Cultivar characterization of stone fruits for their minimal processing

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Revised: 19 August 2013 / Accepted: 6 December 2013 / Published online: 29 December 2013
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Abstract Due to their physicochemical properties, minimal processing of fruits is challenging because of their quick quality loss. Therefore, several preservative steps are needed, such as washing treatments, modified atmosphere packaging, cultivar selection, etc. The latter is an important pre-harvest condition due to the fact that many functional compounds and enzymes are dependent on the cultivar. The aim of this study was to compare the minimal processing adaptation of different stone fruits (nectarine, peach, and plum), focusing on visual and functional quality. The fruit underwent minimal processing in a clean room (temperature and relative humidity were kept at 8 °C and 70 %, respectively) and was washed during 2 min into 2 % w/v ascorbic acid, 1 % w/v citric acid, and 1 % w/v calcium lactate solution. To sum up, nectarine and peach offered a better adaptation, and medium-season cultivars had higher quality maintenance. Nevertheless, late cultivars should not be ruled out before hand on account of their remarkable functional content.

Keywords Fresh-cut · Stone fruits · Antioxidant activity · Browning · Total phenolic content

Introduction

Fresh-cut fruits are demanded by consumers, due to their interest in healthy and ready-to-eat produces. Thus, minimally processed fruits are prepared for consumption by using mild processes such as: washing, cutting and peeling, pit removal, and so on. However, their shelf-life is short mainly on account

of appearance, texture, functional loss, and microbial spoilage. Therefore, the combined use of preservative techniques (chemical-based washing treatments or physical treatments) is needed, constituting the hurdles technology (Artés and Allende 2005; Rico et al. 2007; Toivonen and Brummell 2008). One of the most important aspects to control when extending whole or fresh-cut produce's shelf-life is raw material and its quality and pre-harvest conditions. Namely, cultivar selection is a crucial step for minimal processing because most fruits and vegetables constituents are dependent on pre-harvest conditions (for example, harvest date), affecting quality and post-harvest or fresh-cut behavior (Artés and Allende 2005; Pérez-Marín et al. 2011; Alcobendas et al. 2012). For instance, functional or enzyme content depend on cultivar, both of them playing an important role in enzymatic browning. Thus, browning results in one of the main causes affecting visual quality loss during storage. Consequently, different behavior for the same fruit is expected when diverse cultivars are selected for minimal processing.

Stone fruits are quite popular among customers due to their flavor and nutritional content. Nectarine and peach are high-functional fruits as a consequence of their quality, bioactive compounds, and antioxidant content (Legua et al. 2011; Leong and Oey 2012; Tarrago-Trani et al. 2012). Moreover, plums are well-known for their healthy properties and high functional content (Vicente et al. 2009; Pennington and Fisher 2010; Rendina et al. 2012), taking into account that variations owing to pre-harvest conditions were found (Díaz-Mula et al. 2009). Many studies about nectarines and peaches have been carried out in order to increase their durability using conservation techniques such as controlled or modified atmosphere (Akbudak and Eris 2004; Cano-Salazar et al. 2013) or heat treatments (Malakou and Nanos 2005; Koukounaras et al. 2008), especially in post-harvest market. For plums, many authors have characterized some cultivars and studied techniques to increase their shelf-life and keep quality (Wu et al. 2011; Ozturk et al. 2012; Singh and Singh 2012). However,

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concerning minimal processing, nectarines, peaches, and plums might show different responses. Thus, the two former seem to offer an acceptable adaptation. Indeed, some studies focused on improving both quality and shelf-life of fresh-cut nectarine and peach. Furthermore, many of them paid attention to browning retention. Indeed, peaches have been considered for their minimal processing for long (Wright and Kader 1997). Moreover, visual quality of minimally processed nectarine and peach was measured, considering cultivar selection determinant (Gorny et al. 1998, 1999). Another study focused on visual appearance of fresh-cut nectarine (Pace et al. 2011). Finally, the effect of nitrogen oxide and ascorbic acid on peach slices was studied to reduce their browning (Li-Qin et al. 2009). However, from our point of view, there are not many studies about minimally processed plums, probably due to their accentuated browning. The aim of this study was to assess the adaptation of stone fruits (nectarine, peach, and plum) in minimal processing, focusing on: color, firmness, phenolic content and antioxidant activity. Finally, cultivar selection is proposed according to overall quality and functional content.

