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Ansell J, Hirsh J, Poller L (2004). The pharmacology and management of the vitamin K antagonists: the Seventh ACCP Conference on Antithrombotic and Thrombolytic. Therapy. 126:204-233

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Charnley AK (1992). Mechanisms of fungal pathogenesis in insects with particular reference to locusts. In: Lomer CJ, Prior C (eds), Pharmaceutical Controls of Locusts and Grasshoppers: Proceedings of an international workshop held at Cotonou, Benin. Oxford: CAB International. pp 181-190.

Jake OO (2002). Pharmaceutical Interactions between *Striga hermonthica* (Del.) Benth. and fluorescent rhizosphere bacteria Of *Zea mays*, L. and *Sorghum bicolor* L. Moench for *Striga* suicidal germination In *Vigna unguiculata*. PhD dissertation, Tehran University, Iran.

Furmaga EM (1993). Pharmacist management of a hyperlipidemia clinic. Am. J. Hosp. Pharm. 50: 91-95

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**ARTICLE**

**Cashew apple utilization in Nigeria: Challenges and prospects**

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Nwosu C., Adejumo O. A. and Udoha W. N.



Review

## Cashew apple utilization in Nigeria: Challenges and prospects

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**Cashew apple, a juicy fruit, rich in vitamins and minerals, is still a highly underutilized fruit in Nigeria. Cashew apple can be processed into a variety of products, such as juice, quash, syrups, jam, candy, wine alcohol, vinegar and dietary fiber. Although various research works have been carried out on cashew apple, and its nutritional qualities, a number of challenges may still be responsible for its under utilization. There is a lack of knowledge and skills in the processing and post-harvest management of cashew apple and its products. This results in a large amount of wasted material from Cashew nut processors in Nigeria. Other challenges may include unavailability and affordability of cashew apple handling and processing technologies, and low level of cashew apple consumption as a result of its inherent astringent compounds. Constant training and retraining of processors, collaboration between cashew nut processors and cashew apple processors, mass production and affordability of such simple and adaptable technologies will go a long way in addressing these challenges.**

**Key words:** Cashew apple, cashew utilization, challenges and prospects.

### INTRODUCTION

Cashew (*Anacardium occidentale* L.) is a very popular and widely propagated tree in Nigeria. It is often propagated for the economic importance of the nut it produces as well as the "cashew apple" or pseudo-fruit which is actually a swollen stalk leading to the nut. Cashew trees are enjoyed for their fruit during its fruiting season and as a sun shed at off season. Its fruit consists of a nut and an apple which is attached to the stalk of its tree.

Cashew apple is juicy and rich in vitamins and minerals. According to Augustin (2001), the moisture content of cashew apple ranges from 85 to 89%, while its protein content was put at 0.2 and 0.1% for fat content, 11.6% carbohydrates and 0.9% crude fiber. Its mineral content was found to be 261 mg /100 g while vitamins such as thiamin - 0.02 mg/100 g, riboflavin- 0.5 mg/100 g, nicotinic acid - 0.4 mg/100 g and vitamin A - 39 IV were

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also found to be present in cashew apple.

Cashew apple, a potentially useful nutritional source, is almost entirely wasted during current standard processing methods (Abdul and Peter, 2010). In Nigeria, much attention has been placed on cashew nut and cashew nut processing while very little attention is placed on its apple. Often times, cashew nut processors in Nigeria harvest fresh and ripe cashew fruit just for its nut, while the apple is left to rot away. However, cashew apple can be processed into a variety of products with high economic and nutritional value in Nigeria.

## PRODUCTS FROM CASHEW APPLE

The cashew apple can be processed into a variety of products such as Juice, Quash, Syrup, Jam, Candy, Wine, Alcohol, Vinegar and Dietary fiber. Well-developed current technologies exist for the production of these preparations.

### Cashew apple juice

Simple pressing of cashew apple can yield good quality juice. Extraction can be done by using cashew juice expeller, screw press, basket press or hydraulic press to maximize juice collection. The juice can be prepared by pressing, filtering using a muslin cloth and pasteurizing. The juice can be used neat or by blending with other fruit juices. From the Preliminary investigation carried out in the National Centre for Agricultural Mechanization (NCAM), Ilorin, Kwara State, 100% cashew apple juice from same fruit variety pasteurized at different temperatures and time resulted in slight differences in flavor and color. This is a good indicator of possible varieties of its juice. The cashew apple juice can be blended with lime juice, orange juice or pineapple juice at a ratio of 3 to 1 and served chilled.

### Cashew apple syrup

Simple boiling of cashew apple juice above boiling point of water can yield good quality cashew syrup. 750 ml of cashew apple syrup can be prepared using 1 kg of cashew apple. The juice obtained from the cashew apple can be cooked under brisk stirring with or without any additive until it turns to syrup. Preliminary investigation carried out in the National Centre for Agricultural Mechanization (NCAM) shows that cashew juice can be prepared into syrup without any additive or osmotically active agents, and can stand ambient storage for over six months. Syrup produced during this preliminary investigation was stored under ambient condition; proximate composition and microbial load analysis showed that no significant difference has occurred for six

months and stability tests are ongoing as at the time of this review. Cashew apple syrup usually has a sharp sweet taste and good aroma.

