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Production, physicochemical and organoleptic properties of African breadfruit yoghurt samples

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Abstract

The physico-chemical and organoleptic characteristics of yoghurt samples made from dried and fresh African breadfruit seeds were investigated. Five kilograms of breadfruit seeds were cleaned and parboiled for 30 minutes at 80°C to remove the hulls. The seeds were dehulled and weighed 2.5 kg each. One batch was immediately ground into flour, and the other was allowed to dry in the sun for 5 days before processing. Breadfruit milk extract was obtained from each batch through a 0.04 mm sieve. The milk was continuously stirred for 30 minutes and cooled at room temperature. A commercial yoghurt starter culture (a 50:50 mixture of *Streptococcus thermophilus* and *Lactobacillus bulgaricus*) was mixed with African breadfruit milk to produce both fresh and dried African breadfruit yoghurt samples. The milk and yoghurt samples were evaluated. The physico-chemical properties of the milk samples were pH (5.95, 5.88); TTA (0.34%, 0.31%); SG (1.013, 1.011); VI (244 cP, 352 cP) for fresh and dried African breadfruit seeds, respectively. The physico-chemical properties of yoghurt samples were pH (5.24, 5.01, 4.71); TTA (0.85, 0.68, 0.81)%; SG (1.03, 1.04, 1.07); and VI (417, 473, 495) cP for fresh and dried African breadfruit and cow milk, respectively. The panelists preferred the commercial yoghurt over the yoghurt samples from African breadfruit seeds. The yoghurt samples can compete favorably in the market if standards are maintained during and after processing.

Keywords: Overall acceptability, pH, Specific gravity, Titratable acidity, Viscosity, Yoghurt.

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Contents

Contribution of this paper to the literature

This study expands current literature on non-dairy fermented products by establishing African breadfruit as a viable indigenous raw material for yoghurt production. It provides comparative scientific evidence on the influence of fresh and dried breadfruit seed processing on key physicochemical parameters, including pH, titratable acidity, specific gravity, and viscosity, which are critical quality indicators in fermented plant-based yoghurt systems. The research further contributes sensory acceptability data that clarify consumer response to breadfruit-based yoghurt relative to conventional cow milk yoghurt, thereby identifying formulation factors affecting market competitiveness. In addition, the work strengthens the literature on underutilized African food resources by demonstrating the industrial and nutritional potential of breadfruit in functional food development, value addition, and diversification of lactose-free yoghurt alternatives in emerging food systems.

1. Introduction

Plant-based product consumption has increased globally as consumers consider healthier dietary options. This development was also influenced by shifting consumer attitudes toward dairy products due to lifestyle modifications, lactose intolerance, milk protein allergies, and cholesterol levels [1]. As a result, the market for dairy substitutes appeals to a developing market niche and is projected to reach USD 14.36 billion by 2022 [2]. Because functional foods like plant-based yogurt with probiotics have high nutritional content and positive health impacts when consumed, consumers are drawn to including them in their regular diets [3]. Studies on legumes, cereals, grains, fruits, and vegetables have also been conducted [3-5], although the most popular source for yogurt-like products is soybean [6, 7]. Additionally, legumes may be a suitable source for making plant-based yogurt.

Human health, particularly the digestive system, must be taken into account when consuming food and liquids. Probiotic-containing food products are an alternative since they include lactic acid bacteria, which are healthy bacteria. According to Kumalasari et al. [8], lactic acid bacteria generate antimicrobial compounds that function as natural antibiotics to combat harmful bacteria, support digestive health, fend off illnesses, and enhance digestibility in lactose-sensitive people. Since lactic acid bacteria are safe to use, antibacterial, and tolerant of stomach acid, they are categorized as probiotics. Probiotic lactic acid bacteria must be able to generate antimicrobial compounds that can inhibit the growth of harmful enteric bacteria. These compounds include bacteriocins, diacetyl, hydrogen peroxide, and organic acids [9, 10].

A good source of protein, dietary fibers, carbohydrates, oligosaccharides, minerals, and vitamins, legumes are acknowledged as a sustainable food source [11]. Few research studies have used African breadfruit milk, while many have used legume milk from African yam beans [12], *Lupinus campestris* seeds [13], and peanuts [14] in yogurt compositions. Additionally, certain yogurt formulations contain dairy, dairy-derived, and/or animal-based components, such as gelatin, lactose, whey protein, and sodium caseinate, which might undermine the authenticity of plant-based foods [15]. According to Hickisch et al. [16], consumers' adoption of novel products is influenced not only by their health benefits but also by their flavor and feel. Ideal techno-functional qualities, such as emulsification and gelling capabilities, make legumes an ideal choice for making non-dairy yogurt. Food should include at least 6 log cfu/ml of probiotics before consumption, but 7 to 9 log cfu/ml is ideal for gastrointestinal health benefits [3, 17]. Therefore, to enhance the growth and survival of probiotics during storage, legumes must offer an ideal habitat. Thankfully, resistant starch found in legumes can function as a prebiotic, generating a mutually beneficial relationship with probiotics within the food matrix [3, 4]. Because they contain little or no cholesterol and saturated fats, non-dairy yogurts provide a number of nutritional advantages over cow milk yogurt [18]. A common fermented milk product, yogurt is made by fermenting milk with microorganisms like Lactobacillus delbrueckii subsp. bulgaricus and Streptococcus thermophilus. The synthesis of aromatic compounds and the formation of milk acid are facilitated by starter cultures [19]. Because of its high protein, vitamin, mineral, and calcium content, yogurt offers numerous health benefits. Additionally, the inclusion of beneficial bacteria known as probiotic bacteria increases its health advantages [20, 21]. Yogurt's probiotic bacterial component has been shown to strengthen the immune system and prevent illness. To enhance its health benefits, yogurt can be fortified with plant extracts or other nutrients to promote probiotic growth [22, 23]. By utilizing the probiotic activity of lactic acid bacteria (LAB) and their "generally recognized as safe" (GRAS) status, this advances our understanding of creating functional foods [24]. It is commonly consumed as a wholesome and nutritious food because of its sensory qualities. Based on its ingredients, yogurt is classified as either plain or flavored. Flavored yogurt contains additives, but plain yogurt simply comprises dairy ingredients [25, 26].

