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Qualitative and Nutritional Characteristics of Plum Cultivars Grown on Different Rootstocks

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Abstract: Previous study hsas confirmed the influence of rootstock on the scion. Using a suitable rootstock for plum cultivar can affect many qualitative parameters of fruit. This study deals with the pomological and chemical analysis of three plums of Japanese origin (*Prunus salicina*) 'Black Amber', 'Karkulka', 'Shiro' and one European origin (*Prunus domestica*) 'Stanley' grown on five different rootstock (Ishtara, St. Julien A, Torinel, Citation and Penta) planted in Czech Republic. During the year, the phenological phases of date of blooming, flower set, date of ripening, and fruit set were determined. In this study, significant negative correlation ($p < 0.05$, R = −0.6831) was determined between fruit set and fruit weight. Rootstocks did not have influence on the fruit weight, but 'Karkulka' reached significantly higher fruit weight on St. Julien A and Citation rootstocks (32 g) than on the other three rootstocks (24 to 26 g). For all cultivars, fruit firmness and soluble solid content (SSC) were measured. The rootstocks greatly influenced the titratable acidity of plums which reached the highest value for cultivars grown on Citation rootstock (from 0.65 to 2.43%) and the lowest when grown on Ishtara rootstock (from 0.53 to 1.88%). In addition, total phenolic content (TPC), total flavonoid content (TFC), and antioxidant capacity were determined. The cultivars on Ishtara rootstock reached the highest values of TPC (from 336.26 to 562.75 mg (GAE)/100 g). The results presented in this study show influence of rootstock on quality of plums, where Ishtara rootstock was highlighted as the best.

Keywords: plum; fruit quality; trunk cross-section area (TCSA); statistical analysis

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1. Introduction

The plums are favorite fruit produced in temperate zones, mostly in the northern hemisphere. Plums with production of 12.25 million tons are the second most produced stone fruit worldwide after peaches and nectarines [1]. Two species, European plum (*P. domestica*) and Japanese plum (*P. salicina*), are distinguished according to their origin and dominate the modern commercial production [2]. Plums differ often with their pomological and nutritional properties [3]. Both species are rich sources of energy due to their high content of sugars, mainly monosaccharides. In addition, plums contain bioactive and antioxidant compounds such as dietary fiber, sorbitol, phenolic compounds, and minerals [4]. Phenolic compounds with their antioxidant properties have positive effects on human health [5]. An important group of phenolic compounds are anthocyanins which are responsible for the specific blue, violet, or red color of fruit [6].

Many agronomical advantages have been determined for grafted plants. The suitable graft combinations improve plant growth under environmental stresses, yield, and fruit quality [7]. Thus, the relation between used rootstock and fruit quality of plums is the topic of many studies [8–10], although fruit quality is mostly a cultivar-associated trait. In addition, fruit quality, soluble solid content, or titratable acidity may be indirectly affected by several mechanism including budburst, time and abundance of scion flowering, and flower quality [11]. Viruses, phenolic and flavonoid compounds have been proposed as markers for graft incompatibility in *Vitis* [12,13] and *Prunus* [14,15] and these secondary metabolites appears to be increased in heterografted plants (i.e., a graft between two individuals of the different genotype). The increase of phenolic compounds content was also detected in leaves and rootstock phloem exudates of heterografted plants of *Vitis*. Thus, the impact of grafting on a metabolome of different grafted genotypes was confirmed [16].

Radović et al. [17] confirmed a significant amount of phenolic and sugar content in plums depending on the rootstock that was used. In general, the influence of rootstock on European plum quality is well described, while the effect of rootstock on Japanese plums has been poorly studied [18]. The myrobalan (*Prunus cerasifera)* seedling is the most widely used rootstock in Europe. Many problems were reported in association with using this rootstock: non-uniformity, excessive vigour of the scion, grafting incompatibilities with certain cultivars, delayed precocity [17,19]. Better influence on tree vigour, graft-compatibility, leaf mineral content and yield have been determined for new dwarf or semi-dwarf rootstocks (such as St. Julien A, Pixi, Ishtara, Fereley) [8–10,20,21]. Therefore, the aim of this study was to determine the influence of generally used rootstock such as Ishtara, St. Julien A, Torinel, Citation and Penta on acidity, soluble solid content (SSC), total phenolic content (TPC), total flavonoid content (TFC), and antioxidant capacity of Japanese plums and one cultivar of European plum growing in the Czech Republic.

