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Mohammed Aman Nazeer
School of Agriculture, Lovely
Professional University,
Phagwara, Punjab, India

Alan Biju
School of Agriculture, Lovely
Professional University,
Phagwara, Punjab, India

Deva S Biju
School of Agriculture, Lovely
Professional University,
Phagwara, Punjab, India

Patil Satyajeet Sampat
School of Agriculture, Lovely
Professional University,
Phagwara, Punjab, India

Basily P Raju
School of Agriculture, Lovely
Professional University,
Phagwara, Punjab, India

Corresponding Author:
Mohammed Aman Nazeer
School of Agriculture, Lovely
Professional University,
Phagwara, Punjab, India

Review based study on nutritional, medicinal properties, post-harvest technology and packaging of custard apple

Mohammed Aman Nazeer, Alan Biju, Deva S Biju, Patil Satyajeet Sampat and Basily P Raju

Abstract

Custard apple is one of the most delicious arid fruits known mostly for its dessert and confectionery values. *Annona squamosa*, which is one of the most widely grown species of *Annona*. Though rich in its nutritional aspects, it is an under-utilized arid zone crop. It has also been proved that the plant contains several medicinal properties which include antioxidant, anti-diabetic, anti-infective and anti dyslipidemic properties. The leaves are used as a vermicide, for treating cancerous tumors and are applied to abscesses, insect bites and other skin complaints. Scrapings of root-bark are used for toothache. This paper attempts to congregate the nutritional value, phytochemical composition, and medicinal uses of custard apple.

Keywords: Based, nutritional, medicinal, properties, *Annona squamosa*

Introduction

Custard apple is a fruit which is produced from a small tree namely *Annona Saquamosa*. It belongs to the family of Annonaceae. The genus name *Annona* is derived from a Latin word 'Annon'. Custard apple has a variety of species namely *annonasaquamosa*, *annonacherimola*, *annona reticulata*. Custard apple is found widely and it is cultivated throughout India. It is harvested in the month of September to October. The mature fruit take about 6-7 days to ripe and it is highly perishable with a very short post-harvest shelf life of 3 to 4 days under ambient conditions. In India custard apple is grown in states like Punjab, Kerala, Rajasthan, Andhra Pradesh, Tamil Nadu, Gujarat, Madhya Pradesh etc. custard apple is a native of South America and West Indies.

The skin of Custard apple has a waxy texture with a light green colour and it has a moderate thickness of about 0.5cm. The creamy white colour flesh is juicy and has a pleasant aroma. Even after being a climacteric fruit, custard apple has a very short shelf. The biochemical properties of the fruit occur at a very faster rate after it has been harvested.

Custard apple is very rich in sugars; it mainly consists of glucose and fructose. It also contains good amount of vitamin C, magnesium, potassium, and thiamine. It also contains good quantity of iron, potassium, phosphorus. Even though it has high sugar content, it has a very low glycemic index. Custard apple has a lot of benefits like it helps in relaxing muscles and protecting against heart disease, it helps in providing a better immune system it helps in boosting immunity, it has anti-cancer properties, it helps in lowering the risk caused by arthritis, it is also a natural detoxifying agent. Nutritional Significance

Custard apple is a tasty desert fruit that is well recognized for its dessert and confectionary qualities. The fruit is sweet with a slight acidity and has a good texture and flavour. Edible fruits in India are more important because of their nutritional and therapeutic properties. Custard apple's nutritional value and health advantages are based on the plant's bioactive components, which can be found in raw fruits, leaves, processed meals, extracts, dietary supplements, and drinks. Custard apple is rich in carbohydrates and good source of protein. When the fruit is hard, it is high in starch, also it becomes much higher in sugar as it softens. The major portion of the calorie comes from simple carbohydrates. It, however, contains no saturated fats or cholesterol. Glucose and fructose are the two most common sugars present in Custard apple. Custard apple is high in vitamin C anti-oxidants, which aid in the prevention of many diseases and boost the immune system.

The calorific value (104 kcal per 100g of edible portion) is considerably nearly twice that of peach, orange, and apple that may provide long-lasting energy, and delicious taste.

A regular consumption of custard apple has many useful benefits in human health as it is a source of energy, phenolic compounds, natural antioxidants and minerals. Annonaceous acetogenins are the most prominent among them. Asimicin and annonacin are acetogenin compounds that are powerful cytotoxins. Anti-cancer, anti-malarial, and de-worming activities have been discovered in these substances. The phyto-chemicals found in the custard apple protect individuals against a wide range of diseases. Natural antioxidants are important in preventing chronic and degenerative diseases, especially DNA damage and ageing. Vitamin C, iron, calcium, thiamine, amino acid, potassium, carotene,

riboflavin, niacin, and ascorbic acid, magnesium, and dietary fibres are all present in large amounts in custard apple. Despite its high sugar content, custard apple has a low glycemic index and a mild glycemic load. The therapeutic and nutritional benefits of custard apples, as well as their pleasant flavour, have led to an increase in their consumption.

