Pawpaw: An Old Fruit for New Needs

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Abstract

Pawpaw [Asimina triloba (L.) Dunal] is the largest edible fruit native to North America. The species range covers 26 states in the U.S., extending from northern Florida to southern Ontario and as far west as eastern Nebraska. Pawpaw fruits were traditionally consumed by Native Americans, then by European explorers and settlers. Today, pawpaws are consumed by local populations in rural areas from fruit collected from the wild and a few commercial orchards. Despite some consumer and professional grower interest, the high perishability of the fruit has been a major factor slowing the development of a larger market for the fruit. Postharvest recommendations have only recently been developed from our research that indicated pawpaw fruit can be held in refrigerated storage up to a month and subsequently ripen normally. During the past several years, the quest for alternative crops with high nutritional value has increased interest in pawpaw. The fruit are comparable to banana, apple and orange since they are high in vitamin C, magnesium, iron, copper and manganese. They are also a good source of potassium and several essential amino acids, and they contain significant amounts of riboflavin, niacin, calcium, phosphorus and zinc. In addition to a review of these nutritional attributes, data will be presented showing that pawpaw also contains significant total carotenoid content and antioxidant properties. The importance of carotenoids and other antioxidant compounds such as phenolics in reducing heart disease, stroke and some cancers make pawpaw a very balanced and desirable food option.

INTRODUCTION

Pawpaw (Asimina triloba (L.) Dunal) trees grow widely in the mesic hardwood forests of 26 states in the eastern United States ranging from northern Florida to southern Ohio and as far west as eastern Nebraska (Pomper et al., 2003). The trees grow in the wild up to 5–10 m in height, and they are the only member of this tropical family able to grow in a temperate climate (USDA Zone 5) (Pomper et al., 2003). Pawpaw fruit are the biggest fruit native to North America (Pomper and Layne, 2004). The distinctive fleshy fruits have a unique taste, a mix of banana, mango and pineapple, and a soft custard-like texture. Increasing interest in the fruit makes it a potentially high value alternative to tobacco in the southeastern United States (Archbold et al., 2003; Pomper and Layne, 2004). Unfortunately, the high perishability of this fruit, a characteristic that pawpaw shares with other members of the Annonaceae family such as cherimoya and custard apple, hinders the development of a national market (Archbold et al., 2003). After harvest the fruits have a shelf life of only 2–5 days, though recently it has been established that pawpaw fruit can be stored for one month at 4°C with little loss in quality (Archbold et al., 2003). However, longer storage periods cause impaired ripening and internal black discoloration of the fruit (Archbold et al., 2003).

Over the years studies have proven that many compounds commonly found in fruits and vegetables such as vitamin C, vitamin E, and antioxidant compounds such as carotenoids and phenolics have a positive effect on lowering the risk of developing cancer and heart disease in people that consume the products on a regular basis (CDC, 2005). Until now, only limited information has been collected about pawpaw nutritional value. In this study, we have focused on pawpaw antioxidant properties. Total antioxidants and
phenolics have been measured and are compared to published values of fruits more commonly consumed. In addition, many but not all pawpaw have a yellow to orange flesh color, so we have also examined the fruit for carotenoid content.

MATERIALS AND METHODS

Fruit Harvest

Pawpaw fruit were harvested from the Kentucky State University orchard located in Frankfort, KY. The analyses were performed on fruit harvested 2 weeks before ripening, on fruit at harvest, on fruit ripened for 4 days at room temperature (~23ºC), and on fruit cold stored at 4ºC for 4 weeks and then ripened for 2 days at room temperature. Fruit tissues collected at these times were frozen and stored at -80ºC prior to analysis.

Total Antioxidant and Phenolic Evaluation

For antioxidant measurement, 15 g of fruit pulp were weighed, combined with 20 ml of 80% methanol and homogenized. The homogenate was filtered through two layers of cheesecloth and centrifuged at 3600 rpm for 5–6 min. A portion of the supernatant was diluted with deionized water to achieve a 5% methanol concentration.

