Adv. Hort. Sci., 2012 26(1): 32-38

Influence of quality attributes of early, intermediate and late peach varieties on suitability as fresh-convenience products

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Key words: clingstone peaches, fruit puree, harvest season, mechanical damage, nectarines, sensorial analysis, soluble solids.

Abstract: Fresh convenience products represent a category of minimally processed fruit and vegetables (chunks, mousse, smoothies) that respond to the changes in consumer attitudes. Thanks to the image of convenience (time-saving, snack sizes, no waste, smart packaging) and healthiness their sales are steadily increasing. In this study 26 varieties (including peach, nectarines, and clingstone peaches) from Apulian production were divided into three groups according to harvest dates in early (A), middle (B) and late (C) maturing. Physical, chemical and sensorial analyses were performed in order to select high quality fruits for minimal processing according to the harvesting season. A multivariate Principal Component Analysis was applied to discriminate different varieties for quality attributes. Within Group A, 'Honey Kist' showed the lowest acidity and intermediate susceptibility to mechanical damage. For Group B, 'Stark Red Gold', 'Zee Glo' and 'Venus' resulted different in sensorial evaluation, while 'Loadel' and 'Eolia' were more susceptible to browning. For Group C, 'Tardi Belle' and 'Baby Gold7', although more sensitive to mechanical damage, were differentiated for flavor. Results of this work confirm the extreme variability among varieties in terms of sensorial quality, susceptibility to browning and to mechanical damage, and the importance of assessing varietal screening for selection of most suitable varieties for minimal processing.

1. Introduction

Changes in consumers' social environment represent a constraint to vegetable and fruit consumption and lead to convenience orientation (Candel, 2001). A wide assortment of minimally processed vegetables and fruits (chunks, mousse, smoothies) has been developed to meet consumer needs for ''quick'' and convenient products, and to benefit from the healthy image of fruit and vegetables (Ahvenainen, 1996). One of the main factors that influences quality of fresh-cut products is the enzymatic browning that occurs on product surfaces after cutting (Garcia and Barret, 2002). Thus, cultivar study should be aimed at identifying cultivars which are less susceptible to browning, but also have higher nutritional and sensorial quality, covering all the season, and lead to consumer satisfaction and repeat purchase. Cultivar survey represents an important step when developing a new product (Cabezas-Serrano *et al*., 2009 a, b) allowing identification of genotypes that better respond to postharvest handling and to minimal processing.

Peaches and nectarines are nutritionally important because they contain meaningful amounts of carotenoids including β-carotene (especially yellow-fleshed fruits), lutein and β-cryptoxanthin (Gil *et al*., 2002). Although their availability is limited by season they are one of the most important fruit commodities consumed worldwide (Cantin *et al.,* 2009). Many studies on minimally processed vegetables and fruits focus on microbiological quality, safety, processing and packaging issues (Foley *et al*., 2002; Amodio and Colelli, 2008) but still little information is available on varietal susceptibility. In this light, the aim of the present work was to investigate the suitability of peach varieties to be processed as fresh-convenience products throughout the peach season.

Received for publication 29 September 2011
Accepted for publication 22 February 2012

2. Materials and Methods

From June to September 2010, 26 varieties of peach fruits from the Apulia region (Italy) were collected, including peaches (*Prunus Persica* L.), nectarines (*Prunus Persica* L. var Nectarina) and clingstones peaches (*Prunus Persica* L. Batsch). Based on the 'Redhaven' peach maturing date, peach fruits were divided into three groups: early maturing (Group A), middle maturing (Group B) and late maturing (Group C), as shown in Table 1. Fruits were harvested at a commercial maturity stage, typical for each cultivar, as established by the growers. Peach fruits were then transported to the Postharvest laboratory (University of Foggia)

and kept under controlled temperature and humidity (5°C and 95% RH) for one day before processing. Fruits were washed in a NaOCl solution (100 ppm), rinsed in clear water and then gently dried with a paper tissue. Twenty fruits were used to assess mechanical damage, while the remaining fruits were divided into three replicates of 20 fruits and used to evaluate quality attributes. Physical parameters were evaluated mainly on the whole fruit (with the exception of puree viscosity), while chemical and sensorial analysis were performed on the fruit puree.