It has traditionally been employed as an insecticidal and anticancer agent, as well as an anti-diabetic, antioxidant, anti-lipidemic, and anti-inflammatory agent, due to the presence of cyclic peptides. An infusion with 2 handfuls of fresh leaves in 1 lit of water help to treat heart failure, digestion and has antispasmodic properties. Mutagenic properties have been discovered in pulp of custard apple. It is mostly grown as a decorative plant in conjunction with banana plantations.

Table 1: Nutritional Benefits

Sl. No	Plant part	Utilization in food	Effect on Health	Supportive Evidence
1	Fruit	Pulp (raw), Beverages, Jam, Ice cream(flavo ring)	Antioxidants, Anti-diabetic, Anti-viral, respiratory stimulant, improves immune system and nervous system	-Vitamin C present in fruit helps to prevent many diseases and helps in improving immune systems and helps in fighting free radicals in our body. It contains high calorific value which provides sustainable energy. - Minerals present in the fruit helps to prevent cardiac diseases, blood pressure and muscle weakness - Vitamin a help keeping our eye, skin, and hair healthy
2	Leaves	Crushed leaves	Antioxidant, Anti-diabetic prevents ageing, Improves heart health and digestion, Antispasmodic activities,	-Leaves of custard apple contain acetogenins and flavonoids which have cytotoxic, anti- malarial, anti-diabetic and immunological properties. -The leaf extract helps in the maintenance of plasma insulin and lipid profiles as well as the reduction of blood glucose level -The magnesium present in leaves helps in relaxing of heart muscles
3	Seeds	Powdered form and crushed form	Anti-parasitic activities	The seed of custard apple are powdered and used to cure hair fall and dandruff, They also help as remedy for lice
4	Bark	Scraped form and decoction	Cures diarrhea, Sedatives	Helps in reducing toothache

According to table 1 custard apple is high in vitamin A, vitamin C, dietary fibre, antioxidants, calcium, potassium, magnesium, vitamin B6, copper, and has a low fat content, making it a great source of iron. Vitamin A is good for our skin, hair and eyes and helps to get rid of dyspepsia. Potassium and magnesium help to prevent heart disease and high blood pressure, muscle weakness and maintain water

content in our body. Antioxidants in the fruit, such as Vitamin C, help in the fight against free radicals in our bodies. Custard apple should be made as a part of our diet because the copper content aids in constipation relief and high calorie helps in weight gain for athletes. Cofactors for various enzymes involved in oxidation reduction processes and carbohydrate metabolism are vitamins B1, B2, B3, and B9.

Table 2: Medicinal Properties

Sl. No.	Properties	Test method	Description	Reference
1	Anti-microbial Property	Agar diffusion method using four solvent extract. 2 gram positive and 2 gram negative were used.	Leaves of custard apples were proven to have anti-bacterial and anti-fungal activities. An active acetogenin compound called as annotemoyin showed significant anti- bacterial activity	Custard apple: an aromatic medicinal plant fruit with immense nutraceutical and therapeutic potential
2	Anti-diabetic Property	Studies were conducted on animals	Leaves of custard apple were shown to lower blood glucose level. It is affective as substitute for insulin with reduced levels.	A review on nutritional quality and medicinal value of custard apple
3	Anti-diabetic Property	Experiment was conducted on streptozotocin - induced diabetic rats and alloxan - induced diabetics rabbits at different doses (350 mg/ kg body weight)	Custard apple tends to replace insulin by promoting its production and increasing glucose uptake by muscles, resulting in stabilization of blood sugar level	Custard apple: an aromatic medicinal plant fruit with immense nutraceutical and therapeutic potential
4	Anti HIV Property	16,17 - dihydroxy- entkauran - 19- oic acid demonstrated substantial action against HIV replication in H9 lymphocytes cells, with an Ec 50 value of 0.8 g/ml among the 14 identified compounds in a study	Spectral analyses and chemical evidence were used to determine the structures of the newly discovered chemical substance.	https://doi.org/10.20546/ijcmas.2017.609.135
5	Hepetoprotective property	Study was performed on wistar strain of rats. The leave extract of custard apple was used.	Natural treatments derived from custard plant are effective and safe. Therapeutic option for liver damage.	Custard apple: an aromatic medicinal plant fruit with immense nutraceutical and

