Papaya Fortified Cookies-A Review

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***Abstract*— Papaya is a common fruit found in tropical areas that belongs to the Carcicaceae family. In terms of nutrition, papaya is high in and low in B complex vitamins, ascorbic acid, and minerals. Many preserved items, such as sweets, jams, and jellies, may be made from papaya. It may also be made into drinks like as fully prepared beverages and nectar. There are also dried and tinned papaya items available. Papaya by-products such as pectin and papain are valuable in the food business. Papaya is highly valued for its therapeutic benefits, which have been shown by several studies. The current analysis focuses on the key nutritional components, processed products, and therapeutic applications of papaya.**

I. INTRODUCTION

Papaya is a nutrient-dense fruit that is accessible year-round. It is high in three potent antioxidants: vitamin C, vitamin A, and vitamin E. Pantothenic acid and folate are vitamins whereas magnesium and potassium are minerals, and fibre in addition, it includes papain, a digestive enzyme that efficiently cures trauma, allergies, and sports injuries. All of the nutrients in papaya help the circulatory system, protect against heart disease, heart attacks, and strokes, and help prevent colon cancer. The fruit is high in beta-carotene, which protects against free radical damage, which can lead to cancer in some cases. It is said to have aided in the prevention of diabetic heart disease. Papaya reduces excessive cholesterol levels by fiber present in itself.

Papaya (*Carica papaya L*) is a fast-growing hollow-stemmed and short-lived perennial tree in the *Carcicaceae* family that is mainly cultivated from seeds. Papaya is famously difficult to keep as a clean or tree cultivar due to open pollination. This family contains four genera and perhaps twenty species of *carica* endemic to tropical and subtropical regions of the world (Sidhu, 2006). he fruit has gained in popularity in recent years, with the volume of production ranking second only to mango, banana, citrus, and pineapple on a global scale. Even in India, the fruit is more prevalent and comes in a variety of types. (Coorg Honey Dew et.al ,2012).

Between 2004 and 2012, global papaya output increased at a 3.85 percent yearly pace. India is the biggest papaya grower, accounting for 41.56 percent of global output between 2010 and 2012, with a total production of 5,639,310 tonnes in 2014 (APEDA), followed by Brazil (12.25 percent) and Indonesia (7.30 percent). Nigeria (6.79 percent), Mexico (6.18 percent), Ethiopia (2.34 percent), Democratic Republic of the Congo (2.12 percent), Colombia (2.08 percent), Thailand (1.95 percent), and Guatemala (1.85 percent) are other notable papaya producing nations (FOSTAT,2012a, b). This review article discusses the physiology and ripening of papaya, its chemical makeup, several products made from papaya, and the health advantages of papaya.

Papaya trees are quick growing, prolific fruitbearers, and the first fruit is ripe 10-14 months after the plants are introduced into the orchard (Sommer, 1985). In India, it takes around 135-155 days from fertilisation to fruit maturity (Selvaraj et al, 1982a, b). Afruit's weight and length reflect a classic double sigmoid growth curve (Selvaraj et al, 1982a, b; Ghanta et al, 1994; Ong,1983). Another indicator of papaya fruit maturity is the change in latex colour from white to watery (Akamine and Goo, 1997).

II. TAXONOMY OF PAPAYA

The papaya is a member of the *Caricaceae* family, which has four genera worldwide. In India, the genus *Carica Linn.* is characterized by four species, the most frequently grown and well-known of which is *C. papaya Linna*. The kingdom (*Plantea*), order (*Brassicales*), family (*Caricaceae*), genus (*Carica*), and species are all included in the taxonomic classification (*C. papaya*). Papaya, pawpaw, papaw, papita, arand-kharpuja, papaya, papayabaum, and papaia are other common names. Fruit, leaves, and bark are among the components employed.

The *Caricaceae* are members of the order *Brassicales (also known as Capparales*), which are distinguished by the presence of mustard-oil glucosides (glucosinolates) (Jrgensen, 1995; Rodman et al., 1998; Olson, 2002). *Carica L*. contains just one species, C. papaya, according to recent agreement, while the *Caricaceae Carica. Jacaratia* may include six genera (Aradhya et al., 1999; Badillo, 2000; et. Al.). The majority of the genera are neotropical forest plants that can be found in both South America and Mesoamerica, or just in Mesoamerica. *Vasconcellea*, the biggest genus with 21 species, was formerly thought to be a subgenus of (7 species), *Jarilla* (3 species), and *Horovitzia* (1 species) are the other neotropical genera (Badillo, 1993). Cylicomorpha is the sixth genus.

The International Plant Genetic Resources Institute (IPGRI) recognises eight distinct edible fruits from this family. Users from Mexico to South America harvest fruits from wild or semi-wild species. May be a few (thus incipient domestication). Siglalón silvestre, V. stipulata, is a traditional dish in southern Ecuador Small fruits of the Col de Monte (V. monoica) of Ecuador, Peru, and Bolivia are consumed fresh or cooked. Chungay or mito (V. candicans) is a popular dish in Peru (De Feo et al., 1999). Papayuelo (V.Colombian goudotiana) is tiny and apple-like. Tapaculo (bonete) is another edible Vasconcellea.Mountain pawpaw, V. cauliflora, whose fruit pulp is prepared in a variety of ways before being consumed. (Coppens d'Eeckenbrugge and Libreros et.al).