Material and methods

Raw material

The stone fruits in study were nectarines and peaches (*Prunus persica* (L.) Batsch) and plums (*Prunus salicina* Lindl), provided by “AFRUEX, Asociación de Fruticultores de Extremadura” in 2012 season. The cultivars selected were: for nectarine, ‘Big Bang’, ‘Honey Royale’, and ‘Late Fire’; for peach, ‘Rich Lady’, ‘Summer Lady’, and ‘Merryl O’Henry’; for plum, ‘Black Splendor’, ‘Fortune’, ‘Larry Ann’, and ‘Angeleno’. The cultivars were harvested in a commercial ripening stage, at different dates (Table 1), classified as early, medium, and late cultivars. The fruit was washed (in a

150 mgL⁻¹ NaClO solution) and selected outside the clean room in order to obtain uniformly-sized fruits. Then the fruit was introduced in the clean room, whose temperature and relative humidity were kept at 8 °C and 70 %, respectively. The following steps were carried out: (a) *peeling and cutting*: fruits were peeled (except nectarine) using an orange peeler (Pelamatic S. L., Valencia, Spain) and cut in pieces by hand; (b) *washing*: around 10 kg of fruit was washed during 2 min into 2 % w/v ascorbic acid, 1 % w/v citric acid, and 1 % w/v calcium lactate solution; (c) *draining*: the fruit was drained with cold air for 4 min using a drier; (d) *packaging*: approximately 80 g of minimally processed fruit was packed in a 250 ml polypropylene (PP) container (Alta Barrera S. L., Barcelona, Spain); (e) *storage*: packaged samples were stored at 4 °C in refrigeration for 9 days, analyzing them at 0, 3, 6, and 9 days.

Analysis

Head space gas composition

Gas composition (O₂ and CO₂ percentage) of all the fruit packages was measured using an O₂ and CO₂ meter (Oxybaby 6, Witt Gasetechnik GMBH and CO KG, Witten, 2010). To avoid modifications in the head space gas composition due to gas sampling, each package was used for a single determination.

Total soluble solids, titratable acidity and pH

Total soluble solids (TSS), titratable acidity (TA), and pH were measured for each independent homogenate, obtained from fresh-cut fruit. TSS were measured by refractometry using a refractometer (RE40, Mettler Toledo, S.A.E., Coslada, Spain), being expressed as °Brix. TA and pH analyses were conducted using a T50 Graphix automatic titrator (Mettler Toledo, S.A.E., Coslada, Spain), and their results were expressed as g malic acid 100 g⁻¹ fresh weight. Acceptance index (AI = TSS/TA) was also obtained.

Firmness determination

Firmness determination was performed in approximately 25–30 g of fruit pieces for each sample, using an EZ Graph Shimadzu Texture Analyzer (Shimadzu Scientific Instruments, Inc., Columbia, MD) equipped with a Kramer cell and five cutting blades. The rate of advance of the probe during the compression test was 300 mm/s and the maximum force applied was 500 N. Firmness was expressed as N/g and done in triplicate for each cultivar and day.

