The Relationship of Anthocyanins with Color of Organically and Conventionally Cultivated Potatoes

I. Murniece, L. Tomsone, I. Skrabule, A. Vaivode

Abstract—Many of the compounds present in potato are important because of their beneficial effects on health, therefore, are highly desirable in the human diet. Potato tubers contain significant amounts of anthocyanins. The aim of this research was to determine the content of anthocyanins and its relationship with the colour of organically and conventionally cultivated potato varieties. In the research eight potato samples of three potato varieties were analyzed on anthocyanins, dry matter content and color. Obtained results show that there was no significant influence on amount of anthocyanins between different cultivation environments (p>0.05) while between varieties – significant difference (p<0.05). Strong correlation between the amount of anthocyanins and color was determined.

Keywords—Potato variety, anthocyanins, organic, conventional, dry matter.

I. INTRODUCTION

The research in potato chemistry has established the fact that there is a lot more in potatoes than starch [1]. Many of the compounds present in potato are important because of their beneficial effects on health, therefore, are highly desirable in the human diet [2].

In addition to supplying energy, potatoes contain a number of health promoting phytoneutrients such as phenolics, flavonoids, folates, kukoamines, anthocyanins, and carotenoids [3].

Potato tubers contain significant amounts of anthocyanins such as petanin in purple cultivars [4]. Anthocyanins are secondary metabolites of plants, and are the most important subclass of flavonoids [5]. Among flavonoids, anthocyanins are natural pigments, responsible for the red-blue color of many fruits and vegetables. Anthocyanins can impact on the organoleptic characteristics of foods which may influence their technological behavior during food processing and also have implications in the field of human health [6].

A high intake of anthocyanins has been linked to health preventive effects and reduced risks of e.g., certain form of cancer [7], ocular disorders [8] or vascular failures [9].

There are many factors affecting the quality of potatoes. Potato quality varies depending on the growing area, cultivar [10] and aspects of the chemical composition of main crop potato tubers have been shown to depend on the cultivation system as well. The improved qualitative value of organic vs. conventional produce, however, has not been ascertained [11], [12]. Although nutrient content depends on a number of factors, the potato variety is thought to be among the most significant factors [13].

In 2008, the most important arable crop in the EU27 was cereals (44% of the fully converted organic area under arable crops), followed by green fodder (42%), other arable crops such as dried pulses, potatoes, sugar beet, arable seeds and seedlings (7%), fresh vegetables and industrial crops (both 4%) [14]. As a result the interest in organic agriculture and environmentally-friendly agricultural products is increasing, and in particular consumers have made potatoes one of their top organic purchases among fresh vegetables even though organic potatoes carry a price significantly higher than most other vegetables [15].

In this respect, it is not known whether and how different agriculture techniques and/or cultivation systems may affect the nutrients composition of the final product. Comparison of organic and conventional foods in terms of nutritional value, sensorial quality and food safety, has often highlighted controversial results. As a consequence, a clear link between cultivation system and nutritional profile of agricultural products is still missing [16], [17].

The aim of this research was to determine the content of anthocyanins and its relationship with the color of organically and conventionally cultivated potato varieties.

II. MATERIALS AND METHODS

A. Soil and Climate

The potatoes were planted in the middle of May and harvested in last decades of August or first days of September. Field trials were conducted in three replications. The certified potato seed material was used. Seed tubers were planted in rows; the distance between rows was 0.7m and the distance between tubers 0.3m.

The soil type was sod podzolic (PV), loamy sand. Organic matter content in soil was 25mg kg⁻¹, pHKCl was 6.3, the availability in soil of K was low and P was medium. The common agronomic practices were used during vegetation period.

Irisa Murniece is with the Latvia University of Agriculture, Faculty of Food Technology, Jelgava, Latvia (phone: 0037163005644; fax: 0037163022829, e-mail: irisa.murniece@llu.lv);
Lolita Tomsone is with the Latvia University of Agriculture, Faculty of Food Technology, Jelgava, Latvia (e-mail: lotozi@inbox.lv);
Ilze Skrabule is with the State Plant Breeding Institute, Priekuli, Latvia (e-mail: skrabuleilze@gmail.com);
Aija Vaivode is with the State Plant Breeding Institute, Priekuli, Latvia.
Fertilizer was applied at the rate of N1 60kg ha–1 and N2 120kg ha–1. The common agronomic practices were used during vegetation period. Herbicides in field were used for weed control. The fungicides for restriction fungal diseases were used two times in July.

The haulm was cut in last decade of August and the tubers were harvested in the beginning of September. Potatoes were stored at the State Priekuli Plant Breeding Institute at an air temperature of 4°C and at a relative air humidity of 80 ± 5%.

**III. RESULTS AND DISCUSSION**

Dry matter (DM) content varies from 20.77±0.05% (Blue Congo variety when cultivated conventionally with N supply 60kg ha–1) to 32.45±0.77% (Imanta variety, when cultivated organically) (Fig. 1).

