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Cashew apple (*Anacardium occidentale* L.) therapeutic benefits, processing and product development: An over view

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Abstract

Cashew tree cultivation is done primarily aiming cashew nut production. The large amounts of cashew apples are considered as agricultural waste and the by-product of cashew nut production. Cashew apple (*Anacardium occidentale* L.) has multi-purpose; it can be processed to obtain human food. The present study focussed on therapeutic, medicinal benefits and production of value added products like syrup, squash, Juice, Jam, Pickle, Ready To Serve drinks and sweets and Nutritive values preservative methods while processing and off season storage methods of fruit, pulp and juice under skill development training programme to tribal farmers and Conducted sensory evaluation. The process of cashew apple into several by-products can affect its nutritional, microbiological, and sensorial quality attributes. Cashew cultivation is done primarily aiming cashew nut production in tribal areas of Vizianagaram district. An area of 18500 ha of cashew cultivated in the district and the large amounts of cashew apples are considered as agricultural waste and the by-product of cashew nut production. The cashew apple is a nutritious fruit available in abundance during the summer in almost in almost all parts of the world and is reported to poses high therapeutic and medicinal properties. It is also useful as raw material for many industrial applications. However, high perishability, astringency and short shelf life prevent the effective utilization of cashew apples.

Keywords: clarification, product development, de-Tanning, preservation, nutritive values, potassium meta bisulphate, sodium benzoate

Introduction

Cashew nuts, *Anacardium occidentale* L., common name in telugu Jeedi Mamidi, belongs to the Anacardiaceae family and is an evergreen tree native from northeast region of Brazil which expanded spontaneously in South American countries. During the 16th century, it was introduced into India and Africa by Portuguese (Aiyadurai 1966; Asogwa *et al.* 2008) ^[1, 2]. Cashew trees can grow from sea level to an altitude of 1000 m. The tree produces a soft, shiny, and juicy fruit known as cashew apple which bears a single-seeded nut in its bottom covered with a hard gray shell. Cashew nut plays a massive social aid in many developing countries, where thousands of families live from cashew cultivation. The fruit of the cashew tree is an accessory fruit (sometimes called a pseudo carp or false fruit). What appears to be the fruit is an oval or pear-shaped structure, a hypocarpium that develops from the pedicel and the receptacle of the cashew flower, Called the cashew apple, better known in Central America as maranon it ripens into a yellow and/or red structure about 5–11 cm long. It is edible, and has a strong "sweet" smell and a sweet taste. Cashew apples possess anti-bacterial properties and have been proven to be effective in treating stomach ulcers and gastritis, which is usually caused by PH. Its juice is rich in vitamin C and has an anti-scurvy effect. Cashew apple juice is widely utilized in the cosmetic industry due to the presence of antioxidants and is used in the preparation of various creams and shampoos. Cashew extract contains anarcadic acid which is an antioxidant and has been shown to limit the pigmentation effects of aging and to eradicate the cancer cells. Fruit of the cashew tree is used to treat infant's thrush and sore mouth. In the Amazon, people use the tea prepared from the bark and the cashew apple juice for chronic dysentery and as an anti-diarrheal remedy. It is also believed to possess sudorific or sweat-inducing properties. The juice extracted from the cashew apple can also serve as an ointment for aches of rheumatism.

Nutritive values

100g of edible cashew apple has the following nutrition as per the book, "Nutritive Value of Indian Foods" by C. Gopalan *et al.*

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Table 1: Nutritive values of cashew apple

Component	Values
Moisture	86.3g
Energy	51kcal
Protein	0.2 g
Fat	0.1g
Fibre	3.2g
Carbohydrates	11.1g
Minerals	0.8g
Calcium	10mg
Iron	0.2mg
Riboflavin	0.05mg
Thiamine	0.02mg
Niacin	0.3mg
Phosphorus	67mg
Carotene	23micrograms
Vitamin C	180mg