Table 1 Selected stone fruit cultivars and their harvest date. The cultivars were classified as early (E), medium (M) and late (L)

Stone fruit	Cultivar	Harvest date
Nectarine	Big Bang	June 8th (E)
	Honey Royale	July 25th (M)
	Late Fire	September 5th (L)
Peach	Rich Lady	June 25th (E)
	Summer Lady	July 28th (M)
	Merryl O’Henry	August 16th (L)
Plum	Black Splendor	June 20th (E)
	Fortune	July 23rd (M)
	Larry Ann	August 8th (M)
	Angeleno	September 29th (L)

Colorimetric measurements

Twenty fruit pieces for each experience were measured by using a CR-200 tristimulus colorimeter (Minolta, Tokyo, Japan), with an 8 mm diameter viewing area and D65 illuminant. The measurements were carried out in the center of each fruit piece. Chromatic analyses were conducted in accordance with the CIE (Commission Internationale de l'Eclairage 1976) system. L^* , a^* , and b^* values were used to define a three-dimensional color space (Voss 1992; Hutchings 1994). Hue angle ($h^0 = \arctan a^*/b^*$) expressed as degrees ($^\circ$) and Chroma ($C^* = (a^{*2} + b^{*2})^{1/2}$) were obtained from the former colorimetric values. The colorimeter was calibrated on a standard white tile ($L^* = 93.5$, $a^* = -1.0$, $b^* = 0.8$) before each series of measurements. Color change from d 0 to 9 of storage $\Delta E = ((a^*_0 - a^*_9)^2 + (b^*_0 - b^*_9)^2 + (L^*_0 - L^*_9)^2)^{1/2}$, where subscript numbers indicate the sampling day) was also calculated.

Browning potential

Browning potential (BP) was carried out following a modified method from the one proposed elsewhere (Arias et al. 2008). The sample was homogenized, and posteriorly 10 g was centrifuged for 10 min at 14,000 rpm and 4 °C. Then, the sample was filtered by using a 43–48 μ m pore size filter (Filter-lab, Barcelona) and measured at 440 nm with a spectrophotometer (UV-2401 PC, Shimadzu scientific instruments, Inc., Columbia, MD, USA). The samples were kept cold in ice during the process.

Total phenolic content

Total phenolic content (TPC) was measured by spectrophotometry by using Folin-Ciocalteu reactive (Lima et al. 2005). Ten grams of homogenate was extracted in triplicate with 30 ml ethanol solution (800 ml l^{-1} with 27 ml l^{-1} HCl). Once extracted, it was evaporated using a rotary evaporator (R-210, Buchi, Labortechnik Ag, Suiza) at 37–38 °C, getting a final volume of 5–10 ml. The resultant sample was kept in cold (4 °C) and centrifuged at 14,000 rpm for 15 min, using a centrifuge (Allegra 25R, Beckman Coulter TM, Palo Alto, California, USA). Afterwards, the sample was diluted up to 50 ml with distilled water. The colorimetric reaction was developed by mixing 0.4–1.2 ml of the final sample (depending on the cultivar), 5 ml of distilled water and 0.4 ml of Folin-Ciocalteu reactive. After 3 min, 1.2 ml of saturated sodium carbonate was added, diluting the reaction environment up to 10 ml. After 1-hour reaction in darkness, absorbance was measured at 760 nm in a spectrophotometer (UV-2401 PC, Shimadzu Scientific Instruments, Inc., Columbia, MD, USA). TPC was quantified using an external standard, and expressed as mg gallic acid/100 fresh fruit.

Total antioxidant activity

Total antioxidant activity (TAA) was determined by the method proposed elsewhere (Cano et al. 1998). A Thermo Scientific Appliskan spectrophotometer (Thermo Fisher Scientific, Waltham, Massachusetts, USA), equipped with a 24-well plate, was used. For the spectrophotometric reaction, 20 μ l sample juice (obtained after homogenate centrifugation at 14,000 rpm and 4 °C for 15 min) was added to 1 ml ABTS (in 50 mM phosphate, $pH = 7.5$, 0.1 M hydrogen peroxide and peroxidase enzyme solution). Absorbance loss between the beginning of reaction and after 20 min was measured at 750 nm. Trolox (($\pm$)-6-Hydroxy-2,5,7,8-tetramethylchromate-2-carboxylic acid, Fluka) was used as an external standard to quantify TAA, being expressed as mM Trolox.