2. Materials and Methods

2.1. Site of Planting and Plant Material

The location of the plum orchard used in this study is in a temperate climate zone at the Faculty of Horticulture in Lednice, Mendel University in Brno (localisation 48°47′28″ N/ 16°47′33″ E, at an altitude of 172 m). The plum trees were grown in a form of free-standing pyramids, spaced at 5 × 3 m. In total, four cultivars of plum (three *P. salicina* cv. Shiro, Black Amber, Karkulka and one *P. domestica* cv. Stanley) grafted on five different rootstocks (Torinel, Ishtara, Citation, St. Julien A, Penta) were analyzed. The diameter was measured 30 cm above the place of grafting for each tree and is expressed by trunk cross-sectional area (TCSA) which was calculated using formula TCSA = $girth^2/4\pi$.

2.2. Phenological and Pomological Analysis

The beginning of flowering was determined when 25% of the flowers in different parts of the crown were in full bloom. Flower set was evaluated on a scale from 1 (small number of flowers) to 9 (very rich set of flowers). Date of ripening was determined at optimum maturity (Table 1), which was defined when significant proportions of fruits have attained the minimum % color (every fruit must have the minimum percentage of its surface colored) [21].

Ten fruits of each cultivar grown on different rootstock were transported and analyzed immediately to prevent loss of water and content of antioxidants. Collected fruits were used for determination of pomological traits (weight of fruit, thickness of flesh) and fruit firmness (Table 2). The firmness of the fruit ($kg \cdot cm^{-2}$) was measured using a penetrometer FT 327 (Turoni, Italy) (also called a pressure tester).

Table 1. The mean value of trunk cross-sectional area (TCSA) with standard deviation and phenological data of plum cultivars grown on different rootstocks. Flower and fruit set was evaluated according to the scale from 1 (the lowest amount) to 9 (the highest amount).

Cultivar	Rootstock	TCSA (cm^2)	Time of Flowering	Flower Set	Ripening Duration (Days)	Fruit Set
Black Amber	Citation	292 ± 72 a	2/4	9	15	2
	Ishtara	349 ± 33 a	2/4	9	15	2
	Penta	295 ± 48 a	1/4	7	15	1
	St. Julien A	217 ± 11 a	2/4	9	15	2
	Torinel	647 ± 47 b	2/4	9	15	5
Karkulka	Citation	418 ± 25 a	2/4	9	12	5
	Ishtara	356 ± 22 a	2/4	9	12	7
	Penta	481 ± 36 ab	2/4	9	12	7
	St. Julien A	363 ± 43 a	2/4	9	12	3
	Torinel	592 ± 22 b	2/4	9	12	7
Shiro	Citation	279 ± 39 a	28/3	9	8	9
	Ishtara	484 ± 36 b	28/3	9	8	9
	Penta	511 ± 25 b	28/3	9	8	9
	St. Julien A	417 ± 50 ab	28/3	9	8	9
	Torinel	677 ± 26 c	28/3	9	8	9
Stanley	Ishtara	290 ± 18 a	19/4	7	15	5
	Penta	438 ± 28 b	19/4	7	15	5
	St. Julien A	264 ± 10 a	19/4	7	15	5
	Torinel	346 ± 28 ab	19/4	7	15	7

The letters a–c refer to the different group according to the Tukey HSD.

Table 2. The pomological data, fruit firmness, SSC, and titratable acid content (TA) of plum cultivars with different rootstocks.

