

# NUTRITIONAL AND PHARMACOLOGICAL IMPORTANCE OF CUSTARD APPLE (*Annona squamosa*)

## Abstract

Custard apple (Sitaphal) is a delicious, highly perishable, seasonal fruit belongs to family Annonaceae. The fruit has very good commercial importance in India. Almost all the parts of the tree are used in the traditional medicine to treat many health conditions. It is a valuable source of essential nutrients like energy, vitamins, minerals and antioxidants. Many studies reported that the fruit has various pharmacological activities such as antidiabetic, antibacterial, antitumour, antiaging, anti-inflammatory, antigenotoxic, antiarthritic, during pregnancy, immune boosting activity and hepatotoxic activity. Developed of Custard apple incorporated products add variety and storage capacity of the fruit. Among all the fruits, Custard apple is most effective to treat many diseases and disorders. It has valuable therapeutic and nutraceutical potential, which helps to lead a healthy life.

**Keywords:** Custard apple, antioxidant, value addition, sithaphal, antioxidant

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## I. INTRODUCTION

Custard apple (Sitaphal) is a highly perishable, seasonal fruit belongs to Annonaceae family. It is native to tropical America and also available in tropical, subtropical and arid zones of the world. The fruit is considered as poor man's rich food in arid zones of the country (Solanke *et al.*, 2019). Throughout the plains of the India, the fruit is best grown at elevations not exceeding 4000 fts. It has very good commercial importance in India. Tropical climate is most preferable. The tree blooms yellow coloured, trumpet shaped flowers with pleasant sweet smell. The fruits are with rounded knobs and inside has a custard like flesh. Almost all parts of the tree like fruit, leaves, seeds, roots and bark are used to treat many health conditions in the traditional medicine due their good antioxidant, antidiabetic, hepatoprotective, antitumour, antibacterial and cytotoxic activity. It is used to treat wounds and provide relief against plant. Due to development of unacceptable brown colour, cold storage is also not suitable and so it has very limited storage stability. Various treatments and drying methods have been developed to improve the storage capacity of the fruit (Jain *et al.*, 2019; Singh *et al.*, 2019).

## II. AN INTERESTING HISTORY BEHIND THE NAME-SITAPHAL

Mythology says that, during vanavaas Sita, wife of Lord Rama was used to eat this fruit and so the fruit is called as Sithaphal. Some other stories says that when Ravana kidnapped Sita, tear drops of her fall on the ground and gave birth to the Sitaphal tree. In Sanskrit, sheet means cold and phal means fruit. Excess consumption of this fruit gives cold and cooling effect to the body. So called the name-Sitaphal (Singh *et al.*, 2019).

**1. Morphological Characteristics:** The tree is a small fast growing, semi wild, perennial and deciduous tree. It is widely grown in north and central regions of India. The fruit is called Krishnaguru in Sanskrit. The fruits of the plant are 6-10cm diameter with thick scaly skin that resembles appearance of pine cone. The bark of the tree is rough, ash grey colour and characteristic odour. Leaves are alternately patterned, brilliant green colour. The flowers are 2-2.5cm in diameter, fragrant, with 3 green sepals and 6 petals arranged in 2 containers. The flesh of the fruit has high fragrance, sweet, mealy texture and white to pale yellow colour. Seeds are hard, shiny, black to brownish colour entangled in flesh. The fruits are good source of iron, calcium, phosphorus and so generally consumed as fresh or in the form of juice beverages (Morton *et al.*, 2013).

### 2. Taxonomical Classification

Kingdom	Plantae
Family	Annonaceae
species	A. squamosa
order	Magnoliales
Genus	Annona

(Jain *et al.*, 2019)



Leaf



Flower



Fruit

### Custard apple (*Annona squamosa*)

- 3. Nutritional composition:** Chemical composition of custard fruit per 100gm was: edible portion-28-55%, moisture-73.3%, protein-0.3%, fat-0.7%, carbohydrates-0.2%, mineral matter-0.7%, calcium-0.2%, phosphorus-0.4%, iron-1.0%, acidity-0.26-0.65%, sugar-12.4-18.15%, ash-0.4-0.8%, fiber-0.05-4.5%, energy-95-110 kcal, vitamin E-0.6mg, vitamin A-0.6IU, niacin-0.8mg, vitamin B6-0-0.02mg, ascorbic acid-52.13mg, total phenols-26.55mg and antioxidant activity (TE-  $\mu\text{mol}$ )-1815.20% (Srivastava *et al.*, 2017; Jain *et al.*, 2019).

Nutritional composition of seed flour of Custard apple was analysed by Vaidya *et al.*, (2016). The result showed that seed flour has moisture of 2.9%, total carbohydrates-48.15%, protein-18.05%, fat-22%, ash-2%, crude fiber-11%, calcium-18.05mg, Iron-4.95mg, Sodium-87.52mg and Zinc-0.07mg.

