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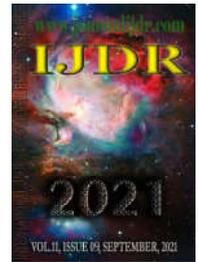
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RESEARCH ARTICLE

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## BLIGHIA SAPIDA ARILS YOGHURT AND ITS CONSUMER ACCEPTABILITY TESTS

Adamu, C., Yakubu, M., Issahaque, R., Mohammed, Z. and \*Adam Issah

Tamale Technical University, Faculty of Applied Science and Technology, Department of Hospitality and Tourism Management P.O. B

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#### \*Corresponding author:

Adam Issah

### ABSTRACT

Ackee is an African, Caribbean and American tree plant belonging to a family (sapindaceae), widely cultivated throughout the tropical and subtropical regions for its edible fruit. The name ackee is derived from the original name Ankye which come from a Ghanaian Twi language and given the botanical name: Blighia Sapida, named after a Brit captain William Bligh in 1793 for taking the plants fruit from Jamaica to England. Ackee has a special place in the cultures of Caribbeans and Africans because of its food medicinal applications. The tree is mostly admired as an ornamental and shade tree in Ghana where it is mainly grown along the streets. The bark, roots and leaves of the tree are applied in traditional medicine to treat various ailments. Ripped arils are edible and nutritious, tasting like milk or coconuts; it is mostly eaten fresh in Africa, but may be dried, fried roasted or mixed into salts or soup and eaten in the Caribbean. The main purpose of the study was to explore for potential culinary use(s) of the edible ackee arils by attempting its use in making yogurt. A two stage descriptive design was employed; first, a standard recipe was developed for ackee arils yoghurt, followed by a descriptive sensory evaluation of the yoghurt using a consumer panel.

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## INTRODUCTION

Ackee is an African, Caribbean and American tree plant belonging to a family (sapindaceae), widely cultivated throughout the tropical and subtropical regions for its edible fruit. The name ackee is derived from the original name Ankye which come from a Ghanaian Twi language and given the botanical name: Blighia Sapida, named after a Brit captain William Bligh in 1793 for taking the plants fruit from Jamaica to England. Ackee is highly appreciated by the Caribbeans and Africans because of its food uses medicinal and aesthetic values. The tree is mostly admired as an ornamental and shade tree in Ghana where it is mainly grown along the streets. The bark, roots and leaves of the tree are applied in traditional medicine to treat various ailments. Although the ripe fruit pulp (aril) is edible and nutritious. The ripe fruit aril tasting like milk or coconuts is eaten fresh (mostly in Africa), dried, fried roasted or mixed into salts or soup in the Caribbean.

**Problem Statement:** Mature ackee arils are edible and highly nutritious, notwithstanding its nature these arils are poorly utilized as food; and therefore, the commercial potential of ackee arils are yet to be fully exploited in Ghana in particular and the sub-region as a whole.

**Study Objectives:** The main objective of the study was to explore other potential culinary use(s) of the edible ackee arils other than only eating them in fresh form as the case currently by using it to make yogurt.

The specific objectives of the research were;

1. To develop a new type of yoghurt from ackee (blighia sapida) fruits arils.
2. To conduct a consumer acceptability or preference on the ackee yogurt.
3. To identify suitable packaging for the ackee arils yogurt.

## LITERATURE REVIEW

In Africa ackee (*Blighia sapida*) is not a major food crop though Africa is its land of origin. However, in Jamaica it is the national fruit and ackee cooked with salt fish is so well liked and hence called the national dish (Goldson, 2007). In West Africa growth of wild ackee is in the forest where they are seen and admired as ornamental plants, shade and wood but not as a major food source (Lancashire, 2006). Ekume (2010) reported that it is distributed widely across Cote d'Ivoire, Ghana, Liberia, Guinea, Senegal, Cameroun, Benin, Nigeria and Togo with very little cultural significance. "Ackee" is a word derived from the Twi language "Ankye" (Akintayo et al., 2002) and

