

Chemical characterization and sensory analysis by blind and visually impaired people of local peach varieties

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Abstract: The interest in locally produced foods by the reintroduction of old varieties is due to their environmental hardiness and suitability for low-input agricultural systems. These managements can often produce fruits with imperfections, preventing the consumer acceptance. We have settled a new sensory evaluation going beyond the appearances, involving blind and visually impaired people to provide a quality evaluation of fruits linked to intrinsic rather than exterior characteristics. The research was conducted over two consecutive harvest seasons on three peach old local varieties ('Alberta', 'Mora di Dolfo' and 'Regina di Weinberger' called *in loco* 'Regina di Bember') grown in central Italy. On fruits, physicochemical traits (fruit weight, peel and flesh color, flesh firmness, pH, total soluble solids, titratable acidity), antioxidant content (total antioxidant capacity and total phenols) and sensory analysis were assessed. The three local peach varieties showed interesting fruit attributes in both studied growth-ripening seasons. The white-fleshed 'Mora di Dolfo', characterized by the highest antioxidant contents, was particularly appreciated by panellists for its aroma. The new sensory analysis, providing an evaluation based on judgment of intrinsic characteristics of peaches, emerges as a valid tool to assess the interest and appreciation of fruits for a conscious consumer's choice.

1. Introduction

In these last years, more consumers are interested in alternative food systems which have grown in tandem with a proliferation of diverse food attribute labels, such as organic, local, humane, fair trade, etc. (Berlin *et al.*, 2009). In particular, locally products, such as fruits and vegetables, not offered by conventional grocery stores, are looking for niche markets, in country and urban areas. Studies indicate that many consumers associate the local foods with higher perceived quality as well as increased freshness and naturalness of the products (Denver and Jensen, 2014). The appeal for local varieties, represented by ancient genotypes, is due to the major environmental hardiness (Negri, 2005) able to tolerate extreme climate events such as an increase in temperatures and frequency or intensity of precipitation. This peculiarity makes ancient genotypes suitable for sustainable cultivations as support for farmers and consumers addressed to choose healthy products.

Fruits and vegetables are well recognized to be important source of vitamins, minerals, fibers and many hundreds of compounds with potential antioxidant activity which, acting against cellular oxidation reactions, may have beneficial effects on human health (Halliwell, 1996). The antioxidant activity of fruits is strongly affected by the species and, within species, by the variety which is the main factor in determining fruit nutritional quality (Scalzo *et al.*, 2005). Among other pre- and post-harvest factors influencing the antioxidant properties, such as cultivation techniques, ripening season, shelf-life and processing, the environmental conditions have an important role. In particular, it has been found that light intensity, temperature together with water availability are related to the antioxidant activity in different fruit species (Lee and Kader, 2000).

The fruit nutritional quality of many commercially important varieties has been characterized, but still scanty is knowledge on the antioxidant properties of ancient genotypes that can show high quality performances, in terms of flavor and nutritional properties (Donno *et al.*, 2012; Jakobek *et al.*, 2013). Recently, a trend to discover and to reintroduce into marketplace genotypes native of a restricted geographical

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area took place (Krawitzkyab *et al.*, 2014). The local varieties, mainly managed by low-input agricultural systems, often produce fruits with defects, preventing the consumer acceptance (Donno *et al.*, 2012). It has been showed that the appearance of fresh fruits is the primary criterion in making purchasing decisions (Kays, 1991). To overcome this approach we have settled a new sensory evaluation going beyond the appearances, involving blind and visually impaired people (Bartolini *et al.*, 2015 a), who having a higher sense of taste and smell (Luers *et al.*, 2014), can provide a quality assessment of fruits linked to intrinsic rather than exterior characteristics.

The aim of this research was to determine some fruit quality traits of three peach local varieties originated from Lucca province (central Italy). Physicochemical and antioxidant parameters were studied, and the innovative sensory analysis involving people with visual disability was introduced.

2. Materials and Methods

Plant material and cultivation site

The research was conducted over two consecutive harvesting seasons (2014-15) on full bearing peach trees of old local varieties: 'Alberta', 'Mora di Dolfo' and 'Regina di Bember'. This latter variety is an example of synonymy; its name was modified by local citizen from the original 'Regina di Weinberger' (Bartolini *et al.*, 2015 a), a Californian variety widespread at the end of fifties which nowadays has lost importance at national level.