III. DISTRIBUTION AND CENTER OF ORIGIN

Carica papaya is endemic to the Western Hemisphere's north-tropical region. Some have proposed that the origins of the species occurred in Central America or to the south of Mexico (Storey, 1992 et. al.). Manshardt and Zee (1994) discovered delicious wild papayas near the Caribbean coast. Southern Mexico and northern Honduras lowlands The female wild plants produced golf ball-sized fruits weighing less than 100 g, which were frequently inedible (Manshardt, 1999). Bitter musty fruits (berries)have a significant investment in seeds that are approximately 25% smaller than domesticated papaya seeds and have stricter criteria for breaking dormancy.

Feral papaya on Central America's Caribbean coast has features that appear to indicate stronger introgression from wild papaya than feral papaya on the Pacific coast, which appears to have less wild traits (Manshardt and Zee, 1994).Greater introgression of domestication features in wild plants, as well as an increase in the occurrence of feral domesticated-type plants, has been discovered westward and southward from the known wild papaya zone.

Table 1- Production of papaya in different Countries

Country	Production
India	5,639,310
Brazil	1,517,696
Indonesia	906,312
Nigeria	775,00
Mexico	742,017
Ethiopia	308,654
Democratic Republic of Congo	295,770
Colombia	283,078
Thailand	271,584
Guatemala	201,000
Other	1,889,758
Total	12,413,031

IV. USE AS CROP AND AGRONOMICAL USES

Non-commercial papaya farming is widespread, and much of the output in some countries is not exported. Instead, farmers eat or exchange the fruits locally. Indonesia, for example, reported that it produced 744,000 tonnes, with fewer than 4 tonnes exported (Setyobudi and Purnomo, 1999 et. al.). In Vietnam, half of farm family’s plant papaya in home gardens, with 5 to 10 million or more cultivating 1-10 trees, but only 5,000-10,000 farmers cultivate papaya in monoculture gardens or huge fields (Le Tran and Tran, 1999 et. al.).

In 2004, the commercially reported output of papaya in 52 countries totalled 6.5 million metric tonnes (FAO, 2005). The total harvested area was 365, 846 hectares. Middle America (Central America plus North America) has seven producing zones, the Caribbean has five, South America has ten, Africa has eleven, the Near East has four, Asia has ten plus Australia, and Oceania has five. Brazil (24.6 percent), Mexico, Nigeria, India, and Indonesia were the top producers, followed by Ethiopia, the Democratic Republic of the Congo, Peru, Venezuela, and China.

In the Philippines, up to 1.5 million farmers earn money from the sale of papaya grown in their backyards, monocultures, or multiple-cropping systems (Kositratana et al., 1999). Income from a unit of land in papaya production may be two to four times that of rice; the total worth of papaya to the small farmer should not be underestimated (The Papaya Biotechnology Network of Southeast Asia-Workshop participants, 1999; ISAAA; cf. Cook, 2004).

V. PHYSIOLOGY AND RIPENING

Papaya trees are quick growing, prolific fruit bearers, and the first fruit is ripe 10-14 months after the plants are introduced into the orchard (Sommer, 1985). In India, it takes around 135-155 days from fertilisation to fruit maturity (Selvaraj et al, 1982a, b). Afruit's weight and length reflect a classic double sigmoid growth curve (Selvaraj et al, 1982a, b; Ghanta et al, 1994; Ong,1983). Another indicator of papaya fruit maturity is the change in latex colour from white to watery (Akamineand Goo, 1973).

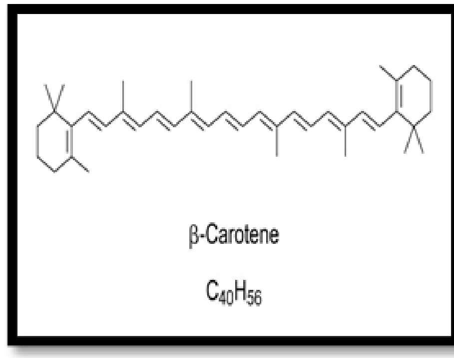
Trees begin to yield fruit within the first year of planting (some varieties within 7-9 months). The plant's commercial life in the large-scale commercial production cycle is normally three years, but it may be less or more in particular locations (Singh, 1990; Watson, 1997). Early, low-bearing plants for an annual crop have been produced in the United States Virgin Islands to reduce damage from papaya ring spot virus and seasonal storms (Zimmerman and Kowalski, 2004). In Hawaii, output reduces drastically in the fourth year, promoting replanting after the third year (Younge and Plucknett, 1981). Continuous production is feasible even in subtropical climates if winter temperatures are regulated, such as by ocean buffering, however flowering during cooler months may result in lower summer yields in some sites.

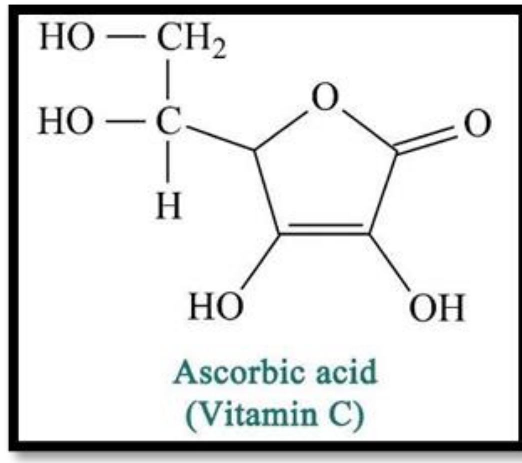
Fruit might begin to mature in 7-9 months, with full-production harvesting likely in another 2 months. The fruits may need to be thinned according on the variety. Sunrise Solo, for example ,may yield up to 5 fruits per node, but is reduced to 2 fruits by hand (Watson, 1997).

