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COMPARATIVE ANALYSIS OF TOTAL ANTIOXIDANT POTENTIAL OF FOUR PURPLE POTATO GENOTYPES AND SEVERAL BERRIES FRUITS

Bădărău Carmen Liliana[1,2]*, Ştefan Floriana Maria[1], Tican Andreea[1]

[*]National Institute of Research and Development for Potato and Sugar Beet, BraŞov
[2] Transilvania University from BraŞov, Faculty of Food and Tourism
* *Correspondence author. E-mail*: carmen.badarau@potato.ro

Keywords: *purple potato, berries, antioxidant capacity, polyphenols, flavonoids.*

ABSTRACT

Potato tubers with purple flesh contain high levels of antioxidants as do some of many berries fruits. This study evaluated the total antioxidant activity (TAC) of four potatoes genotypes with purple colored flesh tubers in comparison with cranberries, blueberries, blackberries and raspberries. The potential antioxidant activity (estimated by ABTS method and DPPH scavenging activity) of the purple potato tubers were closed to that obtained for raspberries. Compared to other rich sources of polyphenols like the berries, the purple potato consumption has as special advantages the bioavailability and economic considerations (lower price).

INTRODUCTION

In terms of total phenols, total flavonoids and other food antioxidants (vitamin C, carotenoids) are associated with total antioxidant capacity (TAC) (Kalita & Jayanty, 2014). However, the TAC consumed by an individual depends on the type and amount of food intake. Therefore, the estimation of TAC provides valuable information on potential health benefits (Wang et al., 1996; Ezekiel et al., 2013). Moreover, the marketing of so called superfoods is commonly based on their antioxidant potential. In fact, a superior antioxidant activity with health benefits has been claimed for a number of antioxidants foods on in vitro antioxidant assays. There is a great variability in the phenolic compounds and the antioxidant activity in the commercial fruits (Lim et al., 2007; Wu et al., 2004; Borges et al 2010). Cranberries, blackberries, black blueberries, raspberries are considered to be superfood because of their antioxidant activity. Because of their diverse range of valuable phytonutrients (as anthocyanins, pro-anthocyanins, phenolic acid and flavonoids), these berries have beneficial effects on human health including anti-neurodegenerative, anti-inflammatory, antidiabetic and anti-obesity effects (Duthie et al., 2000; Wang et al., 1996; Kalita & Jayanty, 2014].

In particular, as in the case of the fruits tested in this paper, potato antioxidants have been shown to have favorable impacts on several measures of cardio-metabolic health, including lowering blood pressure, improving lipid profiles and decreasing markers of inflammation (Valcarcel et al., 2015; Duthie et al., 2000; Wang et al., 2004). This impact could be strong especially for people where potato is the most important food crop and therefore would be of interest to consumers and producers (Valcarcel et al., 2015). New potato cultivars whit high level of antioxidant compounds is considered a realistic approach to increasing dietary antioxidant intake (Navarre et al., 2011; Perla et al., 2012; Lachman et al., 2005).

The main objective of this research work was to assess their potential antioxidant capacity (using two methods ABTS and DPPH) in purple potato tubers (four cultivars) and in cranberries, black blueberries, blackberries and raspberries.

MATERIAL AND METHODS

The following potato genotypes with strong colored flesh were studied:

-‘Albastru Violet Galanesti ‘(‘Blue Purple of Galanesti’)

-‘Blue Congo‘, ‘Blue de la Manche’, ‘Patraque Auvergne’

The berries fruits: cranberries (*Vaccinium myrtillus* L.), black blueberries (*Ribes Nigrum* L.), blackberries (*Rubus fruticosus* L.) and raspberries (*Rubus idaeus* L.) were purchased from commercial market.

In the Figure 1 there were presented the extractions obtained from the samples tested (berries and purple flesh tubers from the genotypes studied).

