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The effect of cultivar on selected quantitative and qualitative parameters of sweet potatoes (*Ipomoea batatas* L.) grown in Slovak republic

Vplyv odrody na vybrané kvantitatívne a kvalitatívne parameter batátov (*Ipomoea batatas* L.) pestovaných v Slovenskej republike

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ABSTRACT

The sweet potato (*Ipomoea batatas* L.) is less-known vegetable species in Slovak Republic. It is known for sweet taste and various possibilities of use in gastronomy. In this study, the effect of cultivar on the important quantitative (yield of marketable tubers per plant, average weight of marketable tubers, yield of marketable tubers per hectare, share of marketable tubers) and qualitative (antioxidant activity, polyphenol content) parameters of sweet potatoes grown in Slovak Republic was tested. The highest yield (1964.16 g/plant; 54.56 t/ha) and average weight (446.18 g) of marketable tubers (> 150 g) were found in white sweet potato cultivar 'Višnjica white'. The highest ratio of marketable tubers was found in orange cultivar 'Beauregard' (87.17%). The purple cultivar 'Višnjica purple' was characterized by significantly lower values of all quantitative parameters of sweet potatoes. On the contrary, the highest antioxidant activity (61.07% DPPH; DPPH: 2,2-Diphenyl-1-picrylhydrazyl) and polyphenol content (4506.90 mg/kg dry weight) were found just in purple cultivar 'Višnjica purple'. The significantly higher values of both parameters, compared to other cultivars, are caused by abundance of anthocyanins. Results of this study revealed that sweet potato is expressed by good yield potential, together with its quality, in conditions of Slovak republic, or Middle Europe in generally.

Keywords: sweet potato, cultivar, yield, marketable ratio, antioxidant activity, polyphenols

ABSTRAKT

Povojník batátový (*Ipomoea batatas* L.) je menej známym druhom zeleniny v Slovenskej republike. Batáty sa vyznačujú sladkou chuťou a ich využitie v gastronómii je rôzne. V rámci štúdie bol sledovaný vplyv odrody na významné kvantitatívne (úroda predajných hľúz z rastliny, priemerná hmotnosť predajných hľúz, úroda predajných hľúz hektára, podiel predajných hľúz) a kvalitatívne (antioxidačná aktivita, celkový obsah polyfenolov) parametre batátov pestovaných v Slovenskej republike. Najvyššia úroda (1964,16 g/rastlina; 54,56 t/ha) a priemerná hmotnosť (446,18 g) predajných hľúz (> 150 g) boli zistené u bielej odrody batátov 'Višnjica biela'. Najvyšší podiel predajných hľúz bol dosiahnutý u

oranžovej odrody 'Beauregard' (87,17%). Fialová odroda 'Višnjica fialová' bola sa vyznačovala výrazne nižšími hodnotami u všetkých sledovaných parametrov. Na druhej strane, najvyššia hodnota antioxidačnej aktivity (61,07% DPPH; DPPH: 2,2-Diphenyl-1-picrylhydrazyl) a obsah polyfenolov (4506,90 mg/kg suchej hmoty) boli zistené práve u uvedenej fialovej odrody 'Višnjica fialová'. Výrazne vyššie hodnoty oboch parametrov, v porovnaní s ostatnými odrodami, sú zapríčinené prítomnosťou antokyanínov v hľuzách batátov. Výsledky štúdie odhalili, že batáty sa v podmienkach Slovenskej republiky, resp. strednej Európy, vyznačujú dobrým úrodovým potenciálom a kvalitou dopestovaných hľúz.

Kľúčové slová: batáty, odroda, úroda, predajný podiel, antioxidačná aktivita, polyfenoly

INTRODUCTION

According to Roullier et al. (2013), sweet potato (*Ipomoea batatas* (L.) Lam., *Convolvulaceae*) belongs to the most widely grown staple crops in the world, but origin of its domestication is not clear. Loebenstein (2009) indicate that sweet potatoes were domesticated before more than 5000 years in tropical America between Yucatan peninsula in Mexico and Orinoco river in Venezuela. The analysis of molecular markers found high diversity of *Ipomoea* genus in Middle America. It confirms hypothesis that this area is the most probable area of sweet potato origin (Huang and Sun, 2000). The average world sweet potato production within period 2007-2016 was ranged from 103.4 mil. tones (Faostat, 2019). According to Musilová et al. (2017), sweet potatoes are grown in Slovak republic only by small growers.

