EFFECT OF THE PRODUCTION PROCESS ON THE CONTENT OF ANTHOCYANINS IN DRIED RED-FLESHED POTATO CUBES

E. RYTEL*[1], A. TAJNER-CZOPEK[1], A. KITA[1], A. SOKÓŁ-ŁĘTOWSKA[2], A.Z. KUCHARSKA[2] and K. HAMOUZ[3]

[1]Department of Food Storage and Technology, Wrocław University of Environmental and Life Sciences, 37/41 Chełmońskiego St., 51-630 Wrocław, Poland
[2]Department of Fruit, Vegetable and Plant Nutraceutical Technology, Wrocław University of Environmental and Life Sciences, 37/41 Chełmońskiego St., 51-630 Wrocław, Poland
[3]Department of Plant Production, Czech University of Life Sciences in Prague, 129 Kamýcká St., 165 00 Praha 6, Suchdol, Czech Republic
*E-mail address: elzbieta.rytel@upwr.edu.pl

ABSTRACT

This study aimed at determining the effect of particular stages in the laboratory manufacture of dehydrated potato cubes on the stability of anthocyanin content in red-fleshed potato varieties. The raw material used in the study was potatoes of the following three red-fleshed varieties: Rosemarie, Herbie 26, and Rote Emma.
The analysed potato varieties differed in their respective content of anthocyanins and polyphenols. A higher content of these compounds was found in potatoes of Rote Emma cv. (216 mg/100 dm polyphenols and 37.3 mg/100 g anthocyanins).
The greatest losses of anthocyanins were noted after peeling and pre-drying and those of total polyphenols were noticed after blanching, pre-drying and drying. In comparison to the raw material, only ca. 25% of anthocyanins and ca. 31% of total polyphenols remained in the finished product. Among the analysed varieties, Rote Emma might be recommended for the production of dried potato cubes. This is because the highest content of biologically active compounds was present in potatoes of this variety after the production process.

1. INTRODUCTION

In comparison to other plant materials (fruits or vegetables), potatoes are convenient study materials, owing to their wide applicability, high availability, high consumption across the world and very good adaptation capabilities. They are one of the few plant materials that produce high crop yields in different climatic zones and under various soil conditions. Although potatoes are materials that are well known to consumers, many scientists worldwide are still undertaking analyses of their chemical composition. Such a high interest in this raw material results from its varietal diversity and, therefore, from its rich chemical composition (BROWN *et al.*, 2008; LISIŃSKA *et al.*, 2009; RYTEL *et al.*, 2014). Recent studies have addressed biologically active compounds of the potatoes varieties that have intensively coloured flesh, containing anthocyanins, which are known for their antioxidative properties (LACHMAN and HAMOUZ, 2005; FURRER *et al.*, 2017; VALIÑAS *et al.*, 2017).

Anthocyanins constitute a large group of plant pigments included in the natural phytonutrients that are soluble in water and occur in almost all parts of a plant (BRIDLE and TIMBERLAKE, 1997; RODRIGUEZ-SAONA *et al.*, 1998; CASTAÑEDA-OVANDO *et al.*, 2009, PIĄTKOWSKA *et al.*, 2011). In cells, they occur in vacuoles in the form of granules of various sizes. A few hundred natural pigments and over 100 chemically synthesised ones are known today. Anthocyanins are widely applied in the food industry as colourants due to their intensive and attractive colour. In addition, their therapeutic properties have been used in folk medicine for years. Today, they are being increasingly used in the cosmetic and pharmaceutical industries (WROLSTAD, 2000; EICHORN and WINTERHALTER, 2005).