Statistical analysis

For statistical studies, SPSS 17.0 software was used (SPSS Inc., Chicago, IL, USA). Correlations were estimated with the Pearson test at $p < 0.05$ significance level. Most analyses were done in quadruplicate. Otherwise, sampling repetitions are specified in each section. Data are expressed as means $\pm$ standard deviation (S. D.) and were analyzed using a one-way analysis of variance (ANOVA). When ANOVA detected significant differences among mean values, means were compared using Tukey's test.

Results and discussion

Head space gas composition

A steady modified atmosphere without water vapor accumulation was achieved at the second day of storage (around 1 % CO_2 and 19 % O_2 levels). Taking into account that minimally processed produce are more tolerant to high CO_2 levels due to a smaller resistance diffusion compared to entire produce (Rico et al. 2007), a mild MAP was observed, especially if atmosphere composition for some whole stone fruits (using controlled atmosphere or modified atmosphere packaging) is considered in a broad range (3–15 % CO_2 approximately) in several studies (Sandhya 2010; Díaz-Mula et al. 2011b; Çetinbaş et al. 2012). Consequently, the obtained atmosphere will let assess cultivar's browning resistance in the presence of an oxidative atmosphere.

Total soluble solids, titratable acidity and pH

TSS and TA were similar to those found in the literature for minimally processed peaches and nectarines (Martins et al. 2011; Pace et al. 2011). Plus, the observed results are not so different from the ones assessed for several whole stone fruits

such as nectarine, peach, and plum (Díaz-Mula et al. 2011a; Thakur and Singh 2012; Cano-Salazar et al. 2013), even though the studied samples underwent minimal processing, implying washing that could have altered quality parameters. Similar behavior (except in some cases) was found among all the studied fruit cultivars during storage, comparing TSS and TA at the beginning and at the end of storage (Table 2). Thus, TSS tended to decrease (except for ‘Big Bang’ and ‘Late Fire’ nectarine), as well as TA. However, this decrease was more intensive for the latter. This fact could be explained by the fastened respiratory activity in wounded tissues, as it happened in minimally processed clingstone peach (González-Buesa et al. 2011). Consequently, there was an increase in AI for all samples. Taking into account each fruit, nectarine and peach showed considerable AI increases from d 0 to the end of storage (from 51 % for ‘Honey Royale’ to 112 % for ‘Big Bang’ and from 50 % for ‘Rich Lady’ to 85 % for ‘Summer Lady’). On the other hand, plums had the lowest increases (from 20 % for ‘Fortune’ to 41 % for ‘Larry Ann’). This could be explained on account of low TA decrease in plums, in general. When cultivars within the same fruit were compared, late cultivars tended to have the lowest TA (except for ‘Late Fire’ nectarine) and the highest pH values. Both for peaches and plums, the late cultivar had the highest pH (3.69 ± 0.01 for ‘O’Henry’ and 3.66 ± 0.01 for plums at the beginning of storage). Considering that low acidity normally imply a more neutral pH, this fact could explain that the samples with low TA (and high pH) showed high BP (Figs. 1, 2, and 3) values on account of the fact that PPO enzyme optimum pH range goes between 5 and 7 (Rico et al. 2007; Ayaz et al. 2008). Thus, ‘Big Bang’, ‘Merryl O’Henry’, and ‘Angeleno’ cultivars might have an increased BP due to their low acidity, that could make PPO activity more effective.

Firmness determination

As it can be observed in Table 3, the highest texture loss was found for plums (at around 40 % for ‘Fortune’ and

‘Angeleno’). On the other hand, nectarine seemed to offer the best results when it comes to firmness preservation, with the lowest texture loss for ‘Big Bang’. Therefore, comparing early cultivars regardless of the fruit, minimally processed nectarine had a better firmness quality retention (followed by peach) than plum. Comparing within the same stone fruit, as a rule, an increase in texture loss was observed from early to late cultivars. Thus, a faster ripening is expected for the latter.

