

PAWPAW FRUIT (*ASIMINA TRILOBA* (L.) DUNAL). PROCESSING AND NUTRACEUTICAL VALUE

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Abstract

Asimina triloba (L.) Dunal, or pawpaw, is the only temperate plant species that belongs to the Annonaceae family. Is a native North American fruit species from Florida to South Canada. In Romania, the first pawpaw plants were brought in Transylvania from North America at the beginning of the 20th Century, in 1926 by Suciu family from Alba County. They were locally cultivated and remained unknown in the rest of country. Only after 2000, have begun to be studied at the Faculty of Horticulture, in Bucharest. Regarding nutritional value, *asimina* is comparable to apple, banana, orange, peach and grape since it is high nutritionally rich fruit with high levels of minerals, vitamins and antioxidant compounds. The color of the fruit changes from white-cream at bright yellow to shades of orange. The flavor of ripe pawpaw fruit resembles a combination of banana, mango and pineapple. Pawpaw fruit are best eaten fresh when fully ripe but the intense tropical flavor may be useful for preparation of food products such as: ice cream, smoothie, candy, juices, cakes and others.

Key words: northern banana, products, minerals, vitamins.

INTRODUCTION

Asimina triloba (L.) Dunal, or pawpaw, is the only temperate plant species that belongs to the Annonaceae family (Padmanabhan & Paliyath, 2016; Zhang Lin, 2016) the tropical custard-apple family and is the largest tree fruit native to the United States (Darrow, 1975; Desmond, 1996). All but one of the 130 genera of the Annonaceae family thrives in the tropical region. Only the genus *Asimina* grows in the temperate climate zone (Callaway, 1993), specifically the USDA growing zone 5 (Brannan et al., 2012; Pomper et al., 1999).

Is a native North American fruit species including nine species of *Asimina* (Padmanabhan & Paliyath, 2016) grows on the eastern part of the continent, from Florida to South Canada (Stan et al., 2022). In the south-eastern part of Florida and Georgia State, there are eight other members of *Asimina* genus: *Asimina incarnata* (flag paw-paw), *Asimina*

longifolia, *Asimina obovata*, *Asimina parviflora* (dwarf paw-paw), *Asimina pygmaea*, *Asimina reticulata*, *Asimina tetramera* (oposum paw-paw), *Asimina × nashii* (Callaway, 1993; Stan et al., 2022; Stănică et al., 2008).

About 70 varieties of *Asimina* have been cited in the literature, but only 40 are currently commercially available (Stănică et al., 2008).

Asimina triloba is a species with high frost resistance, surviving at -25 to -30°C, well adapted to different soil types, preferring loose, well-drained soils, with a neutral or slightly acidic pH. Also, it has a resistance to diseases and pests, being easy to grow in the organic system (Stănică, 2012; Tabacu et al., 2020).

Is reported to be the largest tree fruit native to the United States because the pawpaw fruit, which can grow up to 1 kg by weight (Darrow, 1975; Zhang Lin, 2016).

In 1541, was written the first documentation about *Asimina triloba*. In the present, despite its

long history, it is still a mysterious fruit that is not commonly recognized.

A sensory study of tropical fruits shows that less than 10% of consumers who liked better the pawpaw taste could identify it correctly from other tropical fruits (Brannan et al., 2012; Zhang Lin, 2016).

In Romania, the first *Asimina* plants arrived in Transylvania from North America at the beginning of the 20th Century, in 1926, when in Pianu Nou, Alba County, Ioan Suci family obtained plants from some seeds brought from Ohio State (Cepoiu et al., 2004; Stănică, 2002; Stănică, 2012).

They were locally cultivated and remained unknown in the rest of country (Dănăilă et al., 2004; Stan et al., 2022).

Only after 2000, at the Faculty of Horticulture in Bucharest, was a scientific evaluation of this interesting species started with the goal of studying the propagation techniques, orchard management and its behaviour under Romanian conditions (Cepoiu et al., 2004; Stan et al., 2022; Stănică & Cepoiu, 2003; Stănică et al., 2004; Stănică et al., 2008; Stănică, 2012).

Other *Asimina triloba* genotypes are currently found in Romania in the ‘Dimitrie Brândză’ Botanical Garden of the University of Bucharest and other sites of the city, Geoagiu (Hunedoara County), Simeria, Baia Mare (Cepoiu et al., 2004; Tabacu et al., 2020).

ABOUT *ASIMINA TRILOBA* FRUIT

Usually, the pawpaw fruits is highly perishable and only available for purchase in local markets or from private gardeners’ backyards.

The promotion of pawpaw to standardized markets is relatively difficult for it has weaknesses, due to perishability (Zhang Lin, 2016).

The shelf life of a ripened fruit stored at room temperature is 2 to 3 days, but with refrigeration [4°C (39.2°F)], fruit can be held up to 3 weeks while maintaining good eating quality (Layne, 1996; Templeton et al., 2003). Though the fruit is still at the edible stage, after the color of cut pawpaw pulp turning in dark-brown, its appearance is not favorable and for this reason impact consumers’ perceptions of quality and freshness (Boyd, 2015; Zhang Lin, 2016).