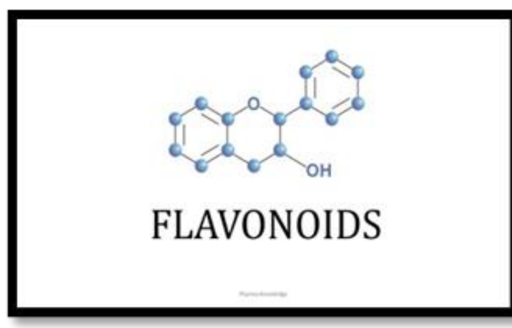
The density of planting varies on the papaya type and the location where it is grown; usual practise is to plant 1160 to 1930 plants per hectare (Watson, 1997), with trees spaced 1.8 to 2.7 m apart in the row and 2.7 to 3 m between rows. Sometimes two rows are planted, for example, 3.25* 1.75* 2.4 m. (PROSEA, 1991). Provision of optimum soil cover for the orchard area between trees is one of the most successful methods (Younge and Plucknett ,1981) shown that clover (e.g., Trifolium) or grass diminishes return when compared to clean cultivation; weedy covering of the space is also detrimental. Trash mulching, as well as a year of clover rotation between many years of continuous papaya cultivation, may boost yields. Mulching with coarse grass hay can significantly boost yields (Elder et al., 2002a).

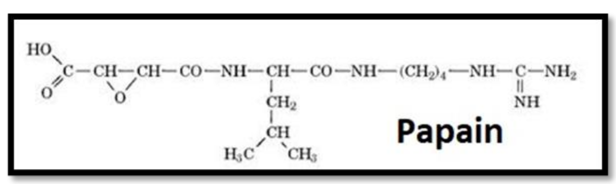
VI. CHEMICAL COMPOSITION

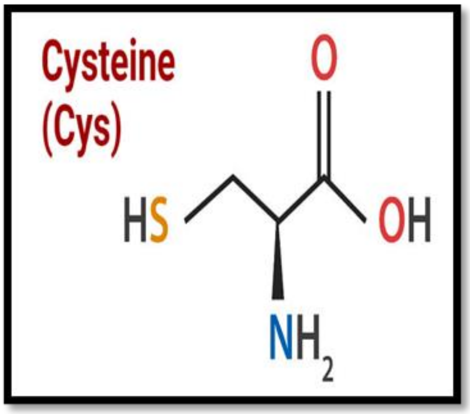
Because it is high in antioxidant nutrients (e.g., carotenes, vitamin C, and flavonoids), B vitamins (e.g., folate and pantothenic acid), minerals (e.g., potassium and magnesium), and fibre, papaya is regarded one of the most essential fruits (EDI, 2012). The papaya plant is laticiferous because it has specialised cells called laticifers. The papaya latex is widely recognised for being a rich source of the four cysteine, endopeptidases, namely papain, chymopapain, glycyl endopeptidase, and caricain (Azarkan et al., 2003), and the latex concentration might vary across fruit, leaves, and roots. The number of laticifers cells that generate latex reduces as the papaya fruit ripens (OECD, 2005). As a result, ripe papaya has less latex and other components.

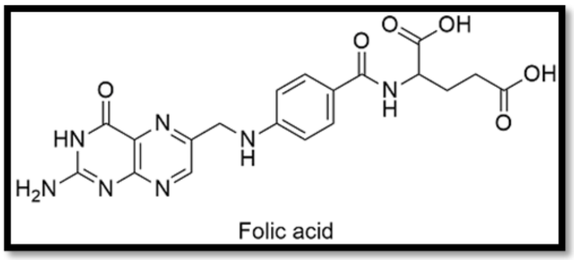












The enzyme content of papaya juice has been known since 1878. (Witmann, 1978). In 1968, the most significant enzyme, papain, was discovered (Drenth et al., 1968). The enzymes chymopapain and papaya protease III were discovered in the 1980s (Jacquet et al., 1989; Zucker et al., 1985). These two key chemicals, papain and chymopapain, are thought to help digestion and are thus commonly utilised to treat digestive issues (Huet et al., 2006). Papain is also utilised in meat tenderization, medicines, beauty items, and cosmetics (EDI, 2012). It has also been utilised in the brewing and wine making industries, as well as the textile and tanning industries. It is also utilised in the treatment of arthritis.

It is vital to notice that the levels and amounts of chemical components differ between the fruit, latex, leaves, and roots. The phytomedicine content of 100 gm of C, papaya leaf, immature fruit, and ripe fruit . Furthermore, the amount of chemicals in plant sections from male and female trees differs. For example, phenolic chemicals are more abundant in male trees than in female trees. The amount of fresh papaya latex and dried latex (crude papain) produced by the tree varies according to its gender and age. Female and hermaphrodite trees produce more crude papain than male plants, while older fruit produces more than younger fruit.