The sweet potato is an important tuberous vegetable with large, starchy and sweet taste (Mohanraj and Sivasankar, 2015). The edible tubers (botanically thickened roots) are characterized by oval, elliptic, obovate, oblong or irregular shape. The skin color of tuber can be white, light-beige, yellow, orange, brownish, pink, red, purple-red, light-purple, medium-purple and brown. The sweet potato tuber flesh is white, beige, yellow, orange or purple. The skin and flesh of tubers can also show a secondary color from mentioned color spectrum (UPOV, 2010). The most typical color of sweet potato flesh is orange, caused by abundance of carotenoids (Alam et al., 2016; Islam et al., 2016).

Antioxidants are defined as substances which are possible to form relatively stable non-toxic products with free radicals. From this view, antioxidants are very effective in their small amount and retard or protect an oxidation of biomolecules (Lamprecht, 2015). The oxidative stress causes an ageing process of organism and many chronical diseases, including neurodegenerative (Parkinson's, Alzheimer's or Huntington's disease) and cardiovascular diseases, cataract, cancer (Maulik et al., 2013), metabolic (obesity and diabetes type II., diabetic angiopathy) and autoimmune diseases (Hegedűsová et al., 2016), atherosclerosis (Toledo-Ibelles and Mas-Oliva, 2018), rheumatic arthritis (van Vugt et al., 2008) or skin ageing (Masaki, 2010). Recently, the evaluation of antioxidant activity of food sources is often part of many research studies. The antioxidant activity expresses an amount of plant metabolites which can share in elimination or reduction of oxidation processes. It is a complex ability of foodstuffs, or nutrition additive, to scavenge free radicals and defend against their harmful effects. In living systems, reactions of antioxidants with free radicals have a certain continuance and speed and kinetic of these reactions is marked as antioxidant activity (Hegedűsová et al., 2016). The antioxidant activity of vegetables, fruits or other plant products can be determined by various methods (Pisoschi and Negulescu, 2011), e. g. spectrometry (DPPH; ABTS; FRAP; ORAC etc.) or chromatography (liquid or gas chromatography).

The purple color of sweet potato flesh is caused by abundance of anthocyanins which belong to the wide group of polyphenols (Li et al., 2013, Tang et al., 2015). In the end of 20th century, the significant increase of people about consumption of natural polyphenols was observed due to their antioxidant (elimination of free radicals), anti-inflammatory or antimicrobial properties (Velderrain-Rodríguez et al., 2014).

Pradeep and Sreerama (2015) characterized polyphenols as antioxidant substances with indirect effect through protection of endogenous antioxidant enzymes in human organism. According to Rasouli et al. (2017), food with higher polyphenol intake helps to decrease a risk of wide spectrum of chronical diseases, including obesity, diabetes, cancer or cardiovascular diseases. Polyphenols are secondary plant metabolites which are generally involved in the protection of human organism against UV radiation or various harmful pathogens. Epidemiological studies expressively indicate that long-term and regular consumption of food rich on polyphenols provides to human organism a protection against formation and development of various types of cancer, diabetes, osteoporosis, cardiovascular or neurodegenerative diseases (Pandey and Rizvi, 2009).

Nowadays, the climate change is evident in the world. Because of temperature change, some tropical or subtropical vegetable species is possible to grown in areas non-typical and non-traditional for these crops. In this study, the evaluation of selected quantitative and qualitative parameters of sweet potatoes grown in Slovak republic was done in four cultivars with different-colored tuber flesh (orange, purple, white).

