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A SHORT REVIEW ON SAPOTA (*MANILKARA ZAPOTA* L.) FRUIT: NUTRITION PROFILE, ETHNOMEDICINAL VALUES, AND UTILIZATION IN THE FOOD INDUSTRY

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Abstract: This article focused on the significance of the *Manilkara zapota* L. (sapota) fruit and its nutritional content, therapeutic benefits, and application in the food sector. Since fruits are abundant in vital micronutrients, useful substances, and free radical-scavenging antioxidants, and their preventive properties can be very helpful for preserving public health. More than 40 scientific publications with the keywords "Sapota - overview, geographical extent, nutritional profile, ethnomedicinal values, and uses in the food industry" were taken into consideration for this review from a number of databases between 2011-2022. The most well-known and frequently grown fruit from the Sapotaceae family is the *Manilkara zapota*, sometimes referred to as sapota. Sapota has a wide range of bioactive substances in addition to being a rich source of nutrients (sugars, protein, and amino acids), minerals (calcium, iron, and potassium), and vitamins (vitamin A, vitamin C, folate, and pantothenic acid). They have a variety of pharmaceutical properties like antimicrobial, anti-inflammatory, antipyretic, antiviral, antidiarrheal, antihyperglycemic, antiparasitic, antibiotics, anticancer, antitumor, and hypercholesteraemic properties. Sapota fruits have a limited time in storage. Therefore, sapota fruit is typically processed into a variety of culinary items, such as squash, jellies, jam, osmo-dehydrated slices, nectar, chutney, pickles, and blended sapota beverages, to deal with its perishability. The future scientific research on this fruit will undoubtedly rely heavily on this review work.

***Index Terms - Manilkara zapota* L., Nutrient content, Pharmaceutical properties, Culinary items.**

1. INTRODUCTION

Sapota is a member of the Sapotaceae family, which has 700 species across a wide range and 35 or 40 inadequate taxa. Sapodilla, chickoo, and sapota are all popular names for *Manilkara zapota* (L.) P. Royen. The Spanish word zapotilla, which means "sapote" (a soft edible fruit) comes from the name Sapodilla (Bano and Ahmed, 2017). There are also other names that may be used as synonyms for the scientific name of sapota, including *Achras sapota* L., *Achras zapotilla* Nutt., *Achras zapota* L. var. zapotilla Jacq., *Achras mammosa* L., *Manilkara achras* (Miller) Fosberg; *Sapota zapotilla* (Jacq.) Coville; *Sapota achras* Miller; and *Sapota zapotilla* (Coville) (Madani et al., 2018).

Sapota is a significant small fruit crop and may be regarded as one of the fruits that is healthy because it contains a variety of healthful nutrients. It is a tasty fruit known for its mellow and sweet pulp, granular texture, and pleasant scent. Its pulp is red, or light brown, and its thin skin is yellowish with a dull shade of brown (Siddiqui et al., 2014). It includes minerals like iron, potassium, copper, and calcium, as well as proteins, amino acids, and phenolic substances like carotenoids, catechin, chlorogenic acids, gallic acids, ascorbic acids, leucodelphinidin, leucopelargonidin, and leucocyanidin. With the abundance of phytochemicals, sapota is a rich source of antioxidants and a free radical scavenger. Due to its numerous beneficial characteristics, sapota is a perishable fruit that has played a significant part in traditional Indian medicine (Dola et al., 2019; Oza et al., 2020; Durairajan and Raja, 2022).

In sapota seeds, numerous phytochemicals like saponin, sapotin, and sapotinine are present. Since the seeds contain the toxin hydrocyanic acid, they should be removed before consumption (Cortez et al., 2013).

1.1 Vernacular Names

The word "sapota" has several different names across the world. The *Manilkara zapota* plant is also known as shown in Table 1 (Rojas-Sandoval and Praci, 2017).