Anthocyanins are unstable compounds. They undergo various transformations in the water environment depending on pH value, which, in turn, might contribute to a change in the colour of the products that contain them. Few scientific reports are available on the effect of processing conditions on anthocyanins in red- or purple-fleshed potato varieties (PERLA *et al.*, 2012; LACHMAN *et al.*, 2013; KITA *et al.*, 2015). Anthocyanins of potatoes are acylated derivatives of cyanidin, and their colour differs depending on the medium pH. Potatoes contain anthocyanins, which are stable not only in an acidic medium, such as in the form of pigments isolated from fruits, but also in neutral and slightly basic media (EICHORN and WINTERHALTER, 2005; FRIEDMAN and LEVIN, 2009; CHUNG *et al.*, 2017).

A dynamic increase has recently been observed in the manufacture of potato products, the main ones including French fries, chips and dehydrated potato products. Production of the latter is successively increasing in response to the needs of the market. Today, consumers look for 'convenient' foods that not only enable the fast preparation of meals in households or catering facilities but which are also characterised by high organoleptic and nutritional values. The drying process facilitates the possibility of manufacturing a wide array of preserved semi-products or potato products that meet these criteria. A new and interesting solution is the use of red-fleshed and purple-fleshed potatoes to manufacture such products.

This study aimed at determining the effect of particular stages in the laboratory manufacture of dehydrated potato cubes on the stability of anthocyanin content in red-fleshed potato varieties.

2. MATERIAL AND METHODS

2.1. Material

The raw material used in the study was potatoes of the following three red-fleshed varieties: Rosemarie, Herbie 26 and Rote Emma, all of which were sourced from the plantations of the Czech University. The study was conducted in the growing season from 2015 to 2016 in three technological replications. The effect of particular stages in the laboratory manufacture of dehydrated potato products on changes in the content of anthocyanins in the raw material, semi-products and finished products that were made from colour-fleshed potatoes was investigated.

The method of dehydrated dice production in laboratory conditions was as follows:

The potatoes were washed, peeled (1.5 mm) using a laboratory carborundum peeler, diced into 10×10×10 mm cubes by a manual cutting device in the laboratory and rinsed with distilled water at a temperature of 20°C. Subsequently, the potato cubes were blanched in water at 75°C for 5 min and pre-dried in a laboratory oven at 120°C for 1 hour. Afterward, the temperature of drying was decreased between 55 and 60°C to obtain a final moisture content of about 12% (about 8 hours). A total of 1 kg samples of potato were taken during each stage of laboratory processing (LISIŃSKA and LESZCZYŃSKI, 1989; RYTEL, 2012; RYTEL et al., 2014; RYTEL et al., 2017).

The raw material (unpeeled potatoes) was determined for the following proximate chemical composition: dry matter, starch, total and reducing sugars. Wet samples, which included unpeeled potatoes, peeled potatoes, skins, potato after blanching and pre-drying, were frozen and lyophilised by using a freeze dryer (temperature -35°C, pressure 5 Pa, time 12 h) (Edwards, England). All raw materials, semi-products and finished products obtained during laboratory production were ground in a laboratory mill. The prepared samples were examined for determining the content of anthocyanins.

2.2. Extraction of anthocyanins

The samples were prepared according to the method described by NEMŚ et al. (2015). The freeze-dried raw materials, semi-products and finished products were extracted with 70% aqueous acetone (0.1% acetic acid) in a graduated tube. The mixture was homogenised using a vortex and allowed to stand for 2 h at room temperature. The acetone-water solution was partitioned with chloroform to remove lipophilic compounds. Next, the acetone-water fraction was collected and put into a Büchi rotary evaporator (Merck, Darmstadt, Germany) until all residual acetone evaporated. The remaining extract was brought to a known volume with 50% methanol and stored at 20°C until it was analysed. The samples were filtered with 0.45 μm and 0.22 μm filters before HPLC-PDA and UPLC-MS/MS analyses.