Colorimetric measurements

As it can be observed in Figs. 1, 2, and 3 and Table 3, nectarine and peach offered moderate visual quality loss compared to plum. Thus, the lowest and highest ΔE was found for ‘Honey Royale’ nectarine and ‘Angeleno’ plum, respectively (Table 3). Moreover, h° decreased to a greater extent for plums. If each fruit is taken into account, early and especially late cultivars offered the worst visual quality retention. Hence, ΔE values were lower in the case of medium cultivars such as ‘Honey Royale’, ‘Summer Lady’, and ‘Fortune’ for nectarine, peach and plum, respectively. Considering that ΔE is dependent on L^* , a^* , and b^* changes during storage, this results are in accordance with observed L^* and a^* evolution. The samples that showed the lowest color change (ΔE) offered stable L^* and a^* values. According to some authors, browning could be related to L^* and h° fall and a^* increase (Martin-Diana et al. 2005; Albanese et al. 2007). Therefore, it could be said that ΔE is due to browning for the studied samples. Thus, for nectarines (Fig. 1), ‘Late Fire’ and ‘Big Bang’ had the highest L^* drop and a^* rise, respectively. Accordingly, these cultivars showed the highest ΔE . In the case of peaches (Fig. 2), ‘Rich Lady’ offered the strongest a^* evolution during storage, whereas for plums (Fig. 3) ‘Angeleno’ had the highest a^* increase. For most of the studied samples (Table 3) a decrease in h° was found, probably due to browning, except for ‘Honey Royale’ nectarine that kept h° practically constant and ‘Black Splendor’ plum, whose red flesh masked browning and its consequent h° decrease. Again, intermediate cultivars had the

Table 2 Total soluble solids (TSS) and total acidity (TA), expressed as °Brix and % mallic acid, respectively

Stone fruit	Cultivar	TSS ₀	TSS ₉	TA ₀	TA ₉
Nectarine	Big Bang	11.08±0.10 ^b	12.25±0.06 ^c	0.71±0.01 ^b	0.37±0.01 ^b
	Honey Royale	13.90±0.12 ^a	13.03±0.10 ^b	0.34±0.02 ^c	0.21±0.02 ^c
	Late Fire	11.90±0.89 ^b	13.98±0.13 ^a	0.88±0.01 ^a	0.60±0.01 ^a
Peach	Rich Lady	12.88±0.13 ^b	12.25±0.06 ^b	1.07±0.03 ^a	0.68±0.05 ^a
	Summer Lady	13.65±0.06 ^a	13.60±0.03 ^a	0.78±0.01 ^b	0.42±0.02 ^b
	M. O’Henry	12.98±0.10 ^b	12.48±0.10 ^b	0.72±0.02 ^c	0.40±0.02 ^c
Plum	Black Splendor	11.00±0.12 ^c	10.80±0.05 ^d	1.71±0.01 ^a	1.28±0.01 ^a
	Fortune	13.38±0.05 ^b	13.08±0.05 ^c	1.22±0.05 ^c	0.99±0.03 ^b
	Larry Ann	13.55±0.10 ^b	13.53±0.22 ^b	1.37±0.02 ^b	0.97±0.05 ^c
	Angeleno	14.85±0.06 ^a	14.63±0.05 ^a	0.63±0.05 ^d	0.46±0.02 ^d

Subscript number indicates the sampling day. Within the same day and stone fruit, different letters indicate significant differences among cultivars (Tukey’s test, $p < 0.05$)

Fig. 1 Visual parameter and browning potential evolution for minimally processed nectarine cultivars. Within the same day, different letters indicate significant differences among cultivars (Tukey's test, $p < 0.05$)

mildest h° decrease on account of their moderate browning. Moreover, C^* decrease was found for all samples, probably due to color intensity loss on account of phenolic degradation.