MATERIALS AND METHODS

Local climate conditions

The field experiments with sweet potatoes were realized at Slovak University of Agriculture in Nitra in 2016 and 2017. The climate of this area is characterized by warm and dry summer and slightly warm, dry or very dry winter. According to the long-term climatic normal (1951 - 2000) for Nitra, annual mean temperature is 9.9 °C and mean rainfall total is 548 mm (Šlosár et al, 2016). Within vegetation period of sweet potatoes (May - September), the average air temperature was 18.7 °C in 2016 and 19.3 °C in 2017. The rainfall total, during vegetation period, was 312 (2016) and 216 mm (2017).

Plant material

Sweet potato seedlings were purchased from Croatian producer. Within this study, four cultivars of sweet potato with different tuber flesh color were used (Figure 1). The sweet potato cultivar 'Beauregard' was only one certified cultivar with characteristic orange flesh color. Other three cultivars were referred according to the market place from which tubers for seedling production were purchased. These sweet potato cultivars were named as 'Dubaian' (orange cultivar from United Arab Emirates), 'Višnjica white' and 'Višnjica purple' (white and purple cultivar from Croatia). The basic characteristics of all sweet potato cultivars, evaluated according to the descriptor UPOV (2010), is described in the Table 1.

Experiment organization

The planting of sweet potato seedlings was realized on the 25th May 2016 and 1st June 2017 when the risk of later spring freeze is significantly reduced in Slovak Republic. Based on agrochemical soil analyses (table 2), nitrogen was only applied on the soil supply level of 75 kg/ha. The sweet potato was grown by hillock system (height = 0.30 m) with distance of 1.20 m between rows. In each row, 18 sweet potato seedlings were planted in distance of 0.30 m. Rows of each tested cultivar was divided to three replications with 6 sweet potato plants. The black non-woven textile was used for soil mulching because of better microclimate around sweet potato plants. The harvest of sweet potato tubers was realized on the 6th October 2016 and 13th September 2017. Sequentially, harvested tubers of sweet potato were classified according to average tuber weight to the two size classes: marketable (>150 g) and non-marketable (<150 g) tubers.

Qualitative parameters of sweet potatoes were evaluated only in marketable tubers. The average sample of individual sweet potato cultivar was prepared from 6 tubers. Within sample preparation, tubers were quartered and opposite quarters were used for qualitative analyses.

Table 1. Basic morphological characteristics of tubers in tested sweet potato cultivars

Parameter	Beauregard	Dubaian	Višnjica white	Vinšjica purple
Shape	ovate	ovate	ovate	irregular
Main skin color	ligh-purple	red-purple	beige	red-purple
Secondary skin color	orange	-	pink	-
Main flesh color	orange	orange	white	purple
Secondary flesh color	beige	-	-	beige

Table 2. Agrochemical soil analysis before experiment establishment in 2016 and 2017

Year	pH_{KCl}	Humus (%)	Nutrient content (mg/kg soil)					
			N_{min}	P	K	Ca	Mg	S
2016	7.14N	4.17H	13.0M	198.8VH	487.5VH	6100H	816 VH	26.3M
2017	7.18N	3.75G	10.1M	147.5H	477.5VH	5850H	762.6VH	91.3H

Note: N_{min} – N mineral (N inorganic); N – neutral; G – good; M – medium; H – high; VH – very high