Table 2: Chemical composition & nutritive value of cashew apple

Composition	Constituents	Range	Reference
Sugars	Total sugars (sucrose, maltose, raffinose and two higher saccharides (unidentified) Reducingsugars (glucose and fructose)	6.3–9.9 g/100 g 6.24–9.8 g/100 g	Azoubel <i>et al.</i> (2005) ^[4] ; Damasceno <i>et al.</i> (2008) ^[6] Azoubel <i>et al.</i> (2005) ^[4] ; Damasceno <i>et al.</i> (2008) ^[6]
Vitamins	Vitamin C	126–372 mg/100 ml	Price <i>et al.</i> (1975) ^[13] ; Morton and dowling (1987) ^[11] ; Gunjate and patwardhan (1995) ^[8] ; Damasceno <i>et al.</i> (2008) ^[6]
Minerals	Ca, P, Fe, K, Mg,Zn,Na	0.9-21.4 mg/100 g 1.53 g/L 16–105 g/L	Morton and Dowling (1987) ^[11] Osho (1995)
Amino acids	Ala, Phe, Ser, Leu, Glu, Asp, Pro, Tyr	0.88-3.36mM	Oliveira <i>et al.</i> (2002) ^[12]
Polyphenols	Gallic acid, protocatechuic acid, β -cryptoxanthin, zeinoxanthin, lutein	215.1–412.8 mg/100 ml	Lowor and Agyente-Badu (2009)
Organic acids	Malic acid, citric acid, lactic acid	0.1–0.36 g/100 ml	Price <i>et al.</i> (1975) ^[13] ; Joseph (2010)
	Tannins	0.22–0.58 g/100 ml	Price <i>et al.</i> (1975) ^[13] ; Gunjate and patwardhan (1995) ^[8]
	Protein	0.1–1.04 g/100 g	Price <i>et al.</i> (1975) ^[13] ; Osho (1995)
	Carotene	0.03–0.74 mg/100 g	Morton and Dowling (1987) ^[11]
	pH	3.67–4.53	Gunjate and patwardhan (1995) ^[8] ; Osho (1995);

Ca -calcium, P -phosphorus, Fe -iron, K -potassium, Mg- magnesium, Zn- zinc, Na -sodium, Ala -alanine, Phe -phenylalanine, Ser -serine, Leu -leucine, Glu- glutamic acid, Asp- aspartic acid, Pro- proline, Tyr -tyrosine, TSS- total soluble solids

Therapeutic value: Traditionally, cashew apples are used to cure a number of chronic diseases like scurvy, diarrhoea, uterine complaints, dropsy, cholera and rheumatism (Attri 2009) ^[3]. It is also taken as a cure for stomach disorder and is used for treating sore throat infections in Cuba and Brazil. In Bolivia, it is taken as brain stimulant to enhance human memory, regarded as a potent diuretic and is known to possess sudorific properties. Many properties of fresh cashew apple juice have been proposed and continue to be proposed for its therapeutic values like anti-oxidant, anti-fungal, anti-bacterial,

Anti-tumor, anti-inflamatery, anti-mutagenic. Cashew apple juice has been reported to have antitumour, antimicrobial urease inhibitory and lipoxygenase activity and acts against the Gram-negative bacterium *Helicobacter pylori*, which causes gastric diseases. The anacardic acids 6[8'(Z),11'(Z),14'-pentadecatrienyl salicylic acid, 6[8'(Z),11'(Z)-pentadecadienyl salicylic acid, and 6[8' (Z)-pentadecenyl salicylic acid, are consumed by many people for their antibacterial activity against the Gram-positive bacteria such as *Streptococcus mutans*, *Brevibacterium ammoniagenes*, *Staphylococcus aureus*, *Bacillus subtilis* and

Propioni bacterium acnes and characterized as cytotoxic principles against several tumors. Anacardic acids, along with (E)-2-hexenal have been found to exhibit broad antimicrobial activity. The total anacardic acid content in cashew apple is 1.1 g/kg and suggested for their utilization in functional food formulations. Anacardic acids are used in cosmetics for disinfection. Ascorbic acid and tannic acid contribute considerably to the overall antioxidant capacity of the juice. The antioxidant activity of cashew apple is correlated well to the quantities of alkyl phenols, anacardic acids and cardols. The antioxidant activity of anacardic acid-1(6-[8(Z), 11(Z), 14-pentadecatrienyl] salicylic acid) relates to the inhibition of superoxide generation (IC₅₀=0.04 mM) and xanthine oxidase activity (IC₅₀=0.30 mM) Preservation and processing of juices modifies anacardic acids and hence, fresh juice has higher antioxidant activity compared to processed juice (cajuina) (Cavalcante *et al.* 2003) ^[5]. The anacardic acid content of natural juice is 17.9 mg/100 g whereas for cajuina, 0.41 mg/100 g suggested that cardols (phenolics) were also found to inhibit various pro-oxidant enzymes, involved in the production of reactive oxygen species. The natural as well as processed juices possess radical trapping, mutagenic and anti-

