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ВЛИЯНИЕ НА СОРТА И ПОЧВЕНОТО ТОРЕНЕ ВЪРХУ ОБЩОТО СЪДЪРЖАНИЕ НА ПОЛФЕНОЛИ ПРИ ЛУКА (*ALLIUM CEPA* L.)
THE EFFECT OF CULTIVAR TYPE AND SOIL NUTRIENT SUPPLEMENTATIONON THE TOTAL POLYPHENOL CONTENT IN ONION (*ALLIUM CEPA* L.)

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Abstract

Onion, the second most important horticultural crop in the world after tomatoes, is intensively grown and widely consumed in Slovakia. A three-year field small-plot experiment was established at an agricultural farm in Western Slovakia using a block method. The aim of this experiment was to examine the impact of modified soil nutrient supplementation: 140 kg N. ha^{-1}, N:S (140:19 kg.ha^{-1}) and N:S:Fe (140:19:5 kg.ha^{-1}) on the total polyphenol content (TPC) in selected onion cultivars (white – cv. Pueblo, yellow – cv. Mundo, red – cv. Robin and Kamal).

The study showed that the total polyphenol content in onion was affected both by cultivar type (genotype) and soil nutrient supplementation. The highest average content of polyphenols was found in red cultivars treated with 140 kg N. ha^{-1} i.e. cv. Robin and cv. Kamal - 1048.25 and 1068.68 mg.kg^{-1} of fresh matter, respectively. Consumption of vegetable cultivars with high content of polyphenols may contribute to an antioxidant-rich diet that leads to major health benefits.

Key words: onion, soil nutrient supplementation, polyphenols.

INTRODUCTION

The recent studies suggest that an onion-rich diet may prevent cancer, asthma and cardiovascular diseases due to its great antioxidant potential. The onion could be evaluated as a major dietary source of flavonoids and polyphenolic antioxidants (Lachman et al.,2003 b; Haytova and Babricov, 2006; Roldán et al., 2008).

Phenolic acids, both in free and bound forms, are a major group of polyphenolic compounds in oni-on. Polyphenols, especially flavonoids, are effective antioxidants. Fresh onion contains a small amount of essential oils (0.01%) consisting of sulphur compounds (Lachman et al., 1999).

Total polyphenol content in the onion is in the interval from 76.1 to 154.1 mg GAE (gallic acid equivalents)/100 g fresh mass (Marinova et al., 2005, Brat et al. 2006). The chemical composition of the onion bulb is variable. The qualitative and quantitative chemical composition of antioxidants in onion is affected by genotypic and environmental factors (Yang et al, 2004, Morgen et al. 2007).

The aim of this study was to examine the effect of modified soil nutrient supplementation (based on nitrogen, sulphur and iron) on the total polyphenol content (TPC) in selected onion cultivars.

MATERIALS AND METHODS

A three-year field small-plot experiment was carried out in the village of Madunice (West Slovakia). This region has a mild, warm, dry climate with mild winters, the average annual air temperature of 9.4°C and the average annual precipitation of 533 mm.

The study examined the impact of modified soil nutrient supplementation:

140 kg N.ha^{-1} (variant I),
N:S (140:19 kg.ha^{-1}) (variant II)
and N:S:Fe (140:19:5 kg.ha^{-1}) (variant III)

on the total polyphenol content (TPC) in the following onion cultivars:

white – cv. Pueblo, yellow – cv. Mundo, red – cv. Robin and Kamal.

The seeds of onion cultivars were sown in early April. The exact distances between rows and the exact distance between seeds in the row were applied. The study was designed with four replications using a block method. The same plot size of 5 m^2 was used. Doses of mineral fertilizers were applied based on the nutrients content in soils of the Madunice village in individual years (table 1).

Determination of the total polyphenol content

The total polyphenols content in onion cultivars was determined according to the modified methodology of Lachman et al. (2003 b). All samples were prepared as follows: a 0.5 cm^3 aliquot was diluted with 30 mL of distilled water. Next, 2.5 mL of the Folin-Ciocalteau's reagent was added to the sample. After the solution agitation and standing for 3 minutes, 7.5 mL of 20 % Na_2CO_3 p.a. solution was added to the sample. After thorough agitation and standing for 2 hours at laboratory temperature, the absorbance of samples was measured using a 1 cm cuvette at λ = 765 nm on Helios γ spectrophotometer (the Shimadzu UV-1800).

The total polyphenol content in samples was expressed as mg/g gallic acid equivalents (GAE).