The numerous advantages of papaya stem from its high presence of vitamins A, B, and C, as well as proteolytic enzymes such as papain,chymopapain, which has antiviral, antifungal, and antibacterial properties. The seed methanolic extract and 2, 3, 4trihydroxytoluene (caricaphenyl triol) (200 g/ml) shown *Aspergillus flavus* has considerable antifungal action.*Candida albicans* and *Penicillium citrinium* (Singh and Ali, 2004).

Papaya contains variable amounts of carotenoids such as â-carotene, lycopene, â-cryptoxanthin, and â-zeacarotene (Sugiura et al,2002). Selvaraj et al. (1982) discovered a five to tenfold rise in carotenoids concentration (as â-carotene) in yellow skinned varieties. The colour of papaya flesh changes from green unripe fruit to yellow or crimson throughout ripening. The primary distinction between yellow and red fleshed cultivars is the absence of lycopene in yellow fleshed papaya. After blanching and drying in papaya fruit, carotenoids, which are more heat stable, retained more than anthocyanins.

The following chemical compounds are found in various sections of papaya: fruit, fruit juice, seed, root, leaves, bark, and latex.

1. 1.Fruit-Protein, fat, fibre, carbs, minerals such as calcium, iron, vitamin C, thiamine, rivoflavin, niacin, and carotene, anino acid, citric acid, and malic acid (green fruits), volatile chemicals such as benzylisothiocynate, cis and trans 2, 6-dimethyl-3,6 epoxy-7 octen-2-ol, alkaloids
2. N-butyric, n-hexanoic, and n-octanoic acids, lipids; myristic acid, palmitic acid, stearic acid, linolenic acid, linoleic acid, oleic acid.
3. Fatty acids from seeds, crude protein, crude fibre, papaya oil, carpaine, caricin, glucotropacolin, and an enzyme called myrosin.
4. Myrossin enzyme and root-carposides Carpain, pseudocarpain, dehydrocarpaine I and II, choline, vitamins C and E, and carposide are all found in the leaves. Bark contains glucose, fructose, sucrose, xylitol, and -sitosterol. Latex-Papain, chemopapain, peptidases A and B, and lysozymes

VII. NUTRITIONAL COMPOSITION OF PAPAYA

Ripe papaya has the following nutrients: energy (163 kj), protein (0.6 g), fat (0.1 g), minerals (0.5 g), fibre (0.8 g), carbs (7.2 g), beta-carotene (888 m), total carotene (2 740 m), salt (3 mg), iron (0.10 g), vitamin A (1 094 IU), vitamin E (0.73 mg), niacin (3 mg), and water (89 percent). These nutritional properties of papaya aid in the prevention of cholesterol oxidation. Papaya is high in iron and calcium, as well as vitamins A, B, and G, and is an excellent source of vitamin C. (ascorbic acid). C. papaya extract and fruit juice include alkaloids, glycosides, flavonoids, carbohydrates, saponins, terpenoids, steroids, and tannins.

Table2-Comparasion for nutrients present in leaves ,unripe and ripe fruit(papaya)

No.	Name of nutrient	Leaves	Unripe fruit	Ripe fruit
1	Calories	79cal	26 cal	46 cal
2	Vitamin A	18,250 SI	50 SI	365 SI
3	Vitamin B1	0.15mg	0.02 mg	0.04mg
4	Vitamin C	140mg	19mg	78 mg
5	Calcium	353 mg	50 mg	23 mg
6	Hydrate charcoal	11.9 gm	4.9 mg	12.2 mg
7	Phosphorus	0.0 gm	16 mg	12 mg
8	Iron	0.8 gm	0.4mg	1.7 mg
9	Protein	8.0 gm	2.1 gm	0.5 mg
10	Water	75.4 gm	92.4 gm	86.7 gm

VIII. PHARMACOLOGICAL PROPERTIES OF PAPAYA

C. papaya has been shown to have antioxidant, anti-hypertensive, wound healing, hepatoprotective, anti-inflammatory, antimicrobial, antifungal, anti-fertility, histaminergic, diuretic, anti-amoebic, anti-tumor, anthelmintic, effect on smooth muscles, antimalarial, hypoglycemic activity, immuno-modulatory activity, anti-ulcer activity, and anti-sickling.

ANTIOXIDANT ACTIVITY

The impact of a methanolic extract of unripe C. papaya fruits on the activities of antioxidant enzymes such as glutathione peroxidase (GPx), glutathione transferase (GST), glutathione reductase, catalase, and glucose-6-phosphate dehydrogenase in mice was studied in vivo. The ethyl acetate fraction significantly increases the activities of glutathione reductase, GST, GPx, and glucose-6-phosphate dehydrogenase. Following injection of ethyl acetate fraction, there was a significant reduction in GPx in the kidney. It has been proposed that quercetin and -sitosterol are responsible for the antioxidant potential.

ANTIHYPERTENSIVE ACTIVITY

For anti-hypertensive action, an ethanolic extract of ripe C. papaya fruit was utilised. In the normotensive, renal, and DOCA-salt hypertensive animals, the basal mean arterial blood pressure (MAP) was (93.84.5), (175.25.1), and (181.36.2) mmHg, respectively. Both hydralazine (200 L/100 g, i.v.) and an ethanolic extract of unripe C. papaya fruit (20 mg/kg, i.v.) significantly reduced MAP in normotensive, renal, and DOCA-salt hypertensive animal groups compared to controls. In the hypertensive group, however, the extract induced approximately 28% higher MAP depression than hydralazine. According to the findings, the unripe fruit of C. papaya has substantial anti-hypertensive effect.