2.3. Quantification of anthocyanins by HPLC-PDA

The content of anthocyanins was determined according to KUCHARSKA et al. (2017) by using a Dionex (USA) HPLC system equipped with an Ultimate 3000 model of a diode array detector, an LPG-3400A quaternary pump, an EWPS-3000SI autosampler and a TCC-3000SD thermostated column compartment, all of which were controlled by the Chromeleon v. 6.8 software. The Cadenza Imtakt column C5-C18 (75 × 4.6 mm, 5 μm) (Portland, USA) was used. The following solvents constituted the mobile phase: 4.5% formic acid (Solvent A) and 100% acetonitrile (Solvent B). The following elution conditions were applied: 0-1 min 5% B in A; 1-20 min 25% B in A; 20-27 min 100% B in A; and 27-30

min 5% B in A. The flow rate was 1 mL/min, and the injection volume was 40 µL. The column was operated at 30°C. Anthocyanins were monitored at 520 nm, and their content was expressed in cyanidin 3-O-glucoside equivalents (CygE)/100 g dm.

2.4. Identification of anthocyanins by UPLC-qTOF-MS/MS

The method for anthocyanin identification was previously described by MIZGIER *et al.* (2016). Anthocyanins were identified on Acquity ultra-performance liquid chromatography (UPLC) system coupled with a quadrupole-time of flight (Q-TOF) MS instrument (UPLC/Synapt Q-TOF MS, Waters Corp., Milford, MA, USA) with an electrospray ionisation (ESI) source. They were separated on an Acquity TM BEH C18 column (100 mm × 2.1 mm i.d., 1.7 µm; Waters) (Merck, Darmstadt, Germany). The detection wavelength was set at 520 nm. The mobile phase was a mixture of 4.5% formic acid (Solvent A) and 100% acetonitrile (Solvent B). The gradient program was as follows: initial conditions - 99% (A), 12 min - 75% (A), 12.5 min - 100% (B) and 13.5 min - 99% (A). The flow rate was 0.45 mL/min, and the injection volume was 5 µL. The column was operated at 30°C.
The major operating parameters for the Q-TOF MS were set as follows: capillary voltage, 2.0 kV; cone voltage, 40 V; cone gas flow, 11 L/h; collision energy, 28-30 eV; source temperature, 100°C; dissolution temperature, 250°C; collision gas, argon; dissolution gas, nitrogen; flow rate, 600 L/h; data acquisition range, m/z 100-2000 Da; and ionisation mode, positive. The data were collected by the Mass-Lynx TM V 4.1. software.

2.5. Analytical methods

The dry matter content of fresh potato samples and freeze-dried materials was determined by the reduced weight after drying at 105°C until a constant weight was achieved (HORWITZ and LATIMER, 2005). The contents of total and reducing sugars were determined by the colorimetric method with DNS (HORWITZ and LATIMER, 2005). The starch content was determined in raw potato tubers by measuring their specific gravity while the quantity of anthocyanins was analysed by HPLC-PDA (KUCHARSKA *et al.*, 2017), and their profile by UPLC-qTOF-MS/MS (MIZGIER *et al.*, 2016) of samples that were prepared as described in the work of NEMŚ *et al.* (2015). The polyphenol content was determined using the Folin-Ciocalteu colorimetric method, as described by SINGLETON *et al.* (1999) and KITA *et al.* (2015). All analyses were carried out in triplicate.

2.6. Statistical analysis

The study's results were subjected to statistical calculations by using the Statistica 13.1 software (StatSoft Polska Sp. Z o.o., Kraków, Poland). The significance of the differences between mean values was determined by conducting a multi-way analysis of variance and Duncan's test (P≤0.05). All experiments were performed in three technological replications within two years of investigation, and the present results show the mean values of all data in a combined way.

3. RESULTS AND DISCUSSION

Potatoes of red-fleshed and purple-fleshed varieties are rarely used to manufacture fried or dried food products. This is because of their lesser popularity among producers and consumers and, consequently, their lower availability in the market. In addition, potatoes

of colour-fleshed varieties usually have a higher content of total sugars and reducing sugars in comparison to those of the common yellow-fleshed or white-fleshed varieties. These compounds determine the colour of the finished product (KITA *et al.*, 2015). Dehydrated potato products should be manufactured from potatoes that have a high content of dry matter (from 21 to 25%) and starch (from 15 to 19%) and those in which the content of reducing sugars is below 0.5% (LISIŃSKA *et al.*, 2009). In the potatoes of red-fleshed varieties that were analysed in our study, contents of dry matter, starch and reducing sugars met the above requirements in tubers of Herbie 26 and Rote Emma var. Potatoes of Rosemarie var. had a lower content of dry matter and starch and over 0.6% of reducing sugars (Table 1).