Statistical analysis

The analysis of variance (ANOVA), the multifactor analysis of variance (MANOVA) and the Duncan's multiple range test were done using the Statgraphic Centurion XVII (StatPoint Inc. USA).

RESULTS AND DISCUSSION

The study showed that the total polyphenol content (TPC) in onion ranged from 105.19 to 1415.45 mg GAE/kg of fresh matter in our experiment (table 2–4).

Similar results were obtained by Yang et al. (2004), Lachman at al. (2003 b), Gökçe et al. (2010) and Kaur et al. (2009) for ten different colored onions. The highest content of polyphenols was found in red cultivars i.e. cv. Robin and cv. Kamal in the last year of the experiment – 1415.45 and 1347.25 $mg \cdot kg^{-1}$ of fresh matter, respectively (variant I – table 4). TPC is significantly affected by the cultivar type (genotype) in the three years of trial (figure 1–3). On the basis of the statistical evaluation for the whole period of research we can conclude that varietal differences in total polyphenol content and were found: red cv. Kamal > red cv. Robin > yellow Mundo cv. Red > white cv. Pueblo (figure 4). Kamal could be recommended for consumption in fresh state (salads) regarding high le-vels of polyphenols.

The difference in the TPC between the variants we have found only in the second year of the experiment (figure 1–3). We can conclude that soil nutrient supplementation didn't significantly impact the TPC.

However, the TPC in cultivars was different in for each year the experiment indicating that the TPC onions can also be influenced by environmental factors.

Table 1. Nutrients content in soils of the Madunice village in individual years

year (%)	pH	humus	Nutrient content ($mg \cdot kg^{-1}$ soil)						
			N_{an}	K	P	Mg	Ca	S	Fe
1	5.96	2.82	7.2	260	35	830	4 200	18,0	19.68
2	6.90	4.16	13.5	242.5	17.5	935.0	5 600	27.5	14.13
3	6.73	2.86	8.9	200.0	25.0	-	-	-	-

Table 2. The total polyphenol content in selected onion cultivars (mg GAE.kg^{-1} of fresh matter) – results obtained in the first year of the experiment

Variant	Variety			
	Pueblo	Mundo	Robin	Kamal
Control*	517.00	759.90	798.00	802.70
I (N)	521.70	755.10	858.00	760.80
II (N:S)	534.10	743.70	905.60	867.50
III (N:S:Fe)	569.40	826.50	859.90	779.90

**without fertilizers*

Table 3. The total polyphenol content in selected onion cultivars (mgGAE.kg^{-1} of fresh matter) – results obtained in the second year of the experiment

Variant	Variety			
	Pueblo	Mundo	Robin	Kamal
Control*	272.18	744.62	753.19	813.20
I (N)	402.68	959.88	871.31	1098.00
II (N:S)	371.24	972.27	778.91	855.11
III (N:S:Fe)	430.29	1015.13	837.97	931.31

**without fertilizers*

Table 4. The total polyphenol content in selected onion cultivars (mg GAE.kg^{-1} of fresh matter) – results obtained in the third year of the experiment

Variant	Variety			
	Pueblo	Mundo	Robin	Kamal
Control*	105.19	652.15	1207.66	1088.51
I (N)	112.13	689.66	1415.45	1347.25
II (N:S)	205.27	644.71	818.57	959.05
III (N:S:Fe)	270.59	734.21	1040.67	844.94