Table 1. Vernacular Names of *Manilkara zapota Plant*

English	sapodilla; naseberry; marmalade palm
Spanish	chicozapote; nispero; sapotillo; zapote
French	sapotier; sapotillier
Cambodia	lomut
Laos	lamud
Portuguese	sapoti; sapotilheira
Malaysia	ciku
Italy	sapota
Netherlands	sapodilla; pruimboom; sapodilleboom
Philippines	chico
Thailand	lamut; lamut-farang
India	chikko

1.2 Taxonomical Hierarchy

The taxonomical hierarchy of the sapota plant is shown in Table 2 (Rojas-Sandoval and Praci, 2017).

Table 2. Taxonomical Hierarchy of *Manilkara zapota* Plant

Domain	Eukaryota
Kingdom	Plantae
Phylum	Spermatophyta
Subphylum	Angiospermae
Class	Dicotyledonae
Order	Ebenales
Family	Sapotaceae
Subfamily	Sapotoideae
Genus	*Manilkara*
Species	*Manilkara zapota*

1.3 Species

There are 11 species of sapota in the genus Manilkara as shown in Table 3 (The Plant List, 2012).

Table 3. Some Species of Genus *Manilkara*

Manilkara achras (Mill.) Fosberg	*Manilkara breviloba* Gilly
Manilkara calderonii Gilly	*Manilkara conzattii* Gilly
Manilkara gaumeri Gilly	*Manilkara grisebachii* (Pierre) Dubard
Manilkara meridionalis Gilly	*Manilkara rojasii* Gilly
Manilkara striata Gilly	*Manilkara tabogaensis* Gilly
Manilkara zapotilla (Jacq.) Gilly	

1.4 Description of the Plant

According to botany, sapota is a medium-sized tree often referred to as a "chicle" tree, that is slow-growing, long-living, evergreen, and may grow up to 20-30 m in height having a 1.5 m diameter of the trunk (Woo et al., 2013; Dewangan et al., 2019). Small, bisexual, bell-shaped, cream-colored flowers with a diameter of 10 mm are produced individually or in groups on the leaf axils close to the branch tips (Panda et al., 2014; Bano and Ahmed, 2017). The sapota fruit matures around eight months after blossoming. The fruit which is typically accessible from May to September. The fruits are shown on the branches, which are securely connected by a short stem (Carvalho et al., 2014). It is an ellipsoid or ovoid-shaped fruit that is initially dark in color, slightly sweet in flavor, and pale yellow-brown in texture. The center of their brownish flesh contains 3-12 tiny, flattened, smooth, black seeds that are ¾ inch in length. The fruit weighs around 150 gm and ranges in size from 3/8 inch (9.5 mm) in diameter as shown in Figure 1 (Padmavathi, 2018; Bangar et al., 2022). The mature, ripe fruit is soft and juicy, in contrast to the immature fruit's harsh, and abrasive texture (Durairajan and Raja, 2022). Fruit's ripening stage impacts its physicochemical characteristics, which in turn affects the quality of processed goods made from it (Pawar et al., 2011).