mutagenic activity and these properties can be related to the chemical constituents of the juices. The total radical-trapping antioxidant potential (TRAP) assay indicates lower oxidative damage-induced mutagenesis by co- and post-treatments with J Food Sci Technol the natural and processed cashew apple juice (Cavalcante *et al.* 2003) [5] assessed the antimutagenic properties of fresh and processed cashew apple juice against direct mutagens (Methyl Methane Sulfonate, 4-Nitroquinoline-N-oxide) and indirect mutagen (benzo(a) pyrene) and suggested that both kinds of juices can protect the cells against mutagenesis. The presence of chemically active components (ascorbic acid, anacardic acid, carotenoids, condensed tannins, quercetin, and other phenolic compounds) in fresh and processed cashew apple juice are responsible for the anti-mutagenic mechanism, which is shown to be involved in stimulation of DNA repair or reversion of DNA damage. The popular juices in Northeast Brazil, unprocessed and processed, suppress mutagenicity of hydrogen peroxide (H₂O₂)

Methods and materials used

Fruit Collection: Crisp, firm, tight and full colour developed apples suits well for processing. Cashew apple suited for processing should have Medium to large size, More than 70% Juice, More than 11% Sugar 0.39- 0.42% acidity Since highly susceptible to physical injury, leading to microbial spoilage during harvest and poor storability. If the apples are left un gathered, rotting and spoilage of cashew apples occur within hours after harvest leading to inferior quality juice.

Processing Techniques

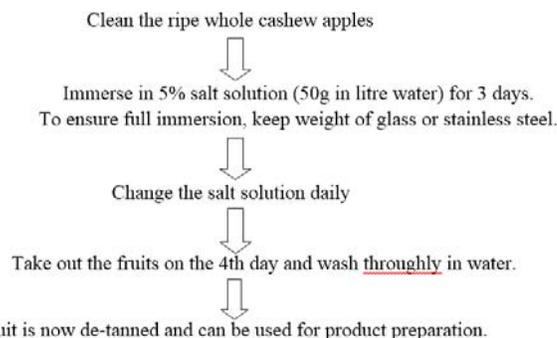
Clarification of cashew apple juice using clarifying agents

The clarification of cashew apple juice by removing phenols and tannins is an important step in cashew apple processing, because these compounds are responsible for its astringency. The clarifying agent, sago at a concentration of 2 g/L, decreased the tannins by 42.85% with visual clarity of 94%. The same clarifying agent with the same concentration along with sterile filtration decreased the tannins by 41.75% with improved visual clarity of 96% (Talasila *et al.*, 2011).

Storage stability of cashew apple juice

The test of the efficiency of chemical preservatives in combination (sodium benzoate and sodium meta bisulphite at 0.1 g/L each, sodium benzoate and citric acid at 0.1 g/L each and sodium meta bisulphite and potassium meta bisulphite at 0.05 g/L each) prolonged shelf life of cashew apple juice up to 20 days. Vitamin C and total sugars of the preserved samples were found to be almost stable. Sensory attributes also revealed good overall acceptability of the juice. The shelf life of juice treated with citric acid and benzoic acid at 0.1 g/L each and stored at 4°C was prolonged up to 90 days (Talasila *et al.*, 2011). Storage temperature (frozen, refrigeration or room temperature) differently affect physico-chemical stability and storage of cashew apple juice kept at room temperature for 24 h, refrigerated for seven days or frozen for 120 days showed that the ascorbic acid content in fresh cashew apple juice was 147.29 ± 0.41 mg/ 100 ml and decreased to 6.57% when kept under room temperature. For the juices stored when refrigerated and frozen, reduction rates of ascorbic acid were 1.16%/day and 0.05%/day respectively. However, the cashew apple juices and hydrolyzed cinnamic acid.

Adopted method for this Study: De-Tanning of Fruit



Clarification of juice

Extract juice by pressing with hand or using a press and strain through muslin cloth. Add 2.5g Potassium Beta Bisulphite (KMS) or 0.8g sodium benzoate and 5g citric acid for every litre of juice and stir well. Take 5g powdered Sago in minimum quantity water, heat and make into paste by stirring and cool it. Add Sago paste into juice and mix well by stirring. Instead of sago, PVP@1.4g per litre can also be used. Keep for 12 hours (overnight), allow the tannin to settle and decant the upper layer of clear juice carefully without mixing with sediments. This juice will be devoid of tannin. The juice is stored in well-sterilized air tight plastic barrels and can be used for off season. Product preparation for jam, candy, tatty fruity and chutney preparation, tannin is to be removed from the whole fruit. It is called de-tanning