in West Africa it is also called Nisin (Mitchell *et al.*, 2001). In Nigeria it is commonly known as ackee and called Gwanja Kwa (Hausa), Insin (Yoruba) and Okpu (Igbo) (Morton, 2007). It is also known as arbor de seso and sesovegetal by name in Spanish, Panquesito (Columbia), aki (Costa Rica, Castanheiro de Africa (Portuguese) (Michel *et al.*, 1998). Rashford, (2001) reported that in Jamaica it is referred to as the 'Big Ackee'. It is on record that Thomas Clarke introduced ackee to the Eastern parishes in 1778, however it was captain Bligh who took the unnamed tree to Kew Garden in the year 1793 and got named as *Blighia Sapida* in his honor by Koenig (Lancashire, (2006). In Jamaica Ackee has become a major economic crop, despite the numerous reports of its poisoning nature at least since the 1880 named the Jamaica vomiting sickness which was found to be caused by Ackee, Jamaicans held onto the fruit and has been home to Ackee research dating back to the 1950s.

Ackee was outlawed in Trinidad in 1900 after it had caused some fatalities and banned from the US for 27 years until 2000 when it was allowed to be imported again. (Morton, 1987). Research did include identifying natural toxic chemicals in the ackee and how maturity changes these chemicals in various parts of the ackee fruit. How these natural chemicals change with cooking and identifying other natural chemicals with medicinal potential (Golden *et al.*, 2002, 2006; Webster *et al.*, 2006). Ackee presents as shrubs and trees and tendrils bearing vines with about 140 to 150 genera and a total of 1400 to 2000 species worldwide (Adeyemi, 2011). Immature young ackee fruits are green but turn red or yellow upon maturation. The portion that can be eaten is called the aril and is found in the mature opened pod. Arils must be separated completely from the seed and the red membrane attached to it be removed. Three pegs are found in an average ackee pod, less frequently 2 or 4 and rarely 5 pegs. The "cheese" and "butter" are 2 types of Ackee recognized in Jamaica. The "butter" aril is yellow in color and soft and during cooking loses its shape easily. The "cheese" aril is creamy and hard, when cooked it retains its shape. Mitchell *et al.*, (2008) reported that the cheese variety is preferred by processors for export because it retains its shape during cooking. The fruit is pear shaped and splits open on maturation into 3 cream or butter colored fleshy, and glossy arils which are nutty- flavored and are attached to a black nearly round smooth, hard shiny seeds (Janick, and Pauli 2006). This was supported by Akintayo *et al.*, (2000) had earlier given a similar description that is. a straw to bright red and that the fruits whilst on the tree split open to expose 3 blade glossy seeds surrounded by arils which is thick, oily and yellow in colour. The fruits also have fatty acids, vitamin A and protein in abundance (Shama *et al.*, 2009). The fruit develops from blossoms which progress into small, hard green fruit that grow until they get to about 4–6 cm, at which time they become yellow or red in color. These eventually ripen and open to expose the seeds and the aril (arils). During this process, as the fruit is undergoing changes related to maturation, the hypoglycemic toxin associated with the fruit also undergoes dramatic changes.

**Nutrients content per 100g of the ackee aril:** A 100g of ackee arils has approximately 150 calories, 15g of fat, and 3g of protein and less than 1g of carbohydrates. This versatile high fat fruit therefore, could be suitable for persons who follow a ketogenic or other high fat diet. Ackee contains a moderate amount of carbohydrates, protein, and fat, providing 51-58% of the dry mass of the arils as composed of fatty acids – linoleic, palmitic, and stearic acids. The raw ackee fruit is a rich source of vitamin C. The ackee arils are said to be rich in potassium, magnesium, calcium and sodium but low in phosphorus and zinc. Some studies show that the high oil content of ackee arils can be compared to that of peanuts, rapeseed and sunflower seeds and higher than that of soybeans. The ripe arils contain all essential amino acids and they have been found to be rich in linoleic, oleic, palmitic and stearic fatty acids all of which are known to help reduce the risk of coronary heart diseases when included in a well-balanced diet. Several researchers have reported varying results for the mineral composition of ackee arils. The arils are generally reported to be rich in potassium, magnesium, calcium and sodium but low in phosphorus and zinc with potassium being the most abundant mineral (Akintayo *et al.*, 2002; Howélé *et al.*, 2010; Oyeleke *et al.*, 2013).