Total antioxidant was measured using the ferric reducing/antioxidant power (FRAP) assay as described by Arnous et al. (2002). For this assay, 0.2 ml of the 5% methanol pawpaw extract above was combined with 0.042 ml of 3 mM ferric chloride in 5 mM citric acid. This solution was vortexed and incubated for 30 minutes in a 37ºC water bath. After incubation, 0.758 ml of 1 mM 2,4,6-Tris(2-pyridyl)-1,3,5-triazine (TPTZ) was added and absorption was read at 620 nm against a 5% methanol standard. Results were expressed as g ascorbic acid equivalents /100 g fresh weight (FW).

Total phenolics were measured using a modified version of the Glories’ methods as described by Fukomoto and Mazza (2000). For this assay, 0.5 ml of the 5% methanol pawpaw extract was combined with 0.24 ml of 0.1% HCl in 95% ethanol and 4.31 ml of 2% ethanol. The solution was vortexed and absorbance was read at 280 nm against a blank containing 5% methanol. Results were expressed as g chlorogenic acid equivalents /100 g fresh weight (FW).

Total Carotenoid Evaluation

Total carotenoid analyses were performed as described by Schaub et al. (2004) in the quick carotenoid analysis protocol.

RESULTS AND DISCUSSION

Regarding nutritional value, pawpaw fruit are comparable to banana, apple and orange (Table 1). Pawpaw fruit are high in vitamins such as niacin, vitamin C, protein and minerals, and they can be considered an excellent source of potassium, calcium, phosphorus, iron and magnesium, all very important micronutrients that are often lacking in the diets of children and seniors.

Pawpaw fruit are rich in antioxidant compounds. The pawpaw antioxidant content is similar to values for strawberry and orange, and is almost ten times higher than values for banana and apple, comparing our results with data reported by Pellegrini et al. (2003). Pawpaw antioxidant values were at their maxima in ripe fruit at harvest and decreased by 40% in fruit kept for 4 days at room temperature or cold stored for one month then ripened (Fig. 1).

In contrast, phenolic compound content was high in unripe fruit, decreased in ripe fruit, but increased again during cold storage (Fig. 2). The higher phenolic content detected in fruit ripened 4 days on the bench could be related to post-ripening senescence events, while that observed in cold-stored fruit could be an early sign of the storage injury discoloration that we have previously observed with fruit cold-stored for more than one month.
Total carotenoids reached their highest value in fruit ripened for 4 days after harvest (Fig. 3). As observed in tomato and mango, carotenogenesis may continue after harvest as long as the fruits are kept intact (Rodriguez-Amaya, 2001). Carotenoid content of pawpaw is about 80% higher than that of banana and grapefruit, 70% higher than strawberry, and 40% higher than apple, orange and mandarin. However, when compared to plant products rich in carotenoids, pawpaw carotenoid content is more than 2000% lower than the values listed in literature for carrots and tomatoes (Heinnonen et al., 1989).

The present data show that pawpaw is a nutritionally rich fruit with high levels of antioxidant compounds, minerals and vitamins that, along with a unique taste, make it an interesting alternative to the most commonly consumed fruits such as banana and apple. We believe that pawpaw could be a very balanced and desirable food option for people who want a healthy diet that can help prevent cancer and heart disease problems, the leading causes of death among the developed nations.

ACKNOWLEDGEMENTS

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Literature Cited


### Tables

Table 1. Fruit nutritional value (Source: Peterson, 1991; Full USDA Nutrient Database listings.)

<table>
<thead>
<tr>
<th>Nutritional Value</th>
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<th>Banana</th>
<th>Apple</th>
<th>Orange</th>
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Figures

Fig. 1. Total antioxidant content of pawpaw fruit 2 weeks before harvest (BH), at harvest (H), 4 days after harvest (H+4), and after 4 weeks of cold storage and subsequent ripening (CS). Data are mean ±SE, n=6, or 4 for CS only, and are expressed as g ascorbic acid equivalents (AAE)/100 g FW.

Fig. 2. Total phenolic content of pawpaw fruit 2 weeks before harvest (BH), at harvest (H), 4 days after harvest (H+4), and after 4 weeks of cold storage and subsequent ripening (CS). Data are mean ±SE, n=6, or 4 for CS only, and are expressed as g chlorogenic acid equivalents (CAE)/100 g FW.
Fig. 3. Total carotenoid content of pawpaw fruit at harvest (H), 4 days after harvest (H+4), and after 4 weeks of cold storage and subsequent ripening (CS). Data are mean ±SE, n = 4, and are expressed as µg carotenoid/g FW.