The orchards were located in a traditional area at high agricultural vocation (Tuscany, Lucca province, lat. 44.02 N, long. 10.27 E) and trees were grown in similar soil conditions, using low input farming practices.

The main climatic parameters, minimum-maximum temperatures and rainfall data were provided by the Regional Agro-meteorological Service of Florence (SIR) (<http://www.sir.toscana.it>).

At physiological maturity stage, samples of peaches were collected and analyzed to determine the main physicochemical, antioxidant and sensory traits.

Physicochemical analysis

From each fruit ($N = 30$ per variety), measurements of weight, peel and flesh color, flesh firmness (FF), total soluble solids (TSS), pH and titratable acidity (TA) were determined. Fruit weight was expressed according to the following size categories (Della Strada *et al.*, 1984): very small (≤ 90 g), small (91-125

g), medium (126-160 g), large (161-195 g), very large (>195 g). Peel and flesh color was evaluated using color charts according to UPOV Code (International Union for the Protection of New Varieties of Plants, Geneva) for peach. The red cover color area of peel (CC) was visually evaluated and expressed as percentage. Firmness was assessed with a manual penetrometer on two peeled opposite areas at the equatorial region of peach, using an 11-mm-wide plunger (Model 53200SP TR, TR-Turoni & C. Inc Forlì, Italy). TSS were measured using a refractometer (Model 53015C TR, TR-Turoni & C. Inc Forlì, Italy) and expressed in °Brix at room temperature. The fruit pH was recorded with the help of an electronic pH meter, and TA was determined on fruit juice by titrating a known volume of juice with 0.1N sodium hydroxide (NaOH) to pH 8.1. TA was expressed as milliequivalents of malic acid per 100 grams of fresh weight (meq malic ac. 100 g FW⁻¹).

Total antioxidant capacity (TAC) and total phenol (TP) analysis

Total Antioxidant Capacity (TAC) and Total Phenols (TP) analyses were carried out on the same fruits that had been previously subjected to the physicochemical determinations. Fresh fruit samples (flesh with peel) of 3 g (in triplicate) were immediately frozen and stored at -20°C until extraction. The samples were homogenized using an ultra-Turrax blender at 4°C to avoid oxidation. The extraction was performed in 80% ethanol for 1 h in a shaker in the dark and subsequently centrifuged at 4°C for 10 min at 2600 g. The supernatant was used for TAC (Total antioxidant capacity) and TP (total phenol) analysis.

TAC was evaluated using the improved Trolox equivalent antioxidant capacity (TEAC) method (Arts *et al.*, 2004). The TEAC value was calculated in relation to the reactivity of Trolox, a water-soluble vitamin E analogue that was used as an antioxidant standard. In the assay, 40 µl of the diluted samples, controls or blanks added to 1,9690 µl ABTS^{•+} solution, resulted in a 20-80% inhibition of the absorbance. The decrease in absorbance at 734 nm was recorded 6 min after an initial mixing, and plotted against a dose-response curve calculated for Trolox (0-30 µM). Antioxidant activity was expressed as micromoles of Trolox equivalents per gram of fresh weight (µmol TE g FW⁻¹). Trolox was purchased from Sigma Chemical Co. (St. Louis, MO).

TP content was determined according to the improved Folin-Ciocalteu (F-C) method (Waterhouse, 2001). The assay provides a rapid indication of the

antioxidant status of the studied material and is valuable for different food samples. The standard compound for the calibration curve was gallic acid (GA, Sigma Chemical Co, - St. Louis, MO). Total phenol content was calculated as milligrams of GA equivalent (GAE) per gram of fresh fruit weight (mg GAE g FW⁻¹). The absorbance of the blue colored solutions was read at 765 nm after incubation for 2 h at room temperature.