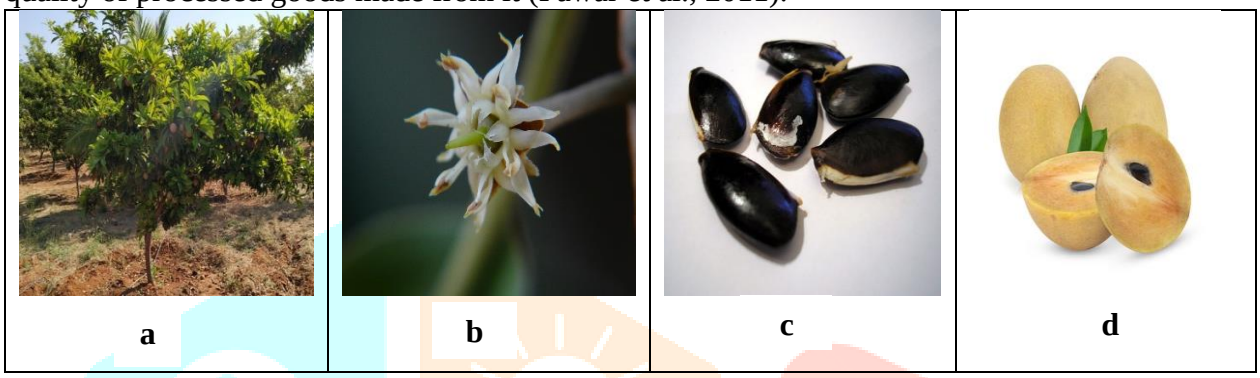

Figure 1. Sapota: (a) whole plant; (b) flower; (c) seeds; (d) fruit

1.5 Origin and Geographic Scope

The sapota or sapodilla is a tropical evergreen tree that is indigenous to Central America and Southern Mexico, but it has since spread to many other nations with tropical and subtropical climates. Thailand, Pakistan, Sri Lanka, Vietnam, Bangladesh, Maldives, Belize, Indonesia, Malaysia, and Caribbean are other countries where sapota is cultivated (Milind and Preeti, 2015; Uekane et al., 2017). In India, the fruit is widely referred to as "chikku" and is mostly planted for its fruit value; but, in some nations, such as Guatemala and Southeast Mexico, it is commercially grown for the manufacturing of "chuckle", which is a coagulated milky latex made from the bark of the sapota tree. The primary component of chewing gum is the chuckle (Siddiqui et al., 2014).

With an output of 11,56,060 Megatonne (MT) of fruit from a crop area of 97,000 Hectare (ha) in 2017-18, India is one of the world's top producers of sapota. Due to its high yield per unit area and year-round fruiting, the crop is becoming more and more popular. Around 2,039 metric tonnes of sapota, worth 35.3 million rupees, are exported from India (Anoymous, 2011). In India, there are currently more than 35 sapota varieties being grown commercially (Durairajan and Raja, 2022). The states of Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, and West Bengal are among those that cultivate a significant amount of sapota. India's top sapota grower is the state of Karnataka, where 2,93,000 ha of plants yield 3,60,000 MT of fruit annually (Suhasini et al., 2013).

2. NUTRITIONAL PROFILE

Sapota's abundance of vital nutrients encourages general health and well-being (Antala et al., 2021). The nutrient-rich fruit sapota includes glucose, fructose, sucrose, dietary fiber, minerals (calcium, iron, phosphorus, potassium, and magnesium), vitamins (vitamin A, vitamin C, thiamine, riboflavin, pantothenic acid, and folate), as well as a number of phytochemicals, fatty acids, and polyamines. It has been found that polymeric changes, interactions with other substances, such as sugars, and a decline in polyphenol content as fruit size increases are all associated with a reduction in astringency throughout fruit growth and ripening (Oliveira et al., 2011; Tewari et al., 2021). Alanine, glutamic acid, glycine, methionine, proline, hydroxyproline, phenylalanine, taurine, tyrosine, threonine, serine, valine, and phosphoethanolamine are among the amino acids added to sapota fruit (Panda et al., 2014).

There are 24 antioxidant components in the sapota fruit extract, including polyphenols, flavonoids, terpenes, and glycosides. Due to the fruit's antioxidant properties, the polyphenol content is able to counteract oxidative stress (Kamaruddin et al., 2021). The sapota fruit's methanol extract contains bioactive flavonoids such (-)-epicatechin, (+)-gallocatechin, myricitrin, gallic acid, quercetin, and (+)-catechin, the latter three of

which have been shown to inhibit the activity of the enzyme's elastase and collagenase (Pientaweeratch et al., 2016). Catechin, dihydromyricetin, epicatechin, gallocatechin, gallic acid, methyl chlorogenate, myricetin, quercetin, leucocyanidin, leucopelargonidin, leucodelphidin, galloyl chlorogenate, and galloyl chlorogenic acid are some of the phenolic compounds. The sapota also reported that isolation of lupeol-3-acetate, apigenin-7-*O*-α-L-rhamnoside, myricetin-3-*O*-α-L-rhamnoside, oleanolic acid, and caffeic acid (Fayek et al., 2012; Barbalho et al., 2015).