Cultivar	Rootstock	Weight of Fruit (g)	Thickness of Flesh (mm)	Fruit Firmness ($kg \cdot cm^{-2}$)	SSC (°Brix)	TA (%)	SSC/TA (%)
Black Amber	Citation	71 ± 3 a	17.1 ± 0.4 a	1.39 ± 0.06 a	16.5 ± 0.3 a	1.36 ± 0.02 ab	12.12
	Ishtara	50 ± 1 a	15.0 ± 0.5 a	1.62 ± 0.06 a	19.9 ± 0.4 ab	1.30 ± 0.01 a	15.26
	Penta	48 ± 4 a	14.4 ± 1.5 a	1.53 ± 0.06 a	14.4 ± 0.9 a	1.34 ± 0.01 a	10.78
	St. Julien A	60 ± 3 a	15.1 ± 0.4 a	1.44 ± 0.06 a	19.7 ± 0.4 c	1.43 ± 0.01 b	13.77
	Torinel	57 ± 4 a	15.8 ± 0.6 a	1.44 ± 0.09 a	19.1 ± 0.6 ab	1.56 ± 0.02 c	12.19
Karkulka	Citation	32 ± 1 b	10.7 ± 0.4 ab	0.98 ± 0.05 a	14.2 ± 0.3 b	2.07 ± 0.02 b	6.86
	Ishtara	26 ± 2 a	10.2 ± 0.5 ab	0.74 ± 0.07 a	12.9 ± 0.2 a	1.83 ± 0.01 a	7.07
	Penta	24 ± 1 a	9.5 ± 0.5 a	0.81 ± 0.06 a	15.2 ± 0.3 c	2.28 ± 0.04 c	6.66
	St. Julien A	32 ± 1 b	11.5 ± 0.5 b	0.94 ± 0.12 a	12.5 ± 0.2 a	1.90 ± 0.01 a	6.55
	Torinel	24 ± 1 a	9.5 ± 0.5 a	0.80 ± 0.07 a	16.2 ± 0.2 d	2.37 ± 0.01 c	6.84
Shiro	Citation	34 ± 2 a	10.6 ± 0.5 a	0.96 ± 0.05 ab	14.6 ± 0.2 a	2.19 ± 0.01 b	6.66
	Ishtara	31 ± 2 a	11.4 ± 0.3 a	0.78 ± 0.04 a	15.1 ± 0.4 a	1.88 ± 0.01 a	8.00
	Penta	37 ± 1 a	11.7 ± 0.7 a	1.19 ± 0.07 abc	13.8 ± 0.3 a	1.91 ± 0.02 a	7.24
	St. Julien A	33 ± 1 a	10.7 ± 0.7 a	0.98 ± 0.06 bc	14.1 ± 0.2 a	1.94 ± 0.04 a	7.26
	Torinel	29 ± 1 a	10.7 ± 0.2 a	1.28 ± 0.02 c	14.7 ± 0.2 a	2.43 ± 0.01 c	6.05
Stanley	Ishtara	45 ± 2 a	10.8 ± 0.7 a	1.24 ± 0.08 a	21.9 ± 0.5 ab	0.53 ± 0.01 a	41.60
	Penta	41 ± 2 a	9.9 ± 0.4 a	0.98 ± 0.06 a	23.5 ± 0.5 ab	0.66 ± 0.01 c	35.46
	St. Julien A	45 ± 1 a	11.5 ± 0.4 a	1.37 ± 0.10 a	22.3 ± 0.4 a	0.62 ± 0.01 b	36.03
	Torinel	39 ± 1 a	8.9 ± 0.3 a	1.02 ± 0.07 a	24.5 ± 0.4 b	0.65 ± 0.01 c	37.80

The Tukey HSD test was used to compare the values for different used rootstocks, where a–d marks different group.