Browning potential

Concerning BP, the results are shown in Figs. 1, 2, and 3. Comparing fruits, nectarine had the lowest BP, followed by peach, whereas some plum cultivars showed BP values over 2 absorbance units. These results are in accordance with observed color changes, which were stronger for plums on account of their higher BP. If cultivars within the same fruit are compared, different behavior was observed. In the case of nectarines, 'Late Fire' cultivar did not offer enough juice to carry out the experience (data not shown). 'Honey Royale' seemed to have the highest BP during storage. This fact is not in accordance with color results because this cultivar was the

one that best stabilized color parameters, not showing severe browning. A similar result was observed for peach cultivars, with 'Summer Lady' offering high BP whereas changes in color due to browning were negligible. These results might be explained by other factors, such as turbidity, that might interfere with absorbance and alter BP measurements. Nevertheless, for plums, some similarities were found between BP and color. In this case, 'Black Splendor' and 'Angeleno' cultivars offered the highest BP, whereas 'Fortune' and 'Larry Ann' cultivars showed the lowest results. For the former, the observed red flesh and severe browning for 'Black Splendor' and 'Angeleno', respectively, could explain these values. For the latter, the results are in accordance with the mildest changes observed for L^* , a^* , h° , and ΔE , that is, mild browning took place for intermediate cultivars. Moreover, low acidity could contribute to a high BP because PPO activity might be more effective at neutral pH, as explained in section "Total soluble solids, titratable acidity and pH".

Fig. 2 Visual parameter and browning potential evolution for minimally processed peach cultivars. Within the same day, different letters indicate significant differences among cultivars (Tukey's test, $p < 0.05$)

Fig. 3 Visual parameter and browning potential evolution for minimally processed plum cultivars. Within the same day, different letters indicate significant differences among cultivars (Tukey's test, $p < 0.05$)

Total phenolic content

Many authors have pointed out the high phenolic content of stone fruit cultivars. Our results were similar to those found in literature despite the fact that fresh-cut fruits are washed, losing some functional content. However, and according to some authors, TPC are significantly present in peel (which was removed during minimal processing for peach and plum), making understandable the lower results for peach (Lozano et al. 2009; Legua et al. 2011). For nectarine (Fig. 4a), there was a considerable decrease from d 0 to 3, probably due to PPO activity which could speed up phenolic degradation in the presence of oxygen due to the mild MAP obtained (González-Buesa et al. 2011). Early and medium cultivars offered similar TPC, whereas 'Late Fire', that is, the late cultivar, had higher TPC when compared with the remainder at the same day of storage. For peach (Fig. 5a), similar results were found, with 'Rich Lady' showing the lowest TPC value and the strongest decrease. On the other hand, medium ('Summer Lady') and late ('Merryl O'Henry') cultivars had the highest TPC and considerable losses during storage. In the case of plums (Fig. 6a), all cultivars had similar TPC at d 0 (between 150 and 200 mg gallic acid/100 g fw), with values

for early and late cultivars slightly higher. In addition, different evolution was observed depending on the cultivar. On one hand, 'Black Splendor' and 'Larry Ann' cultivars offered a steady decrease during storage, whereas 'Fortune' and 'Angeleno' plums had an increase from d 3 of storage. The decrease could be explained by the fact that enzyme activity could spoil phenolic compounds as substrates. The increase found for this experience could be explained by phenol biosynthesis, that could have taken place under stress conditions (Tomás-Barberán and Espin 2001). To sum up, it could be said that there was a general functional loss after storage. Plus, late cultivars tended to offer the highest TPC.