Table 1 - Peach varieties grouped in Peach, Nectarine and Clingstone

Peach type		
Peach	Nectarine	Clingstone
Royal Glory	Big Bang	Loadel
Prince Diamond	Big Top	Eolia
Red Elegance	Honey Kist	Baby Gold7
Rome Star	Amiga	
Marilyn	Bigi Lara	
Zee Lady	Ambra	
O'Henry	Laura	
Tardi Belle	Spring Bright	
	Fire Top	
	Maria Camilla	
	Zee Glo	
	Guerriera	
	Venus	
	Stark Red Gold	
	Lidy Star	

Physical and chemical analysis

For each variety the resistance to mechanical damage, in particular the susceptibility to impact bruising, was assessed on 20 fruits. Fruits were individually impacted on one side from a fixed height (30 cm) using a free-falling steel ball (40 g and 21.4 mm diameter), and held at room temperature for 48 hr before measuring. The extension and depth of the bruise (in mm) after peeling was measured. In addition, for each variety the incidence of mechanical bruising (%) was calculated as the ratio between the number of fruits damaged and the total number of fruits considered.

Peach fruit firmness was assessed for each replicate, measuring the force (in N) required by a 8-mm probe to penetrate the peeled surface in two opposite regions of the fruit mesocarp, using a digital penetrometer (TR, Italy).

Flesh fruit color was measured with a colorimeter (CM 2600d, Konica Minolta, Japan) in the CIE L*a*b* mode, taking two measurements per fruit after removing the peel. Hue angle (h°) was calculated as arctg b*/a*.

In order to carry out analysis on the fruit puree, fruits from each cultivar were divided into three groups of 15 fruits each, corresponding to three replicates and from each replicate three subsamples were analyzed. Fruits were peeled, de-stoned, cut into big chunks and blended for 90 s. The purees were promptly transferred to sealed glass jars and stored at 5°C.

A few drops of peach puree were used to measure the total soluble solids content (TSS) with a digital hand refractometer (Atago, Japan). A small amount of fruit puree was transferred to a falcon tube and centrifuged with a centrifuge (PK 121R, Thermo Electron Corporation, France) at 4°C for 5 min. Five grams of surnatant were then used to measure the titratable acidity (TA), with an automatic titrator (TitroMatic 1S, Crison, Spain) measuring the volume of NaOH 0.1N to reach a final pH of 8.1. Results were expressed as percent of citric acid referred to the juice. At the same time, the pH was also measured for each puree sample.

To determine the dry matter content, puree samples were desiccated in an oven at 105°C up to constant weight and the dry matter content was calculated as difference from initial weight.

Peach fruit puree viscosity was determined on samples at 20°C by means of a consistometer (Bostwick, USA); the final results were expressed in cm * 30 s^{-1}.

Sensorial analysis

Sensorial evaluations were carried out on the puree samples, kept at 5°C, within 3 hr after processing. Puree of each variety was distributed into clear plastic cups labeled with a three-digit code. The sensorial test was performed in a sensorial laboratory with 10 trained panelists. To evaluate the intensity of aroma, freshness, sweetness and sourness, an hedonic scale, from 1 to 5, labeled 1=*less intense* to 5=*very intense*, was used. For overall quality the scale reference was 1= *really poor* and 5= *excellent*. For the level of browning, scale reference was 1= *severe browning* and 5= *not browned*.

Statistical analysis

Standard deviation was calculated on mean values for each quality attribute. Principal Component Analysis (PCA) was performed on the data. The biplot technique was used to display the relative positioning of quality attributes and cultivars according to the first two PCs.

3. Results and Discussion

Analysis of fruits in terms of physical, chemical, and sensorial attributes, revealed significant variation among the cultivars.