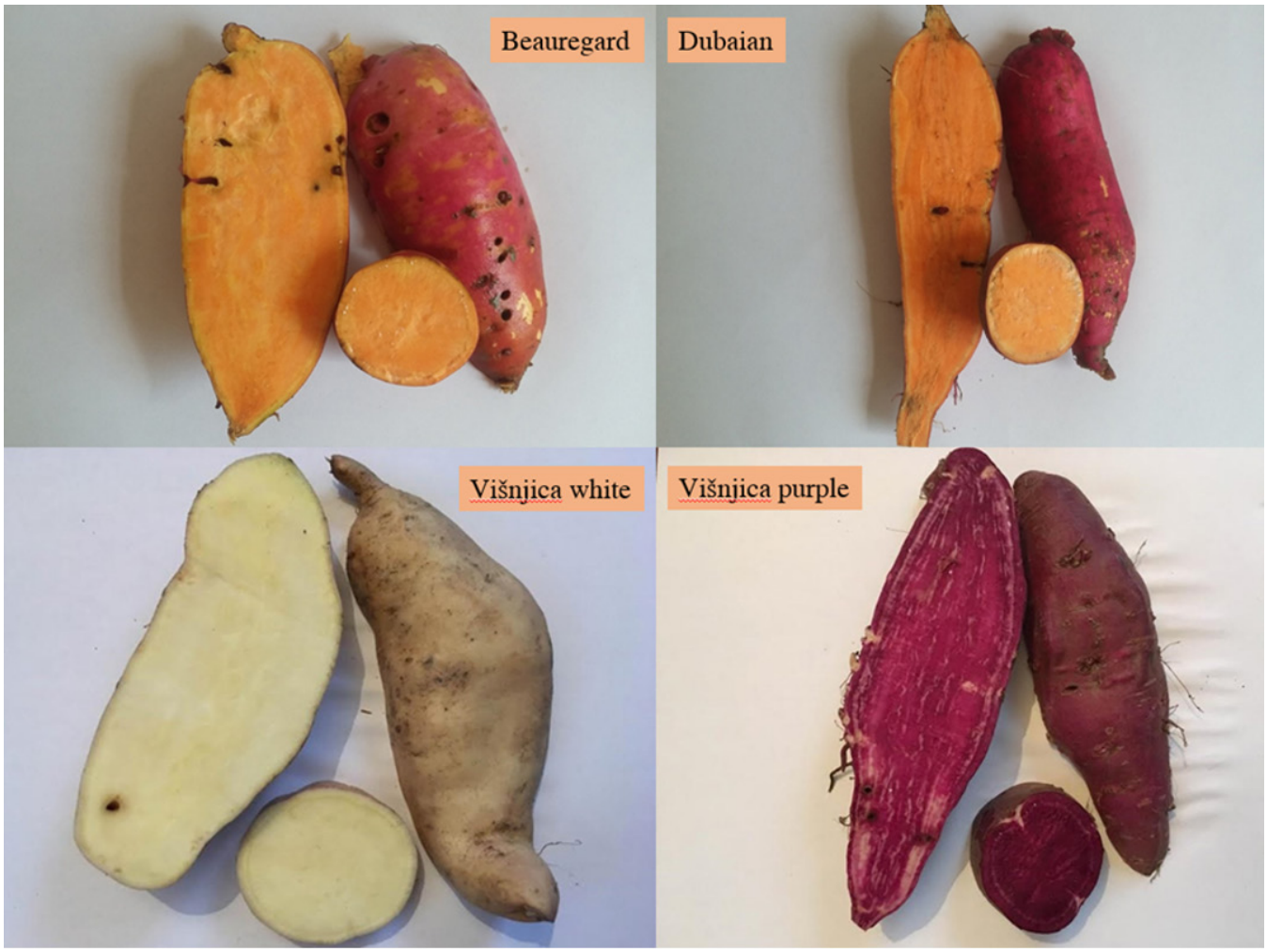

Figure 1. Sweet potato cultivars tested in experiment

Determination of antioxidant activity

The antioxidant activity was determined by method of DPPH (2,2-Diphenyl-1-picrylhydrazyl) according to Hegedűsová et al. (2018) in fresh matter of sweet potato tubers at the Department of Chemistry, Janos Selye University in Komárno. Prepared sample of sweet potatoes was homogenized 1 minute and 10 g of mild material was mixed with 40 ml of water methanol solution (70%). Sequentially, 20 g of mixture was mixed with 30 ml of methanol (96%). Prepared mixture was stored at room temperature for 20 hours and it was sequentially extracted 4 hours in orbital shaker. Finally, mixture was filtered. From each sample extract, 0.2 ml was pipetted and mixed with 1.8 ml of methanol (70%) and 4 ml of DPPH solution (25 mg/l). Simultaneously, 2 ml of methanol and 4 ml of DPPH solution was mixed and used as reference sample (blind experiment). The absorbance of all samples was measured after 30 minutes in wavelength of 517 nm. The antioxidant activity of sweet potato samples was calculated as a percentage of DPPH decoloration according to following formula:

$$AOA\ (\%) = (1 - A_S * w / w_{10} / V) / A_{ref}) * 100$$, where

A_S - absorbance of sweet potato sample,

w - sample weight (g),

w_{10} - conversion factor to 10 g of sample,

V - pipetted sample volume,

A_{ref} - absorbance of reference sample (blind sample).