Here below is the nutritive value of fresh sapota fruit in Table 4 (Singh et al., 2021).

Table 4. Nutritive Value of Fresh Sapota Fruit in 100 gm

Nutrients (100 gm)	Value
Energy	83 kcal
Protein	0.44 gm
Carbohydrates	19.9 gm
Dietary Fiber	5.3 gm
Total Fat	1.10 gm
Cholesterol	0 mg
Vitamins	
Vitamin A	60 IU
Vitamin C	14.7 mg
Niacin	0.200 mg
Folate	14 µg
Electrolytes	
Potassium	193 mg
Sodium	12 mg
Minerals	
Calcium	21 mg
Magnesium	12 mg
Iron	0.80 mg
Zinc	0.10 mg
Copper	0.086 mg
Phosphorus	12 mg

3. ETHNOMEDICINAL VALUES

Sapota possesses a powerful antioxidant, antibacterial, antimicrobial, anti-inflammatory, antipyretic, antiviral, antidiarrheal, antihyperglycemic, antiparasitic, antibiotics, anticancer, antitumor, analgesic, diuretic, pulmonary disease, hypercholesteraemic, hemorrhoids, helping in blood pressure, increase and strengthen bones quality, constipation, HIV infection, blood pressure, stress relief, immune system boosting properties, and beneficial effects on cardiovascular health as well. The pulp of sapota fruit is a fantastic source of dietary fiber and works wonders to induce bowel movements (Osman et al., 2011; Srivastava et al., 2014; Liu et al., 2019; Baskar et al., 2020; Chaudhary and Kumar, 2020; Antala et al., 2021; Motalab et al., 2022). It can be used as medicine for cough, and fever also (Sari et al., 2018). The sapota fruit also has positive effects on leptin and insulin levels, as well as glycemia and plasma lipids (Barbalho et al., 2015).

In addition to being essential for keeping healthy skin and mucous membranes, vitamin A helps to promote normal eyesight. It is thought that eating a lot of vitamin A-rich foods like sapota helps protect against lung and mouth cancer. Similarly, to that, vitamin C helps the body fight off free radicals and build up a defence against viruses. Due to their involvement as enzyme cofactors in a number of metabolic bodily processes, these nutrients are crucial for optimal health (Jaiswal, 2018).

When ingested in large quantities, the high fiber content of sapota may result in gastrointestinal issues including flatulence (Jaiswal, 2018).

4. APPLICATION IN THE FOOD INDUSTRY

The sapota fruit is high in nutrients such as beauty-enhancing vitamins (A, C, and E), so it has the potential to be used as an herbal cure in cosmetic and skin care products. On the skin, the three vitamins provide a hydrating effect. As natural antioxidants, vitamin C and E are employed in anti-aging treatments to lessen wrinkles and fine lines (Kaur et al., 2020).

Sapotas' shelf life is just 6-9 days at 25 °C, and at lower temperatures, it is susceptible to chilling harm. Since it has the added feature of being high in sugar (~25 °Brix) and fiber (41% on a dry basis), it may thus be kept more effectively in the form of a jam- or jelly-like product (Shinwari and Rao, 2020). In the food

industry, the sapota fruits may be used to make a variety of products, including jam, jellies, squash, osodehydrated slices, dried sapota pieces, blended sapota beverages, nectar, milkshakes, sweet chutney, candies, pickles, and preserves (Menezes and Athmaselvi, 2016; Jadhav, 2018). The fruits of sapota are occasionally consumed as dried fruits or used to make sherbet or ice cream (Liu et al., 2019).