During the growing season, the pawpaw has a whitish to light-green color. The color of the

pulp changes from creamy white through bright yellow to shades of orange that turns to brown at maturity (Brannan et al., 2012; Layne, 1996; Levine et al., 2015; Peterson, 2003; Pomper & Layne, 2005; Wood & Peterson, 1999; Zhang Lin, 2016).

Pawpaw fruit has a sweet and sour taste, the flavor of ripe pawpaw fruit resembles a combination of banana (*Musa × paradisiaca*), mango (*Mangifera indica*), and pineapple (*Ananas comosus*); however, flavor varies among varieties, with some fruit displaying more complex flavor profiles (Desmond, 1996; Kobayashi et al., 2008; McGrath & Karahadian, 1994b; Nam et al., 2018; Padmanabhan & Paliyath, 2016; Pomper & Layne, 2005; Stan et al., 2022) and the soft flesh surrounds two rows of large bean-shaped dark brown seeds. The skin of pawpaw should not be eaten. (Brannan et al., 2012; Wood & Peterson, 1999; Zhang Lin, 2016).

Although pawpaw is sometimes confused with papaya (*Carica papaya*), but it is an entirely different species (Levine et al., 2015). Papaya is a tropical plant grown in tropical regions, but pawpaw can grow well in tropical regions as well as in humid microthermal climates (Padmanabhan & Paliyath, 2016; Stan et al., 2022).

In the Figure 1 we found some health benefits of pawpaw fruits.

NUTRITIONAL COMPOSITION AND HEALTH BENEFITS

Pawpaw is a nutritionally rich fruit with high levels of antioxidant compounds, regarding nutritional value. The pawpaw antioxidant content is similar to values for strawberry and orange, and is almost ten times higher than values for banana and apple (Nam & Jang, 2018; Pellegrini et al., 2003).

Brannan et al. (2015), reported that pawpaw fruit contains a large amount of procyanidins, which have antioxidant effects, and Kobayashi et al. (2008), demonstrated that pawpaw fruit exhibits antioxidant activity (Nam et al., 2018). Pawpaw is a nutritionally superior fruit, being a good source of some vitamins, minerals, and amino acids than in apple (*Malus sylvestris* var. domestica), grape (*Vitis* spp.), and peach (*Prunus persica*) (Jones & Layne, 1997;

Peterson et al., 1982; Templeton et al., 2003). Are high in vitamins such as vitamin C, niacin, protein and minerals, amino acids 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, along with unique taste, make it an interesting alternative to the most commonly consumed fruits (Galli et al., 2007; Stan et al., 2022; Templeton et al., 2003).

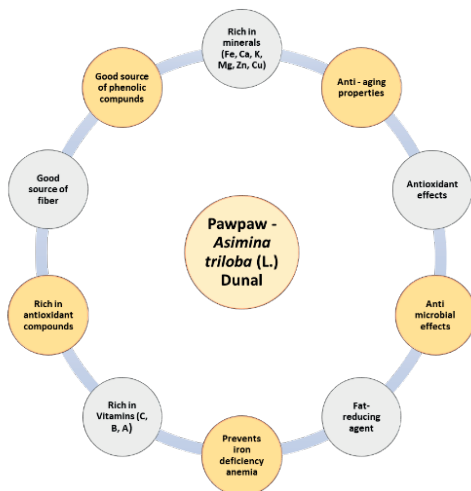


Figure 1. Health benefits of pawpaw - Source: Original

A pawpaw's caloric content is composed of about 13.5% fat, in contrast with apples (5.5% fat) and bananas (4.7% fat) (Jones & Layne, 1999). Because other fruit purees have been successfully used to replace fat in baked products (Charlton & Sawyer-Morse, 1996;

Swanson & Munsayac, 1999), the composition of the pawpaw fruit makes it a unique and realistic candidate as a fat-reducing agent in baked goods (Duffrin et al., 2001). The general nutritional value data of pawpaw are presented in the Table 1.

Table 1. Fruit nutritional value of pawpaw

Nutritional value (per 100 g)	[1] [2] [3]; [4]; [5]			Vitamins (per 100 g)			Minerals (per 100 g)				
	[1]	[2]	[3]; [4]; [5]	[1]	[2]	[3]; [4]; [5]	[1]	[2]	[3]; [4]; [5]		
Energy (Kcal)	85	84	80	Vitamin A (IU)	82	1	Calcium (Ca)/(mg)	13	8	7.9	
Moisture (g)	74.5	79.1	75.3	Thiamine (B1)/(mg)		0.8	Iron (Fe)/(mg)	0.2	0.3	56	
Carbohydrates (g)	23.8	18.6	18.8	Riboflavin (B2) (mg)		6	Magnesium (Mg)/(mg)		10	35.9	
Lipid (g)	0.6	0.4	1.2	Niacin (B3)(mg)		6.5	Manganese (Mn)/(mg)			74.3	
Protein (g)	0.7	1.5	1.2	Vitamin C (mg)	24.01	1.0	30.5	Phosphorus (P)/(mg)		5.9	
Ash (g)	0.4	0.4	0.7								
Dietary fiber (g)	4.5	5.8	2.6					Potassium (K)/(mg)	201	239	345
Total Sugar (g)	16.3	13.1						Zinc (Zn)/(mg)		0.5	6.7
Fructose (g)	2.2	1.7	2.6					Copper (Cu)/(mg)			22.2
Sucrose (g)	11.4	9.3	8.2					Sodium (Na)/(mg)	1.0		1.0
Glucose (g)	2.7	2.1	2.9								