2.3. Soluble Solids and Titratable Acidity

Total SSC (°Brix) was determined in ten fruits of each plum cultivar grown on different rootstock using a Kruss AR4D refractometer (Kruss, Germany) at room temperature. Potentiometric titration of total acids content was performed in homogenized fruit mix with 0.1 mol.L^{-1} NaOH solution with known factor up to pH 8.1 measured by combined

SenTix^{TM} 81 pH electrode (WTW^{TM}, Prague, Czech Republic) coupled with inoLab 7110 pH meter (WTW^{TM}, Prague, Czech Republic). The result is expressed as % malic acid equivalent [22].

2.4. Antioxidant Capacity, Total Phenolic and Flavonoid Content

Antioxidant capacity, TPC, and TFC were measured in methanol extracts using a SPECORD® 50 PLUS spectrophotometer (Analytik, Jena, DE, Germany) according to the protocol [23]. Five grams of sample was diluted in 50 mL of 75% methanol for 24 h. TPC was determined in samples of methanol extracts after their reaction with the Folin-Ciocalteu reagent at a wavelength of 765 nm. The result was expressed in equivalent of mg gallic acid (GAE) per 100 g fresh weight (FW). TFC was determined after reaction of methanol extracts with aluminium chloride and sodium nitrite, the reaction was determined at a wavelength of 510 nm. The result was expressed in mg catechin equivalent (CAE) per 100 g FW. Total antioxidant capacity was determined using 2,2-diphenyl-1-picrylhydrazyl (DPPH) based on the decolorizing property of the hydrogen radical of DPPH with hydrogen donors. The total antioxidant capacity was measured at 515 nm and expressed in mg Trolox equivalent (TE) per 100 g FW.

2.5. Statistical Analysis

Statistical analysis was performed in Statistica 12 (TIBCO, Palo Alto, CA, USA) and Microsoft Excel software. Single-factor ANOVA analysis (level of significance = 0.05) was used for statistical processing and the Tukey HSD test was subsequently used to evaluate the statistical significance of differences between the individual variants. Between fruit appearance level and fruit weight and between values of antioxidant capacity, TPC and TFC, the correlation relationship and coefficient of determination R were determined using Statistica 12 (TIBCO, Palo Alto, CA, USA).

3. Results

3.1. Tree Vigor and Phenological Observation

The tree vigour (Table 1) was significantly higher for all Japanese cultivars on Torinel rootstock. For the cultivar 'Stanley' Penta rootstock influenced the vigour the most. The lowest value of TCSA were determined for 'Black Amber' and 'Stanley' with St. Julien A rootstock, for 'Karkulka' with Ishtara rootstock and for 'Shiro' with Citation rootstock. The average values of TCSA for used rootstocks increased in order St. Julien A (315 cm^2), Citation (330 cm^2), Ishtara (370 cm^2), Penta (431 cm^2), and Torinel (565 cm^2).

There was no significant difference in flowering depending on used rootstock (Table 1). The plum trees started to bloom from the earliest cultivar 'Shiro', second 'Black Amber' and 'Karkulka' and the cultivar 'Stanley' which bloomed the late. Flower set was mainly the highest level, except cultivar 'Stanley' and cultivar 'Black Amber' on Penta rootstock, where lower quantity of flowers was determined.

The date of ripening differed depending on the cultivars. The first matured the cultivar 'Shiro' 15th July on rootstock Citation, Ishtara and St. Julien A. 'Shiro' on Penta and Torinel rootstock ripened three days later. All varieties ripened with the highest level of fruit set. Next, the cultivar 'Karkulka' ripened on 3rd August on all rootstock, followed by cultivar 'Stanley', which ripened on 6th September on Ishtara rootstock and two days later on remaining rootstocks. The last ripened the cultivar 'Black Amber' on 21st September on all rootstocks. The fruit set differed according to used rootstocks, where cultivars with Torinel rootstock reached the highest level on average, followed by Ishtara, Penta, Citation, and St. Julien A.

