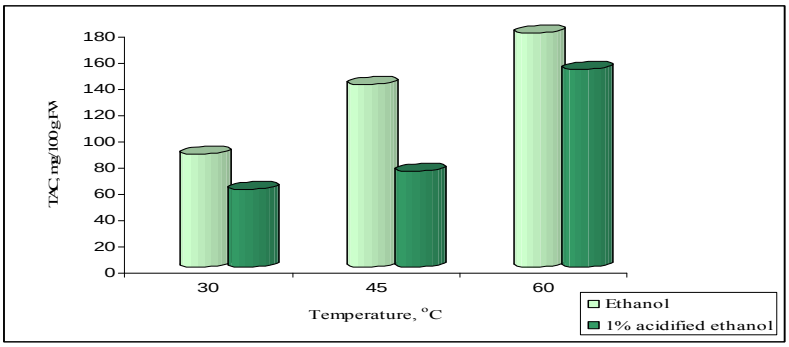

Fig. 5. Influence of extraction solvent on the anthocyanin pigments

Fig. 5 shows the influence of extraction solvent on the anthocyanins pigments. Even if the extraction efficiency is higher in the case of ethanol (178.25±4.23 mg cyanidin 3-glucoside equivalent/ 100 g Fresh Weight) compared with 1% acidified ethanol (150.73±2.68 mg cyanidin 3-glucoside equivalent/ 100 g Fresh Weight), this is more stable in acidic medium.

3. Conclusions

The highest anthocyanin content was found at extraction temperature of 60^{o}C, for an extraction time of 60 min. with ethanol as solvent. The lowest anthocyanin content was found at extraction temperature of 30^{o}C, for an extraction time of 40 min. with ethanol as solvent. The anthocyanin content are lower when is used as solvent 1% acidified ethanol. The results are similar with literature reports about purple potato anthocyanin content determined through differential pH method. The disadvantage of this method is that it cannot provide information regarding the individual anthocyanins.

R E F E R E N C E S

[1] *Steffen L. M., Jacobs J. D. R., Stevens J., Shahar E., Carithers T., Folsom A. R.,* Associations of whole-grain, refined-grain. And fruit and vegetable consumption with risks of all-cause mortality and incident coronary artery disease and ischemic stroke: The Atherosclerosis in Communities (ARIC) Study, Am. J. Clin. Nutr., **78**, 2003, p. 383-390

[2] *Augustin J.,* Variations in the nutritional composition of fresh potatoes, J. Food Sci., **40**, 1975, p. 1295–1299

[3] *Lewis CE, Walker J. R. L., Lancaster J. E., Sutton K. H.,* Determination of anthocyanins, flavonoids and phenolic acids in potatoes. I: Colored cultivars of Solanum tuberosum L, J. Sci. Food Agric., **77**, 1998, p. 45–57

[4] *Brown C. R.,* Antioxidants in potato, Am. J. Potato Res., **82**, 2005, p. 163–172

[5] *Ignat I., Volf I., Popa V. I.,* A critical review of methods for characterization of polyphenolic compounds in fruits and vegetables, Food Chemistry, **126**, 2011, p. 1821-1835

[6] *Rodriguez-Saona L. E., Giusti M. M., Wrolstad R. E.,* Anthocyanin pigment composition of red-fleshed potatoes, J. Food Sci., **63**, 1998, p. 458–465

[7] *Eichhorn S., Winterhalter P.,* Anthocyanins from pigmented potato (Solanum tuberosum L.) varieties, Food Res. Intern., **38**, 2005, p. 943–948

[8] *Chmielewska Z.,* Sur les colorants des pommes de terre violette 'Negresse', Bull. Soc. Chim., **5**, 1936, p. 575–588.