- 4. Storage of Custard Apple Pulp:** Custard apple pulp can be best stored for 4 weeks at 0°C temperature by treatment with 0.1-0.5% ascorbic acid (Gamage *et al.*, 1997). Discolouration of pulp of the custard apple was decreased by adding with 2000ppm of ascorbic acid (Pawar *et al.*, 2011) and its shelf life was improved to 6 months by addition of 1500ppm of KMO<sub>4</sub> (Sravanthi *et al.*, 2014). Storage capacity of the pulp was improved by treating with 100ppm ascorbic acid, storing in polyethylene (200gauge) package and deep frozen in alcohol bath at -18°C (Chikhalikar *et al.*, 2010). Chitosan coating improved the storage stability of Custard apple to 30% and also maintained their high sensory and nutrient qualities during a storage period of 12 days at 100°C (Trung *et al.*, 2011).

Patidar *et al.* (2021) studied the effect of different proportions of different edible coating (chitosan, benzyl adenine and calcium chloride) on the stage stability of Custard apple found that the higher combination of treatments like CaCl<sub>2</sub> 6.0%+ Chitosan 1.5% + BA 150 ppm improved the shelf life the fruit with good quality up to 12days than the untreated sample. Custard fruits treated with 1-Methylcyclopropene 200ppb and 1% coating of chitosan inhibited the physiological loss of weight, ripening process and improved the shelf life and quality of the Custard apple storage during storage (Pimpalalle *et al.*, 2018).

### III. MEDICINAL PROPERTIES OF CUSTARD APPLE

There are numerous health benefits with tree due to their potent bioactive compounds in every part of the plant. Some bioactive compounds like anonaine, isocorydine, aporphine, coryeline, norcorydine, and glaucine are extracted from the plant parts. Hence all parts of the plant have been used in Ayurveda for centuries in India for management of diabetes. Some unique compounds have been extracted from the custard apple. They are very long chain fatty acids unique to the Annonaceous family. Many invitro and in vivo studies reported that the fruit have antihypertensive and anticancer properties. acetogenins present in the Annonaceous species provides protection against 60 types of cancer cells (Nair and Agrawal, 2017).

Reomerine, annonine and dehydroreomerine are the apomorphine alkaloids present in the roots produce relaxant effect on skeletal muscles. A yellow resin isolated from the seeds exhibits sympathetic action such as dilatation of pupil, decreases secretions, dryness of mouth and also found to have anti-tumour activity (Morton *et al.*, 1999). Fruits are consumed to cool fevers, to increase milk secretion after birth, for worms and parasites, astringent for dysentery and diarrhoea. The seeds of the plant were crushed and used to treat many internal and external parasites (Churchill *et al.* 1880). Decoction made from the leaf is consumed to treat cough, cold, intestinal infections and acidity condition (Pandya *et al.* 2011).

Custard apple leaves extensive pharmacological properties like good antioxidant, antimicrobial, antimalarial, antidiabetic, hepatoprotective, antiviral, anticancer activities. Leaf extracts helps to reduce blood glucose level and lipid peroxidation by maintaining plasma insulin and lipid profiles (Kumar *et al.*, 2021).

- 1. Antiulcer Activity:** A chemical compound namely 1-(4- $\beta$ -D-glucopyranosyl oxy phenyl)-2- ( $\beta$  -D - glucopyranosyloxy)-ethane was isolated from the twigs of Custard apple and screened for antiulcer activity in models with gastric and duodenal ulcer and the results were compared with the standard omeprazole drug. The results of in vivo study reported anti-secretory through reduced, total acidity and pepsin in pyloric ligation. Cytoprotection of plant was apparent with protection in alcohol induced, aspirin models and enhanced mucin level in pyloric ligation model (Yadav *et al.* 2011).
- 2. Hepatoprotective Activity:** Alcoholic and aqueous extracts of leaves were screened for hepatoprotective activity in Wistar strain of rats with isoniazid and rifampicin induced hepatotoxicity. The results of the found that there was significant decrease in total bilirubin, ALP, AST, ALT,  $\gamma$ -GT and increase in total protein level was observed in hepatotoxic group. The hepatotoxic group showed hepatocytic necrosis and inflammation in the centrilobular region with portal triaditis. In tested group of animals, minimal inflammation with moderate portal triaditis and normal lobular architecture was seen. The study concluded that the tree leaves have the ability to cure hepatic injury induced by isoniazid and rifampicin (Singh *et al.* 2019).
- 3. Anti-inflammatory Activity:** The leaves extract showed analgesic and anti-inflammatory activity in a dose dependent manner when compared to compared to the standard drugs like pethidine sulfate and indomethacin (Singh *et al.*, 2011).

