



Evaluation of biochemical properties of peach and nectarine cultivars and Hybrids

SWAPNIL PANDEY*, ANIRUDH THAKUR and HARMINDER SINGH

Punjab Agricultural University, Ludhiana 141 004, India

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ABSTRACT

Prunes are now occupying an important position in subtropical climates with respect to fruit crop diversification and human health. In the present study, 4 hybrids and 6 cultivars of sub tropical peaches and nectarines were evaluated for their phenolic content and antioxidant activity during 2015-16 and 2016-17. Total phenolic content (mg/100 g) and antioxidant capacity (%) present in the pulp was evaluated at Department of Fruit Science, PAU, Ludhiana (Punjab) India. During the study, it was found that the phenol content ranged between 10.32-51.21 mg/100 g in the year 2015-16 and 10.50-51.67 mg/100 g mg in 2016-17 among the hybrids and cultivars. The antioxidant capacity ranged between 63.51-83.25% in the year 2015-16 and 65.00-84.64% in 2016-17 among the hybrids and cultivars selected for study. Overall, peach and nectarines are rich in phenolic compounds and antioxidant activities and can serve as excellent sources of phyto-chemicals and natural antioxidants. Further, it can be concluded that a large variability exists for these compounds, which offers the scope for selection of superior cultivars and the hybrids.

Key words: Antioxidant, Ascorbic acid, Nectarine, Peach, Phenol

Fruits and vegetables have health benefits against many chronic diseases, like cardiovascular disease, cancer, and diabetes (Del Rio *et al.* 2013). Due to the presence of phenolics and different antioxidant components in them and their health-promoting properties, they have been considered as health foods (Noratto *et al.* 2009). Free radicals are extremely unstable, reactive and potentially toxic and they are a part of normal metabolic processes. Many research findings proved that the over production of Reactive Oxygen Species (ROS) like hydroxyl radicals, superoxide anions, and hydrogen peroxide, can cause DNA damage, protein oxidation and lipid peroxidation in living cells (Adibhatla and Hatcher 2008). Excessive ROS production in living organisms causes heart disease, diabetes, liver injury, cancer and aging (Tell *et al.* 2004). Antioxidants are the compounds which inhibit the free radicals formation. Antioxidants like ascorbic acid help in termination of chain reactions which are responsible for production of free radicals. Plants and animals maintain complex systems of overlapping antioxidants produced internally such as glutathione and enzymes or supplemented through diet like vitamin A, C, and E to balance the oxidative state, but the innate defense may not be enough to neutralize severe or

continued oxidation caused by ROS. Therefore, the input of exogenous antioxidants is critically important to maintain an adequate level of antioxidants for balancing the ROS in the human body.

Peaches (*Prunus persica* (L.) Batsch) are nutritionally as well as commercially important and one of the most popular fruits consumed worldwide. Polyphenols are mainly responsible for antioxidant capacity in Peaches. Phenolic compounds have been characterized in peach germplasms across the world by various workers such as USA (Cevallos-Casals *et al.* 2006), Italy (Di Vaio *et al.* 2008), Spain (Reig *et al.* 2013), Brazil (Rosato *et al.* 2009) and Pakistan (Manzoor *et al.* 2012). There is lack of such information in India particularly in subtropical peach cultivars. Therefore, the present study was planned with the objectives to assess the antioxidant capacity and total phenolic contents in different peach and nectarine hybrids and cultivars of subtropics.

MATERIALS AND METHODS

Place and material: The study was conducted at Fruit Research Farm of PAU, Ludhiana, Punjab during 2015-16 and 2016-17. The experiment was laid out in Completely Randomized Design (CRD) with three replications. The different peach and nectarine cultivars and hybrids, viz. Florida Grand × Tropic Beauty, Tropic Beauty × Florida Grand, Flordaglo × Tropic Sweet, Sun Coast × Punjab Nectarine, Florida Grand, Tropic Beauty, Flordaglo, Tropic Sweet, Sun Coast and Punjab Nectarine were taken for study.

*Corresponding author e-mail: swapnilpandey.kanchan10368@gmail.com

Recommended cultural practices including dose and time of fertilizer application, irrigation scheduling and plant health management were performed as per standard procedures.

Physico-chemical analysis: Total soluble solids (TSS) (°Brix) were recorded with the help of hand refractometer. The titratable acidity (%) was determined by titrating the juice against standard alkali solution (0.1 N NaOH). Ascorbic acid content was determined by titration with 2, 6-dichlorophenolindophenol, according to the AOAC (2007).

Estimation of phenols: The phenol content was estimated following the standard methods described by Swain and Hill (1959).

DPPH radical-scavenging activity: The free radical scavenging activity of the pulp was performed by measuring the decrease in absorbance of DPPH solution at 517 nm in the presence of the extracts by the method proposed by Liyana and Shahidi (2005).