Evaluation of physical and chemical attributes

The resistance to mechanical damage showed a different incidence among the cultivars. Percentage of incidence to mechanical damage is shown in Table 2: it was not related to the fruit harvest dates but only to the cultivar, even if cultivars in Group B seemed to be more resistant to mechanical damage than the others. Within Group A, most

of the varieties showed a bruise incidence around 55%; 'Amiga' was the most damaged variety (73.7%) whereas 'Spring Bright' did not show any evidence of damage. Within group B only the clingstone peach 'Loadel' showed a high bruise incidence (80%) whilst for the other varieties the average incidence was less than 30%. In Group C all the varieties evaluated were characterized by a high bruise incidence, especially for 'Tardi Belle' (100%).

No differences among the cultivars were found in bruise depth (data not shown) and only the results related to bruise extension are reported. Cultivars from Group A showed a great variability (Table 2), while in Group B the average value of bruise size was 6 mm with the exception of 'Guerriera' and 'Marilyn' that showed the highest (9 mm) and the lowest (2 mm) values, respectively. Within Group C, 'Baby7' and 'Tardi Belle' showed the same bruise size, which was significantly higher than that of 'O'Henry'. Results confirmed that bruise size and incidence of mechanical damage does not correlate with flesh firmness, as reported by Mitchell and Kader (1989). In fact, within the range of commercial maturity studied (Table 2), varieties with the same firmness (i.e. 'Big Bang' and 'Spring Bright') showed different response to mechanical damages (55 and 0% respectively), confirming the great variability within the same peach type and among cultivars.

Fruit flesh color, expressed as hue angle value (Table 2), was not statistically different among cultivars in Groups B and C, while in Group A 'Royal Glory' presented a significantly greener value (hue angle greater than 90°, in the second quadrant of L*a*b* color space) than 'Bing Bang', 'Amiga', 'Ambra', and 'Laura', although showing a very low flesh firmness and acidity.

Fruit puree viscosity was different among the studied varieties; values ranged from 1.5 (in 'Eolia') to 9 cm * 30 s^{-1} (in 'Ambra'), with the most frequent values between 4 and 5.5 cm * 30 s^{-1} (Table 2). The high variability among cultivar viscosity was related to the maturity level; indeed in some cases it seemed influenced by fruit firmness. Group A presented cultivars with higher values compared

Table 2 - Chemical and physical parameters evaluated on peach, nectarine and clingstone peach varieties for Group A (early maturing), Group B (middle maturing) and Group C (late maturing)