**without fertilizers*

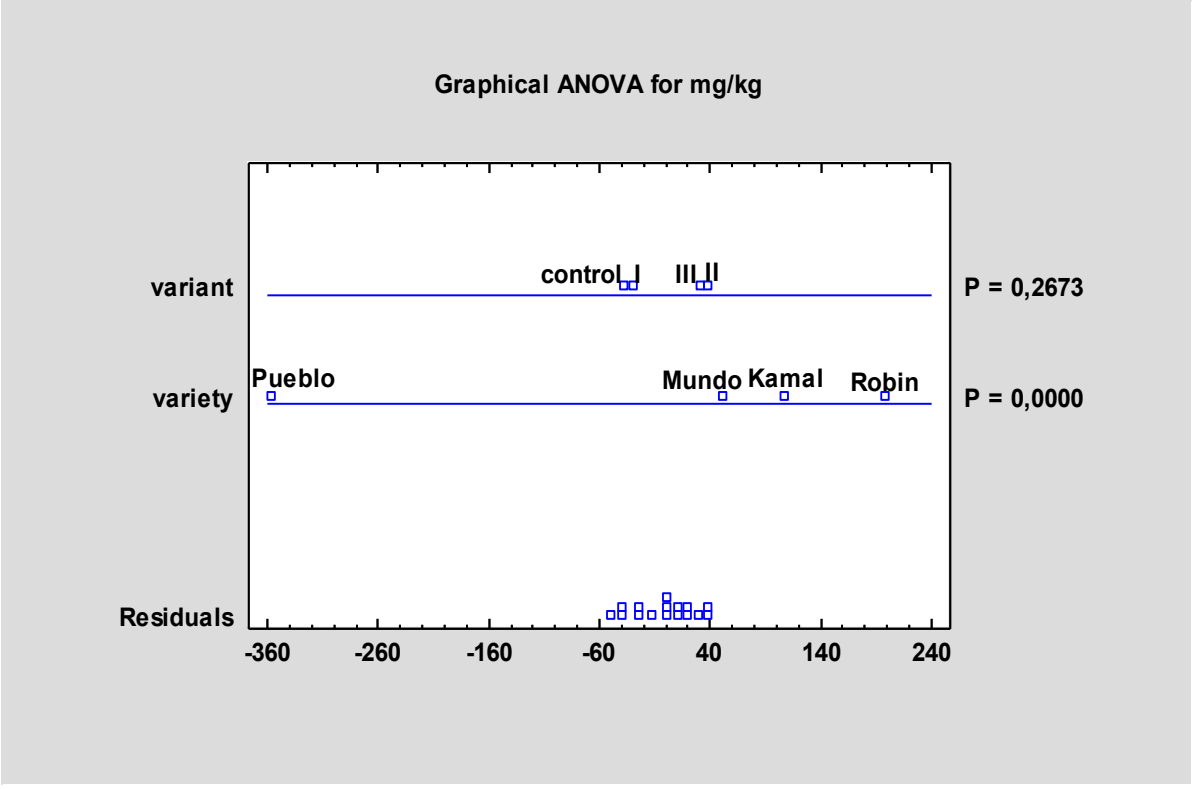


Fig. 1. *Graphical ANOVA for TPC in selected onion cultivars in the first year of the experiment*