Statistical analysis: The data were analyzed according to Completely Randomized Design (CRD) with three replications, using SAS v9.0.0 software and separation of mean was done using Least Significant Difference (Fisher's LSD) test at ≤ 0.05 level of significance.

RESULTS AND DISCUSSION

The analytic properties of peach hybrids (Table 1) and cultivars (Table 2) reveal that the maximum TSS (12.31 °Brix, 12.63 °Brix) was observed in Florda Grand × Tropic Beauty in 2016-17, respectively. Minimum TSS (11.69 °Brix, 12.00 °Brix) was recorded in Suncoast × Punjab

Nectarine during the same period. Cultivar Tropic Sweet recorded the maximum TSS (12.47 °Brix) and Suncoast recorded the minimum TSS (11.18 °Brix) in 2016 while Tropic Beauty recorded maximum TSS (12.50 °Brix) and Suncoast recorded the minimum TSS (11.37 °Brix) in 2017. The mean value of TSS ranged between 11.84-12.47 °Brix in hybrids and 11.28 to 12.10 °Brix in cultivars. The mean value of titratable acidity ranged between 0.69-0.74% in hybrids and 0.78-0.90% in cultivars. Among the hybrids, the maximum titratable acidity (0.84%, 0.85%) was observed in Flordaglo × Tropic Sweet in 2016 and 2017, respectively. The minimum titratable acidity (0.68%, 0.70%) was recorded in Florda Grand × Tropic Beauty in 2016 and 2017, respectively. Cultivar Suncoast recorded the maximum titratable acidity (0.89%, 0.91%) and Punjab Nectarine recorded the minimum titratable acidity (0.78%, 0.79%) in 2016 and 2017, respectively. Among hybrids, the maximum TSS: acid ratio (18.30, 18.02) was observed in Florda Grand × Tropic Beauty during 2016 and 2017, respectively, whereas, the minimum TSS: acid ratio (14.23, 14.21) was recorded in Flordaglo × Tropic Sweet during the same period. Cultivar Tropic Sweet recorded the maximum TSS: acid ratio (15.88) in 2016 and Tropic Beauty (15.71) in 2017. Suncoast recorded the minimum TSS: acid ratio (12.53, 12.49) in 2016 and 2017 respectively. The mean value of titratable acidity ranged between 14.22-18.16 in hybrids and 12.51-15.24 in cultivars.

In the present investigation, total soluble solid contents and titratable acidity varied significantly among the tested hybrids and cultivars. It was found that sugar contents are

Table 1 Analytic properties of peach and nectarine hybrids

Hybrids	TSS (°Brix)			Titratable acidity (%)			TSS: Acid ratio		
	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean
Florda Grand × Tropic Beauty	12.31	12.63	12.47 ^a	0.68	0.70	0.69 ^b	18.30	18.02	18.16 ^a
Tropic beauty × Florda Grand	11.93	12.33	12.13 ^b	0.82	0.83	0.83 ^a	14.71	14.87	14.79 ^b
Flordaglo × Tropic Sweet	11.82	12.03	11.93 ^{ab}	0.84	0.85	0.85 ^a	14.23	14.21	14.22 ^b
Suncoast × Punjab Nectarine	11.69	12.00	11.84 ^{ab}	0.74	0.75	0.74 ^b	16.15	16.12	16.13 ^{ab}
LSD _{0.05}	0.42	0.44	0.46	0.10	0.06	0.08	2.43	2.28	2.14

*Values with the same letters are not significantly different according to Fisher's LSD test at 5% level

Table 2 Analytic properties of peach and nectarine cultivars

Cultivar	TSS (°Brix)			Titratable acidity (%)			TSS: Acid ratio		
	2016	2017	Mean	2016	2017	Mean	2016	2017	Mean
Florda Grand	11.73	12.47	12.10 ^a	0.79	0.83	0.81 ^{bc}	14.54	15.03	14.78 ^{ab}
Tropic beauty	11.32	12.50	11.91 ^{ab}	0.79	0.80	0.79 ^{bc}	14.40	15.71	15.05 ^{ab}
Flordaglo	11.56	11.73	11.65 ^{bc}	0.83	0.84	0.83 ^b	13.99	14.03	14.01 ^b
Tropic Sweet	12.47	11.77	12.12 ^a	0.79	0.81	0.80 ^{bc}	15.88	14.59	15.24 ^a
Suncoast	11.18	11.37	11.28 ^c	0.89	0.91	0.90 ^a	12.53	12.49	12.51 ^c
Punjab Nectarine	11.40	11.43	11.42 ^c	0.78	0.79	0.78 ^c	14.62	14.54	14.58 ^{ab}
LSD _{0.05}	0.33	0.54	0.39	0.07	0.04	0.04	1.87	0.95	1.20