Table 1. Chemical composition of raw potatoes.

Chemical compounds (g/100 g fresh matter, fm)	Potato variety		
	Herbie 26	Rosemarie	Rote Emma
Dry matter	22.8 ± 0.12^c	17.9 ± 0.09^a	20.9 ± 0.10^b
Starch	15.4 ± 0.11^b	14.0 ± 0.11^a	15.4 ± 0.12^b
Total sugar	0.71 ± 0.09^a	0.86 ± 0.07^b	0.69 ± 0.10^a
Reducing sugar	0.51 ± 0.08^a	0.60 ± 0.09^b	0.69 ± 0.10^a

a, b, c - different letters indicate significant differences among the varieties following the LSD test (p>0.05), ± SD (standard deviation); n = 6.

Taking into consideration the attractive colour of the flesh and the higher content of biologically active compounds, potatoes of red- and purple-fleshed varieties might be an interesting alternative to traditional light-fleshed potato varieties and might be recommended for the manufacture of potato products. Tables 2 and 3 present the contents of anthocyanins and total polyphenols determined at particular stages in the laboratory manufacture of dehydrated potato cubes.

Table 2. Contents of pigments (mg/100 g dry matter, dm) and total polyphenols (mg/100 g dm) in red-fleshed potatoes and skins.

Pigments	Potato variety					
	Herbie 26		Rosemarie		Rote Emma	
	Unpeeled potatoes	Skins	Unpeeled potatoes	Skins	Unpeeled potatoes	Skins
Pelargonidin-3-rutinoside-5-glucoside	3.20±0.12[b]	6.81±0.11[a]	-	-	9.46±0.13[b]	10.5±0.12[a]
Pelargonidin-3-rutoside	2.04±0.11[b]	4.35±0.10[a]	2.90±0.12[a]	1.36±0.07[c]	2.33±0.10[a]	6.32±0.10[b]
Pelargonidin-3-caffeoylrutinoside-5-glucoside	4.85±0.20[a]	0.74±0.08[a]	4.94±0.09[a]	2.98±0.08[b]	8.48±0.11[b]	15.5±0.14[c]
Pelargonidin-3-pcoumaorylrutinoside-5-glucoside	2.95±0.10[b]	0.40±0.06[a]	1.81±0.11[a]	2.20±0.10[b]	10.5±0.12[c]	-
Pelargonidin-3-feruloylrutinoside-5-glucoside	13.1±0.11[c]	6.38±0.11[b]	5.10±0.13[a]	6.31±0.12[b]	6.52±0.11[b]	0.43±0.03[a]
Sum of analysed anthocyanins	**26.1**±0.13[b]	**18.7**±0.10[b]	**14.7**±0.12[a]	**12.8**±0.11[a]	**37.3**±0.22[c]	**32.8**±0.17[c]
Total polyphenols	188±4.53[a]	196±5.13[b]	186±3.99[a]	94±4.01[a]	216±5.32[b]	204±4.89[c]

a, b, c - different letters indicate significant differences among varieties following the LSD test (p>0.05), ± SD; n = 6.

Table 3. Content of pigments (mg/100 g dm) and total polyphenols (mg/100 g dm) in potatoes after particular technological stages.