HEPATOPROTECTIVE ACTIVITY

The aqueous and ethanol extracts of C. papaya dried fruit were tested for hepato protective efficacy in rats against CCl4-induced hepatotoxicity. C. papaya aqueous (250 mg/kg, p.o.) and ethanol (250 mg/kg, p.o.) extracts shown considerable hepatoprotection by decreasing biochemical markers such as SGPT, SGOT, serum bilirubin, and akaline phosphatise.

WOUND HEALING PROPERTIES

The wound healing activity of C. papaya fruit aqueous extract [100 mg/(kg.d)] in excision and dead space wound models were used in streptozotocin –induced diabetic rats for 10 days. The aqueous extract reduces wound area by 77 percent compared to the standards' 59 percent contraction to wound. As a consequence, the results indicated that the aqueous extract of C. papaya showed powerful wound healing properties.

ANTI-INFLAMMATORY ACTIVITY

The ethanolic extract of C. papaya leaves was tested in rats with carrageenan-induced paw oedema, cotton pallet granuloma, and formaldehyde-induced arthritis. The extract's ulcerogenic action was also studied. The extract demonstrated a considerable decrease in paw oedema in the carrageenan test at a dosage of 25-250 mg/kg p.o. At larger dosages, the extract caused mild mucosal irritation.

ANTIMICROBIAL ACTIVITY

Using the agar diffusion technique, an aqueous extract of C. papaya leaves and roots at various doses (25, 50, 100, and 200 mg/mL) shown antibacterial efficacy against several human pathogenic bacteria.

ANTIFUNGAL ACTIVITY

The latex of C. papaya and fluconazole work together to prevent the development of *Candida albicans*. The upshot of this synergistic impact is partial cell wall disintegration. Latex proteins appear to be responsible for antifungal activity, and the minimal protein concentration for full suppression has been observed to be around 138 mg/mL.

ANTIFERTILITY ACTIVITY

The crude extract of C. papaya bark [5-10 mL/(kg.d), p.o for 4 weeks] on the seminiferous tubules of rats caused full fertility loss due to a decrease in sperm motility and morphological changes. Thus, the bark demonstrated that it was safe and could be used as an efficient male contraceptive in animals.

HISTAMINERGIC ACTIVITY

C. papaya crude extract (0.5-512 g/mL) produced concentration-dependent contraction of ileal strips suspended in tyrode solution, which was mediated by the H1-receptor and is reliant on extracellular Ca2+ influx.

DIUERITIC ACTIVITY

When rats were administered aqueous root extract of C. papaya orally at a concentration of 10 mg/kg, there was a considerable increase in urine production and comparable profiles of urinary electrolyte excretion to those of hydrochlorothiazide.

PAPAYA BASED PRODUCTS

Because the papaya fruit grows quicker with larger yields and has a broad variety of types, it may be utilised to make commercially feasible products on a commercial scale, with plenty of room for mixing with other fruits. Because of the fruit's moderate flavour, the goods may be complemented with other strong flavours, allowing for tailor-made sensory products. Aside from consumption as a fresh fruit, a variety of processed food products derived from papaya are used, including puree (Brekke et al., 1972; Martin et al., 1972; Flath and Forrey, 1977; Nath and Ranganna, 1981), jam (Parsi, 1976, Teangpook and Poasantong, 2013), jelly (Yi-zhuo et al., 2013; Mie, 2013), etc

PAPAYA CANDY

Papaya candies are fruit made with a high sugar content. The primary basic components are papaya and sugar. Kumar (1952) describes the preparation of papaya candy as follows.

Fully mature but unripe fruit is hand peeled, deseeded, and cut into 0.5–1.0 cm cubes.

$\Downarrow$

These cubes are soaked in 4% brine solution for 2 weeks, taken out and leached in running tap water to remove the salty taste.

$\Downarrow$

The fruit is boiled in 25^{o} Brix syrup for a few minutes and then allowed to stand overnight.

$\Downarrow$

The sugar content of syrup is increased by 10% by boiling the mixture of fruit/syrup and allowed to stand overnight.

$\Downarrow$

This process is repeated for 5 days until the syrup concentration reaches between 70 and 75^{o} Brix after standing.

$\Downarrow$

Other fruit essences such as orange, pineapple, raspberry, and strawberry are added to the syrup and allowed to stand overnight.

⇩

A translucent candied papaya is obtained at this stage, which can be rolled in powder sugar to prevent stickiness.

The researchers concluded that when high SO2 levels were utilised, the drying rate was reduced. The colour of the leather was affected by drying and storage temperatures, and the addition of SO2 protected against darkening at high drying and storage temperatures. (Cherian and Cheriyan ,2003) investigated the sensory acceptability of papaya leather by creating two distinct products, papaya leather and papaya+mango (60:40) mixed leather, and comparing the two leathers with a control plain mango leather. Ahmad et al. (2005) created a fruit bar from of ripe papaya pulp and tomato pulp (75:25). With the mixture of the three hydrocolloids, seven distinct fruit bars were created.