* Values with the same letters are not significantly different according to Fisher's LSD test at 5% level

linked to the °Brix of the fruit juices. The fruit sweetness and sugar contents are strongly interlinked but widely controlled by the acidity and flavor of the fruit that acts as an antagonist (Crisosto *et al.* 2006). Significant variations have been reported in the past with respect to fruit quality indices (TSS and titratable acidity) in different fruit cultivars (Tavarini *et al.* 2008). Relationship between high titratable acidity and low total soluble solid contents has also been reported by Fathi *et al.* (2013). These variations in physio-chemical properties might be dependent on genotypic and/or year of production, variation among trees and fruits on the same tree (Vizzotto *et al.* 2007).

Total phenolic content and antioxidant capacity of peach and nectarine hybrids (Fig 1) and cultivars (Fig 2) revealed that the total phenolic content ranged between 10.32-51.21 mg/100 g in the year 2016 and 10.50 to 51.67 mg/100 g in 2017 among the hybrids and cultivars. Among the hybrids, maximum phenols (51.21, 51.67 mg/100 g) were observed in Flordaglo × Tropic Sweet in 2016 and 2017, respectively. Minimum phenolic content (12.05, 12.28 mg/100 g) was recorded in Tropic Beauty × Florda Grand in 2016 and 2017, respectively. Cultivar Flordaglo recorded the maximum phenolic content (28.69, 30.13 mg/100 g) and Tropic Beauty recorded the minimum phenolic content (10.32, 10.50 mg/100 g) in 2016 and 2017, respectively. The mean value of total phenolic content ranged between 12.17 to 51.44 mg/100 g in hybrids and 10.41-25.06 mg/100 g in cultivars. Antioxidant capacity ranged between 63.51-83.25% in the year 2016 and 65.00 to 84.64 in 2017 among the hybrids and cultivars. Among the hybrids, maximum antioxidant capacity (83.25, 84.64%) was observed in Flordaglo × Tropic Sweet in 2016 and 2017, respectively. Minimum antioxidant capacity (71.60, 72.67%) was recorded in Florda Grand × Tropic Beauty in 2016 and 2017, respectively. Cultivar Flordaglo recorded the maximum antioxidant capacity (82.72, 83.26%) in 2016 and 2017, respectively. Tropic Beauty recorded the minimum antioxidant capacity (63.51, 65.00%) in 2016 and 2017, respectively. The mean value of antioxidant capacity ranged between 72.14-83.95% in hybrids and 64.25 to 82.99% in cultivars. According to the earlier reports, it was suggested that for the evaluation of antioxidant potential of samples, the use of a scavenging stable DPPH radical is highly reliable (Lee *et al.* 2003). The superior antioxidant activity of the sample is associated with the highly

reduced DPPH on higher radical scavenging activity (Ghfar *et al.* 2010). However, in the present study all the cultivars were grown under same cultural practices and environmental conditions, therefore, variations in fruit quality characters and bioactive compounds may be linked to the varietal differences. The results were in accordance with the findings of Qadri *et al.* (2017). The characterization of peach genotypes for these compounds offers the scope for identification of superior peach cultivars and their hybrids, which will further broaden the genetic base of peach in our country.

Significantly higher difference in total phenolic contents and antioxidant activity was noticed by Hegedus *et al.* (2011) among a wide range of apricot genotypes that were grown

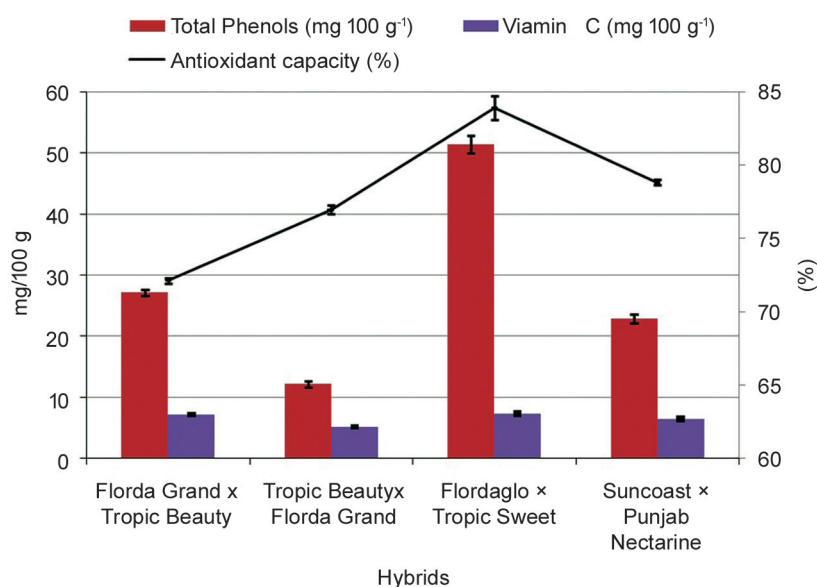


Fig 1 Total phenolic content, Vitamin C and antioxidant capacity of peach and nectarine hybrids.