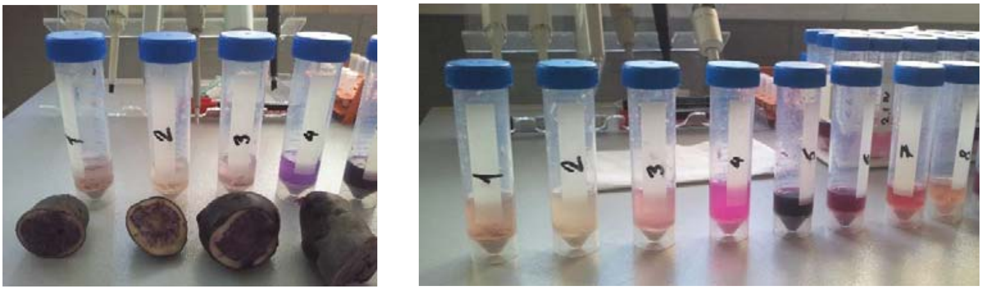

Figure 1. Purple flesh potato tubers and samples extracts.

Extraction

Antioxidant compounds were extracted from the material mentioned above. One gram of freeze dried food material was weight into a falcon tube and 10 ml of aqueous 96 % ethanol was added. The mixture was homogenized for 5 min. (Vortex), centrifuged at 10000 rpm for 10 min. and filtered through Whatman (Number 400) filter paper (Kalita & Jayanty, 2014).

DPPH assay. Volumes 20µl of the extracts were added to 20µl of distillated water in a 96 –well bottom microplate. 200µl of 120mg/l DPPH radical solution (using ethanol as a solvent) was then added and mixed thoroughly. The absorbance was measured using a plate reader (TecanSun Rise, software Magellan) at 515nm after keeping the plates in the dark for 30 min. A control with 20 µl of ethanol (no extract) was also included in each plate. The DPPH radical scavenging activity was calculated with the following formula (Kalita & Jayanty, 2014):

$$DPPH\ radical\ scavenging\ activity\ (\%) = [(A_{control} - A_{sample}) / A_{control}] \times 100\ (\%)$$

where A is the absorbance (of the control and samples) at 515 nm.

ABTS assay. This assay was performed by adopting the method of Arnao et al. (2001). The stock solution included an 8 mM ABTS radical solution and a 3mM potassium persulfate solution. The working solutions was prepared by mixing the two stock solutions in equal quantities and allowing them to react for 12 h at room temperature in the dark. The solution was then diluted by mixing 1 ml ABTS radical solution with 60ml ethanol to obtain an absorbance of approximately 1 unit at 724 nm using the microplate reader. Sample extract (150 µl) was allowed to react with 2850 µl of the ABTS solution for 2 hours in the dark. The ABTS antioxidant capacity was expressed in µmol Trolox equivalents (µmol TE) /g.

Statistical interpretation. The experiments were carried out in triplicates and statistical analysis was performed by one way analysis of variance (ANOVA) at $p < 0.05$ significance level using. Also, Duncan's multiple range test were used.

RESULTS AND DISCUSSIONS

DPPH radical-scavenging activity

The reduction capability of DPPH radical was determined by decrease in absorbance at 517 nm induced by antioxidants (included in the samples studied). Figure 2 presents the DPPH scavenging activity of the ethanol extracts of berries and potato tubers.

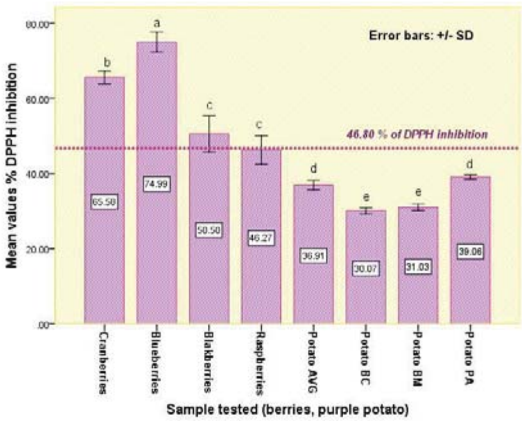

Figure 2. Antioxidant activity of cranberries, blueberries, blackberries, raspberries and different purple potato tubers (AVG = Albastru Violet de Galanesti – cv. 'Blue Purple of Galanesti'; BC = cv. 'Blue Congo'; BM = cv. 'Blue de la Manche'; PA = cv. 'Patraque Auvergne') by DPPH assay. Values not followed by the same letter are significantly different (P=0.05) according to Duncan's test. Abbreviations: DPPH=2, 2-diphenyl-1-picrylhydrazyl; SD=standard deviation.