Determination of total polyphenol content

Total polyphenol content in sweet potatoes was determined by the method of Lachman et al. (2003) at the Department of Chemistry SUA in Nitra and it was expressed as mg of gallic acid equivalent per kg dry matter. Gallic acid is usually used as a standard unit for phenolic content determination because a wide spectrum of phenolic compounds. The total polyphenol content was determined by using of Folin-Ciocalteau assay. The Folin-Ciocalteau phenol reagent was added to a volumetric flask containing 100 ml of extract.

The content was mixed and 5 ml of sodium carbonate solution (20%) was added after 3 minutes. The volume was adjusted to 50 ml by adding of distilled water. After 2 hours, the samples were centrifuged for 10 minutes and the sample absorbance was measured at 765 nm of wavelength against blank. The polyphenol concentration was calculated from a standard curve plotted with known concentration of gallic acid.

Statistical analysis of results

The statistical analysis of obtained results was performed by using of the Statgraphic Centurion XVII (StatPoint, USA). Results were evaluated by analysis of variance (ANOVA) and average values were tested by LSD test performed at the significance level of 95% ($P<0.05$).

RESULTS

Yield of marketable tubers per plant

The statistical analysis of obtained results showed statistically significant differences of marketable tuber yield per plant among examined sweet potato cultivars (table 3). Yildirim et al. (2011) examined the effect of cultivar on the yield of marketable sweet potato tubers per plant in Turkey and its values were ranged from 172.9 ('Višnjica purple') to 738.8 g ('Višnjica white'). These values are markedly lower in comparison with results obtained in this study, except of purple cultivar 'Višnjica purple'. The lower yield of sweet potato per plant (380 - 460 g) was also found in experiment in Nigeria (Uwah et al., 2013). On the contrary, comparable yield of marketable tubers per plant (1071 - 1600 g) was found in Romanian experiment (Maria and Rodica, 2015). Similar results (1185.62 - 1455.54 g) was reached in the field experiment in Slovak Republic (Šlosár et al., 2016).

Average weight of marketable tubers

The statistically significant differences of average tuber weight among tested sweet potato cultivars were found, except of orange cultivars and their interaction 'Beauregard'-'Dubaian' (table 3).

Table 3. Quantitative parameters of marketable sweet potato tubers (average values for 2016-2017)

Cultivar	Yield per plant (g ±SD)	Average weight (g ±SD)	Yield (t/ha ±SD)	Marketable ratio (% ±SD)
Beauregard	1546.13±260.44^{c}	418.32±28.36^{b}	42.95±7.23^{c}	87.17±3.33^{d}
Dubaian	1414.41±365.99^{b}	411.84±20.13^{b}	39.29±10.17^{b}	85.08±2.54^{c}
Višnjica white	1964.16±464.93^{d}	446.18±23.18^{c}	54.56±12.91^{d}	80.60±3.41^{b}
Višnjica purple	657.36±100.55^{a}	311.52±30.17^{a}	18.26±2.79^{a}	71.44±3.86^{a}

$^{a, b, c, d}$ Values with different lowercase letters in column are significantly different at P<0.05 by LSD in ANOVA. SD - standard deviation. Marketable ratio - counted from total sweet potato yield

The average weight of marketable tubers was ranged from 311.52 ('Višnjica purple') to 446.18 g ('Višnjica white'). Compared to these values, Maria and Rodica (2015) found lower average weight of marketable sweet potato tubers in Romania (210 - 400 g). Ellong et al. (2014) also presented the significant variability of average tuber weight (308.91 - 647.75 g) in Martinique. The significantly lower values of average tuber weight (177.3 - 198.2 g) were found in Nigerian experiment (Sokoto and Sadiq, 2016).