3.2. Pomological Data and Fruit Firmness

The significant influence of rootstock to weight of fruit was determined only for the cultivar 'Karkulka', where the rootstocks St. Julien A and Citation greatly increased the weight of fruit in comparison to other rootstocks (Table 2). Cultivar 'Black Amber' reached a higher value of weight of fruit on Citation rootstock, 'Shiro' on Penta rootstock, and 'Stanley' on St. Julien A rootstock.

The highest thickness of flesh was determined to be the same for cultivars with the same rootstocks as for values of weight of fruit. Similar to weight of fruit, St. Julien A significantly increased the thickness of flesh at the cultivar 'Karkulka' when compared to the other rootstocks.

The differences in fruit firmness on different rootstocks were determined only for cultivar 'Shiro', where the value increased in order Ishtara, Citation, St. Julien A, Penta, and Torinel.

3.3. Soluble Solids and Titratable Acids

The soluble solids content differed in relation with different rootstock except the cultivar 'Shiro' (Table 2). The cultivar 'Karkulka' (14.20°Brix on average) reached the significant highest value with Torinel rootstock. For the cultivar 'Shiro' (14.45°Brix on average) the highest value was determined for Ishtara rootstock. The cultivar 'Black Amber' (17.90°Brix on average) reached the highest value with Ishtara rootstock. The European plum cultivar 'Stanley' (23.08°Brix) highly exceeded other cultivars, and the highest value was determined with Torinel rootstock.

The significant differences have been evaluated for titratable acids (TA), where all cultivars reached the lowest value of titratable acids with Ishtara rootstock and the highest with Torinel rootstock, except the cultivar 'Stanley', where the highest value was for Penta rootstock. The highest SSC/TA values were reached for cultivars with Ishtara rootstock, and the lowest values were different for each cultivar/rootstock combination.

The determined data were averaged for different rootstocks (Figure 1). The highest average value of soluble solids was determined for cultivars with Torinel rootstock (18.63°Brix), followed by Ishtara (17.45°Brix), St. Julien A (17.14°Brix), Penta (16.74°Brix), and Citation (15.08°Brix). The highest value of titratable acids reached the cultivars with Citation (1.87%), followed by Torinel (1.75%), Penta (1.56%), St. Julien A (1.47%) and Ishtara (1.38%). The fruit firmness ranged from 1.10 kg·cm^{-2} (Ishtara), 1.11 kg·cm^{-2} (Citation), 1.13 kg·cm^{-2} (Penta), 1.14 kg·cm^{-2} (Torinel) to 1.18 kg·cm^{-2} (St. Julien A).

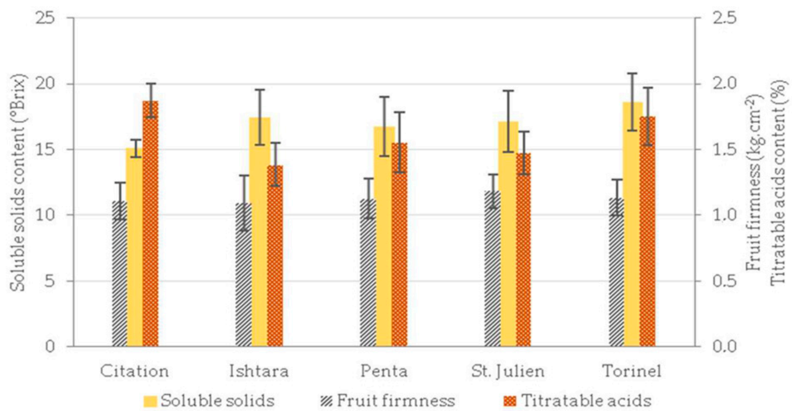

Figure 1. Average values of SSC (°Brix), titratable acids content (%) and fruit firmness (kg·cm^{-2}) for analyzed plum cultivars with Citation, Ishtara, Penta, St. Julien A and Torinel rootstock. The vertical lines represent the standard deviations.