Sensory evaluation

The sensory evaluation was carried out on fruits of the varieties 'Alberta' and 'Mora di Dolfo' as they have the same harvest time (end of July) but different characteristics, such as taste, ground peel (yellow and light-green) and flesh color (yellow and white), respectively. The test was performed without visual inspection, in collaboration with blind and visually impaired persons of the 'Blind and Visually Impaired People Italian Association' of Lucca (Italy). This is an original experiment on stone-fruits realized for 'going beyond the appearances' that, to our knowledge, is the only one after an experience carried out in Sicily (<http://www.consorzioparsifal.it>). Taking into account the disability of the assessors-consumers, a tentative of protocol was established using an acceptability test, as a pertinent option for specific applications (Varela and Ares, 2012). In both years, the same 10 blind and visually impaired persons, aged between 26 and 65, performed the evaluations on the selected varieties. In order to make the evaluation phase easier, prior the acceptability test a short training stage (5 hours) was provided outlining methodology and procedure of the sensory method.

A room equipped with individual sites was used. To each panellist, room-tempered and washed half-unpeeled anonymous peaches were served in randomized order, and samples were evaluated in one session. The panellist were invited to rinse the mouth with mineral water and eat saltless bread between samples, in order to avoid tiring effects. The fruit attributes evaluated were the following: shape, size, texture, aroma, sweetness, acid taste, juiciness (Shinya *et al.*, 2014). Moreover, participants were asked to assess the fruit global appreciation. A continuous non-structured 9-point hedonic scale was utilized for evaluation: 1= dislike extremely; 2= dislike very much; 3= dislike moderately; 4= dislike slightly; 5= neither like nor dislike; 6= like slightly; 7= like moderately; 8= like very much; 9= like extremely (Porretta, 2000).

The blind judges were requested to indicate the

score for each attribute and they were supported by sighted persons helping them to fill the data form. Judges were not informed about the characteristic of fruits such as peel and flesh color.

Statistical analysis

Physicochemical data of each variety were compared using a Student's *t*-test analysis with two treatments (2014 and 2015 harvest seasons); for each season, 30 repetitions/parameter were used, excluding TA and pH, where three composite samples containing ten fruit per sample were considered. A two-way ANOVA analysis were performed to test the effects of year and variety on the main physicochemical and antioxidant parameters. Differences on the content of antioxidants and phenolics between the three varieties were investigated with the analysis of variance (ANOVA), using Tukey's post hoc test at $P \leq 0.05$. A correlation analysis of antioxidant capacity versus total phenol content was calculated and correlation coefficient was reported in terms of goodness of fit. For the sensory evaluation, taking judges as factors, results were compared through the Student's *t*-test analysis between harvest seasons. Spearman's correlations were performed to estimate relationships among sensory and physicochemical traits of fruits. Data are reported as means \pm standard errors of the means (SEM), and the analysis were all performed using the statistical package GraphPad Prism 5 (GraphPad Software, Inc.).

3. Results and Discussion

Weather conditions

During the fruit growth, from May to July, the considered harvest seasons were characterized by different weather conditions, in terms of temperatures and rainfall events (Table 1). In particular, at the final stages of fruit ripening the strongest differences were observed: the amount of precipitation was consistently higher in 2014 when, only on July, more than 300 mm of rainfall occurred. This condition was unusual for Lucca area in comparison to

Table 1 - Monthly minimum and maximum temperatures (°C) and cumulative rainfall (mm) from May to July, over a 2-year period (2014-2015)

Month	2014				2015			
	T. Min.	T. Max.	Average	Rainfall	T. Min.	T. Max.	Average	Rainfall
May	11.8	23.7	17.8	39.8	13.0	24.5	18.8	34.4
June	16.0	29.4	22.7	48.0	16.8	30.2	23.5	29.8
July	17.4	28.7	23.2	314.6	20.7	33.9	27.3	7.4
Average	15.1	27.3	21.2		16.8	29.5	23.2	
Total rainfall				40.4				71.6

average values of the last 10 years, ranging from 8.6 to 60.2 mm (SIR Toscana). The cumulative rainfall of the early summer seasons (May-July) was about 400 and 72 mm in 2014 and 2015, respectively. The second year was particularly drought and warm by mean temperatures of 4-5°C more than 2014.