Yield of marketable tubers per hectare

The marketable yield of sweet potato tubers per hectare (t/ha) was calculated according to the yield of marketable tubers per one plant. Within calculation, density of 27000 plants per hectare was used. The plant density was calculated according to the plant spacing (1.2 x 0.3 m) used in this experiment. In this study, statistically significant effect of cultivar on the yield of sweet potato marketable tubers per one hectare was found (table 3). The average yield of marketable tubers, dependent on the sweet potato cultivar, was ranged from 18.26 ('Višnjica purple') to 54.56 t/ha. According to the Faostat database (2019), the average yield of sweet potatoes was ranged from 12.23 to 13.23 t/ha in period 2007-2016. Mentioned values are significantly lower compared to the yield reached in this experiment. Compared to the Faostat data, Szarvas et al. (2018) found similar sweet potato yield in orange cultivar (13.93 t/ha) in Hungary. Sanoussi et al. (2016) examined the marketable yield of sweet potatoes in cultivars with different flesh color in Benin and its values was ranged from 12.65 to 76.38 t/ha. Authors found, similarly as in this study, the highest sweet potato yield in the cultivar with white flesh color. Maria and Rodica (2015) reached yield of marketable sweet potato tubers comparable to this study in the field experiment in Romania, concretely in the range from 35.6 to 53.3 t/ha. Similar yield of sweet potato tubers was presented in the study of Jian-Wei et al. (2001) who grown sweet potatoes in nine localities in China. Authors found the variability of sweet potato yield in the range from 22.1 to 63.6 t/ha ($\bar{x}$ = 36.7 t/ha), dependent on the locality and potassium nutrition. Bonte et al. (2008) examined the effect of cultivar and planting date on the yield of marketable sweet potato tubers in USA. In the cultivar 'Beauregard', authors found lower yield of tubers (22.5 - 36.8 t/ha) in comparison with this experiment. The lower yield of sweet potatoes, compared to previous studies, was presented by Uwah et al. (2013) in Nigeria, concretely in the range from 20.8 to 25.5 t/ha. The significant variability of marketable sweet potato yield was found in the study realized by Mitra (2012) in India. Its values were in fifteen orange cultivars varied from 6.67 to 27.48 t/ha. Significant differences of sweet potato yield (4.57 - 54.7 t/ha), dependent on its cultivar, was also showed in experiment realized by Sideman (2015) in USA. The significantly lower yield of marketable sweet potato tubers (3.4 - 14.4 t/ha) was found in Turkey (Yildirim et al., 2011). Compared to results of this study, lower marketable yield of sweet potato tubers was also found in Papua New Guinea (Hartemink, 2003), Brazil (Oliveira et al., 2010) or Ghana (Sowley et al., 2015).

Marketable ratio of tubers

The statistical analysis of obtained results showed statistically significant difference of percentage ratio of marketable tubers among tested sweet potato cultivars (table 3). The highest ratio of marketable tubers was found in orange cultivar 'Beauregard' (87.17%), followed by orange cultivar 'Dubaian' (85.08%), white cultivar 'Višnjica white' (80.60%) and 'Višnjica purple' (71.44%). Sokoto et al. (2007) tested the effect of various plant spacing on the marketable ratio of sweet potato tubers. In the same spacing as in this experiment, authors found significantly lower share of marketable tubers, concretely only 48.99%. Hartemink (2003) found the variability of marketable ratio of sweet potato tubers in the range from 83.53 to 89.56%. These values are comparable to realised experiment. Sideman (2015) examined the marketable ratio of tubers in dependency on sweet potato cultivar and experimental year and its values was varied from 56 to 94%. In orange cultivar 'Beauregard', marketable ratio of tubers was ranged in following way: 71% (2008) < 85% (2010; 2011) < 91% (2009). Mentioned values are comparable to results in this study, except of year 2008. Marketable ratio of sweet potato tubers, presented by Goldy and Wendzel (2008), was ranged from 24.06 to 70.52%. Authors found significantly lower values of this parameter (66.18%) compared to this experiment. Nair et al. (2015) also found lower ratio of marketable tubers in sweet potato cultivar 'Beauregard' (83.90%) in comparison with its value reached in this experiment. On the contrary, author found comparable ratio of marketable tubers (86.17%) in second tested orange cultivar 'Evangeline' compared to orange cultivars used in this experiment. Krochmal-Marczak et al. (2018) found significant differences of marketable tuber ratio among sweet potato cultivars with different flesh color. The highest percentage ratio was found in purple cultivar 'Carmen Rubin' (67.3%), followed by orange cultivar 'Beauregard' (58.5%) and white cultivar 'White Triumph' (54.7%).