Ripening group	Cultivar	Bruise incidence %	Bruise extension (mm)	Firmness (N)	Hue angle (°)	Viscosity (cm*30 s^{-1})	pH	TA (% citric acid)	TSS (°Brix)
A	Big Bang	55	6±0.1	37.6±6.7	75.9±6.4	4.4±0.1	3.77±0.04	0.55±0.70	8.7±1.6
	Big Top	50	11±0.5	43.3±9.1	85.5±8.1	4.6±0.1	3.65±0.13	0.75±0.15	11.7±0.9
	Honey Kist	36	8±0.4	28.0±10.1	87.7±8.2	7.4±0.3	4.00±0.09	0.65±0.09	16.3±2.4
	Amiga	74	10±0.5	19.5±9.0	71.6±11	6.5±0.3	3.37±0.21	1.22±0.13	10.6±0.1
	Bigi Lara	50	12±0.3	25.4±7.7	86.4±5.4	7.5±0.1	3.55±0.03	1.00±0.09	10.9±0.3
	Ambra	60	7±0.2	21.0±7.6	77.8±7.9	9.1±0.5	3.57±0.15	1.19±0.08	10.9±0.3
	Laura	29	4±0.4	18.6±8.2	79.8±3.5	8.4±0.3	3.63±0.09	1.03±0.06	10.4±0.4
	Spring Bright	0	0±0.0	37.9±10.5	83.2±4.4	5.5±0.2	3.69±0.16	1.18±0.20	11.1±0.8
	Royal Glory	65	11±0.3	18.8±9.5	91.4±5.0	3.5±0.2	3.85±0.10	0.68±0.11	9.9±1.0
	Fire Top	25	3±0.1	31.2±11.0	82.8±10	3.4±0.2	3.50±0.06	1.41±0.13	11.7±0.5
B	Maria Camilla	11	6±0.2	25.9±9.1	87.7±6.0	4.6±0.3	3.39±0.05	1.21±0.16	10.2±0.9
	Zee Glo	25	6±0.1	16.8±4.3	85.4±3.8	7.1±0.2	3.43±0.03	1.32±0.38	11.4±1.2
	Guerriera	22	9±0.5	13.2±5.7	82.1±5.7	5.1±0.1	3.49±0.05	1.08±0.10	12.1±1.0
	Diamond Princess	15	8±0.3	16.5±7.2	81.7±4.1	4.8±0.1	3.38±0.13	0.88±0.08	11.7±0.5
	Red Elegance	25	6±0.3	61.9±13.9	84.1±2.7	2.1±0.1	3.44±0.02	0.93±0.08	12.2±0.4
	Rome Star	0	0±0.0	40.7±11.6	81.7±4.2	4.3±0.2	3.52±0.03	0.88±0.03	12.3±0.4
	Loadel	80	6±0.3	32.7±6.0	83.1±4.5	4.5±0.1	3.59±0.06	0.76±0.08	13.4±0.9
	Eolia	25	5±0.2	42.1±14.2	79.0±4.3	1.5±0.2	3.81±0.14	0.77±0.06	12.2±0.4
	Venus	20	6±0.4	37.4±13.2	80.2±5.3	4.1±0.1	3.35±0.07	1.25±0.15	13.3±0.6
	Stark Red gold	20	9±0.8	17.3±4.5	71.4±10	5.5±0.2	3.38±0.04	1.24±0.05	13.5±0.6
	Lidy Star	30	4±0.2	13.0±3.10	78.4±4.8	5.1±0.2	3.76±0.10	0.82±0.06	13.0±0.5
	Marilyn	6	2±0.0	27.6±12.7	82.7±8.2	4.0±0.3	3.53±0.05	0.96±0.13	13.5±0.6
	Zee Lady	20	4±0.2	25.8±10.6	81.5±2.7	3.5±0.2	3.46±0.07	0.96±0.09	13.1±0.3
C	O'Herny	64	4±0.2	62.6±8.7	80.3±4.1	7.0±0.3	3.43±0.06	0.78±0.03	13.4±0.7
	Tardi Belle	100	5±0.1	42.9±9.3	81.6±4.3	7.5±0.1	3.59±0.07	0.69±0.08	12.8±0.4
	Baby Gold 7	87	5±0.1	41.5±5.3	78.6±3.5	4.0±0.3	3.67±0.06	0.52±0.03	12.9±1.2

Mean values±standard deviation.

to the other two groups, in particular 'Ambra' and 'Laura' (9.1 and 8.4 cm * 30 s^{-1} respectively) that were characterized by a low flesh firmness (21 and 18.6 N), whereas 'Red Elegance' that showed low viscosity (2.1 cm * 30 s^{-1}) had a high flesh firmness (61.9 N). Viscosity is an important technological parameter for the formulation of smoothies and fruit purees, due to its influence on product smoothness (or thickness) which may have an effect on the mouth feel of the product.