Potato variety	Technological stage	Pelargonidin-3-rutinoside-5-glucoside	Pelargonidin-3-rutoside	Pelargonidin-3-caffeoyl-rutinoside-5-glucoside	Pelargonidin-3-p-coumarylrutinoside-5-glucoside	Pelargonidin-3-feruloylrutinoside-5-glucoside	Sum of analysed anthocyanins	Total polyphenols
Herbie 26	Potato after peeling	2.54±0.10[c]	1.62±0.09[b]	0.52±0.07[b]	0.07±0.06[c]	9.39±0.12[d]	**14.1**±0.12[d]	**185**±3.71[c]
	Potato after blanching	2.22±0.11[b]	0.15±0.04[a]	0.54±0.05[b]	0.04±0.008[b]	5.51±0.10[c]	**8.46**±0.11[c]	**179**±2.55[b]
	Potato after pre-drying	0.60±0.04[a]	0.10±0.01[a]	0.50±0.06[b]	0.01±0.007[a]	4.30±0.09[b]	**5.51**±0.10[b]	**172**±4.01[b]
	Potato after drying	-	-	0.18±0.08[a]	-	2.10±0.08[a]	**2.28**±0.09[a]	**141**±1.98[a]
Rosemarie	Potato after peeling	-	1.03±0.09[c]	3.51±0.10[d]	1.22±0.09[c]	2.49±0.11[c]	**8.25**±0.12[d]	**181**±4.02[d]
	Potato after blanching	-	0.39±0.01[b]	3.45±0.11[c]	0.96±0.08[b]	2.09±0.08[b]	**6.89**±0.11[c]	**168**±3.25[c]
	Potato after pre-drying	-	0.29±0.03[b]	2.79±0.12[b]	0.41±0.06[a]	1.81±0.10[a]	**5.30**±0.12[b]	**151**±3.44[b]
	Potato after drying	-	0.20±0.02[a]	2.47±0.10[a]	-	1.80±0.11[a]	**4.47**±0.09[a]	**146**±2.56[a]
Rote Emma	Potato after peeling	1.32±0.09[c]	0.94±0.07[b]	3.32±0.14[c]	10.7±0.14[d]	5.90±0.12[b]	**22.2**±0.17[c]	**194**±2.07[d]
	Potato after blanching	1.02±0.08[b]	0.72±0.05[a]	2.41±0.10[b]	7.18±0.12[c]	6.02±0.12[b]	**17.3**±0.18[b]	**152**±2.67[c]
	Potato after pre-drying	0.81±0.03[a]	-	1.10±0.09[a]	4.18±0.10[a]	4.99±0.11[a]	**11.1**±0.10[a]	**128**±1.98[b]
	Potato after drying	-	-	1.09±0.08[a]	5.42±0.11[cb]	4.88±0.10[a]	**11.4**±0.11[a]	**112**±1.91[a]

a, b, c, d - different letters indicate significant differences among varieties following the LSD test (p>0.05), ± SD; n = 6.

The mean content of total polyphenols in potatoes of the analysed varieties was 197 mg/100 g dm. The highest content was found in both skins and whole tubers of Rote Emma potatoes, whereas the lowest was found in Rosemarie potatoes (Table 2). The content of anthocyanins in the analysed potatoes ranged from 14.7 mg/100 g dm (Rosemarie var.) to 37.3 mg/100 g dm (Rote Emma var.). Their contents were lower in skins and were on average 21.4 mg/100 g dm (Table 2). However, the lowest anthocyanin content was determined in skins of Rosemarie var. According to other authors (FOSSEN *et al.*, 2003; FRIEDMAN and LEVIN, 2009; FURRER *et al.*, 2017), the content of anthocyanins in potatoes might vary greatly from a few to a few dozen mg per 100 g dm. As reported by HAMOUZ *et al.* (2011), the anthocyanin content in potatoes of purple-fleshed varieties ranged from 6.88 mg/100 g⁻¹ dm (Valfi var.) to 57.3 mg/100 g dm (Violette var.) and in potatoes of red-fleshed varieties from 13.5 mg/100 g dm (Rosalinde var.) to 21.2 mg/100 g dm (Highland Burgundy Red var.). In turn, according to KITA *et al.* (2013), purple-fleshed potatoes contain these compounds in a range from 40.2 to 184.7 mg/100 g dm. The quantitative and qualitative composition of anthocyanins in potatoes is highly diverse and depends, primarily, on the potatoes' variety, cultivation site and weather and climatic conditions (LACHMAN *et al.*, 2009; HAMOUZ *et al.*, 2011). According to SULC *et al.* (2017), the red-fleshed potato varieties might also contain other anthocyanin glucosides, e.g. peonidin, apart from pelargonidin.