As shown in this figure, the blueberries had the highest level of % DPPH inhibition, followed by cranberries, blackberries, purple potato AVG (Blue Purple of Galanesti), Patraque Auvergne, Blue Congo and Blue de la Manche (with significant variations $p<0.05$).The raspberries samples had close values of DPPH scavenging activity with some purple potato varieties

ABTS scavenging activity

The DPPH assay was used for evaluate the free radical-scavenging ability of the extracts. But the DPPH antioxidant activity depends upon a lot of factors (reaction time, kind of the phenolic compounds and the redox potential of the extracts. ABTS free radicals are more active than DPPH free radicals and unlike reactions with these radicals occur in less than a millisecond. The analysis is based on the reduction of the blue green ABTS radical by hydrogen-donating antioxidants and the decomposition of the ABTS radical is observed by the determining the absorption at 600 nm. Figure 3 shows the ABTS radical cation-scavenging activity of the ethanol extract of berries fruits and purple potato tubers samples. The blueberries samples had the highest ABTS value (244.0± 5.291 □mol TE/g) than the other samples extracts.

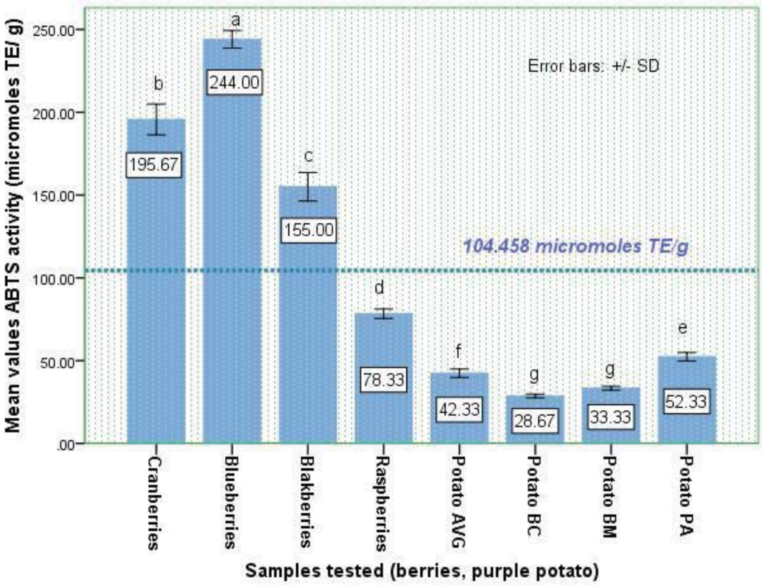

Figure 3. Antioxidant activity of several berries (cranberries, blueberries, blackberries, raspberries) and different purple potato tubers backed (AVG = Albastru Violet de Galanesti –Blue Purple of Galanesti; BC= Blue Congo; BM= Blue de la Manch; PA= Patraque Auvergne) by ABTS assay. Values not followed by the same letter are significantly different (P=0.05) according to Duncan's test.

The ABTS antioxidant potential was in the following order; blueberries > cranberries > blackberries >raspberries > potato cv. 'Patraque Auvergne' > potato cv. 'Blue Purple of Galanesti' > potato cv. Blue de la Manche > potato cv. 'Blue Congo'. There were significantly differences between the food samples tested. The antioxidant capacity estimated by ABTS assay for potato tubers from cv. Patraque Auvergne and Blue Purple of Galanesti was closed to that of the raspberries.