Total antioxidant activity

As far as TAA is concerned, some similarities with TPC might be found. Generally, there was a constant TAA decrease during storage, probably explained by functional compound degradation after minimal processing (González-Buesa et al. 2011). In the case of nectarine (Fig. 4b) 'Late Fire' had the highest TAA, as in the case of TPC. However, medium cultivar 'Honey Royale' had lower TAA than 'Big Bang', whereas they had a similar TPC. For peach, 'Summer Lady'

Table 3 Color and texture quality results for the studied samples

Stone fruit	Cultivar	h^*_0	h^*_9	C^*_0	C^*_9	ΔE_9	Firmness loss (%)
Nectarine	Big Bang	94.75	91.46	88.60	86.56	5.34	6.72
	Honey Royale	90.24	90.84	87.24	86.62	0.86	27.05
	Late Fire	90.62	88.18	92.87	87.58	6.07	28.12
Peach	Rich Lady	97.77	92.24	90.93	87.92	5.87	12.17
	Summer Lady	88.74	85.94	90.24	88.32	3.56	12.50
	M. O'Henry	87.91	87.49	89.55	85.59	5.49	30.50
Plum	Black Splendor	28.51	33.09	51.79	49.56	7.30	9.42
	Fortune	90.96	84.83	67.05	64.74	5.06	40.18
	Larry Ann	93.63	86.70	69.38	66.48	7.26	24.67
	Angeleno	96.77	86.07	74.42	72.95	10.46	39.56

Subscript number indicates the sampling day

Fig. 4 Total phenolic content (a) and total antioxidant activity (b) for minimally processed nectarine cultivars. Within the same day, different letters indicate significant differences among cultivars (Tukey's test, $p < 0.05$)

had the highest value, whereas 'Merryl O'Henry' had the lowest TAA, even though they had a comparable TPC. As far as plums are concerned, TAA were similar at the beginning

Fig. 5 Total phenolic content (a) and total antioxidant activity (b) for minimally processed peach cultivars. Within the same day, different letters indicate significant differences among cultivars (Tukey's test, $p < 0.05$)

Fig. 6 Total phenolic content (a) and total antioxidant activity (b) for minimally processed plum cultivars. Within the same day, different letters indicate significant differences among cultivars (Tukey's test, $p < 0.05$)

of storage except for 'Larry Ann', with the highest TAA (over 20 mM Trolox). This fact is not in accordance with TPC, where this cultivar had the lowest value. Summing up, there was a global antioxidant activity loss, and some incongruence between TAA and TPC were found probably due to different antioxidant compounds such as vitamin C.

Conclusions

A cultivar characterization was carried out in order to compare different stone fruit cultivars for their minimal processing. In conclusion, for each fruit some cultivars potentially valid for minimal processing were found, achieving at least a 6-day shelf-life. Similar behavior among cultivars was observed regardless the studied fruit. Late cultivars tended to lose visual and texture quality to a greater extent, making advisable the selection of early or intermediate cultivars from this point of view. Moreover, the higher acidity found for the latter might imply a natural microbiological barrier, implying less intensive sanitation or conservation techniques. Nevertheless, late cultivars had a considerable total phenolic and antioxidant content, making them a high-value product that might deserve additional conservation steps. When the fruits were compared, similar findings were observed. Nectarine and peach were

more suitable for fresh-cut processing, whereas minimally processed plums offered a considerable quality loss. Nevertheless, their high functional content could encourage their minimal processing, making necessary additional or more intensive conservation techniques. Summing up, the selected cultivars were: ‘Honey Royale’ nectarine, ‘Summer Lady’ peach, and ‘Fortune’ plum. A compromise choice was made in order to assure enough functional content, intermediate texture loss, and the best visual quality retention. Finally, additional studies are needed, such as the use of innovative conservation techniques (ultrasound) or microbiological shelf-life determination.

Acknowledgments The authors acknowledge the ‘RITECA Project, Cross-border Research Network of Extremadura, Centro and Alentejo, financed jointly by the European Regional Development Fund (ERDF), through the Operational Program of Cross-border Cooperation Spain-Portugal (POCTEP) 2007–2013 (0401_RITECA_II_4_E)’. Dr. Bohoyo-Gil thanks the ‘Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA)’ for the research contract. M. C. Fuentes-Pérez thanks the research grant TE10016 conceded. We appreciate the fruit supply by “AFRUEX”.

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