In contrast, as claimed by other authors (LACHMAN *et al.*, 2009; NEMŚ *et al.*, 2015), both the flesh and skins of potatoes contain the same anthocyanins. However, potatoes of the red-fleshed varieties that were analysed in the present study differed in both the composition and content of acylated compounds (Table 2). In Rote Emma var. potatoes, the majorly identified anthocyanin glucoside was pelargonidin-3-*p*-cumaorylrutinoside-5-glucoside, whereas, in potatoes of Herbie 26 and Rosemarie varieties, it was pelargonidin-3 feruloylrutinos-5-glucoside (Table 2). Pelargonidin 3-rutinoside-5-glucoside was also found to be a predominating glucoside in skins of Herbie 26 and Rote Emma var. potatoes. In contrast, the skins of potatoes of Rote Emma var. differed in the composition of glucosides. They did not contain pelargonidin-3-*p*-cumaorylrutinoside-5-glucoside, and the majorly identified compound in it was pelargonidin-3-feruloylrutinoside-5-glucoside (Table 2). According to VALIÑAS *et al.* (2017), the flesh of potatoes differs in the composition and contents of individual anthocyanins. This is probably due to the migration and transport of metabolites between flesh and skin or vice versa. As of now, however, no research works have addressed this issue.

The first technological stage of processing potatoes into most dried products is peeling. In this study, the potatoes were peeled manually, so the depth of peeling might be greater and exceed 1.5 mm. There were no differences in the composition of anthocyanin glucosides in the peeled potatoes, but their losses were observed. After peeling, the total content of anthocyanins decreased by 43% on average (Fig. 1).

According to FURRER *et al.* (2017), peeled potatoes contain ca. 7% fewer anthocyanins in comparison to the non-peeled ones. The great differences in the loss of anthocyanins, which was observed after potato peeling, might have resulted from the manner and depth of skin removal. In the study conducted by FURRER *et al.* (2017), the potatoes were industrially peeled; therefore, their peeling depth could be significantly less than after manual peeling. During deeper manual peeling, the skin was removed along with the layer of flesh underneath. According to LACHMAN *et al.* (2013), manual peeling of potatoes up to a depth of ca. 1-2 mm does not affect anthocyanin loss; however, the lack of such an effect depends on the variety. In potatoes of the purple-fleshed variety, namely, Violette, the content of anthocyanins decreased by 41% after peeling, whereas it increased by 127 to 286% in potatoes of other colour-fleshed varieties (LACHMAN *et al.*, 2013). Anthocyanins occur in higher amounts in the flesh of potatoes rather than in the skin.