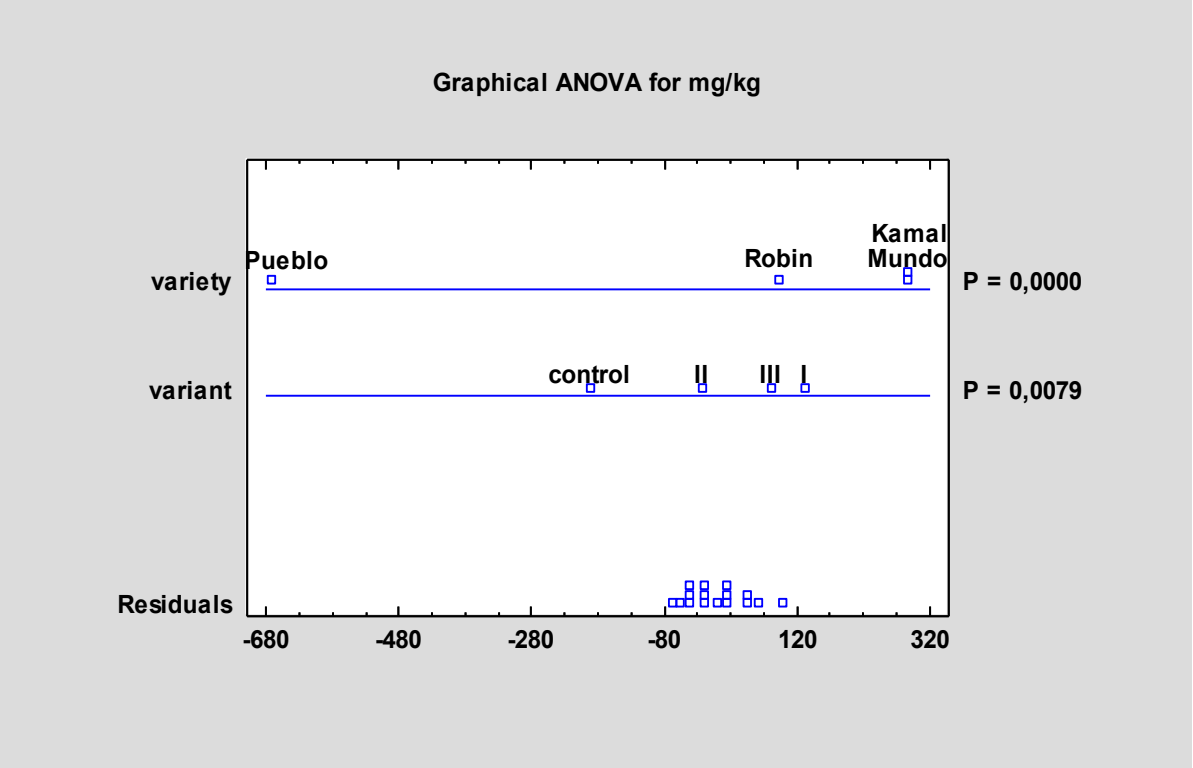


Fig. 2. *Graphical ANOVA for TPC in selected onion cultivars in the second year of the experiment*

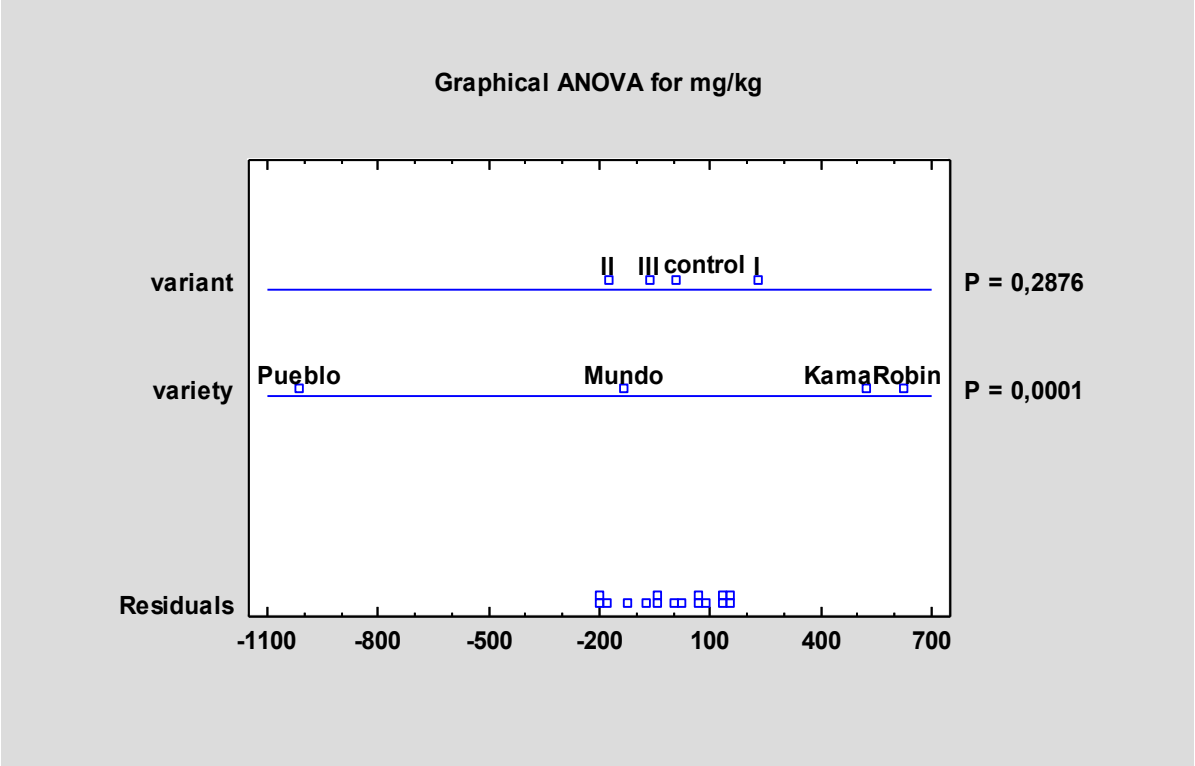
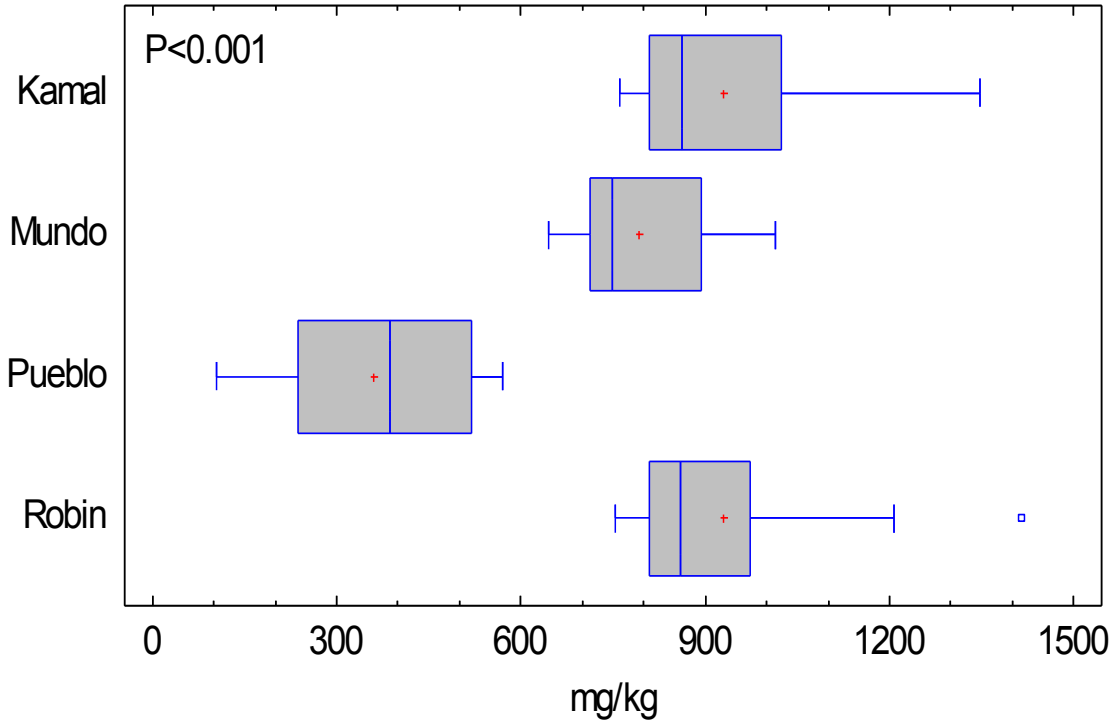