yeleke *et al.* (2013) postulated that dried ackee arils can serve as a good source of minerals for bone formation. This has been attributed to its calcium/phosphorous ratio being greater than 2, a condition which facilitates the absorption of calcium in the small intestine (Nieman *et al.*, 1992). Also, inclusion of dried ackee arils in the diet will be good for the prevention of high blood pressure since its sodium/potassium ratio is less than 1. Since fetus growth and development requires sufficient zinc supplies from the mother, Howélé *et al.* (2010) underscores the importance consuming ackee arils to pregnant women because of the high zinc content.

**Table 1. Nutrient content per 100g of fresh ackee arils**

Nutrients	Quantity
Protein	2.9g
Water	76.7g
Carbohydrates	0.8g
Fiber	2.9g
Calcium	35mg
Iron	0.7mg
Folates	41mg
Niacin	1.10mg
Riboflavin (B2)	0.07mg
Ascorbic Acid (Vitamin C)	30mg

**Consumption of ackee arils:** According to Paulet (2012), the species is highly appreciated by local people due to its numerous uses; it is said to be one of the most appreciated in the environment where it occurred naturally. The ackee is a major food in Jamaica. In South America, the fruit has been used to treat colds, fever, and diseases as varied as edema and epilepsy. Ackee is an unsaturated fat, and has additional health benefits through its high protein content, being a good source of vitamins B and C, zinc, calcium and fiber," reports the National Institutes of Health (NIH). The arils may be consumed safely when the fruit becomes red and opens under the light of the sun. It is then commonly boiled in water or milk and eaten alone or in meat or fish dishes. It is also consumed raw in some African countries. When ingested unripe, ackee produces vomiting and fatal cases of poisoning.

**Functional properties of ackee aril flours:** Crude ackee aril oil is observed to have a reddish-brown colour but becomes bright yellow upon its purification. Functional properties of ackee aril flour were comparable to other legume flours currently employed in the food industry. Akintayo *et al.* (2002) found similarities in the protein solubility curve of the ackee arils with that of soybean, great northern bean and Telfaira Occidentalis and concluded that ackee aril soluble proteins may thus be used in the formulation of acid foods, such as meat and milk-analogue products and protein-rich beverages. Emulsion capacity of ackee aril flour was greater than that of soy flour and wheat flour but lower than that of sunflower while foaming capacity was found to be higher than that of *A. breviflorus* berth seeds but lower than that of soy flour and sunflower seed flour. The foaming stability of ackee arils after 2 h was better than that of soy-protein concentrate. Water absorption capacity of ackee aril flour was lower than that of soy flour and sun flower seed flour. The oil absorption capacity was found to be higher than that of soy and wheat flours but lower than that of sunflower seed flour. Ackee aril flour has been found to have least gelation concentration of 8 % which is lower than that of pigeon pea, lupin seed and winged bean flours. These results were based on oven-dried non-defatted ackee aril flours (Akintayo *et al.*, 2002). Information on functional properties of defatted aril flours under different drying condition is, however, limited.

## METHODOLOGY

**Study Design:** This research employed a descriptive design in two stages; first, a standard ackee aril yoghurt recipe is developed and second, a preference sensory analyses of the yoghurt is conducted using a consumer panel.

### Recipe development for akee aril yoghurt

- Blend fresh ackee arils into a smooth puree
- Make a non-dairy milk solution and heat to 180 degrees Fahrenheit alone or with the arils puree.
- Cool the boiled milk-aril puree mixture to 40- 45 degrees Fahrenheit.
- Stir in a yoghurt starter or active culture to the mixture of arils and milk solution.
- Pour the mixture into jars or nice container with a tight fitting lid and incubate for 9 -12 hours.
- At the end of incubation add sweetener and flavouring (vanilla essence in this recipe).