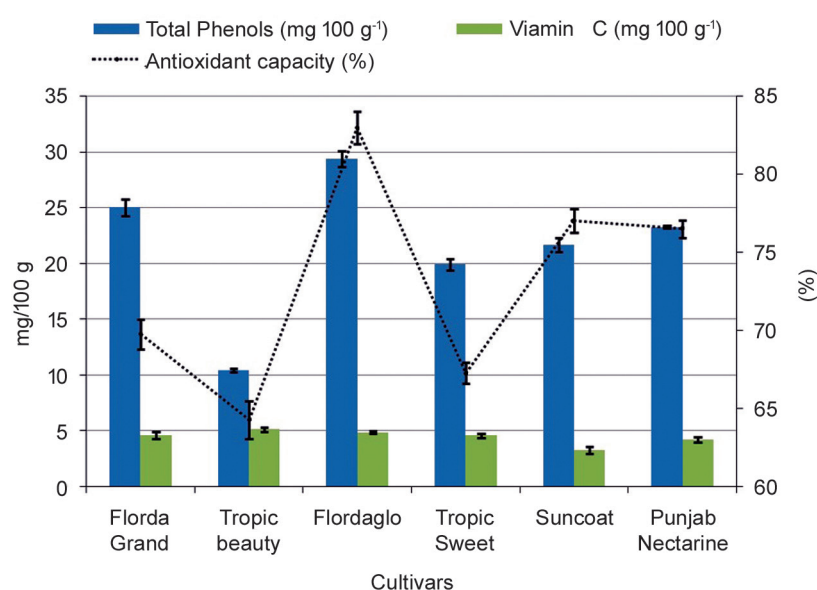


Fig 2 Total Phenolic content, Vitamin C and antioxidant capacity of peach and nectarine cultivars.

under same environmental conditions. Similarly, Cantin *et al.* (2009) also observed a huge genotypic influence on antioxidant activity of the fruits. The phenolic compounds are considered to be highly beneficial as an antioxidant, anticancer, anti-inflammatory and immunity-stimulating agents for human health (Gao *et al.* 2013). The wide range of total phenolic values and antioxidant capacities may be attributable to the different species, geographical origin, and maturity at harvest, cultural and environmental conditions (Kirakosyan *et al.* 2004). In this study, it was found that the species influenced the total phenolic contents than other factors. Liu *et al.* (2015) concluded that the late-maturing varieties possess higher phenolic contents than the early-maturing varieties in peach and nectarine.

Vitamin C content was significantly different for the available hybrids (Fig 1) and cultivars (Fig 2) of peaches and nectarines. Vitamin C content ranged between 3.23-7.27 mg/100 g in the year 2016 and 3.26-7.36 mg/100 g in 2017 among the hybrids and cultivars. Maximum vitamin C (7.27, 7.36 mg/100 g) among the hybrids was observed in Flordaglo × Tropic Sweet in 2016 and 2017, respectively while minimum (5.12, 5.22 mg/100 g) was recorded in Tropic Beauty × Florda Grand in 2016 and 2017, respectively. The vitamin C content was maximum in Tropic Beauty (5.10, 5.12 mg/100 g) and minimum in Suncoast (2.23, 3.26 mg/100 g) in 2016 and 2017, respectively. The mean content of vitamin C ranged between 5.17-7.18 mg/100 g in hybrids and 3.25-5.11 mg/100 g in cultivars. Ascorbic acid is a water-soluble antioxidant predominantly present in many fruits, and plays an important role in the elimination of free radicals (Penicaud *et al.* 2010). The results of vitamin C in the present studies on peach and nectarines suggest them as good sources of ascorbic acid. Cantin *et al.* (2009) also noticed significant differences in ascorbic content of 218 peach genotypes of different progenies.

The quality traits and the content of phytochemicals in peach and nectarine fruits are highly dependent on cultivars. It has been noticed that fruits with high antioxidant activity are considered healthy because of their potential towards preventing free radical formation. In this study, it was observed that peaches and nectarines have high antioxidant activity and total phenolic content. It was reported that hybrids possess more of the antioxidant capacity and total phenolic content than the parental genotypes and the antioxidant capacity differences among hybrids and cultivars were significant. Hence, the varieties that have higher antioxidant capacity should be preferred. The positive correlation found between antioxidant activity and total phenolic content indicates that phenolic compounds are a major contributor to the antioxidant activity of peach and nectarine fruits. The studies will be very helpful in the screening of peach and nectarine genotypes for their health promoting properties.

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