Croatian Traditional Apple Cultivars: Why are they more resistant to plant diseases?

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Introduction

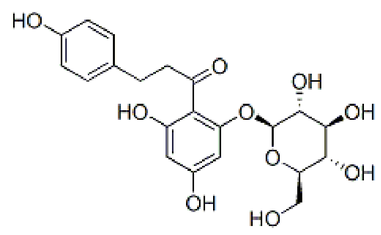
Polyphenols are molecules with strong biological activity, which are the bearers of apple resistance to plant diseases, as well as to abiotic stress from various sources. Moreover, it has been shown that apple cultivars with higher content of polyphenols are more resistant to plant diseases. Some of the biological activities of polyphenols are antiphlogistic, antimutagenic and antioxidant activity. In addition to the above, some polyphenols such as chlorogenic acid, phloridzin and quercetin showed potent antimicrobial and antifungal activity by targeting intracellular processes in microorganisms or inducing irreversible permeability changes in cell membrane.

Materials & Methods

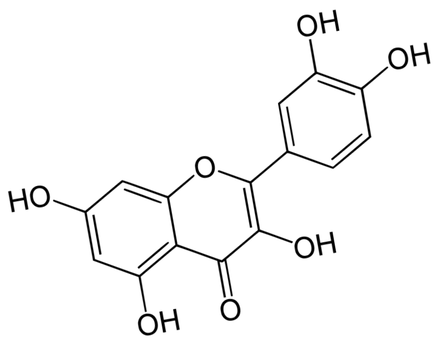
Apple used for the experiment were ten Croatian traditional and five conventional apple cultivars. This study aimed to quantify, compare and detect the amount of phloridzin, chlorogenic acids and quercetin by high- performance liquid chromatography with diode-array detectors. The mobile phase consists of A (water containing 1% formic acid) to B (methanol containing 1% formic acid). The sample of 5µL was injected in duplicate onto the column kept at 50 °C and a flow rate of 1 mL/min. Polyphenols were identified by the comparison of their retention time and UV-Vis spectra to those of pure standards, and detected at 280, 320 and 360 nm. The amount of polyphenols was expressed as mg/100 g of DW .

Results and Discussion

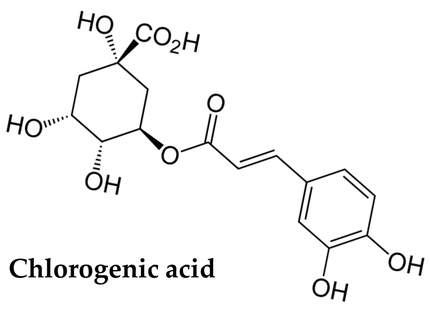
The results showed that Croatian traditional apple cultivars had significantly higher amount of quercetin, chlorogenic acid and phloridzin. In Croatian traditional apple cultivars, the highest number of chlorogenic acid had ´Božičnica´ (30.29 ± 0.34 mg/ 100 g DW), the highest amount of phloridzin had ´Mašanka´ (3.12 ± 0.01 mg/100 g DW) and the highest amount of quercetin had ´Petrovnjača´ (11.68 ± 0.09 mg/100 g DW). The highest content of the total phenolic acids, total dihydrochalcones, and total flavonols in Croatian traditional apple cultivars were detected in ´Božičnica´, ´Mašanka´ and ´Petrovnjača´ (**Table 1**). Many studies emphasize the health- promoting effects of different polyphenols. First of them is chlorogenic acid, CA, playing several important and therapeutic roles, such as antibacterial, antioxidant activity, hepatoprotective, cardioprotective roles, etc. Phloridzin is commonly anticipated for playing a defensive role against various kinds of pathogens as well as it is involved in resistance to various diseases. Furthermore, quercetin is known as a strong antioxidant, mainly due to the presence of catechol group in ring B.



Phloridzin



Quercetin



Chlorogenic acid

Table 1. The amount of chlorogenic acid, phloridzin, quercetin, total phenolic acids, dihydrochalcones and flavonols in Croatian traditional and conventional apple cultivars

		Chlorogenic acid	Phloridzin	Quercetin	Total phenolic acids	Total dihydrohalcones	Total flavonols
		mg/100 g DW					
Conventional apple cultivars	**Granny Smith**	13.57 ± 0.19	0.57 ± 0.01	1.19 ± 0.04	14,24	0,14	9,31
	Idared	7.90 ± 0.11	1.22 ± 0.01	2.90 ± 0.05	8,56	0,09	11,27
	Golden Delicious	4.34 ± 0.19	0.40 ± 0.00	3.34 ± 0.13	4,78	0,05	13,30
	Jonagold	5.56 ± 0.17	0.71 ± 0.00	1.69 ± 0.05	6,14	0,06	9,78
	Fuji	6.62 ± 0.20	0.39 ± 0.00	2.89 ± 0.03	6,99	0,07	19,11
	Petrovnjača	14.29 ± 0.16	1.02 ± 0.01	11.68 ± 0.09	15,15	1,20	12,47
	Kleker	11.31 ± 0.17	1.22 ± 0.02	7.44 ± 0.19	11,89	1,42	8,22
	Mašanka	16.58 ± 0.14	3.12 ± 0.01	9.53 ± 0.12	16,85	3,52	10,10
	Amovka	11.94 ± 0.22	0.40 ± 0.01	7.31 ± 0.09	12,33	0,57	7,88
	Srčika	17.16 ± 0.13	1.61 ± 0.02	9.74 ± 0.23	18,21	1,82	5,63
	Paradija	23.83 ± 0.47	0.85 ± 0.01	9.58 ± 0.06	24,46	1,07	10,40
	Kanada	12.34 ± 0.11	0.99 ± 0.00	3,22 ± 0.03	16,41	1,19	9,42
	Božičnica	30.29 ± 0.34	0.77 ± 0.00	3,39 ± 0.35	31,94	0,89	7,64
	Ivandija	12.59 ± 0.17	1.1 ± 0.01	3,02 ± 0.04	13,67	1,37	8,75
	Šampanjka	12.39 ± 0.39	0.26 ± 0.01	0,82 ± 0.28	13,99	0,38	4,50
	Petrovnjača	14.29 ± 0.16	1.02 ± 0.01	11.68 ± 0.09	15,15	1,20	12,47

Conclusion

In conclusion, Croatian traditional apple cultivars had significantly higher amount of phloridzin, chlorogenic acid, quercetin unlike conventional apple cultivars. Furthermore, total phenolic acids, dihydrochalcones and flavonols were also detected in Croatian traditional apple cultivars in higher amount than conventional ones. These results present the beginning of the research on the resistance of Croatian traditional apple cultivars to plant diseases.