As for chemical attributes (Table 2), within Group A 'Amiga' showed the lowest pH value (pH 3.37) that was significantly different from 'Honey Kist' (pH 4), which indeed were characterized by a different TA: higher for 'Amiga' (1.22% citric acid) and lower for 'Honey Kist' (0.65% citric acid). In terms of total soluble solids (TSS), 'Honey Kist' showed the highest soluble solid content (16.3°Brix) even though its flesh firmness was similar to the other cultivars. The high TSS value confirms its non-acid characteristics, showing the highest TSS:TA ratio as well (25); this ratio is commonly used as a quality index because it is related to taste perception (Byrne *et al*., 1991). Other researchers (Liverani *et al*., 2003) indicated that the TSS:TA ratio at commercial harvest in non-acid cultivars is three to four times higher than in acid cultivars. 'Royal Glory' showed high pH value (pH 3.85) together with a low TA (0.68% citric acid) and low TSS (9.9 °Brix); this cultivar was significantly different from 'Fire Top' and 'Bigi Lara' that had similar pH values (pH about 3.5) and similar TSS contents (11.7 and 10.9°Brix respectively) but a different TA content (1.41 and 1.00% citric acid respectively). Peach fruit acidity is controlled by several factors such as the cultivar, environmental conditions, canopy position, crop load and fruit maturity (Crisosto *et al*., 1997; Castellari *et al*., 2006). Cultivars with the same flesh firmness as 'Spring Bright' and 'Big Bang' showed similar pH values (pH 3.69 and 3.77 respectively) but different TA values (1.18 and 0.55% citric acid) and TSS (11.1 and 8.7°Brix); this implies that at harvest not only the firmness but also the other chemical attributes must be taken into account to select the right maturity stage for harvesting.

Within Group B, 'Maria Camilla' resulted different from the other cultivars since it showed a lower TSS content (10.2°Brix) with pH 3.39 and high TA (1.21% citric acid). Even if it was in the range of maturity for consumption (firmness 25.9 N) it would have had a low potential impact on consumer preference due to the very low TSS:TA ratio (8.4). 'Eolia' and 'Lidy Star' showed the highest pH values (pH 3.81 and 3.76 respectively) and they were similar in TA (0.77 and 0.82% citric acid) and TSS (12.2 and 13°Brix). 'Eolia' was significantly different from 'Venus' and 'Stark Red Gold' that had lower pH together with higher TA (1.25 % citric acid) and same TSS (13.3 °Brix). With regard to harvest date, it has been reported that medium and late season cultivars have a greater capacity to accumulate sugars compared to early season cultivars, and this is due to the non-interruption of the growing process, sugar accumulation, acid degradation and aroma synthesis (Byrne, 2002). Among late maturing varieties (Group C), 'O'Henry' showed lower pH value (pH 3.43) than the others, indeed it also had higher TA (0.78) than 'Baby Gold7' and no differences in terms of TSS were found among them. The lowest TA value in 'Baby Gold7' gave a higher TSS:TA ratio value (24.8, data not shown) with a potential high consumer preference.

Dry matter includes both soluble (largely sugars) and insoluble solids (mainly the structural carbohydrates and starch). As a large proportion of the dry matter at harvest is starch plus soluble sugars, its value can be related to the soluble sugars that will be contained in the ripe fruit. Indeed in accordance with TSS values, dry matter contents ranged between 8.6% for 'Big Bang' and 16.4 % for 'Honey Kist'. Burdon *et al*. (2004) proposed dry matter in kiwifruit as being both a maturity indicator for timing harvest and also as a predictor of the sensory quality of the fruit once ripe. Results obtained in the present study on peach fruits were in accordance with this theory since peach fruit cultivars ('Honey Kist', 'Lidy Star', 'Stark Red Gold', 'Baby Gold7') with high dry matter content showed a higher value of TSS and were also preferred for sweetness by panelists during sensorial tests.

Sensorial analysis

It is well documented that in peach organic acids and soluble sugars are the major determining factors of fruit taste and, together with the volatiles (responsible for the aroma), have an impact on the overall eating quality of the fruit (Iglesias and Echeverría, 2009). Among the cultivars tested, 'Honey Kist' was the most preferred from Group A together with 'Big Bang', 'Laura' and 'Ambra' as indicated by the overall evaluation score (Table 3). The puree obtained with 'Honey Kist' was described as sweet and fresh, and received a high overall evaluation (score 4.4). Varieties in Group B showed differences for aroma, freshness, sweetness, and overall evaluation: 'Zee Glo', 'Guerriera', 'Diamond Princess', 'Stark Red Gold', 'Venus', 'Lidy Star' and 'Loadel' resulted the most pleasant with a score between 3 (intense or fair) and 4 (good). Moreover, 'Maria Camilla', 'Zee Glo', 'Diamond Princess', and 'Stark Red Gold' were evaluated positively in terms of color, with a score of 3.5 (slightly browned). In Group C 'Tardi Belle' and 'O'Henry' were evaluated well balanced on freshness and aroma while 'Baby Gold7' was considered the sweetest, most probably because of its high TSS:TA ratio.