4. **Anti-Bacterial and Wound Healing Activity:** Custard apple leaves extracted with different solvents were subjected to antibacterial screening by cut plate method. All the extracts showed significant healing properties and the maximum result was showed by the petroleum ether extracts (Shenoy *et al.*, 2009).
5. **Larvicidal Activity:** The ethanolic leaf extracts of Custard apple reported larvicidal activity against *A. stephensi* and other mosquitoes. But the chemical substance which is toxic for the larval species has to be identified (Kaushik *et al.*, 2009).
6. **During Pregnancy:** Kaur *et al.* (2015) described the health benefit of consumption of custard apple during pregnancy. The fruit is useful for the development of nervous system, brain and immunity system of the foetus. The chance of miscarriage and duration of labour was decreased by the daily consumption of the fruit. It is also called as the pregnancy wonder fruit, as it helps in coping up with morning sickness, nausea and mood swings. It is a good source of copper and helps to prevent premature births. Being good source of vitamin C and vitamin A, which is very useful for the foetus for the development of hair, eyes, skin and haematic blood tissues.
7. **Stress and Depression:** The B-complex vitamins play an important role in the production of neurotransmitters in the brain such as GABA. As it is a good source of B complex vitamins, helps to calm down stress, irritability, tension, depression and provides relaxation (Kaur *et al.*, 2015).
8. **Antiaging Activity:** For maintenance of structure and elasticity of skin, collagen is an important substance. Two important amino acids like L-lysine and L-proline helps in the production of collagen in the body are present in the custard apple. High level of antioxidants in the fruit provides protection against free radicals and helps to fight with the symptoms of aging, promotes growth of new cells, helps to reverse discolouration and firms the skin (Vohora *et al.*, 1975).
9. **For Good Digestive System:** Consumption of fruit also improves the digestive system function by flushing out the toxin substances from intestines and promotes proper functioning of the bowels. The fruit is also effective in treating indigestion, heartburn, ulcers, acidity and gastritis. Powder of unripe custard apple was used to treat diarrhoea and dysentery (Kaur *et al.*, 2015).
10. **Anti-Platelet Activity:** The entkaurane diterpenoids, isolated from the stem of Custard apple exhibited showed complete inhibitory effects on rabbit platelet aggregation at 200  $\mu$ M (Misha *et al.* 1979).
11. **Detoxifying Agent:** Custard apple is an important source of antioxidant, soluble fiber and makes it as an excellent laxative agent. Consumption of fruit removes toxins from the body and makes skin glowing. For people with hyper-thyroidism, custard apples are good for those who need to gain weight. Ulcers, abscesses and boils can be cured by the crushed leaves of the plant (Junya *et al.*, 2006).

#### IV. VALUE ADDED PRODUCTS FROM CUSTARD APPLE

Wine was produced from the custard apple by fermentation with *Saccharomyces cerevisiae* yeast. The developed wine resulted good antioxidant activity, total phenolic content and also able to protect  $\gamma$ -radiation induced DNA damage (Umesh *et al.*, 2013). Custard apple seed flour and protein isolate was developed by the alkali method (Vaidya *et al.*, 2016).

Patil *et al.*, (2011) developed that squash from custard apple in different formulations. Among them, squash made with 40% fruit pulp scored high but the acceptability was decreased with the increasing of storage period. Custard apple milk shake composition and its economics was studied by Poul *et al.*, (2009). It was found that milk shake prepared with buffalo milk and fruit pulp in the ratio of 90:10 has good economical and captured high popularity due to their high nutritive and therapeutic benefits. Toffees prepared with 55% of Custard apple pulp was best scored in all sensory attributes (Mundhe *et al.*, 2008). A low-fat ice cream was developed by incorporation of 15% custard apple pulp, 15% sugar, 10% fat in different combinations of ascorbic acid. 0.3% of ascorbic acid was best scored in all attributes (Pawar *et al.*, 2011).

Custard apple firni was made by adding rice flour to thickened with milk and flavoured with Custard apple pulp and refrigerated to enhance perfect consistency and flavour. Sitaphal rabdi was prepared with mixing of cardamom, saffron after shimming with almonds and pista in stove and after combined with pulp of the fruit. Custard apple kheer was developed from the cooked rice and custard apple pulp in different proportions and flavoured with cardamom (Singh *et al.*, 2019). Custard apple jam was developed from the 50% pulp and can be best stored for 4 months of storage (Singh *et al.*, 2006).

Custard apple jelly and juice were developed and subjected to sensory and nutritional composition by the Bala *et al.* (2018). Parihar *et al.* (2018) developed and analysed the storage stability of Custard apple jam. Among the different formulations, 50% pulp, 75% TSS and 0.3 % acidity was scored high and the product can be best for organoleptically for about 4 months.

#### V. CONCLUSION

Custard apple is a delicious, seasonal fruit with limited shelf life of about 2-3 days. The fruit has good nutritional and medicinal properties. A number of treatments are developed to improve the storage capacity of the fruit. Due to good antioxidant and nutraceutical properties of Custard apple, different parts of the tree are used as antidiabetic, antiaging, anti-hyperlipidaemic, anticancer and antiulcer properties. Development of value-added products from the Custard apple good potential in future.

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