Physicochemical and antioxidant fruit parameters

Harvest time and mean values of the main physicochemical traits of the peach varieties, recorded over a 2-year period, are presented in Table 2. Under the environment of Lucca area, the harvest time occurred between the first ('Regina di Bember') and third decade of July ('Alberta' and 'Mora di Dolfo'). Considering the physical traits of fruit, all varieties showed attractiveness: - 'Alberta' was characterized by fruit of medium size with yellow ground peel (10-50% red cover color) and deep yellow flesh; - 'Mora di Dolfo' had a large fruit size, light-green peel (30-50% red cover color) and white flesh; - 'Regina di Bember' had a medium-large fruit size, yellow ground peel, (50-90% extensive red cover color) and deep yellow flesh (Fig. 1).

Within each variety, values of chemical parameters showed variations between years, particularly for soluble sugars (TSS), titratable acidity (TA) and pH. 'Regina di Bember' had the greatest differences in relation to the weather conditions occurred during the ripening period of the considered years. TSS ranged from about 9 to 12 °Brix, and TA changed between 8 and 6 meq malic ac. 100 g FW⁻¹ in the wettest (2014) and driest (2015) year, respectively. As a consequence, the TSS/TA ratio varied greatly with the lowest values in the wettest year. A similar trend was recorded in 'Alberta' where TA changed while TSS did not differ as much. No changes in chemical parameters were observed in 'Mora di Dolfo', performing well under the rainy climatic conditions of 2014. In both years, fruits exhibited similar values in TSS (11.8-13.9 °Brix), TA (9.6-9.8 meq malic ac. 100 g FW⁻¹) and, as a consequence, in their ratio.

The ANOVA results comparing harvest year and variety effect showed significant interactions 'year x variety' for TA and TSS/TA (Table 3). During the latter stages of fruit development, the influence of weather

Table 2 - Harvest time, peel and flesh color, red cover color (CC, %), and main physicochemical parameters recorded on three local peach varieties, over a 2-year period: fruit size, flesh firmness (FF, Kg/0.5 cm²), total soluble sugars (TSS, °Brix), pH, titratable acidity (TA, meq malic ac. 100 g FW⁻¹), sugars/acids ratio (TSS/TA)

	'Alberta'		'Mora di Dolfo'		'Regina di Bember'	
	end July		end July		early July	
Harvest time	end July		end July		early July	
Peel color	yellow, 10-50% CC		light green, 30-50% CC		yellow, 50-90% CC	
Flesh color	deep yellow		white		deep yellow	
Fruit size	medium		large		medium-large	
	2014	2015	2014	2015	2014	2015
FF	1.2±0.3	1.7±0.1	3.9±0.5	5.0±0.4	2.8±0.5	3.3±0.4
TSS	10.7±0.4	11.6±0.2	11.8±0.9	13.9±0.4	9.2±0.4	12.2±0.7 *
pH	3.80±0.1	4.15±0.1 *	3.71±0.0	3.75±0.0	3.81±0.0	3.76±0.0
TA	10.2±0.1	6.1±0.1 *	9.6±0.1	9.8±0.1	8.3±0.1	6.2±0.1 *
TSS/TA	1	1.9 *	1.2	1.4	1.1	2.0 *

Mean±SEM. Within each variety, asterisk indicates significant differences between years by Student *t*-test (*P*≤0.05).



Fig. 1 - The peach old local varieties 'Alberta', 'Mora di Dolfo' and 'Regina di Bember' (originally 'Regina di Weinberger').

Table 3 - Two-way ANOVA results. Variables: TSS (°Brix), TA (meq malic ac. 100 g FW⁻¹), TSS/TA, TAC (µmol TE g FW⁻¹), and TP (mg GAE g FW⁻¹)

Main effects	TSS	TA	TSS/TA	TAC	TP
	<i>P</i>				
Year	0.0001 ***	0.0015 **	< 0.0001 ***	0.6980 ns	0.2792 ns
Variety	0.0015 **	0.0001 ***	<0.0001 ***	<0.0001 ***	<0.0001 ***
Interaction Year x Variety	0.5636 ns	0.0389 *	0.0016 **	0.0113 *	0.2500 ns

*, **, ***: significant at *P*≤0.05, 0.01, 0.001, respectively. ns= not significant.

conditions on pomological and quality properties has been proved: among fruit quality parameters, soluble solids content can vary substantially from year to year, and rainfall and summer sunshine have been identified as the main affecting factors (Choi *et al.*, 2003). In peach, extensive rain may reduce the sweetness, while severe water stress or regulated irrigation deficit techniques caused a soluble sugar increased, as a recognized physiological response to stress (Kwon *et al.*, 2008).