Antioxidant activity

The statistical analysis of gained results (table 4) showed statistically significant effect of cultivar on the antioxidant activity of sweet potato tubers (DPPH method: 2,2-Diphenyl-1-picrylhydrazyl). The highest antioxidant activity (AOA) was found in purple cultivar 'Višnjica purple' (61.07% DPPH), followed by orange cultivars 'Beauregard' (42.78%) and 'Dubaian' (39.89%) and white cultivar of sweet potatoes 'Višnjica white' (26.02%). Compared to these results, Eleazu and Ironua (2013) found expressively higher value of AOA (85.28%) in the study realized in Nigeria.

Table 4. Antioxidant activity and total polyphenol content in sweet potato tubers (average values for 2016-2017)

Cultivar	Antioxidant activity (% DPPH ±SD)	Total polyphenols (mg/kg d. w. ±SD)
Beauregard	42.78±8.45^{c}	2159.68±164.27^{b}
Dubaian	39.89±8.03^{b}	2447.00±311.88^{c}
Višnjica white	26.02±4.62^{a}	1409.88±286.83^{a}
Višnjica purple	61.07±10.93^{d}	4506.90±449.08^{d}

$^{a, b, c, d}$ Values with different lowercase letters in column are significantly different at P<0.05 by LSD in ANOVA. SD - standard deviation

Teow et al. (2007) determined AOA in different-colored cultivars of sweet potato by using of DPPH method in USA and its value was expressed in Trolox equivalents (µmol TE/g of fresh weight). Authors stated similar interaction of AOA and flesh color as it was showed in this experiment. The highest AOA was found in purple sweet potato cultivars, followed by cultivars with orange and white flesh color. In Chinese experiment, Ji et al. (2015) tested the effect of cultivar on the AOA of sweet potatoes (DPPH method) and found its highest values in cultivars with purple flesh color (81.2 mg TE/g dry weight), followed by cultivars with lighter flesh color, involving white (55.2 mg TE/g d. w.), red (50.4 mg TE/g d. w.) and yellow (43.3 mg TE/g d. w.) sweet potato cultivars. Within field experiment in USA (Grace et al., 2014), values of AOA were increasing in following order of different-colored sweet potato cultivars: purple flesh (8.47 mg TE/g d. w.) < yellow flesh (0.56 mg TE/g d. w.) < light-yellow flesh (0.53 mg TE/g d. w.) < orange flesh

(0.51 mg TE/g d. w.). Tang et al. (2015) also found (DPPH method) the highest value of sweet potatoes in purple-flesh cultivars (25.64 - 27.79 mg TE/g d. w.), followed by cultivars with orange (25.07 mg TE/g d. w.), yellow (23.43 mg TE/g d. w.) and white (23.33 mg TE/g d. w.) flesh color. Mentioned differences among cultivars was also confirmed by another used method of AOA determination (FRAP).

Similarly to results of this study, Rumbaoa et al. (2009) also found the significantly higher AOA in purple cultivars of sweet potato compared to white-fleshed cultivar in experiment in Philippines. On the contrary, Salawu et al. (2015) found only slight differences of AOA between purple-fleshed (0.24 mg TE/g f. w.) and white-fleshed (0.23 mg TE/g f. w.) in Nigerian experiment. It was also confirmed by another determination method of AOA (ABTS).