Product Development

Preparation of cashew apple syrup

Ingredients:

Clarified cashew juice -1 litre, Sugar- 2 kg Citric acid -15g, lemon yellow colour -0.5g

Method of preparation

Add sugar 2 kg/litre into the stored clarified cashew juice and heat it moderately. Continue heating with stirring till the suger completely dissolves. Add citric acid-15g/litre (dissolved in little quantity of juice) and stir well. Remove the solution from the stove, cool, strain and then add colour (dissolved in little quantity of syrup). Now syrup is ready. To store the syrup for long periods without spoilage, pour it in to well sterilised glass bottles/new food grade pet bottles and cork air- tight (Don't fill completely, leave some air space). Keep in cool dry place. Dilute the syrup with five times cool water to use as fresh drink.

Preparation of cashew apple squash

Ingredients

Clarified cashew apple juice- 1.0 litre, water-1.40 litre, Sugar-1.6 kg, Citric acid -2-5 g.(as per requirement)Lemon yellow colour 1 pinch (1.25mg)

Method of preparation

Take required quantity of suger and citric acid in water and boil. Towards the end switch off the flame and add clarified cashew apple juice immediately in hot condition it self. Remove frame flame, coll, add colour, strain, bottle in sterilized glass bottles or new food grade PET bottles and seal it air tight. Keep in a cool dry place. Dilute the squash with three times cool water to use as fresh drink.

Preparation of cashew apple jam

Ingredients: De-tanned cashew apple pulp - 1 kg, Sugar- 1 kg, Citric acid- 2-5g (based on acidity of pulp).

Method of preparation

Add sugar and citric acid to pulp, keep for half an hour and cook with continuous stirring. Confirm end point by conducting sheet test (Dip a spoon in to the boiling pulp and let the product run of the sides of the spoon. If on cooling, the product falls off in the form of a sheet instead of flowing readily in a single stream, it means that the end point is reached. Otherwise continue boiling till the sheet test is satisfactory).When the end point is reached, transfer hot jam into sterilized glass bottles. While bottling, bottle must be kept on an insulating material like thick cloth or a wood board to prevent breakage. Close the bottle well. Jam can be stored for long periods without spoilage. De-tanned cashew apple pulp and mango pulp can be mixed in 50 : 50 ratio to make mixed cashew jam.

Preparation of cashew apple pickle

Ingredients

De-tanned and sliced raw green fruit - 1 kg, Gingelly Oil -100 ml, Chilli Powder -100 g. Fenugreek powder- 10 g, Turmeric powder- 5 g, Mustard powder-2 g, Garlic pas -10 g. Ginger paste -10 g, Green chilli paste -10 Vinegar -150ml, Sodium benzoate -1 pinch (0.75g).Citric acid -1 g, Salt to taste.

Method of preparation

Boil gingelly oil in steel vessels and put mustard, Fry ginger, garlic and green chilly pastes in boiling gingelly oil, till they are brown. Turmeric powder, fenugreek powder, chilli powder, asafoetida powder and mustard powder are added to it and stir When the colour of chilli powder changes, add sliced raw green fruit, citric acid (dissolved in hot water) sodium benzoate and vinegar and stir well. Add required quantity of water and salt (if necessary) by thorough stirring. Cover the vessel well and allow to cool. Transfer into clean dry glass jar, pour half tea-spoon gingelly oil over it and seal it. Use the product after keeping for one week.

Preparation of cashew apple chutney

Ingredients

De-tanned ripe cashew apple- 1 kg, Sugar -750 gm, Coriander powder -1 teaspoon Cumin powder (jeerakam) -1 teaspoon, Cinnamon powder -1 teaspoon Clove powder-1 teaspoon

Cardamom powder -1 teaspoon Pepper powder -1 teaspoon Large Onion-1 no.Ginger-30 g Venigar- 20 ml.

Method of preparation

Remove black spots and parts of pedicel from de-tanned cashew apple by steel knife and slice them into small pieces. Make a sugar syrup by adding equal quantity of water and boil. Add sliced cashew apple, chopped Onion, grated ginger and vinegar into sugar solution and stir well. Tie all powdered spices (coriander, cinnamon, cumin, clove, cardamom, and pepper) in a cloth bag and drop it into the syrup just a little before the final stage of boiling and stir well. Boil the mixture until it is sufficiently thickened. Remove from the stove and allow it to cool. Store in clean and dry sterilized jars.