Fig. 3. *Graphical ANOVA for TPC in selected onion cultivars in the third year of the experiment*



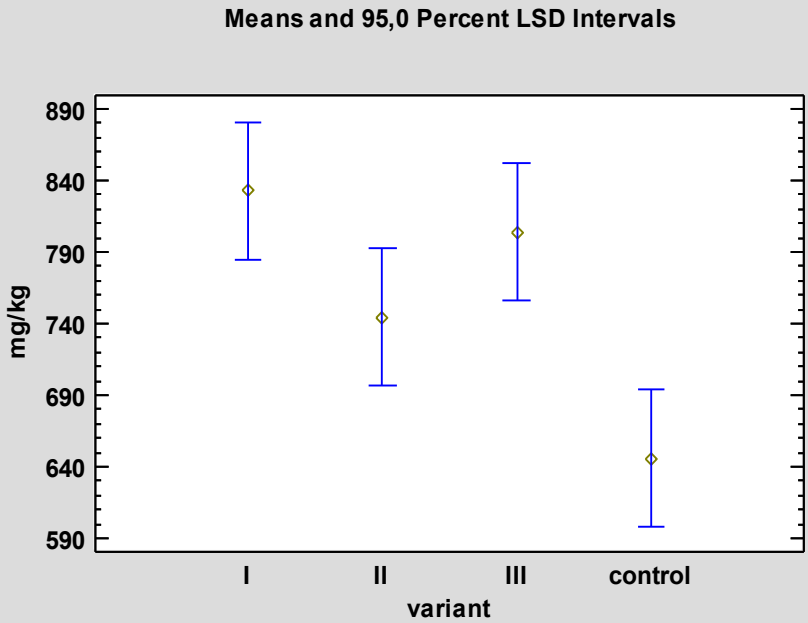


Fig. 4. *Statistical analysis (ANOVA) of the TPC in selected onion cultivars in three years of the experiment*

CONCLUSIONS

1. The study showed that the total polyphenol content (TPC) in onion is significantly affected by the cultivar type (genotype).

2. The highest content of polyphenols was found in red cultivars i.e. cv. Robin and cv. Kamal. The soil nutrient supplementation didn't significantly imapct the TPC.

3. Our experiment indicating that the TPC in onion may also be affected by environmental factors.

4. Consumption of vegetable cultivars with high content of polyphenols may contribute to an antioxidant-rich diet that lead to major health benefits.

5. The research results obtained in this study can be used for the development of guidelines for farmers to use a great antioxidant potential of onion through the optimization of cultivation practices.

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