As regards TAC (Fig. 2A), related to several bioactive compounds such as phenolics, flavonoids, anthocyanins and vitamin C (Gil *et al.*, 2002), the considered local varieties showed higher values than those reported in literature for commercial varieties of which, generally, only the flesh was analysed (Scalzo

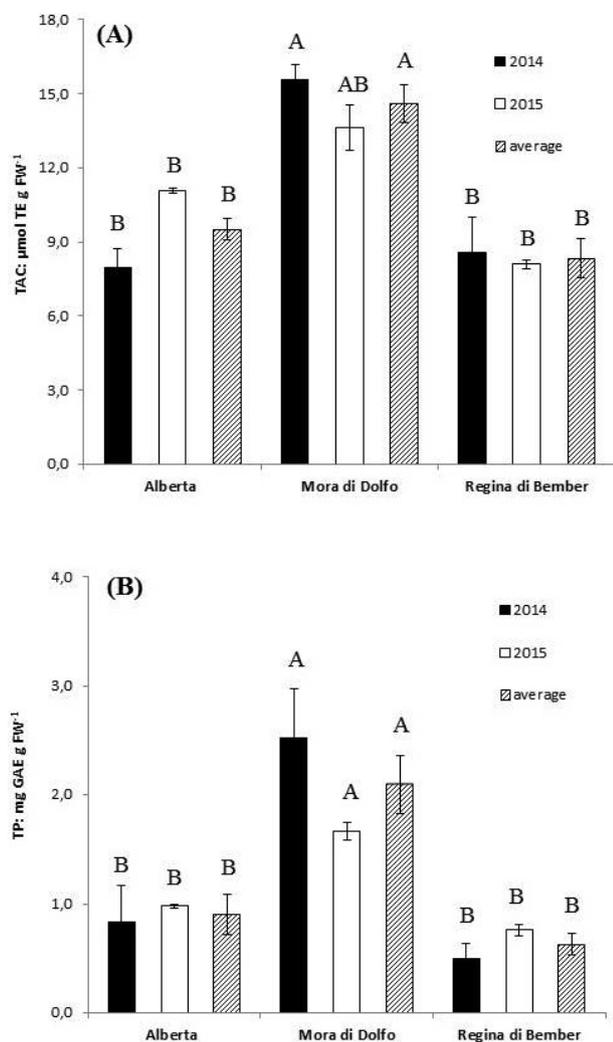


Fig. 2 - (A) Total antioxidant capacity (TAC) and (B) total phenols (TP) in peach fruits of local varieties recorded over a 2-year period. Values (means \pm SEM) are expressed for TAC as μmol of Trolox Equivalent per g of fresh weight ($\mu\text{mol TE g FW}^{-1}$), and for TP as mg of Gallic Acid Equivalent per g of fresh weight (mg GAE g FW^{-1}). Different letters indicate significant differences at $P \leq 0.01$.

et al., 2005). By the contrary, our investigation assessed samples constituted by flesh with peel, fraction of fruit with a key role in determining the antioxidant properties of the whole fruit (Remorini *et al.*, 2008; Zhao *et al.*, 2015). In both years, significant differences were observed: 'Mora di Dolfo' was characterized by the highest TAC levels, on an average of about $14 \mu\text{mol TE g FW}^{-1}$; 'Alberta' and 'Regina di Bember' had similar average values ($8.5\text{-}9.5 \mu\text{mol TE g FW}^{-1}$).

The TP content (Fig. 2B), likewise TAC results, was the highest in 'Mora di Dolfo' (about $2 \text{ mg GAE mg FW}^{-1}$), while the other varieties showed values from 0.7 to $0.9 \text{ mg GAE mg FW}^{-1}$. The relevant antioxidant content of the white-fleshed variety 'Mora di Dolfo' is in agreement with works reporting the tendency of white-fleshed cultivars to have significantly higher antioxidant content than yellow-fleshed peaches and nectarines (Cantini *et al.*, 2009). A significant relationship between TAC and TP content was found (Fig. 3), confirming phenolic compounds as important contributors to the antioxidant activity of peach fruits (Karav and Eksi, 2012).