Therefore, during the shallower peeling of tubers, the percentage content of these compounds in dry matter increases.
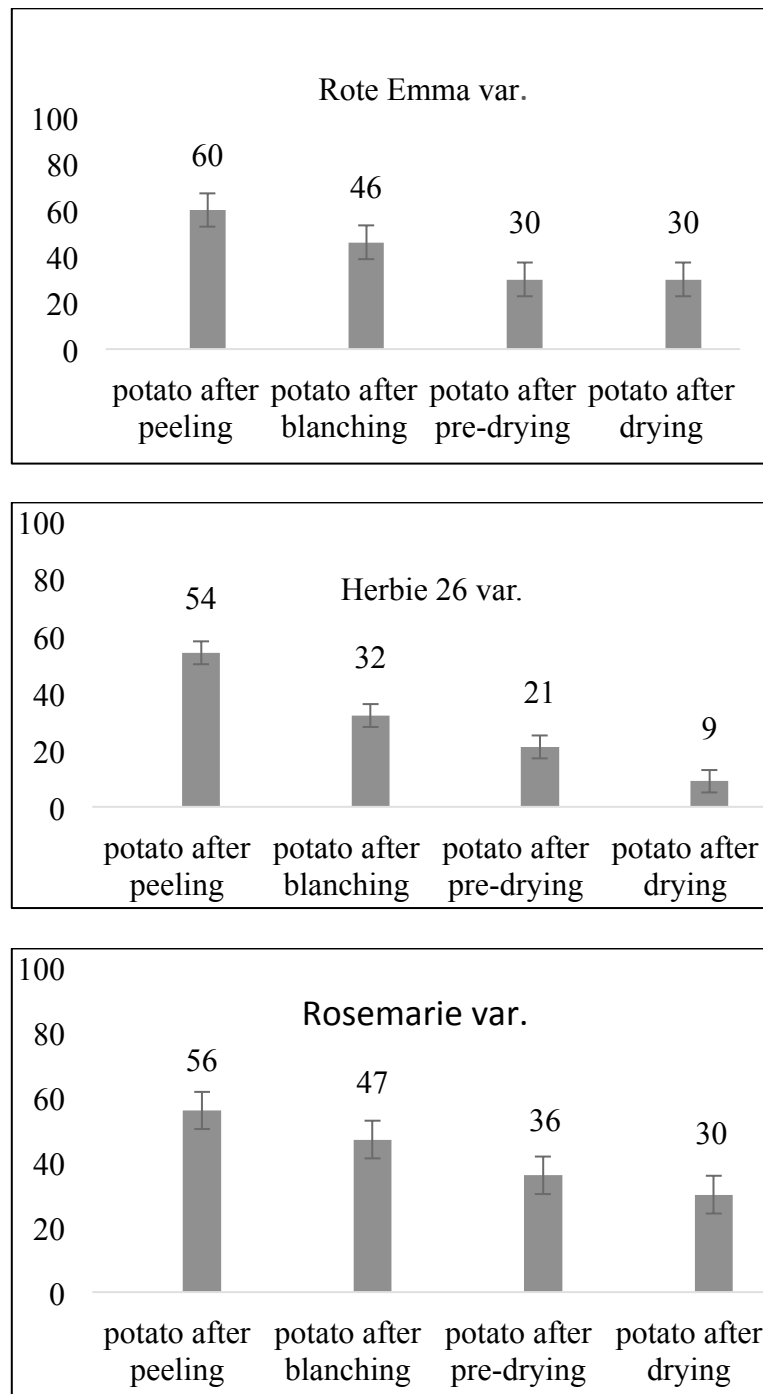

Figure 1. Anthocyanin residue (%) in potatoes after technological stages of dehydrated dice processing (mean of years).

Another stage of processing involves blanching potato cubes. The extensive disintegration of the raw material (cubes) and its exposure to a temperature of 75°C for 15 min caused successive loss of anthocyanins (Table 3, Fig. 1). After blanching, their total content of