			Isoniazid and arifampicin were used to induce experimental hepatotoxicity.	therapeutic potential
6	Anti-malarial Property	Three know aporphine alkaloids were isolated from the bark.	Structures of compounds were identified as N Nitrosoxylophine, roemerolidine and duguevalline.	https://doi.org/10.20546/ijcmas.2017.609.135

In table 2 various experiments were conducted to prove the medicinal values of custard apple. The tests conducted and the descriptions of testes are given in the table. Some of the medicinal properties proved were that, custard apple has anti-microbial property, anti-diabetic property, anti HIV property, anti-malarial, Hepetoprotective property.

Post-harvest processing of custard apple

The aim of this study is to access the postharvest quality of custard apple. Custard apples ripen normally at storage temperatures of 15 to 30 degrees Celsius, but at temperatures above 25 degrees Celsius, the fruits are prone to fungal attack. Fruits held at 20 degrees Celsius were best for eating and storage, while those stored between 0.5 to 10 degrees Celsius suffered from chilling harm. Fruits have been packaged differently and stored in the refrigerator. Fruits were left unpackaged, individually wrapped in pvc film, or packed in expanded polystyrene trays wrapped in PVC film, and stored at 10 °C for five days. At harvest and every four days during storage, data on mass loss, pulp hardness, soluble solids, titratable acidity, pH, vitamin C, and water activity were determined. Custard apple kept at 10 °C and wrapped with PVC film lost less weight.

The ripening rate was influenced by temperature, film, and combination. The temperature and packaging film independently reduced the ripening % when the fruits were held for different storage intervals, such as one week and two weeks. Any observable qualitative and quantitative loss of food along the supply chain, from harvest to consumption or other end uses, is classified as post-harvest losses. Fruit and vegetable post-harvest losses are estimated to be between 35 and 40%. This is due to food value chain's infrastructure and management issues. Fruits are lost after they have been harvested. Considering the management constraints of a certain food value chain the higher crop production management and conservation to reduce post-harvest losses, quality and quantity are required. Not only can postharvest losses result in the loss of the crop, but they also result in the loss of money.

Researchers have worked on a variety of factors to improve the storage life of fruits. To address this, an experiment was carried out to investigate the effect of modified atmosphere packing utilising three different types of films and low temperature storage at 8, 12, and 15 °C, with weekly observations recorded. The respiration rate and ethylene production rate both increased as the storage temperature and time increased. The physiological weight loss in packaged fruits was significantly reduced. Titratable acidity increased with storage time but ascorbic acid showed the exact opposite trend. Many tropical and subtropical fruits have been reported to benefit from modified atmospheric packaging to prevent chilling harm.

The fruits could be stored at a low temperature (8 °C) for up

to 3 weeks without losing quality, although the appearance of the fruits was unappealing due to chilling injury. When packed in LDPE or Cryovac PD-961 film and stored at 12 °C, the storage life of custard apple fruits could be extended up to two weeks without any chilling injury signs, and the fruits ripened properly in three days at room temperature. The fruits could be maintained in acceptable condition for up to two weeks at 15 °C, although they began ripening while storage inside films.

Factors influencing storability

Temperature: Custard apple fruits ripen in temperatures between 15 and 30 degrees Celsius, while they are susceptible to fungal assault at temperatures above 25 degrees Celsius and during storage. Chilling injuries were induced by temperatures below 15 degrees Celsius. The addition of carbon dioxide or the removal of oxygen and ethylene had no influence on the rate of ripening. Low oxygen and ethylene levels, temperatures between 15 and 20 °C, 10% carbon dioxide, and a low relative humidity (85–90%) in the storage are proposed for storage of custard apples.

Effect of chemical treatment: Custard apple pulp turns pink when exposed to air due to the activity of the peroxidase enzyme and becomes bitter when cooked over 55 °C, making it useless. Heat treatment is not an option for preservation. To protect the environment 1 percent citric acid must be added to the pulp, along with 0.1 percent sodium benzoate, with 50-100ppm sodium benzoate.

