Total Phenolic, Carotenoid, and Anthocyanin Content and Antioxidant Activity of Peach and Plum Genotypes

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Abstract
Fruits contain a range of phenolics and carotenoids which have been implicated in improving human health. The objective of this study was to characterize the phytochemicals and antioxidant activity (AOA) exhibited in peaches and plums and to determine if any associations existed between these phytochemicals and AOA. Twenty-two peach varieties and fifty-three plum varieties with different flesh and skin color were analyzed for their antioxidant content and AOA. Total phenolics, anthocyanins, and carotenoids were analyzed spectrophotometrically. AOA was evaluated by 2,2-diphenyl-1-picrylhydrazyl (DPPH). Carotenoid content was higher in yellow-flesh (2-3 mg β-carotene/100 g fw, fresh weight) than in white or red-flesh peaches (0.01-1.8 mg β-carotene/100 g fw). AOA was about 2-fold higher in red-flesh varieties than in white/yellow-flesh peach varieties. Among the peaches, the AOA was best correlated with phenolic content. Among the plums, the anthocyanin content increased with the red color intensity. Although the plums varied widely in phenolic content, the red/purple-flesh plums generally had higher phenolic content (400-500 mg chlorogenic acid/100 g fw) than the other plums. Carotenoid content in plums was similar for all varieties. AOA tended to be higher in red/purple-flesh varieties as compared to light colored flesh plums. As with the peaches, the best correlations were between the AOA and the total phenolics content of the fruit.

INTRODUCTION
Fruits are being promoted for their health benefits against cancer and age-related diseases (Prior and Cao, 2000; Wargovich, 2000). This increasing interest for healthy foods has guided plant breeders to select varieties of different crops based on higher phenolic content and antioxidant activity. A range of phytochemicals have been reported in Prunus including carotenoids, anthocyanins, and phenolics (Gil et al., 2002) that may act as natural antioxidants in our diet (Wang et al., 1996), which in turn may provide health-promoting effects to consumers (Kim et al., 2003). The antioxidant activity in both peaches and plums depends on the genotype tested and the levels found in plum overlap levels found in blueberry (Cevallos et al., 2002) with a good correlation between total phenolic and antioxidant activity. Information pertaining to phytochemicals and antioxidant activity may help breeders develop healthier fruit varieties. The objective of this study was to characterize phytochemicals present in a range of peaches and plums, and to select varieties with high antioxidant activity.

MATERIALS AND METHODS
The study was conducted in 2003 at the Department of Horticultural Sciences, Texas A&M University. Twenty-two peach cultivars with flesh color ranging from white
to red and 45 plum varieties with flesh color ranging from yellow to red were assayed for
45 total phenolics, total carotenoids, anthocyanins and antioxidant activity. Phenolics were
45 quantified by the Folin-Ciocalteau method (Swain and Hillis, 1959), carotenoids and
45 anthocyanins were quantified with a spectrophotometer (Talcott and Howard, 1999;
45 Fuleki and Francis, 1968). Antioxidant activities were quantified by the DPPH radical
45 method (Brand-Williams et al., 1995).

RESULTS AND DISCUSSION

Peach cultivars with dark red colored flesh have higher anthocyanin content than
the white or yellow cultivars. The concentration ranged between 45-266 mg of cyanidin
3-glucoside/100 g of tissue. Low concentrations of anthocyanins were found on the skin
or close to the stone of the white/yellow flesh cultivars. The highest phenolic content was
present in a red fleshed cultivar. However, in general the level of phenolics of the red-
45 flesh cultivars overlapped that found in most cultivars of the white/yellow-flesh peaches,
ranging between 136 and 1,259 mg of chlorogenic acid/100 g of tissue. Most peaches had
less than 400 mg of chlorogenic acid/100 g of tissue. Antioxidant activity was about 2-
fold higher in red-flesh cultivars than in yellow or white cultivars. In general, phenolic
content and antioxidant activity found in these cultivars are higher than those previously
reported for stone fruits (Gil et al., 2002). Carotenoid content found in yellow-flesh
cultivars (2-3 mg β-carotene/100 g tissue) was 5-fold higher than in white or red-flesh
cultivars. For peaches, the antioxidant activity recorded significant correlations with
phenolics when calculated on all tested or red fleshed cultivars. Significant
correlations were recorded for the same groups of cultivars also for antioxidant activity
and anthocyanins, although very low (0.12) for red flashed cvs. As related to light flesh
cultivars the only significant correlation of antioxidant activity was found with
carotenoids (Table 1).

Among plums, the anthocyanin content increased with the red color intensity in
the flesh. Although the plums varied widely in phenolic content, the red-flesh plums
generally had higher phenolic content (many with greater than 400 mg chlorogenic
acid/100 g tissue) than the light colored plums (most with less than 400 mg chlorogenic
acid/100 g tissue). Phenolic content is higher than previous reported in plum (Kim et al.,
2003). Carotenoid content in plums was similar for all cultivars (0.2-2.0 mg β-
carotene/100 g tissue). The highest antioxidant activity was found among the red-flesh
cultivars. However their levels overlapped those found among the various flesh colors.
Antioxidant activity was best correlated with the phenolic content in plums (Table 2). The
antioxidant activity found is higher than that previously reported in stone fruits (Gil et al.,
2002).

The most consistent correlations, in both peaches and plums, were found between
antioxidant activity and total phenolic content. However, other correlations, such as
antioxidant activity and anthocyanins in peaches and antioxidant activity and carotenoids
in both yellow fleshed peaches and plums, appear to provide additional information worth
of more detailed investigations.

Literature Cited
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Tables

Table 1. Correlations of antioxidant activity with anthocyanins, total phenolics, and carotenoids contents in peach.

<table>
<thead>
<tr>
<th>Peach group</th>
<th>Anthocyanins</th>
<th>Phenolics</th>
<th>Carotenoids</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>0.58*</td>
<td>0.72*</td>
<td>ns</td>
</tr>
<tr>
<td>Red flesh</td>
<td>0.12*</td>
<td>0.57*</td>
<td>ns</td>
</tr>
<tr>
<td>Light flesh</td>
<td>ns</td>
<td>ns</td>
<td>0.22*</td>
</tr>
</tbody>
</table>

Table 2. Correlations of antioxidant activity with anthocyanins, total phenolics, and carotenoids contents in plum.

<table>
<thead>
<tr>
<th>Plum group</th>
<th>Anthocyanins</th>
<th>Phenolics</th>
<th>Carotenoids</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>0.06*</td>
<td>0.55*</td>
<td>0.16*</td>
</tr>
<tr>
<td>Red flesh</td>
<td>0.15*</td>
<td>0.44*</td>
<td>0.10*</td>
</tr>
<tr>
<td>Light flesh</td>
<td>ns</td>
<td>0.89*</td>
<td>0.29*</td>
</tr>
</tbody>
</table>