anthocyanins decreased by 19% on average in potatoes of the Rote Emma and Rosemarie varieties, and by 40% in those of Herbie 26 var. compared to the peeled potatoes (Table 3). As reported by other authors (MULINNACI *et al.*, 2008; LACHMAN *et al.*, 2013), losses of anthocyanins after blanching might range from 16 to 29%. The extent of these losses can be determined by the pH value of the blanching bath, the degree of raw material disintegration, temperature and the time during which the product is exposed to it (MULINNACI *et al.*, 2008). According to FURRER *et al.* (2017), the stability of anthocyanins in potatoes depends on their variety and the type of heat treatment, specifically, after thermal processing (i.e. blanching, freezing, roasting and frying), the content of anthocyanins decreased by 3 to 29% on average in purple-fleshed potatoes. However, it increased by a few percentage points in red-fleshed potatoes. As demonstrated by LACHMAN *et al.* (2013), processes, such as roasting, microwaving and steaming, prevent anthocyanin losses. After such their processes were conducted, these authors reported a significant increase in total anthocyanins in purple-fleshed and red-fleshed potatoes, even though the above processes were applied to whole tubers with skins (non-peeled and non-disintegrated). Probably, this method of material preparation has a protective effect on the anthocyanin content in potato tubers. As reported by BROWN *et al.* (2008), microwaving and cooking cause smaller changes in anthocyanin content than frying or roasting. In our study, blanched potato cubes were pre-dried at 120°C for 1 hour. The impact of high temperature on the material contributed to the successive loss of anthocyanins. After this stage, their content decreased by 23% (Rosemarie var.) to 35% (Herbie 26 var.) compared to the blanched potatoes; however, no changes were found in the composition of the analysed anthocyanin glycosides (Table 3). Further drying of potato cubes at 50°C for 8 hours caused changes in the composition of the studied compounds. In the case of Herbie 26 var., the potato cubes that were dried to a moisture content of ca. 12% (finished product) did not contain pelargonidin-3-rutinoside-5-glucoside, pelargonidin-rutinoside-5-glucoside or pelargonidin-3-*p*-cumaorylrutinoside-5-glucoside and were characterised by the lowest total content of anthocyanins (2.28 mg/100 g) in comparison to the potatoes of the other varieties (Table 3). According to other authors (KITA *et al.*, 2013; NEMŚ *et al.*, 2015), high-temperature processes (over 100°C), such as frying or extrusion, not only cause greater losses of anthocyanins that range from 50 to 80% but also changes in the composition of anthocyanin glycosides. According to CASTANEDA-OVANDO *et al.* (2009), anthocyanins are highly unstable and susceptible to degradation. Their stability depends on multiple factors, e.g., pH, storage temperature, chemical structure, their content, exposure to light and oxygen, solvent and presence of enzymes, flavonoids, proteins or metal ions. In our study, the greatest losses of anthocyanins in the production process of dehydrated potato cubes were attributed to the processes of peeling (43% on average) and pre-drying (31% on average), whereas blanching caused their content to decrease by only 26% on average (Fig.1). This was despite the considerable disintegration of the material. Changes in the content of anthocyanins varied depending on the variety, and the greatest losses were found upon processing potatoes of Herbie 26 var.

The production process of dry potato cubes also caused losses in total polyphenols (Table 3). The greatest loss of these compounds was noted after the following thermal processes: blanching, pre-drying and drying. According to KITA *et al.* (2015), the heat processes used in potato production not only cause the degradation of phenolic compounds but also the transformation of different groups of polyphenols.

The content of anthocyanins in the finished product was ca. 23% on average (Fig. 1) and that of polyphenols was ca. 31% of their initial content in the raw material (Tables 2 and 3). Despite high losses of total polyphenols and anthocyanins during the manufacture of dehydrated products, potatoes of red-fleshed and purple-fleshed varieties might be an alternative to the potatoes with yellow or white flesh. Literature data support the

conclusion that smaller losses of anthocyanin compounds occur upon processing potatoes with skin, and, perhaps, the use of this type of material should be recommended.

4. CONCLUSIONS

The analysed potato varieties met the established requirements for tubers intended for the manufacture of dehydrated potato products. However, only potatoes of Rosemarie var. had lower than recommended content of dry matter and starch and over 0.6% of reducing sugars. Potatoes of Rote Emma variety might be recommended for the production of dried potato cubes, as they m*et al*l the requirements and had the highest content of total polyphenols and anthocyanins. In addition, dried potato cubes made of this variety preserved the highest content of biologically active compounds.

The process of laboratory production of dehydrated potato cubes caused losses of anthocyanins and total polyphenols in semi-products and finished products. The greatest losses of anthocyanins were noted after peeling, and pre-drying and those of total polyphenols were noticed after blanching, pre-drying and drying. In comparison to the raw material, only ca. 23% of anthocyanins and ca. 31% of total polyphenols remained in the finished product.

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