Packaging of custard apple

Packaging and shelf life of custard apple is one of the most important concerns for maintaining the quality of custard apple. A study was conducted by Venkatram *et al.* (2013), in which polypropylene bags were injected with oxygen and carbon dioxide gas with the use of modified atmospheric packaging. The experiment was initiated by taking custard that was light green in colour. Matured and clean fruits were packed in polypropylene bags (PPB) with proportion of carbon dioxide and oxygen gasses with the help of modified atmospheric packaging. Total six test were conducted: Test 1 was carried out by 3% O₂ and 5% CO₂ along with PPB, test 2 was carried out by 3% O₂ and 10% CO₂ along with PPB, test 3 was carried out by 5% O₂ and 5% CO₂ along with PPB, test 4 was carried out with 5% O₂ and 10% CO₂ along with PPB, test 5 was carried out with air along with PPB and test 6 was considered as control i.e. no packaging was done.

The test samples were stored in horizontal racks at a temperature of 15 C. The samples were observed at 2 day intervals during storage. For evaluating, the physicochemical properties such as repining days, shelf life, total soluble solids, acidity, brix acid ratio, sugars and ascorbic acid were used. The result of the experiment is given in the below table.

Table 3: Show the Packaging material used Composition of gasses

SL NO	Packaging material used	Composition of gasses	Physicochemical Properties						
			Days taken for Ripening	Shelf life	Total soluble solids	Titratable Acidity (%)	Brix acid Ratio	Total sugars	Ascorbic acid
1	Polypropylene Bag	3% O ₂ + 5% CO ₂	9 days	12 days	19.87	0.27	82.38	14.40	42.17
2	Polypropylene Bag	3% O ₂ + 10% CO ₂	10 days	11 days	19.70	0.27	82.00	14.39	42.17
3	Polypropylene Bag	5% O ₂ + 5% CO ₂	10 days	11 days	19.72	0.27	82.37	14.40	42.17
4	Polypropylene Bag	5% O ₂ + 5% CO ₂	10 days	11 days	19.73	0.27	82.38	14.40	42.17
5	Polypropylene Bag	Air	8 days	12 days	20.90	0.27	86.31	15.06	41.07
6	Polypropylene Bag	Control	7 days	8 days	22.18	0.23	99.61	16.22	40.10

ERMA hand refractometer and titration method were used to estimate total soluble solids and titratable acidity (percent). By dividing the TSS value by the acid value, the Brix-Acid ratio was determined. Lane and Eyon's method was used to determine the sugars (reducing and total percent) in the custard apple pulp. By removing reducing sugars from total sugars, non-reducing sugars (percent) were calculated. The 2, 6-dichlorophenol indophenol titration method was used to evaluate the ascorbic acid content (mg/ 100 g of pulp).

Another study was conducted by Silva *et al.* (2012), in which the experiment was performed in a randomized design with

three systems: fruits packed which are individually wrapped in PVC film, fruits packed in expanded polystyrene trays and over wrapped with PVC film and fruits which were kept as control (unpacked). The packaged fruits were stored for an interval of 0, 4, 8, 12 and 16 days at temperature of 10 degree Celsius. The samples were observed at every 4 day interval. For evaluating, the physicochemical properties such as mass loss, firmness, water activity, total soluble solids, titratable acidity, vitamin C and ph. were used. The result of the experiment is given in the below table

Table 4: Show the conditions of Physicochemical Properties

SL NO	Conditions	Physicochemical Properties						
		Mass loss (g)	Firmness	Water activity (Aw)	Total soluble solids	Titratable Acidity (%)	Vitamin C	Ph.
1	Fruits individually wrapped in PVC film	1.8	60.9	0.975	22.5	0.10	107.9	5.84
2	Fruits in trays over wrapped with PVC film	2.5	61.7	0.976	22.2	0.10	107.9	5.90
3	Unpacked fruits (control)	10.6	69.4	0.974	23.4	0.11	133.3	5.93

The mass loss was obtained by weighing the fruit using digital weighing scale with a 0.1 g precision. The firmness was measured by using a penetrometer with an 8mm tip. The total soluble solid is obtained by using a manual refractometer. Titratable acidity was obtained by titration of Noah of 0.1N by taking phenolphthalein as indicator. Vitamin C was obtained by titration of DCPIP (dichlorophenolindophenol). Ph. value was obtained by using an electronic potentiometer by using 5g pulp with 50ml of distilled water.

Conclusion

The result of the study suggested that ripening of custard apple fruit at low temperature can delay the ripening period. Therefore, farm level ripening chamber could be developed for custard apple fruits in which fruits can be ripened and ripening period can be delayed as per the requirement. The mature fruits after harvest ripen quickly and become excessively soft within 2 to 3 days at ambient condition and become unfit for consumption. Therefore, development of technique for extending the shelf life of fruits is the only answer for getting the remunerative profit from it. Ripening of custard apple fruits occurred earliest at high temperature and delayed at low temperature.

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