Preparation of cashew apple candy

Ingredients

De-tanned ripe cashew apple-1 kg, Sugar -1 kg, Citric acid-1g, Potassium meta bisulphite 4 pinches Preparation of cashew apple candy.

Method of preparation

De-tanned ripe cashew apples are kept it in a solution of potassium meta bisulphite (two Pinches) for 2-3 days. Thoroughly wash the apples in water. Remove black spots and parts of pedicel. Keep in perforated crate of stainless steel and steam for 10-20 minutes without over cooking at 0.35kg pressure. Make deep holes in the apple using bamboo sticks or steel forks.

Preparation of sugar syrup: Dissolve 250 g sugar in one litre of water and heat well. Dissolve citric acid and potassium meta bisulphite (KMS 2 pinches) in this solution.

Preparation of Candy: Drop the pre-prepared apples into the boiling sugar so that the apples are completely immersed. Switch off the flame, cover the container with lid and keep it as such for one day. Take out the fruits on the 2nd day, add 125 g sugar, and drop the apple while heating. Repeat it for 5 days. On 7th day, volume of sugar syrup will be reduced to one-third. Keep the apples as such for 8-10 days. Remove the apples from the syrup solution, drain for 30 minutes and dry it slowly in open area by spreading in a polythene sheet. Keep in clean, dry glass jars and store in cool dry place.

Approximate Nutritive values in 100 gm of cashew apple value added products

Name of the Product	Protein	Fat	Carbohydrate	Energy	Calcium	Iron	Vitamin A	Vitamin C
Syrup	0.19	0.01	77	310	11.5	0.16		45
RTS	0.14	0.01	122	489	16.5	0.2	5.7	4.5
Squash	0.17	0.1	108	422	16.5	0.2	90	10.7
Mixed fruit jam	0.036	0.6	10	451	22	0.6	71	29
Pickle	2.04	1.2	30	589	41	1.4	44	34
Candy	0.1	0.2	24	322	27	2.0	10	28

Sensory Evaluation

Sensory method of evaluation was adopted for experiment as they are inexpensive, easy to conduct and accurate results be obtained. In sensory evaluation, the common sensory tests are referred to a single stimulus, paired stimuli, duo-trio, triangle preference tests like ranging test, hedonic scale and sewing test.

Hedonic scale was adopted in the present study to measure the consumes acceptability of the products developed. Hedonic scale relates to pleasurable or pleasurable experience. At one

session all the samples were served to the panelists. The panelists were used to rate the acceptability of the product of the scale ranging from like extremely to dislike extremely". Scale with different ranges were used for score card.

Result and discussion

Skill development training programme conducted for 5 times throughout season to tribal women and youth to create awareness and improved consumption of cashew apple. Conducted palatability test all products are accepted by

women and youth. Squash, juice got highest acceptance score of 5 by women on colour, taste odour and method of preparation jam, candy got score of 3-4 due to process of preparation and material availability at their homes. they started processing at house hold level and willing to start a cottage industry by the support of ITDA.

Mean sensory scores of cashew apple products

Attributes	Products with Cashew apple					
	Syrup	Squash	Juice	Jam	pickle	candy
Appearance	4	4	5	3.2	3.1	3
Colour	4	5	5	3.3	3.2	3
Texture/ consistency	3.7	4	4	3.1	3	3.1
Taste	4	4.1	4	3.2	3.1	4
Flavour	4	4	4	3.2	3	3
Overall acceptability	4	4	4	3.4	3.2	3

Sensory evaluation of in these products syrup squash juice got good response to prepare and for consumption at house hold level by farmers. jam, pickle, candy are taking lot of processing in preparation.

Conclusion

Product development with cashew apple in tribal areas under skill development training is improved consumption instead of throwing fruits in soil for compost. Cashew (*A. occidentale* L.) apple the quality of post harvested has been influenced by the production systems. Cashew apple is subjected to several processes after the harvest which influences its physico-chemical characteristics and quality attributes. There are many traditional and industrial ways of removing the astringency of cashew apple juice, while clarifying the juice. It is important to encourage the valorization of cashew apples in developing countries by the improvement of the process of cashew apples available in these countries in order to contribute to the nutritional needs of the populations. Approximately 90 % of the crop salvages on the soil. Due to lack of awareness about the nutritional values of cashew apples and suitable technology for preservation, thousands of tons of cashew apples are wasted every year. Improved shelf life of cashew apple juice minimises wastage of these fruits and would derive benefits even during off-season. Juice preservation also has the potential for developing a village level cottage industry thereby generating income to the rural and tribal areas people.

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