3.4. Antioxidant Capacity, TPC and TFC

The measured parameters for cultivars with different rootstock were mostly significantly different according to the Tukey's HSD test (Table 3). All cultivars except 'Stanley' reached the highest values of antioxidant capacity with Ishtara rootstock. 'Stanley' reached the highest value on Torinel rootstock. The lowest value of antioxidant capacity was determined for the cultivars on St. Julien A rootstock except the cultivar 'Black Amber', which reached the lowest value on Penta rootstock. The same trend was determined for total phenolic content (TPC), except 'Shiro', where antioxidant capacity increased in the rootstocks in the following order: St. Julien A, Penta, Torinel, Citation, Ishtara and TPC increased in in the following order: Penta, St. Julien A, Citation, Torinel, Ishtara. The values of TFC increased in different orders for different variants. The cultivar 'Black Amber' reached the highest value of TFC on Citation rootstock, 'Karkulka' on Torinel rootstock, 'Shiro' on Ishtara rootstock, and 'Stanley' on Torinel rootstock. Data of antioxidant capacity, TPC, and TFC were averaged depending on different rootstocks (Figure 2). The average values of TPC (range from 562.75 to 336.26 mg (GAE)/100 g) and AC (ranged from 145.07 to 234.76 mg (TE)/100 g) increased in the following order: St. Julien A, Penta, Citation, Torinel and Ishtara. The average values of TFC ranged from 45.51 to 95.00 mg (CE)/100 g and increased in the following order: St. Julien A, Ishtara, Torinel, Penta, and Citation.

Table 3. The antioxidant capacity, TPC, and TFC of plum cultivars grown on different rootstocks.

Cultivar	Rootstock	Antioxidant Capacity (mg (TE)/100 g)	TPC (mg (GAE)/100 g)	TFC (mg (CE)/100 g)
Black Amber	Citation	340.3 ± 0.3 d	738.0 ± 0.8 d	111.9 ± 0.4 e
	Ishtara	352.7 ± 0.4 e	774.6 ± 0.2 e	44.3 ± 1.0 b
	Penta	259.9 ± 0.2 a	703.1 ± 2.1 a	35.7 ± 0.7 a
	St. Julien A	274.5 ± 0.2 b	593.2 ± 0.3 b	67.5 ± 0.3 c
	Torinel	297.6 ± 1.3 c	669.6 ± 0.3 c	72.9 ± 1.2 d
Karkulka	Citation	220.3 ± 0.6 b	457.7 ± 0.1 b	138.7 ± 1.0 c
	Ishtara	316.9 ± 0.2 d	685.0 ± 0.2 e	102.8 ± 0.9 b
	Penta	274.0 ± 1.2 c	600.8 ± 0.1 d	150.6 ± 1.4 d
	St. Julien A	171.2 ± 4.5 a	348.5 ± 0.2 a	84.5 ± 1.4 a
	Torinel	279.7 ± 1.1 c	580.5 ± 0.1 c	152.2 ± 1.9 d
Shiro	Citation	93.6 ± 0.1 d	270.9 ± 0.1 c	34.4 ± 0.3 b
	Ishtara	128.9 ± 0.2 e	384.0 ± 0.3 e	60.7 ± 2.0 c
	Penta	65.3 ± 0.1 b	170.1 ± 0.1 a	15.5 ± 0.2 a
	St. Julien A	60.1 ± 0.5 a	173.9 ± 0.1 b	16.4 ± 0.5 a
	Torinel	87.8 ± 1.7 c	297.0 ± 1 d	37.6 ± 0.4 b
Stanley	Ishtara	140.5 ± 0.1 c	407.4 ± 0.1 c	52.7 ± 1.1 c
	Penta	98.4 ± 0.1 b	273.5 ± 0.3 b	29.4 ± 0.4 b
	St. Julien A	74.4 ± 0.4 a	229.4 ± 0.6 a	21.8 ± 0.4 a
	Torinel	163.6 ± 0.2 d	457.0 ± 0.1 d	58.9 ± 3.0 c

The influence of rootstock on different parameters of cultivars was determined using the Tukey HSD test where a–d marks a different group.