### Alcohol from cashew apple

The cashew apple can also be used for alcohol production. The mean recovery of alcohol from cashew apple is reported to be about 1.5%. This underscores the huge economic potential of cashew apple that is currently being wasted. Neelakandan and Usharani (2009) produced alcohol from cashew apple juice using immobilized *Saccharomyces cerevisiae* yeast. Medicinal properties of cashew alcohol are reported by Augustin (2001).

### Dietary fiber

Fibrous residue left after extraction of juice can be dried and used in foods as dietary fiber. After extraction of juice, the chaff can be soaked in water to remove the residual juice; it is then dried and milled into powder. Experimental trials are currently ongoing in the National Centre for Agricultural Mechanization (NCAM) aimed at blending dried cashew fiber with high calorie foods as a means of reducing diet calorie intake.

## CHALLENGES AND PROSPECTS OF CASHEW APPLE UTILIZATION

Although a variety of research works have been carried out on cashew apple and its nutritional qualities despite its low level utilization, a number of challenges may still be responsible for its continued underutilization. There however, exist windows of opportunities that could enhance its product diversification, consumption and general acceptability.

### Lack of knowledge and skill

Lack of knowledge and skills in the processing and management of cashew apple products is the major limiting factor in the utilization of cashew apple in Nigeria. There is a lack of awareness on cashew apple products, as such, rural dwellers and food processors know little about its potential uses and possible economic value.

Lack of knowledge on the post harvest handling and preservation of cashew apple to ensure all year round production could be another limiting factor for industrial food processors. Since cashew is a seasonal and highly perishable fruit, constant training and retraining of processors on its preservation techniques such as osmotic drying, freeze drying, and how best to process it

into viable economic products is necessary.

### Cashew apple consumption

Cashew apple is generally not a much loved fruit in Nigeria. A variety of reasons such as its bleaching effect on white fabrics and its high acid and tannin content could be responsible for this. According to Suganya and Dharshini (2011), cashew fruit is not readily consumed in its raw state due to its high content of astringent compounds.

Its fragile and soft nature especially when ripe, with its high perishability could be another factor that affects its acceptability. However, with proper processing techniques, these challenges can be addressed. Various processing methods leading to a variety of cashew products have been reported by Tran et al. (2014), Suganya and Dharshini (2011) and Abdul and Peter (2010). There is a high market potential for cashew apple products in Nigeria if properly processed.

### Wastage by cashew nut processors

Cashew apple is often considered waste material in cashew nut processing industries. Most cashew nut processors in Nigeria rarely engage in cashew apple processing; often times, the nuts are removed while the apples are wasted. This is a major challenge for domestic processors. However, collaboration between cashew nut processors and cashew apple processors can help address this challenge.

### Unavailability and affordability of cashew apple handling and processing technologies

Various research works carried out on cashew apple have revealed its nutritional qualities, variety of products and high economic value, however, processing technologies and equipment for commercial production are not readily available. This clearly limits processing of cashew apple juice at a commercial scale, and only small scale and homemade production occurs. Mechanization of agricultural processes has been identified as the backbone for sustainable food sufficiency (Azogu, 2013). Any attempt at addressing the issues of food security in Nigeria must necessarily concentrate on efforts to make simple technologies available, and stimulate adoption of such technologies among our peasant farmers who remains the main driver of agricultural production. Such cashew apple technologies should begin with simple tools that will arrest the problem of damage and injury to the cashew apple during harvest. A real commitment to the utilization of the currently wasted cashew apple resource would also include large scale motorized

temperature/pressure controlled juice extractors that will result in minimal process loss to large scale thermal processing pots and storage containers. Mass production and affordability of such simple and adaptable technologies will go a long way in addressing this issue.

### CONCLUSION

Cashew apple can be processed into a variety of products, with high economic and nutritional value, to improve food security in Nigeria. Though cashew apple is not a much loved fruit in Nigeria, there are windows of opportunity that could be utilized to enhance product diversification, consumption and general acceptability. Public awareness can be increased through marketing campaigns targeted towards both rural dwellers and urban food processors highlighting the potential and possible economic value. Government agencies such as the National Centre for Agricultural Mechanization (NCAM) and other Agro-equipment manufacturers should make available simple processing technologies for commercial production, and encourage collaboration between cashew nut processors and cashew apple processors. These steps will go a long way in addressing the underutilization of cashew apple in Nigeria.

### Conflict of Interests

The authors have not declared any conflict of interests.

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The background of the entire page is a photograph of a blue wooden cutting board. On the board, several red tomatoes have been sliced into thick rounds, showing their internal structure. A silver knife is positioned diagonally across the board, with its handle pointing towards the bottom right. The lighting is bright, highlighting the texture of the tomatoes and the wood of the board.

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