It was discovered that seven distinct fruit bar samples had moisture contents of 20.9–22.1 percent and total soluble solids of 78.1–78.8°Brix, respectively, while pH, browning index, and vitamin C contents were in the following ranges: 4.3–4.50,0.137–0.150 (OD), and 40.5–41.4 mg/100. Jadhav et al. (2012) made toffee by mixing noni pulp with papaya pulp in the following ratios: (i)100:0, (ii) 95:5, (iii) 93:7, and (iv) 90:10, and investigated the influence of altering fruit pulp pulp concentration on the sensory quality of noni (Morinda citrifolia L). Toffee consisting of 90% noni pulp, 10% papaya pulp, and 7% guava pulp showed superior overall sensory appeal in terms of appearance, colour, flavour, and consistency.

PAPAYA JAM

Jams are fruit preserves made by combining 45 parts prepared fruit with 55 parts sugar concentrate to produce a semi-solid product with a solid content of 65 percent or more. According to Lal and Das (1956), the processing procedure for papaya jam production is described.

Teangpook and Poasantong (2013) investigated the storage durability of low sucrose papaya jam made from ripe papaya pulp and green lime juice. The developed jam contained 52.10 percent moisture, 45.61 percent total carbohydrate, 0 percent fat, and 1.52 percent dietary fibre and was made up of papaya (32%), lime juice (8%), low ester pectin (0.55 percent), konjac flour (0.5 percent), glucose syrup (9%), salt (0.03 percent), and calcium lactate (0.01 percent). It included 36.46 percent sucrose compared to control jam, which contained 55 percent sucrose, 46° Brix TSS, and a pH of 3.22. The average sensory assessment score was moderate preference, and 79.31% of customers approved.

Cooked slices are mashed, mixed with equal weight of sugar, and the mixture is cooked

⇩

Citric acid at the rate of 5 g/kg of pulp is added to improve the sugar–acid ratio and it also helps in the production of inverted sugars, which prevent sugar crystallization in jam during storage.

⇩

Cooking of fruit pulp/sugar mixture is continued until it attains a thick consistency, which usually corresponds to a TSS of 65–68^{o} Brix.

⇩

Jam is filled hot into clean, dry, and sterilized glass jars, sealed airtight and cooled.

PAPAYA JELLY

Fruit jelly is a preserved fruit product with a distinct texture and substance. The processes for manufacturing jelly are the same as for jam, except that the sliced fruits are cooked in adequate water and citric acid is added to extract pectin, which is then decanted and heated with sugar until it forms sheets or flakes when dipped from a spoon. The temperature is then set to chilly. Yi-zhuo et al. (2013) used single factor experiments and orthogonal testing to improve and produce papaya jelly. The finest papaya jelly recipe includes a 6:5:4 ratio of sodium alginate, agar, and xanthan gum (3.0 g total), 40g of papaya, 0.2g citric acid, and 16g sugar. The papaya jelly was smooth and homogenous, with a pleasant flavour. Look at the top manufacturing processing technologies.

PAPAYA BEVERAGE

The thin pulp of the fruit is blended with sugar and citric acid to make juice or nectar. The completed product has a brix of 15-20% and a slight acid flavour. According to Payumo et al., (1968), the procedure for preparing papaya juice and nectar is described.

Papaya pulp is mixed with sugar (1.5-2.0kg/kg pulp).

⇩

Citric acid (12.5-17.5g/kg pulp), color and flavour are added.

⇩

Nectar is filtered and heated to 85-88°C.

⇩

Filled in plain or lacquered cans and cooled in running water about 38°C

Rodriguez and George (1971) created a high-quality canned papaya beverage using peeled and unpeeled fruit pulp. Before pasteurization, 0.4 percent of sliced, ripe Indian lime was added to enhance the flavor of the beverage. The beverage was pasteurized at 88°C and canned after being adjusted to 15o Brix and pH of 3.7. Even after a year of storage, the product retained its superb organoleptic properties. Chan et al. (1975) investigated the changes in ascorbic acid, carotenoid content, and sensory quality of papaya puree at various levels of processing. Approximately 5.5 percent of the ascorbic acid was damaged during pulping in the manufacture of puree, and an additional 14 percent was lost during vacuum concentration. With the concentration changed, there was no difference in quality, taste, or scent..

Various writers have reported on the creation of various types of papaya juice mixes and nectars. Mostafa et al. (1997) created two fruit nectars from I papaya pulp and (ii) papaya and mango pulps. The two nectars comprised total pulp concentrations of around 20, 30, or 40%, TSS - 15%, and acidity as citric acid - 0.55 percent. Mango pulp was added at a rate of 0, 15, 25, 37.5, or 50% of the total pulp content. A mix of 15% papaya and 15% mango was deemed good and was associated with increased acceptance.

Yadav et al(2013). Investigated optimization research on the formulation of blended fruit nectar based on papaya and bottle gourd. The nectar's constituent composition (percentage) of papaya: bottle gourd juice (2.47:1), sugar (20.95), and citric acid was optimized (0.30). The nectar had a pH of 3.99, an acidity of 0.35 percent, a TSS of 20.80, and hedonic scale sensory scores of 7.43 and 7.18, respectively, for flavor and taste.

FERMENTED PAPAYA PRODUCTS

Wen-Jun and Hong (2008) investigated the brewing method of papaya and jujube for the production of healthy wine. A technique for making wine was published that involved fermenting papaya, jujubes, powdered Eucommia extract, and honey for 48 hours at 30-34° C. Lee et al. (2011) investigated the effect of amino acid addition on fragrance components in papaya wine fermented with Williopsis mrakii. According to the findings, fermentation of papaya juice with W.Saturnus mrakii in conjunction with the inclusion of chosen amino acids (L-leucine, L-isoleucine, L-valine, and L-phenylalanine) can be an efficient strategy to adjust the scent of papaya wine.