Source: ^[1] Brannan et al., 2021; ^[2] Nam et al., 2018; ^[3] Galli et al., 2007; ^[4] Peterson, 1991; ^[5] USDA, 2005

PROCESSING

Pawpaw fruit can be eaten raw, processed and frozen. Ripe pawpaw fruit soften and have a powerful aroma (McGrath & Karahadian, 1994a; Shiota, 1991). The flavor of a pawpaw

fruit can intensify as it over-ripens, as with banana, resulting in pulp that is excellent for use in cooking (Templeton et al., 2003). Currently, pawpaws are primarily consumed as fresh fruit. Pawpaw fruit are best eaten fresh when fully ripe.

The intense tropical flavor and aroma (Shiota, 1991) also may be useful for developing processed food products (blended fruit drinks, baby food or puree, ice creams, juices, jam and other products, as are their *Annona* relatives.

Pawpaws easily substitute in equal part for banana in most recipes.

The flesh purees easily and freezes nicely (Alkofahi et al., 1989; Brannan & Wang, 2017; Jones & Layne, 1996; Rupprecht et al., 1986, 1990; Nam et al., 2018; Pomper & Layne, 2005). Research suggests that pawpaw fruit pulp has the potential to be added to various consumer goods to add increased nutritional benefits or flavor enhancement. The intense, tropical-fruit-like flavor makes it a potential source of natural fruit flavor (Brannan et al., 2012; McGrath & Karahadian, 1994a).

Refrigeration of ripe pawpaw pulp exhibits no effect on phenolics, flavonoids, reducing potential, and radical scavenging compared to fresh pulp (Brannan & Wang, 2017; Harris & Brannan, 2009). Frozen pawpaw pulp is commercially available and usually includes ascorbic acid as a browning inhibitor. Nonetheless, frozen tissue browns very easily upon thawing and longer-term frozen storage (Brannan & Wang, 2017).

Enzymatic browning could have a significant effect on both food quality and food nutrition value. Enzymatic browning in pawpaw pulp produces a color deemed undesirable. Although commercial frozen pawpaw pulp preserved with ascorbic acid is on the market, anecdotal evidence suggests that this pulp browns during storage and especially quickly once thawed. A strategy to inhibit enzymatic browning during frozen storage would be useful for the nascent pawpaw industry (Brannan & Wang, 2017).

In the “The edible pawpaw – A collection of delicious and nutritious recipes” book, by the Ohio pawpaw growers association we found a lot of recipes with pawpaw fruits: breads, muffins and biscuits; cake; cream and cheesecake; cookies; custards; dips; ice cream and sherbet; pasta; pies; preserves; jam; puddings; dressing and sauce for salads; smoothie.

Pawpaws varies in flavor and intensity. The sugars in pawpaws are converted at high temperatures into caramel or butterscotch flavours, so the browner the cookies, the more these flavours develop at the expense of the pawpaw flavor. In the Figure 2. are presented most of all the possibilities for storing and processing pawpaw fruits.

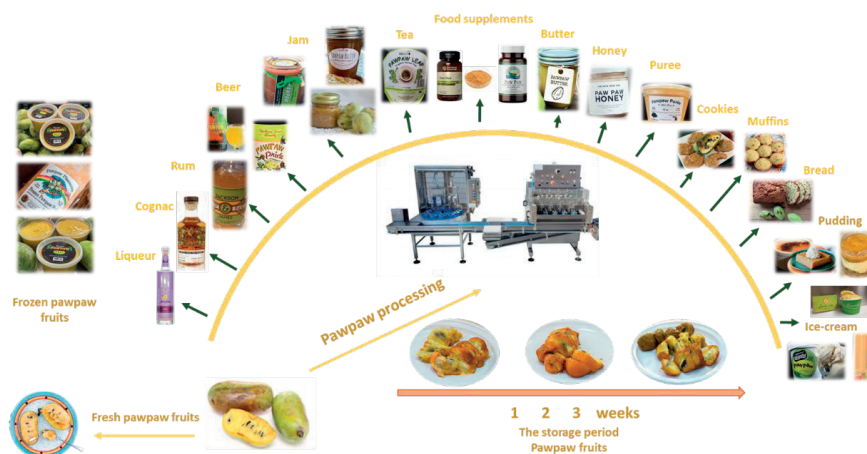


Figure 2. Processing of pawpaw - Source: Original

CONCLUSIONS

Asimina triloba (L.) Dunal is an interesting fruit and with a high nutritional potential for the whole country, but also for Romania.

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