![Fig. 1 Dry matter content in potatoes with different flesh color](image)

DM content in Imanta variety was 23% and 12% lower when potatoes were cultivated conventionally with N supply 60 and 120kg ha–1 respectively. The difference in DM content was not influenced by the cultivation practice while the factor ‘variety’ played an important role – there was significant difference in DM content between Imanta and Brasla varieties (p<0.05).
In the previous research reported by Murniece et al. DM content of Imanta variety in the first study year was 24.71% and almost the same value was in the second year – 24.41%. Potatoes were cultivated conventionally with N supply 60kg ha⁻¹ [20].

DM was higher in organically cultivated potatoes and comparing with the results of Brazinskienė et al. the tendency was in opposite – DM content was higher in potatoes cultivated conventionally [21]. From the Tein et al. research report is clear that tendency of being higher DM content in organically or conventionally cultivated potatoes is very strongly affected by the season - DM content was found to be different per each research year [22].

In addition to supplying energy, potatoes contain a number of health promoting phytonutrients such as phenolics, flavonoids, folates, kukoamines, anthocyanins, and carotenoids [23]. Anthocyanin levels between 5.5 and 35mg 100g⁻¹ FW in potatoes have been reported [24]. Comparing to the results reported by Brown, in the particular research the amount of anthocyanins is found to be lower. The highest amount of anthocyanins was determined in Blue Congo variety i.e. 4.451±0.006mg 100g⁻¹ when potatoes cultivated conventionally with N supply 120kg ha⁻¹ (Fig. 2).

Blue Congo is variety with flesh in purple color; therefore, results of statistical analysis show significant differences on amount of anthocyanins between varieties (p<0.001) while no significant differences between cultivation practice was found (p>0.05).

Average intensity of color in white flesh potatoes is L=70.7, yellow flesh potatoes – L=72.9 and potatoes with purple color – L=35.6 (Fig. 3). Significant affect on color intensity L*, color factor a* and b* was found between varieties. In all cases Blue Congo variety showed the difference while in case of color factor b*, the differences was found between each variety. Cultivation practices did not affect significantly on color (p>0.05) while slight difference is noticed (Fig. 3).

Colored potatoes have attracted the attention of investigators as well as consumers because of their antioxidant activities, taste and appearance [25]. Colored potatoes have the potential to be one of the richest sources of antioxidants in the human diet.

Anthocyanins correlates with the color of potato flesh and strongest correlation was determined with color factor b* i.e., R²=0.691 while with L* it was R²=0.674 and with a* – R²=0.570.

Principal component analysis (PCA) was used to summarize the relationship between color, DM and anthocyanins (Fig. 4). PCA illustrates that variety with white flesh (#2, 4, 7) is with higher DM content and with higher L* value (Lightness). Potatoes with purple flesh (# 5, 8) are high in anthocyanins while DM content in these potatoes presented is low. Potatoes with yellow flesh (# 1, 3, 6) presents high b* value which represents yellowness and DM content in these
potatoes is lower comparing potatoes with white flesh but higher comparing potatoes with purple flesh.

In the PCA values of white flesh potato variety are much closer comparing with the values of purple flesh and white flesh potato varieties. Due to this fact it might be concluded that in particular research cultivation practice influenced much stronger purple fleshed and yellow flesh potatoes.

IV. CONCLUSION

Cultivation practise did not affect the amount of anthocyanins while significance was noticed between varieties (p<0.001).

Even when the amount of anthocyanins in potatoes was very small strong correlation between amount of anthocyanins and color was found.

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REFERENCES


Irina Murniece, Dr. sc. ing., was born in Cesis (Latvia), 1980. Has obtained doctoral degree in the field of Food Science at Latvia University of Agriculture (2010) and Master degree – Food Science and Nutrition at Gent University (Belgium) (2007). Now she is working as a leading researcher at the Department of Food Technology. Her field of the research is potatoes, vegetables and its quality before and after processing as well as analyses of the physical properties of the food. Her interest is human nutrition. She has about 40 published papers and participated in ten different projects both in national and European level.

Lolita Tomsons, PhD student at Latvia University of Agriculture, Faculty of Food Technology, was born in Bauska (Latvia) in 1974. Main topics of research are: biologically active substances and natural antioxidants in foods.

Ize Skrubale, Dr. agr., leading researcher, potato breeder at State Priekuli Plant Breeding Institute. She was born in Latvia, Riga at 1959. She has defended her Dr. in agricultural sciences in Latvia University of Agriculture (2010) and Master degree – Food Science and Nutrition at Gent University (Belgium) at 2007. Now she is working as a leading researcher at the Department of Food Technology. Her field of the research is potatoes, vegetables and its quality before and after processing as well as analyses of the physical properties of the food. Her interest is human nutrition. She has about 35 scientific publications. At present leading researcher in Project “Development, improvement and implementation of environmentally friendly and sustainable crop breeding technologies”, Contract Nr.2009/0218/1dp1/1.1.1.2.0/09/A/VAIA/009.
Aija Vaivode, Mg. agr., scientific assistant, specialized in crop management at State Priekuli Plant Breeding Institute with the experience more than 20 years. She was born in Latvia, 1959.