The similar TAC and TP values observed between years suggest that different rainfall amounts, occurred during the last growth-ripening period of fruit in 2014 (wet year) and 2015 (dry year), did not impact on the antioxidant power of varieties. These interesting results are not in agreement with studies carried out on several fruit species, where a variability in antioxidant levels in relation to climatic conditions has been found. In particular, the water availability markedly determined changes in fruit nutritional properties, and a linear significant inverse relationship between water status and antioxidant content was reported by several authors (Leccese *et al.*, 2010; Laribi *et al.*, 2013; Bartolini *et al.*, 2015 b). Also in peach (cv. Suncrest) the irrigation stress induced a

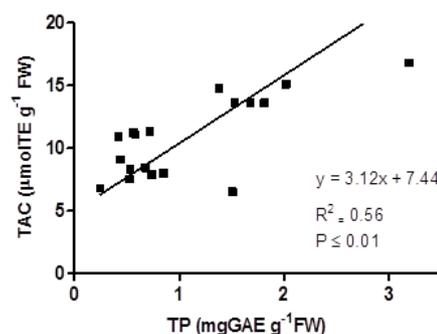


Fig. 3 - Linear regression between total antioxidant capacity (TAC) and total phenols (TP) of the studied varieties (2-year period).

higher biosynthesis of phytochemical compounds (Tavarini *et al.*, 2011).

Analysis of variance (Table 3) showed that variation in TAC and TP between varieties was much greater than between harvest years, indicating that genotype plays a more important role than growing season in influencing antioxidant content in peach, as found in other fruit species (Howard *et al.*, 2003; Leccese *et al.*, 2012). The significant interaction ‘variety x year’ for TAC revealed that environmental growing conditions may impact the capacity of genotype to synthesise antioxidants which are influenced by biotic and abiotic factors (Biesiada and Tomczak, 2012).

Although investigation on the behavior of these varieties has to be continued, the high antioxidant capacity of peaches can be considered as a part of cultivar value (Dalla Valle *et al.*, 2007). This peculiarity would be crucial for breeding strategies selecting genotypes with enhanced antioxidant levels which may provide health benefits to consumers. Moreover, the availability of peach hardy genotypes will be a key factor for future, in view of the climate variability responsible of extreme event increases, such as drought or intense rainfall.

Sensory evaluation

The sensory evaluation, carried out by blind and visually impaired panellists over a 2-year period, was conducted on varieties ‘Alberta’ and ‘Mora di Dolfo’, characterized by yellow and white flesh color, respectively. Considering that color and exterior feature of fruits are nowadays important commercial sensorial traits to attract consumers (Kays, 1991), the judgment carried out by sightless assessors allowed to attain a real intrinsic quality evaluation of fruits. ‘Going beyond the appearances’ revealed its importance particularly under the wet growing season of 2014; in fact, this condition, favoring the presence of defects on peach peel, could have prevented the consumer’s acceptance.

On the basis of panellist’s appreciation, expressed as average degree of linking (1-9), the morphological parameters of fruits (shape and size) were similarly evaluated in both 2014 and 2015 (data not shown), while the organoleptic descriptors (acid taste, aroma, texture, juiciness, sweetness) were differently assessed depending on the harvest season (Table 4). Concerning the global appreciation, the lowest score was attributed in the year (2014) characterized by exceptional rainy events over the ripening period. These conditions could have negatively influenced

components linked to the sensory profile, in agreement with authors who reported that high levels of water before harvest can reduce organoleptic quality and consumer liking degree (Navarro *et al.*, 2010). In fact, blind and visually impaired panellists expressed the best agreement for peaches sampled in 2015 when summer drought conditions occurred. Most of descriptors showed higher scores and, particularly in ‘Mora di Dolfo’, the global appreciation was associated with an increase of aroma and juiciness, as observed in other peach varieties (Di Miceli *et al.*, 2010). Moreover, this variety could seem less susceptible to unfavorable climatic conditions since positively judged also in 2014 (score 6.2), although chemical attributes (TSS, TA) were similar to ‘Alberta’ that, instead, had a lower score (5.2). It has been established that a different sensory perception of peaches could be linked not only to basic organic components (sugars, organic acids, fibers, micro and macro elements) but in great part to the volatile compounds, which define the flavor impact (Bononi *et al.*, 2012).