In general, panelists disliked those varieties that were less sweet and more sour, rating them negatively (score 2-2.5) since TA plays an important role at low TSS levels (<10%). When TSS and TA are low even with a high TSS:TA ratio ('Royal Glory'), the perception of sweetness is low, as reported by Crisosto *et al*. (2006). Moreover, in the selection of new varieties, low acid content (non-acid) and a sweet taste are desirable traits, which give an acceptable flavor and result in better quality for consumers (Nicotra and Conte, 2003).

The nectarine 'Honey Kist', a new variety, was the most appreciated due to its TSS content (16.4°Brix), higher than

the optimum level (11-12%) suggested by Hilaire and Mathieu, (2004) for consumer satisfaction.

Principal component analysis

Each sample from Groups A and B was plotted using the first and second PC factors, which retained 69% of the total variance, while in Group C the first and second PC factors retained 99% of total variance, but in this case only three cultivars were used. Grouping of component loadings separated quality attributes into three groups for all maturing Groups (well displayed by the biplot graphs in figure 1).

Table 3 - Sensorial parameters evaluated on purees of peach, nectarine and clingstone peach varieties for Group A (early maturing), Group B (middle maturing) and Group C (late maturing)

Ripening group	Cultivar	Color	Aroma	Freshness	Sweetness	Sourness	Overall evaluation
A	Big Bang	3.7±0.5	4.4±0.8	4.3±1.1	2.6±0.8	2.9±0.9	3.0±0.8
	Big Top	1.4±0.5	2.6±0.8	2.0±0.7	2.8±0.8	1.8±0.4	2.8±0.8
	Honey Kist	2.4±0.9	3.8±0.8	4.2±0.8	4.0±0.0	1.6±0.5	4.4±0.5
	Amiga	4.2±0.8	3.6±0.5	3.2±0.4	1.6±0.5	3.4±1.5	2.4±1.0
	Bigi Lara	2.0±1.0	3.2±0.8	2.8±0.8	2.4±0.9	1.8±0.8	2.4±0.9
	Ambra	5.0±0.0	4.4±0.9	3.6±0.9	2.2±0.8	3.2±0.4	3.2±0.8
	Laura	4.2±0.4	4.2±0.4	3.0±0.7	2.4±0.9	3.4±0.9	3.0±1.2
	Spring Bright	2.2±0.8	2.8±0.4	2.8±1.3	2.4±0.9	3.4±1.5	2.2±0.8
	Royal Glory	2.0±0.0	3.6±0.5	3.6±0.5	2.0±0.7	3.2±0.4	2.4±0.5
	Fire Top	1.5±0.5	2.6±1.0	2.8±1.0	2.6±1.5	2.7±1.2	2.3±0.9
B	Maria Camilla	3.5±1.5	3.3±0.9	3.3±1.0	3.0±1.2	2.8±0.6	3.5±0.8
	Zee Glo	3.5±1.5	3.3±0.9	3.3±1.0	3.0±1.2	2.8±0.6	3.5±0.8
	Guerriera	1.6±0.5	3.7±1.0	3.2±0.7	3.4±0.9	1.8±0.7	3.3±0.9
	Diamond Princess	3.5±0.4	3.1±1.1	3.5±0.8	2.7±0.5	3.0±1.0	3.1±0.6
	Red Elegance	1.7±0.8	2.1±0.8	2.5±1.4	2.4±0.5	2.8±0.8	2.4±1.1
	Rome Star	1.3±0.5	2.2±0.7	2.8±0.4	2.5±0.8	2.3±1.0	2.8±0.8
	Loadel	2.2±0.7	3.5±0.5	3.2±1.5	3.3±0.4	1.9±0.7	3.6±0.5
	Eolia	1.2±0.4	2.5±0.8	2.8±1.2	3.4±0.6	2.0±0.7	3.2±0.7
	Venus	2.7±1.0	2.7±0.8	2.9±1.0	2.6±0.6	3.2±0.7	2.8±0.8
	Stark Red gold	3.5±1.0	3.0±1.2	3.6±0.9	2.7±1.0	2.7±1.0	2.8±0.7
	Lidy Star	3.0±1.0	3.0±1.0	3.0±1.4	3.5±1.2	2.3±1.1	3.5±1.2
	Marilyn	1.2±0.4	3.1±1.2	2.6±1.2	2.4±0.6	2.9±0.7	2.1±0.6
	Zee Lady	2.8±0.9	3.2±0.7	2.9±0.6	3.1±0.7	2.6±0.5	3.0±0.7
C	O'Herny	3.4±0.8	3.7±0.9	3.4±0.5	2.9±0.8	2.7±1.1	3.3±0.5
	Tardi Belle	3.0±1.0	3.3±0.6	3.7±0.6	2.0±0.0	3.0±1.0	2.7±0.6
	Baby Gold 7	2.7±0.4	3.6±0.9	3.7±1.0	4.0±0.7	1.6±0.5	3.7±0.6