A huge number of articles are available regarding the antioxidant capacity of different fruits and vegetables. Wu et al. (2004) estimated the antioxidant potential of more than 100 types of foods, fruits, nuts, vegetables and dried spices consumed in the USA. Borges et al. (2010) studied the antioxidant activity of some European commercial juices. A critical analysis of the poliphenol and the antioxidant capcity of potato tubers measured by ORAC and DPPH methods was performed by Pillai et al (2013). There was found a high antioxidant potential in purple fleshed potato tubers. Compared with other vegetables, this potential was even higher. Similar results regarding the comparable antioxidant capacity of purple flesh tubers and some berries fruits and grape are reported by Madiwale et al. (2012).

A study in USA estimated that potatoes were the third highest contributor to the daily intake of phenolic compounds, after oranges and apples, with a daily intake consumption of 171 g day^{-1} (Chun et al., 2005). These properties of potatoes could be greater if the cultivars with high antioxidant level become popular for the people. Unfortunately, the Romanian genotype 'Blue Purple of Galanesti', (reported in this study with an antioxidant capacity level closed to that of the raspberries) is not accepted with pleasure by the consumers because the tubers are small, elongated and with deep eyes. Maybe in the future, the potato breeders correct these quality parameters by developing new cultivars with functional food characteristics (Bădărău et al., 2017).

CONCLUSIONS

Significant differences between the samples of the food tested were observed for the antioxidant potential measured by both methods (DPPH and ABTS scavenging activity). Higher antioxidant capacity were found in cranberries, black blueberries and blackberries and close value for raspberries and several intense colored fleshed potato tubers. Among the potato studied, the genotype 'Blue Purple of Galanesti' and the cv. 'Patraque Auvergne' (all with blue skin and purple flesh) had higher values percentage of DPPH inhibition and ABTS radicals scavenging activity, these value were closed to that obtained for raspberries samples. These properties of purple flesh potatoes could be greater if these cultivars with high antioxidant potential level become popular for the people. Therefore, colored potatoes contribute to the daily intake of antioxidants and their consumption thereby may have positive effects on the human health.

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RESEARCHES ON THE ENOLOGICAL POTENTIAL OF THE SAUVIGNON CULTIVAR IN HILLS WINE ZONES OF OLTENIA

Băducă Cîmpeanu C.[1], Mazilu Mihaela Nicoleta[2]

[1]University of Craiova, Faculty of Horiculture
[2]University of Craiova, Faculty of Horiculture, Master Vine-Wine Expertise
Correspondence author. E-mail: *cbaduca@gmail.com, mazilu.mihaela92@gmail.com*

Keywords: *grapevine, climatic changes, vineyard, ripering*

ABSTRACT

The Sauvignon variety enjoys a good reputation on the international wine market, being one of the most popular varieties for quality white wines worldwide. In the vineyards in the hilly area of Oltenia, the variety finds climatic conditions and soil that allow it to put its high quality potential well. Research carried out in the 2014-2017 period in 6 wine-growing areas in the hilly area of Oltenia shows that grapes maturation took place in very good conditions, so that the values of the main chemical constituents of the grapes (sugars, organic acids, flavors) fully suitable for obtaining high-quality wines. The qualitative potential of the variety in the 6 wine years studied was also well emphasized by the values of the analyzed technological indicators, starting with the yield, which had average values between 6.7 and 7.5 tons / ha.

INTRODUCTION

The Sauvignon Blanc wines have undoubtedly achieved worldwide notoriety, largely due to their aromatic character easily recognizable by many consumers around the world (Stoica Felicia, 2015). The main aromatic markers of these wines are known and have been the subject of many studies during the last 20 years. The varietal thiols at the base of the fruity typicality as well as 3-isobutyl-2-methoxypyrazine (IBMP) largely responsible for the more or less marked vegetable nature of these wines, have been particularly studied.

These compounds are of varietal origin and yet the scientific knowledge on vineyard practices influencing their content in wines are still limited (Suklje Katja e.a., 2016). Sauvignon wines have characteristic aromas that are often very intense. The specialists of this grape, experienced winemakers or enlightened amateurs, distinguish many shades, herbaceous to fruity sometimes even animal or empyreumatic, reminiscent of green pepper, ivy, tomato leaf, boxwood, broom, blackcurrant bud, the smell of tomcat, asparagus, grapefruit, white peach, passion fruit and finally wood smoke (Dubourdieu D., 1996).