4.1. Sapota Fruit Jam

Ahmed et al., (2011), prepared the sapota fruit jam. The sapota was carefully cleaned with potable water before the skin was cut off with a knife. It was totally ripe, healthy, and fresh. After the seeds were taken out, a blending machine was used to combine the sapota fruit. Thusly obtained pulp was frozen to preserve it. To prepare 1 kg of sapota jam, 450 gm of sapota pulp or juice, 550 gm of sugar, 5 gm of pectin, and 5 gm of citric acid were used. In a stainless-steel saucepan, pectin and sugar were first combined, and then sapota pulp or juice was added and stirred. A gas burner was then used to heat the mixture until the Total Soluble Solids (TSS) concentration was close to 65%. Citric acid was introduced at that time. When TSS approached 67%, the heating was cut off. The last steps included bottling and parafining. Then, this jam was stored for three months.

4.2. Sapota Jelly and Chutney

Ahmed et al., (2014), prepared the sapota jelly and chutney. Sapota pulp in the quantity of 400 gm was used to make the jelly. Fruit pulp and water were mixed in a blender at a 40:60 (w/v) ratio to homogenize the pulp. The fruit-soluble solids determine how much sugar needs to be supplied. The fruit had a °Brix level of 11, thus 56% sucrose was added. The three equal portions of sucrose were: first added to the pulp and then crushed. Once soluble solids concentration between 18 and 20 °Brix was attained, water was then added. The solution was then heated, and after the initial boiling, the second portion of the previously combined sucrose and pectin (1.5%) was added. The third portion of the sucrose was added following the second boiling. Citric acid was introduced at 60 °Brix to create the gel and avoid sucrose crystallization in the final product. Additionally serving as a preservative, the gel gave the flavor and the essential acidity. Once the mixture reached 65 °Brix, the heating was halted. The jelly was adequately sterilized and cold-bottled in glass bottles while still hot, providing room for the creation of a vacuum after the bottles were sealed. The flasks were sealed and kept at room temperature after cooling.

For the preparation of sapota chutney, many types of spices were required. To prepare 1 kg of sapota chutney, 250 ml of mustard oil added to a frying pan along with 50 gm ginger paste, 30 gm garlic paste, 10 gm chili paste, and 5 gm cumin paste. Then, 150 ml vinegar, 0.75 g sodium benzoate, 15 gm salt, and 500 gm sugar were combined. When the TSS was discovered to be close to 65%, heating was ceased. Last, poured into a glass container that had been cleaned and had its top parafinned.

4.3. Sapota Fruit Bars

Salleh et al., (2017) prepared the sapota fruit bars. 250 gm of sapota pulp was cooked for 10 minutes over low heat. To prevent scorching the bottom, sugar 30%, pectin 1%, milk powder 6%, citric acid 0.6%, and a dash of salt were evenly sprinkled over the cooked pulp while it was being continuously mixed. The mixture was heated until it was homogeneous, then it was put into aluminum trays in a thin layer, and it was then dried in a convection air dryer for 8 hours. Then cooled fruit bars were divided into rectangles. The fruit bars were kept at room temperature in a dry location. Pectin was included in the fruit bars' formulation in varying amounts (0-3%).

5. CONCLUSION

The present study concluded that sapota is a significant small fruit crop that is a medium-sized tree. It may be regarded as one of the fruits that is healthy because it contains a variety of healthful nutrients like macro- and micronutrients, sugars, amino acids, and bioactive compounds. There are 11 species of sapota in the genus Manilkara. In India, the sapota fruit is widely referred to as "chikku" and is mostly planted for its fruit value. The sapota fruit has numerous health benefits and it is a perishable fruit that has played a significant part in traditional Indian medicine that treats various diseases. Additionally, sapota fruits are used to make a variety of food products.

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