### Sensory Acceptability/ preference test for arils yoghurt

**Sample size and sampling methods:** So many articles have been published in relation to the right minimum sample size consumer panelists, in order to assess performance of a new product designs in the marketplace. Moskowitz recommends a sample ranging 40 to 60; Stone and Sidel suggest about 50 to 100 panelists; but Meilgaard et al. (199); Singh and Maharaj (2014) and Stone (2018); have all suggested 75 to 300 participants. Following the above literature facts, this study used a sample of 75 respondents on the Tamale Technical University campus selected by simple random.

**Data collection methods, tools and analyses:** The study gathered primary data using a (7) point hedonic face ranking scale. This was administered to 75 respondents alongside a sample of the ackee fruit desert to taste and rank the appearance, colour, flavour and texture (mouth-feel) of the ackee fruit aril yoghurt. Data was entered in Microsoft excel, word and analysis done and presented through the use of percentages, bar charts and tables.

## RESULTS

Operationally in this study, the response category denoting acceptability ranged from 'OK' as lowest to 'really good' as highest; Non-acceptability on the other hand, was denoted by a polite rejection as in 'a little good' to 'total rejection as in 'really bad'. No respondent had the option of neutrality in their responses.

**Table 1. Respondents' perception of akee yoghurt quality by its organoleptics**

Ranking Scale	Quality characteristic (n = 75)			
	Colour	Flavour	Texture/ mouth-feel	Taste
Really good	30	18	20	27
Good	23	35	23	26
Okay	18	16	21	16
Just a little good	4	5	8	6
Bad	0	1	3	0
Really Bad	0	0	0	0

Overall, the highest acceptance rate (94.67%) of the akee aril yoghurt was by its colour; as many of the respondents who accepted the akee aril yoghurt by its flavour, that is, ninety two per cent, also accepted based how it tasted. The lowest acceptance rate was in respect to the yoghurt's texture by 85.24%. Assessment of acceptability of akee aril yoghurt by its colour, the results show that 40% accepted the product as really good, 30.67% indicated as good, 24% indicated as okay, and polite rejection rate was 5.33%, none of the respondents perceived the yoghurt colour as bad or really bad. Assessment of acceptability based on flavour of the product results reveal that 24% perceived as really good, 46.67% indicated as good, 21.33% indicated as okay, 6.67% politely rejected as just a little good, but 1.33% of the respondents actually rejecting the yoghurt. The results on the assessment of akee aril yoghurt presented in table 4.1 above reveals that, 36% perceived the product to be really good, 34.67% indicated it tasted good, 21.33% indicated perceived its taste to be okay, 8% indicated that it tasted just a little good, whilst none of the respondents perceived the product as tasting bad or really bad.

As indicated in table 4.1 above, acceptability based on texture, 26.67% accepted the product as really good, 30.67% indicated as good, 28% indicated as okay, 10.66% of respondents politely rejected the yoghurt, 4% perceived it was bad (actual rejection), but none totally rejected the akee aril yoghurt by its texture.

## CONCLUSION AND RECOMMENDATIONS

**Conclusion:** The main purpose of the study was to explore the potential use of the underutilized akee fruit arils by using it to make yogurt. The use of ackee aril for making of yoghurt had proven worthwhile and it has also been generally accepted across all of its organoleptic characteristics, i.e. colour, flavour, taste and mouth-feel (texture). However, the market competitive strength of the akee aril yoghurt lies in its colour, but flavour and taste will greatly contribute.

**Recommendations:** From the observations made and challenges encountered in this study, it is recommended that:

- The ackee aril should be included in the Ghana's School Feeding Programme as Snack to enhance beneficiary children nutrition.
- Beverage and Desert manufacturing companies should venture into ackee desert and beverage to make it available to the general public.

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