PAPAYA PICKLE

Raw papaya may be used to make salted pickles the traditional manner by brining and adding spicy vinegar. Su and Liu (2006) investigated the processing procedure of papaya pickle production with spices (including garlic, hot pepper and ginger). Nurul and Asmah (2012) created a papaya pickle and compared its total phenol (TPC), total flavonoid (TFC), â-carotene, lycopene, ascorbic acid content, and antioxidant activity to that of fresh papaya. The pickling process resulted in a considerable drop in the above-mentioned metrics as compared to fresh papaya, according to the researchers.

DRIED PAPAYA PRODUCTS

A variety of low-moisture goods, such as fruit leather, powder, toffees, chunks, rolls, and slices, have been made from papaya puree and are now available on the food commodities market. Siddappa and Lal (1964) patented a method for drying mixes of previously concentrated papaya juices with sugar and other additions. Mehta and Tomar standardised a technique for dehydrating ripe papaya slices after steeping in 70 o brix syrup with 1000 ppm SO_2 to get the highest quality product (1980 a,b). According to Ponting et al. (1966), pulp may also be bedried after adding 5–7.5% sugar, 0.5 percent citric acid, and 0.3 percent potassium metasulphite. This mixture is spread in a 1 cm layer on greased trays and dried in an in cabinet drier at 55–600°C. The dry product had a leathery quality and was rolled and cut into desired sizes.

When maintained at room temperature for 9 months, papaya fruit bars preserved 54%, 46%, and 43% of total carotenes, â-carotene, and vitamin C, respectively, and were considered to have improved texture and aroma with less physicochemical changes (Aruna et al., 1999). The best ratio of papaya puree to pineapple puree for cheese products using fruit blends was 2:1 with 2% pectin and processed to 77–80° Brix (Barbaste and Badrie, 2000). Sensory study revealed a clear preference for the mixed fruit cheese. The shelf life of these items at 4–5°C was around 8 weeks.

PAPAYA PRESERVES

Papaya preserves are made by washing, peeling, and deseeding papaya and then cutting it into pieces; the pieces are then steeped in a solution containing sulfite and calcium chloride for 1-2 days. The treated pieces are blanched in hot water (90 degrees Celsius), cooled, and then immersed in 30 Brix sucrose syrup. More sucrose is progressively added to the syrup until its concentration reaches 45 Brix. The syrup-infiltrated fruit is dipped into boiling water to remove the sugar on their surface, then dried in a hot air oven until the water activity decreases to 0.75 or below (Chen etal., 2005). Papaya preserves are made by washing, peeling, and deseeding papaya and then cutting it into pieces; the pieces are then steeped in a solution containing sulfite and calcium chloride for 1-2 days. The treated pieces are blanched in hot water (90 degrees Celsius), cooled, and then immersed in 30 Brix sucrose syrup. More sucrose is progressively added to the syrup until its concentration reaches 45 Brix. The syrup-infiltrated fruit is dipped into boiling water to remove the sugar on their surface, then dried in a hot air oven until the water activity decreases to 0.75 or below (Chen etal., 2005).

CONCLUSION

Carica papaya is regarded as an important fruit due to its nutritional, pharmacological, and neutraceutical characteristics. Carotenes, vitamin C, and flavonoids, B vitamins such as folate and panthothenic acid, minerals such as potassium and magnesium, dietary fibre, and phytochemicals are all abundant in papaya. Aside from consumption as a fresh fruit, a variety of processed products derived from papaya are used on a commercial scale, including puree, jam, jelly, pickle, candied fruit, blended beverages, canned slices/ chunks,concentrate, fermented juices, dried products, minimally processed products, and by products. The functional components of the papaya, such as the fruit's pectin content, help in the manufacture of numerous processed goods such as jams and jellies.

REFERENCES

[1] Sidhu JS. Tropical Fruits: Guava, Lychee, Papaya. In:Handbook of Fruits and Fruit processing. Editor Hui,Y. H. Blackwell Publishing Professional, USA. 2006;597-634

[2] Sommer NF. Post harvest handling systems: Tropicalfruits. In: Post Harvest Technology of HorticulturalCrops. Edited by Kader AA, Davis CA: CooperativeExtension Service, University of California. 1985; pp 162-169

[3] Selvaraj Y, Pal DK, Subramanyam MD, Iyer CPA.Fruits set and the development pattern of fruits offive papaya varieties. Indian Journal of Horticulture. 1982a; 39; 50-56.

[4] Selvaraj Y, Pal DK, Subramanyam MD, Iyer CPA.Changes in the chemical composition of four cultivars of papaya (Carica papaya L). During growth and development. Journal of Horticultural Sciences 1982b; 57:135-143

[5] Akamine EK, Goo T. Respiration and ethylene production during ontogeny of fruit. Journal of American Society for Horticultural Science.1973; 98:381–383

[6] Matsuura, F.C. A.U, Folegatti, M.I.D.S, Cardo-so, R.L. and Ferreira, D.C 2004. Sensory acceptance of mixed nectar of papaya, passion fruit and Acerola. Science Agriculture(Piracicaba, Braz). 61: 604-608

[7] Sommer NF. Post harvest handling systems: Tropical fruits. In: Post Harvest Technology of

Horticultural Crops. Edited by Kader AA, Davis CA: Cooperative Extension Service, University of California. 1985; pp 162-169.