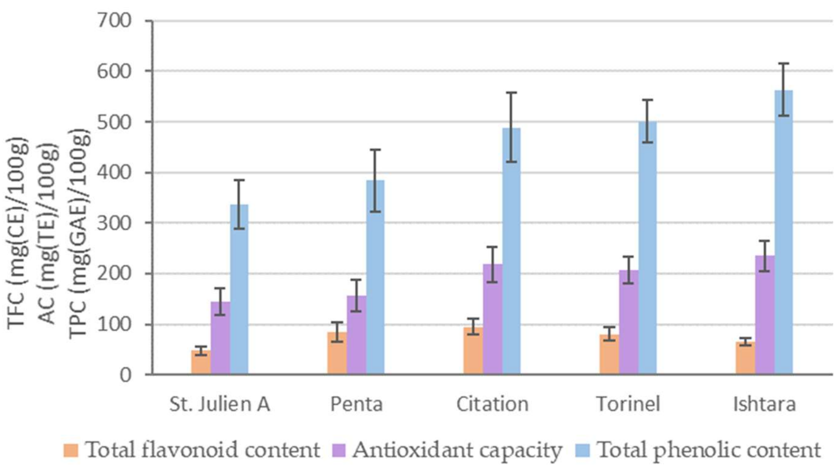

Figure 2. Average values of TFC, antioxidant capacity and TPC for analyzed plum cultivars on Citation, Ishtara, Penta, St. Julien A and Torinel rootstock. The vertical lines represent the standard deviations.

Considerably higher values of TPC and antioxidant capacity were determined for cultivars on Ishtara rootstock in comparison to other rootstocks and between these two parameters significant correlation ($p < 0.05$) with R = 0.9798 was found (Figure 3). In addition, the significant correlations between TFC and antioxidant capacity (R = 0.6660) and TPC and TFC (R = 0.5941) were found. After averaging the values for individual rootstocks, only correlation between TPC and antioxidant capacity was significant (R = 0.9842).

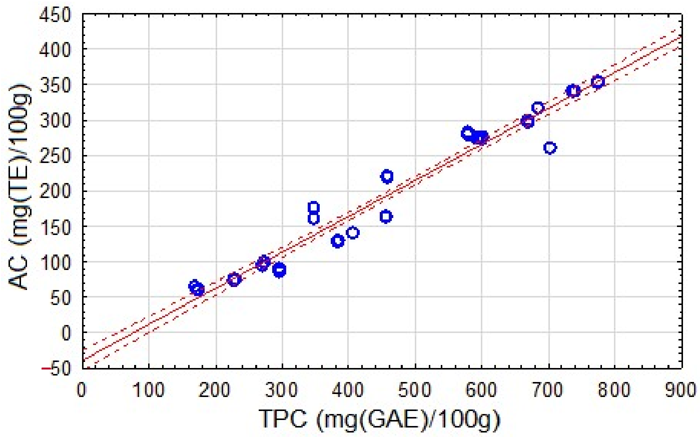

Figure 3. The correlation between TPC and antioxidant capacity with correlation coefficient R = 0.9798.

4. Discussion

In many studies, the evaluation of plum cultivars showed significant differences in fruit yield depending on the used rootstock [9,10]. The yield is an important parameter influencing the fruit weight, and the negative correlations between yield and fruit weight or SSC could be found [24]. In this study, significant negative correlation ($p < 0.05$, R = −0.6831) was determined between fruit set and fruit weight.

The significant differences in TCSA and yield depending on cultivar and rootstock combination have been determined in many studies of plums [10]. In addition, the significant decrease of the yield leads to a simultaneous increase in growth vigour [25–27]. In this study, the results indicated the negative correlation (R = −0.4023) between TCSA and weight of fruit.