Intensity of aroma, freshness, sweetness and sourness scored from 1=less intense to 5=very intense; overall quality scored from 1= really poor to 5= excellent; color scored from 1= severe browning to 5= not browned. Mean values±standard deviation.

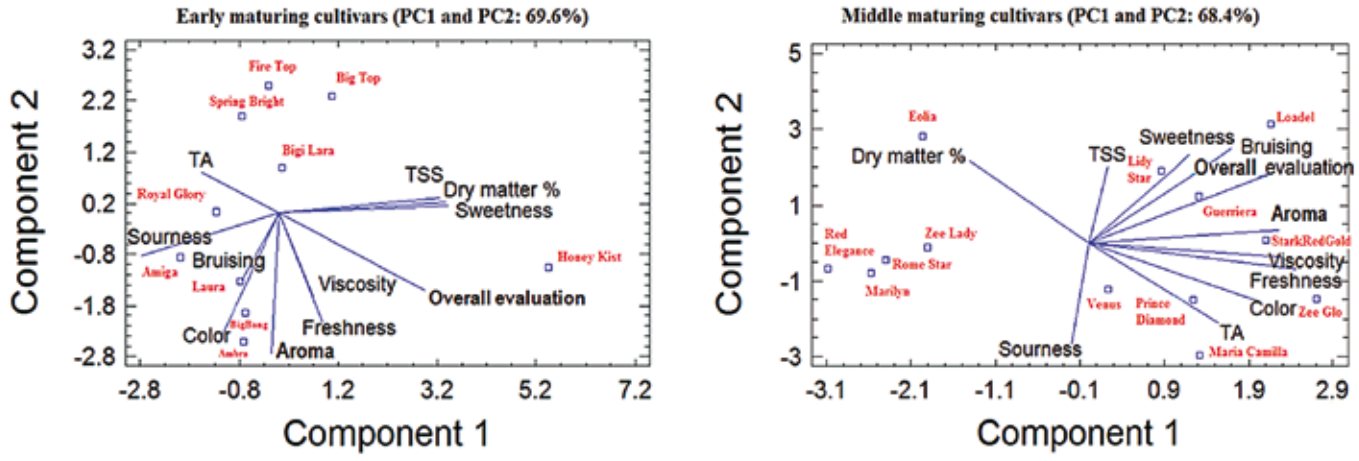

Fig. 1 - Biplot graphs for Group A (early maturing) and Group B (middle maturing) varieties. Grouping of peaches, nectarines and clingstone peaches according to their physical, chemical and sensorial attributes determined by PCA.