The correlation coefficient (Table 5) between global appreciation and some sensory and physicochemical traits of peaches showed that panel’s acceptability was highly and positively correlated with aroma, sweetness and TSS. Moreover, these attributes were significantly correlated each other

Table 4 - Mean scores (acid taste, aroma, texture, juiciness, sweetness and global appreciation) recorded for peach varieties ‘Alberta’ and ‘Mora di Dolfo’, over a 2-year period

Variety/year	Ac. Taste	Aroma	Texture	Juiciness	Sweetness	Glob. appr.
2014						
‘Alberta’	4.0±0.5	5.4±0.7	5.8±0.4	5.8±0.6	5.4±0.7	5.2±0.6
‘Mora di Dolfo’	4.8±1.1	6.2±0.8	5.4±0.9	6.8±0.5	6.2±0.8	6.2±1.0
2015						
‘Alberta’	2.8±0.5	5.8±0.6	5.0±0.5	7.0±0.4	5.7±0.7	6.0±0.4
‘Mora di Dolfo’	3.3±0.6	7.7±0.2 *	5.3±0.5	8.0±0.1*	7.3±0.5*	7.3±0.3 *

Scores were based on a nine-point hedonic scale: 1= extremely dislike; 5= neither like nor dislike; and 9= extremely like. Within years asterisk indicates significant differences between varieties by Student *t*-test ($P \leq 0.05$).

Table 5 - Coefficients of correlation between scores of global appreciation and some sensory and physicochemical traits of peach fruits

Attributes	R Spearman
Acid taste	0.1
Aroma	0.99*
Juiciness	0.8
Sweetness	0.99*
Texture	-0.4
TSS	0.99*
TSS/TA	0.4

Significant coefficients are denoted by an asterisk at $P \leq 0.05$.

(Table 6), confirming TSS as one of the most important quality indicators in determining acceptance judgments for peaches, due to its influence on the perceived sweetness (Crisosto *et al.*, 2006). On the contrary, texture appeared inversely related to global appreciation. The comparison between sensory and the main chemical attributes showed significant relationships: sweetness and aroma and total soluble sugars content were directly related each other.

Table 6 - Spearman's coefficients among sensory (sweetness, juiciness, aroma, texture, acid taste) and physicochemical (TSS, TSS/TA) variables for the tested peach varieties.

Attribute	Sweetness	Juiciness	Aroma	Texture	Acid taste	TSS	TSS/TA
Sweetness	1						
Juiciness	0.8	1					
Aroma	0.99*	0.8	1				
Texture	-0.4	-0.8	-0.4	1			
Acid taste	0.1	-0.6	0.1	0.8	1		
TSS	0.99*	0.8	0.99*	-0.4	0.1	1	
TSS/TA	0.4	0.8	0.4	-0.4	-0.8	0.4	1

Significant coefficients are denoted by an asterisk at $P \leq 0.05$.

4. Conclusions

The three local peach varieties showed interesting quality traits as well as a very high antioxidant content in both studied growth-ripening seasons. The capacity to maintain the bioactive components of fruits also under unfavorable weather events confirms the importance of old genotypes to be more stable in comparison to modern ones (Donno *et al.*, 2012).

The white-fleshed 'Mora di Dolfo', characterized by the highest TAC and TP content, was particularly appreciated by panellists for its excellent eating quality denoted by aroma, sweetness and well balanced sugar/acid ratio. Although fruits of this variety are perishable, like the most white-fleshed peach varieties, it could represent a valid hardiness genotype for farmers who are focused to establish local markets where consumers are obviously willing to pay a premium price for niche products. This variety, as source of appreciable attributes, could be useful for specific breeding programs to develop new peach cultivars combining quality traits, hedonic and enhanced nutritional value, actually of high relevance for the consumer.

The new sensory analysis, carried out by blind and visually impaired assessors, provided a quality evaluation linked to intrinsic rather than exterior characteristics of peaches that could prevent consumers if defects in appearance are present. This type of test

could represent a valid tool to assess the interest and appreciation of fruits for a conscious consumer's choice, going beyond the appearances, for a reintroduction of interesting ancient peach varieties characterized by unconventional fruit quality traits.

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