In contrast, cultivar 'Karkulka' reached a significantly higher fruit weight on St. Julien A and Citation rootstock, and the influence of rootstock on fruit weight of plums was not comparable with findings in studies [28,29]. Some studies highlighted that Ishtara rootstock significantly increased the fruit weight in comparison to other rootstocks [27,30]. In this study, Ishtara did not have a significant influence on the fruit weight.

Fruit firmness, an important key parameter related to fruit ripeness, is often measured in studies of rootstocks' influence. Reig et al. [28] determined firmer plum fruits grown on Ishtara rootstock. In this study, the rootstock Ishtara increased the fruit firmness values only at 'Black Amber', and resulted in the highest, however not significantly, fruit firmness values among the 'Black Amber' rootstock combinations.

The content of SSC and the titratable acidity (TA) are important parameters of plum quality. For all cultivars except the cultivar 'Black Amber', negative correlation between TA and fruit weight was determined, confirming that titratable acidity decreases with fruit mass [28]. In contrast, for all cultivars, positive correlation was determined between TA and SSC. The ratio SSC/TA was different for studied cultivars and the highest values reached the cultivars with Ishtara rootstock. Thus, in these cases, the sweet taste prevailed. Similarly, as in Wolf et al. [3], the higher values of SSC were measured at European plum 'Stanley' than at Japanese cultivars and analyzed cultivars reached the highest values on different rootstock.

The nutritional substances of plums are often studied because of their positive influence on human health. Polyphenolic substances, anthocyanins, and flavonoids accumulated predominately in the fruit skin possess antioxidant and many others positive effects of fruit [31]. Trendafilova et al. [32] studied quality of European plum 'Čačanska Lepotica' and TPC in their study for this cultivar on Ishtara rootstock was 93.7 mg (GAE)/100 g. The values for next four rootstocks were higher. The average value of TPC for cultivars grown on Ishtara rootstock was 562.75 mg (GAE)/100 g and the European cultivar 'Stanley' reached on Ishtara rootstock 407.42 mg (GAE)/100 g. Wolf et al. (2020) [3] determined similar values of TPC ranging from 51.46 to 429.77 mg (GAE)/100 g.

According to the results, when only significant correlation between TPC and antioxidant capacity was significant, there is probably a considerable influence of rootstock on polyphenolic substances and antioxidant capacity of plum cultivars. The results confirmed the different impact of rootstock on scion regarding the different influence upon the metabolic pathways in the plant. Regarding the fact that the heterografted plants (the rootstock and scion are different botanical species) are able to accumulate more polyphenolic substances than the homografted plants (the rootstock and scion are the same botanical species) [12,13,16], the origin of used rootstocks can be compared. The values of TPC were, on average, raised in the following order: Penta (*P. domestica*), St. Julien A (*P. insititia*), Citation (*P. persica* × *P. amygdalus*), Torinel (*P. domestica*), and Ishtara ((*P. cerasifera* × *P. salicina*) × (*P. cerasifera* × *P. persica*)). Primarily, Ishtara rootstock differs from P. cerasifera in its origin and induced higher values of nutritional compounds (TPC and TFC).

5. Conclusions

A long-term intention is to grow healthy trees with a lot of tasty attractive fruit with a large spectrum of nutritional compounds that have a positive effect on human health. A suitable rootstock of plum cultivar can affect all these parameters. In this study, four *P. salicina* and one *P. domestica* planted on five different rootstocks were analyzed. The values of fruit weight, thickness of flesh, and fruit firmness were differently influenced by rootstocks. These results could be related to the plum producer; Citation or St. Julien A had a positive influence on the fruit weight or thickness of flesh of plums. Thus, the fruit are more attractive. The consumer could be interested in the results of titratable acidity and soluble solid content, which were influenced the most by Torinel rootstock. Thus, the plums on the Torinel rootstock had the most prominent and balanced taste. In terms of nutrition, total phenolic content and antioxidant capacity were both the highest for cultivar on Ishtara rootstock, and between these two parameters significant correlation was determined. The flavonoid content of plum cultivars was influenced by rootstock differently for each cultivar.

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