[8] Singh LB, Tripathi RD. Studies on the preparation of papain. Indian Journal of Horticulture. 1957; 14(2):77-80

[9] Singh G, Singh AK. Physicochemical quality ofpapaya fruits (Carica papaya L.) as influenced by different planting times. Indian Food Packer. 1998;52(3):28–32

[10] Drenth J, Jansonius JN, Koekoek R, Swen HM, Wolthers BG. Structure of papain. Nature. 1968;218:929-932

[11] Hewitt H, Whittle S, Lopez S, Bailey E, Weaver S. Topical use of papaya in chronic skin ulcer therapy in Jamaica. West Indian Med J. 2000;49:32-33.

[12] Singh O, Ali M. Phytochemical and antifungal profiles of the seeds of Carica papaya L. Indian J Pharm Sci. 2011;73:447- 451

[13] Siugiura M, Kato M, Matsumoto H, Nagao A, Yano M. Serum concentration of âcryptoxanthin in Japan reflects the frequency of Satsuma mandarin (Citrusunshiu Marc.) consumption. Journal of Health Science. 2002; 48(4): 350–353

[14] Brekke JE, Chan HT, Cavaletto CG. Papaya puree: A tropical flavour ingredient. Food Product Development.1972; 6 (6): 36-37

[15] Flath RA, Forrey RR. Volatile components of papaya (Carica papaya L. Solo variety). Journal of Agricultural and Food Chemistry. 1977; 25 (1):103–109.

[16] Nath N, Ranganna S. Determination of a thermal process schedule for acidified papaya. Journal of Food Science. 1981; 46:201–206, 211

[17] Parsi-Ros O. The preparation of papaya jam. Journal of Agriculture of the University of Puerto Rico. 1976; 60(1); 129-130

[18] Teangpook C, Paosantong U. Production and shelf-life of low sucrose lime juice papaya jam. Pakistan Journal of Nutrition. 2013; 12(9): 870-878

[19] Yi-zhuo L, Ling-wen Z, Qing-xin W. Preparation of healthy papaya jelly. Food Science and Technology.2013; 38(7); 133-136

[20] Lal G, Das DP. Studies on jelly making from papaya fruit. Indian Journal of Horticulture.1956; 13(1):38-44.

[21] Payumo EM, Pilac LM, Maniguis PL. A study of colour changes in stored papaya nectar. Philippines Journal of Science. 1968; 97:127-138.

[22] Chan Jr HT, Flath RA, Forrey RR, Cavaletto CG,Nakayama TOM, Brekke JE. Development of off-odors and off-flavors in papaya puree. Journal of Agricultural and Food Chemistry 1973; 21(4):566–570

[23] Chan Jr HT, Kuo MTM, Cavaletto CG, Nakayama TOM, Brekke JE. Papaya Puree and concentrate:changes in ascorbic acid,carotenoids and sensory quality during processing. Journal of Food Science. 1975; 40 (4): 701–703.

[24] Mostafa GA, Abd-El EAH, Askar A. Preparation of papaya and mang o nectar blends. Fruit Processing.1997; 7(5): 180-185

[25] Yadav BS, Yadav RB, Mohit. KN. Optimization studies on the development of a blended fruit nectar based upon papaya (Carica papaya) and bottle gourd(Lagenaria siceraria). British Food Journal. 2013; 115(7):936-952

[26] Wen-Jun Z, Hong Y. Study on brewing technology of papaya and jujube healthy wine. Food Science and Technology. 2008; 10: 48-50.

[27] Lee PR, Yu B, Curran P, Liu SQ. Impact of amino acid addition on aroma compounds in papaya wine fermented with Williopsis mrakii. South African Journal of Enology and viticulture. 2011; 32(2): 220-228

[28] Su YL, Liu GD. Study on the processing technique of papaya pickles. Food Science and Technology. 2006; 8: 91-93.

[29] Nurul SR, Asmah R. Evaluation of antioxidant properties in fresh and pickled papaya. International Food Research Journal. 2012; 19(3): 1117-24.

[30] Siddappa GS, Lal G. Improvement in or relating to the manufacture of fruit juice products. Indian PatentNo. 49590.1964

[31] Mehta GL, Tomar MC. Studies on dehydration of tropical fruits in Uttar Pradesh. III Papaya (Carica papaya L.) Indian Food Packer. 1980a; 34(4):12-16

[32] Ponting JD, Wtters G, Forrey RR, Jackso R, Stanley WL. Osmotic dehydration of fruits. Food Technology. 1966; 20 (100):125-129

[33] Aruna K, Vimala K, Dhanalakshmi, Reddy V.Physico-chemical changes during storage of papaya fruit (Carica papaya L.) bar (Thnadra). Journal of Food Science and Technology. 1999;36(5): 428-433.

[34] Barbaste A, Badrie N. Development of processing technology and quality evaluation of papaya (Carica papaya) cheese on storage. Journal of Food Science and Technology India. 2000; 37 (3): 261-264

[35] Chan Jr HT, Kuo MTM, Cavaletto CG, Nakayama TOM, Brekke JE. Papaya Puree and concentrate: changes in ascorbic acid, carotenoids and sensory quality during processing. Journal of Food Science. 1975; 40 (4): 701–703