Results of compared studies indicate that value of AOA is significantly increased by content of polyphenol, or more precisely anthocyanins in sweet potato tubers. The correlation between polyphenol content and AOA value was also presented in the study of Šulc et al. (2008) focused on potatoes (*Solanum tuberosum* L.). Authors found that tubers of purple potato cultivars showed about 60% higher polyphenol content and double-fold value of AOA in comparison with white potato cultivars.

Total polyphenol content

The statistical analysis of obtained results showed statistically significant differences of total polyphenol content (TPC) among examined sweet potato cultivars (table 4). Values of TPC were increasing in following order: purple cultivar 'Višnjica purple' (4506,90 mg GAE/kg d. w.) < orange cultivar 'Dubaian' (2447,00 mg GAE/kg d. w.) < orange cultivar 'Beauregard' (2159,68 mg GAE/kg d. w.) < white cultivar 'Višnjica white' (1409,88 GAE/kg d. w.). In Chinese study, Ji et al. (2015) found more than double-fold higher TPC in purple-fleshed sweet potato cultivar (54300 mg GAE/kg d. w.) compared to cultivars with red (25700 mg GAE/kg d. w.), yellow (17800 mg GAE/kg d. w.) and white (9600 mg GAE/kg d. w.) tuber flesh color. These results are significantly higher in comparison with results of realised study. Authors also found a strong interaction between increasing anthocyanin content with connection to the increase of TPC in sweet potatoes. Salawu et al. (2015), Ellong et al. (2014) and Teow et al. (2007) also found more than double-fold higher TPC in purple cultivar compared to white and orange cultivars of sweet potatoes.

The significant effect of cultivar on the TPC in sweet potatoes was also presented in the study of Rumbaoa et al. (2009), realized in Philippines. Authors found increasing values of TPC in following order of tuber flesh color: purple (7368 mg GAE/kg d. w.) < yellow (3107 mg GAE/kg d. w.) < white (1927 mg GAE/kg d. w.). Mentioned values of TPC in purple and white cultivars are higher in comparison with results found in this study. In Slovakian study of Musilová et al. (2017), TPC in sweet potatoes was ranged from 1161 (white cultivar) to 9800 (purple cultivar) mg GAE/kg d. w. Authors found significantly lower value of TPC in orange cultivar 'Beauregard' (1186 mg GAE/kg d. w.) compared to the same cultivar tested in this experiment. Alam et al. (2016) determined TPC in nine sweet potato cultivars with orange flesh color in Bangladesh. Authors found significantly higher content of TPC (3499,63 - 4819,34 mg GAE/kg d. w.) in all cultivars compared to orange cultivars tested in this experiment.

Similarly to previous studies, Grace et al. (2014) also found significantly higher TPC in purple-flesh sweet potato cultivar (39920 mg ChAE/kg d. w.; ChAE - chlorogenic acid equivalent) compared to cultivars with orange (2870 mg ChAE/kg d. w.), yellow (2830 mg ChAE/kg d. w.) and light-yellow (2780 mg ChAE/kg d. w.) flesh color. According to authors, the highest TPC in purple cultivar was caused by abundance of anthocyanins in sweet potato tubers.

CONCLUSIONS

The effect of cultivar on the important quantitative and qualitative (antioxidant activity, polyphenol content) parameters of sweet potatoes grown in Slovak Republic was studied. The highest yield (1964.16 g per plant or

54.56 t/ha) and average weight (446.18 g) of marketable sweet potato tubers (> 150 g) were found in white cultivar 'Višnjica white'. The highest share of marketable tubers was reached in orange sweet potato cultivar 'Beauregard' (87.17%). The significantly lower values of all quantitative parameters of grown sweet potato tubers were found in purple cultivar 'Višnjica purple'. This cultivar is appeared as a less-suitable for growing in Slovak Republic, or Middle European region in generally. On the contrary, this purple cultivar showed the highest antioxidant activity (61.07% DPPH) and total polyphenol content (4506.90 mg/kg dry weight) compared to sweet potato cultivars with orange and white flesh color. Results of this study revealed that sweet potato is expressed by good yield potential, together with its quality, in conditions of Slovak republic, or Middle Europe in generally.

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