In the Early maturing cultivar biplot graph, the first group associates acidity and sourness, the second TSS, sweetness, dry matter and overall evaluation, and the third viscosity, color, bruising susceptibility, aroma, and freshness. Based on this positioning, opposite relationships between acidity and sensorial evaluation, and between sourness and sweetness were found. Specifically, PCA analysis in this study indicated that in Early maturing cultivars, 'Fire Top', 'Spring Bright', 'Royal Glory', 'Big Top' and 'Bigi Lara' were positioned in the upper quadrant along with acidity since TA values were higher than for other varieties. 'Honey Kist' was in the lower right quadrant along with TSS, sweetness, dry matter and overall evaluation. This positioning is in accordance with the chemical and sensorial analysis results; 'Honey Kist' showed the highest TSS value (16°Brix) associated with a high impact on consumer sweetness perception. Cultivars 'Laura', 'Ambra', 'Amiga', and 'Big Bang' were spread in the lower left quadrant according to sourness, color, bruising susceptibility, viscosity, and freshness; in particular 'Ambra' obtained a high sensorial score for aroma and color. It could be concluded that for Group A, nectarine 'Honey Kist' showed the highest TSS content, the lowest acidity, and an intermediate susceptibility to mechanical damage, with a potential positive impact on consumer preference together with 'Laura' and 'Ambra' that retained good color after processing.

In the Middle maturing cultivar biplot graph the first group was associated by TSS, sweetness, sensorial evaluation and bruising, the second by viscosity, freshness, color and TA, the third by sourness. Within this group, an opposite relationship between sweetness and sourness, and between dry matter content and TA was observed. 'Eolia' was in the left upper quadrant along with dry matter in accordance with chemical analysis. 'Lidy Star' and 'Guerriera' were in the upper right quadrant for sweetness and sensorial evaluation, 'Stark Red Gold' was associated with aroma due to the high overall score, while 'Loadel' differentiated for bruising due to the high incidence of mechanical damage. 'Zee Glo', 'Diamond Princess', 'Venus' and 'Maria Camilla' were spread around freshness, TA and color. 'Marilyn', 'Zee Lady', 'Rome Star' and 'Red Elegance' formed a third group positioned in the lower left quadrant between sourness and dry matter, due to their similar dry matter content (13%) and to the high score received for sourness. Within this group 'Stark Red Gold', 'Zee Glo', 'Venus', and 'Diamond Princess' resulted different from the others because of a higher overall evaluation and a lower susceptibility to bruising, indicating their suitability to minimal processing. On the contrary, clingstone peaches 'Loadel' and 'Eolia' were more susceptible to browning after blending, and although pleasant for sweetness and overall quality, their use for fresh convenience products would not lead to promising results.

As for Group C, the principal component analysis is not really meaningful due to the low number of cultivars. From the biplot graph (not shown) it was observed that 'Tardi Belle' was in the upper right quadrant associating with bruising susceptibility, due to the very high incidence to mechanical damage (100%). Although it was the most sensitive to mechanical damage, 'Tardi Belle' differentiated from the other varieties for the well balanced flavor. 'O'Henry' positioned in the lower right quadrant between TA and overall evaluation, while 'Baby Gold7' was in the left quadrant along with sweetness, aroma, freshness, and color, according to the sensorial results obtained.

In conclusion, this work confirms the extreme variability existing among genotypes in terms of sensorial quality, susceptibility to browning and to mechanical damage, and the importance of assessing screening to select the most suitable varieties for minimal processing. From these preliminary data, the best suited cultivars for minimal processing were 'Honey Kist', 'Laura' and 'Ambra' from Group A (early maturing), 'Stark Red Gold', 'Zee Glo', 'Venus' and 'Diamond Princess' from Group B (middle maturing); cultivars from Group C (late maturing) did not show many differences although this may be due to the limited number of varieties evaluated. Further studies are needed in order to better understand the biochemical and technological behavior and to extend the screening to other potentially interesting varieties.

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