Methoxypyrazines are present in the grapes of certain Vitis vinifera varieties including Sauvignon blanc and contribute herbaceous/green aromas to wine. Environmental factors such as light exposure and temperature can influence methoxypyrazine levels, and viticultural interventions such as canopy manipulation have the ability to reduce methoxypyrazine accumulation in grapes (Gregan S. and Jordan B., 2016).

In the Sauvignon Blanc variety, precursors were detected both in the skin and the pulp, while in Melon B., only *S*-3-(1-hexanol)glutathione was detected in pulp, any other precursors being exclusively found in skin. During an industrial pressing cycle, extraction of thiol precursors was enhanced at the end of the cycle (highest pressures), thus producing more varietal thiols in the resulting wines (Roland Aurélie e.a., 2011).

Formation of wine thiol precursors is a dynamic process, which can be influenced by vineyard and winery processing operations. With the aim of increasing thiol precursor concentrations, a study of the effects of storing machine-harvested Sauvignon blanc grapes prior to crushing and pressing was undertaken on a commercial scale. 3-Mercaptohexan-1-ol (3-MH) precursors, 2-S-glutathionylcaftaric acid (grape reaction product, GRP), glutathione (GSH) and a number of C6 compounds were assessed at several time points during the experiment.

The concentration of the cysteine precursor to 3-MH doubled within 8 h and tripled after 30 h while the GSH and cysteinylglycine precursors increased in concentration roughly 1.5 times. (E)-2-Hexenal and GSH levels decreased as thiol precursors, GRP and C6 alcohols increased during storage.

Principal component analysis revealed that precursors contributed to most of the variation within the samples over the storage period, with additional influence, primarily from GSH and GRP, as well as (E)-2-hexenal and (Z)-3-hexen-1-ol. Early storage time points were associated with higher concentrations of GSH and some unsaturated C6 compounds while longer storage times were most closely associated with higher thiol precursor and GRP concentrations (Capone Dimitra e.a., 2012).

During recent years, Sauvignon winemaking methods have undergone many changes—including a return to barrel fermentation of musts originating in the best *terroirs* as well as on-lees aging of new wines, whatever the fermentation method (barrel or tank).

Current Chardonnay and Sauvignon winemaking methods are very similar, but malolactic fermentation is rarely practiced on Sauvignon wines (Ribéreau-Gayon P. e.a., 2006). The viticultural factors influencing the thiol content in the wines are better and better identified. Similarly, it is now accepted that a good sanitary condition of the harvest is the first step necessary to obtain thiols in the wines.

The terroir of course plays an incontestable role since a low to moderate hydric stress favors the presence of precursors. From an oenological point of view, the extraction of the precursors during the pre-fermentation operations is favored by the maceration and the stubulation on mud (Geffroy O. e.a., 2010).

Thiol compounds responsible for tropical fruit associated aroma have been extensively studied over the last 20 years. The occurrence of their non-aromatic precursors in grapes and musts is reported largely mainly for the cultivar Sauvignon Blanc. The presence of these thiols as precursors or free molecules in grape, juice, and wine has been reported in several different varieties, suggesting that they are more or less ubiquitous both for Vitis spp. and interspecific hybrids.

The biosynthetic pathways resulting in these compounds are yet to be completely elucidated, but, in the meantime, industry needs to improve technological knowledge to better manage winemaking steps to enhance the variety-dependent aroma of wine (Román T. e.a., 2018).

MATERIAL AND METHODS

The study conducted between 2014 and 2017 had the following objectives:

- Establishing the values of the main constituents of grape composition at the technological maturity stage, in the vineyards: Drăgăşani, Vâlcea county; Sâmbureşti, Olt County; Segarcea and Cetate, Dolj county; Oreviţa-Stârrmina center Vânju Mare and Gârlă Drâncei center Oprişor, Mehedinţi County;