Animal milk is typically used to make yogurt. However, animal milk lacks fiber and contains lactose. Accordingly, those with lactose sensitivity should avoid consuming yogurt made from cow milk [27]. Since vegetable milk is low in fat, contains fiber, and doesn't contain lactose, it can be used as a substitute for basic components to make yogurt [28]. Because plant milk is high in fatty acids and antioxidant activity, it can lower the risk of diabetes, cancer, and cardiovascular disease. Animal-based diets are increasingly being replaced with plant-based diets that consist of cereals, nuts, seeds, vegetables, and fruit for various reasons, including environmental consciousness and the desire for a healthy lifestyle. Consuming animal products in excess can raise cholesterol and cause cardiovascular disease. As dietary sources of dietary fiber, vitamins, minerals, and antioxidants, cereals, legumes, whole grains, and nuts are categorized as functional and nutraceutical foods [29, 30].

Consumer interest in fermented dairy products is growing due to new food processing methods, shifting social perceptions, and scientific proof of some components' health advantages [31]. In this study, the idea of diversification is based on enriching yogurt with grains to increase the nutrients in the finished product and utilize resource usage through product diversity. Cereals and legumes enable an increase in nutritious composition that yogurt alone cannot provide. The nutritional perspective, customer acceptance, technology transfer opportunities through adaptive research, societal health benefits, and resource mobilization were all considered when selecting the new diverse yogurt product [32].

Health, animal welfare, and environmental issues have led to a greater focus on plant-based dairy products. [26] According to Aydar et al. [29], these items contain a range of legumes, seeds, grains, nuts, vegetables, and fruits. One of the main concerns is food security, particularly the urgent need to reduce chronic malnutrition [33]. The use of plant-based proteins is growing among food producers, and pulses represent a high-quality, sustainable alternative [34]. Pulses, which have a protein level of 18.5–32%, are an inexpensive plant protein source. In impoverished nations, they are popular and are referred to as "the meat of the poor." According to Mehta et al. [35], pulses have a bright future in the food sector because of their numerous advantages. Yogurt and food manufacturing increasingly use plant-based milk, which can be made from peas, peanuts, lentils, almonds, corn, and soy [36].

The current study aimed to design and develop yogurt using African breadfruit seeds and evaluate its physico-chemical and sensory quality attributes, which are similar to those of cow milk yogurt and influence consumer preferences before the final product is produced on a large scale and released onto the market. The findings of this study will improve and educate stakeholders in the non-dairy and dairy sectors regarding the implications and opportunities of diversifying the yogurt market in Nigeria.

2. Materials and Methods

2.1. Source of Materials

Mature fruit heads of breadfruit were acquired from Olokoro in the Abia State local government area of Umuahia South. The Nigerian state of Abia's Umuahia main market is where the sugar, skim milk, and yogurt starter culture were bought. The reagents of analytical grade were used.

2.2. Experimental Site

The breadfruit seeds were dehulled and cleaned in Abia State, Olokoro, Umuahia South LGA. In the Department of Food Science and Technology's Food Processing and Analytical Laboratory at Michael Okpara University of Agriculture, Umudike, breadfruit milk was extracted, yoghurt was made, and the nutritional value of the yoghurt and breadfruit seed milk was examined [37].

2.3. Preparation of Breadfruit Seed Meal

The breadfruit seeds were extracted from the fermenting breadfruit heads' pulp. The extracted seeds were cleaned, and the pulp adhering to them was removed using sand from the stream as an abrasive. After washing, five kilograms of breadfruit seeds were parboiled for thirty minutes at 80 °C to remove the hulls (Figure 1). The dehulled seeds, each weighing 2.5 kg, were prepared in two batches. The first batch was immediately crushed into flour, and the second batch was allowed to dry in the sun for five days before being ground again [38].

Figure 1. Breadfruit seeds being dehulled.

2.4. Preparation of Breadfruit Milk and Breadfruit Yoghurt

According to Onuorah et al. [39], the traditional Chinese method was used to manufacture the breadfruit milk extract. After grinding, the fresh batch produced a smooth breadfruit slurry. After adding water, the slurry was passed through a 0.04 mm screen to yield breadfruit milk. The dry sample underwent the same process. After 30 minutes of constant stirring, the filtrate was allowed to cool to room temperature. The flowchart for preparing African breadfruit yoghurt is shown in Figure 2. The approach described by Agim-Ezenwaka et al. [40] was employed. A prepared breadfruit milk batch of 250 ml was pasteurized at 82 °C for 15 minutes. Next came the addition of skim milk and sugar (to taste). A temperature drop to 42 °C was allowed, and the samples were homogenized using a Linsan standard mixer QF-3479. The samples were separated into fermentation plates and, after cooling to 42 °C, inoculated with 1% commercial yoghurt culture (a 50:50 mixture of Streptococcus thermophilus and Lactobacillus bulgaricus). They were placed in an incubator set at 32 °C for 16 hours after being covered with foil. The mixture was placed in the refrigerator at 4 °C at the end of the incubation period to stop the fermentation [38].

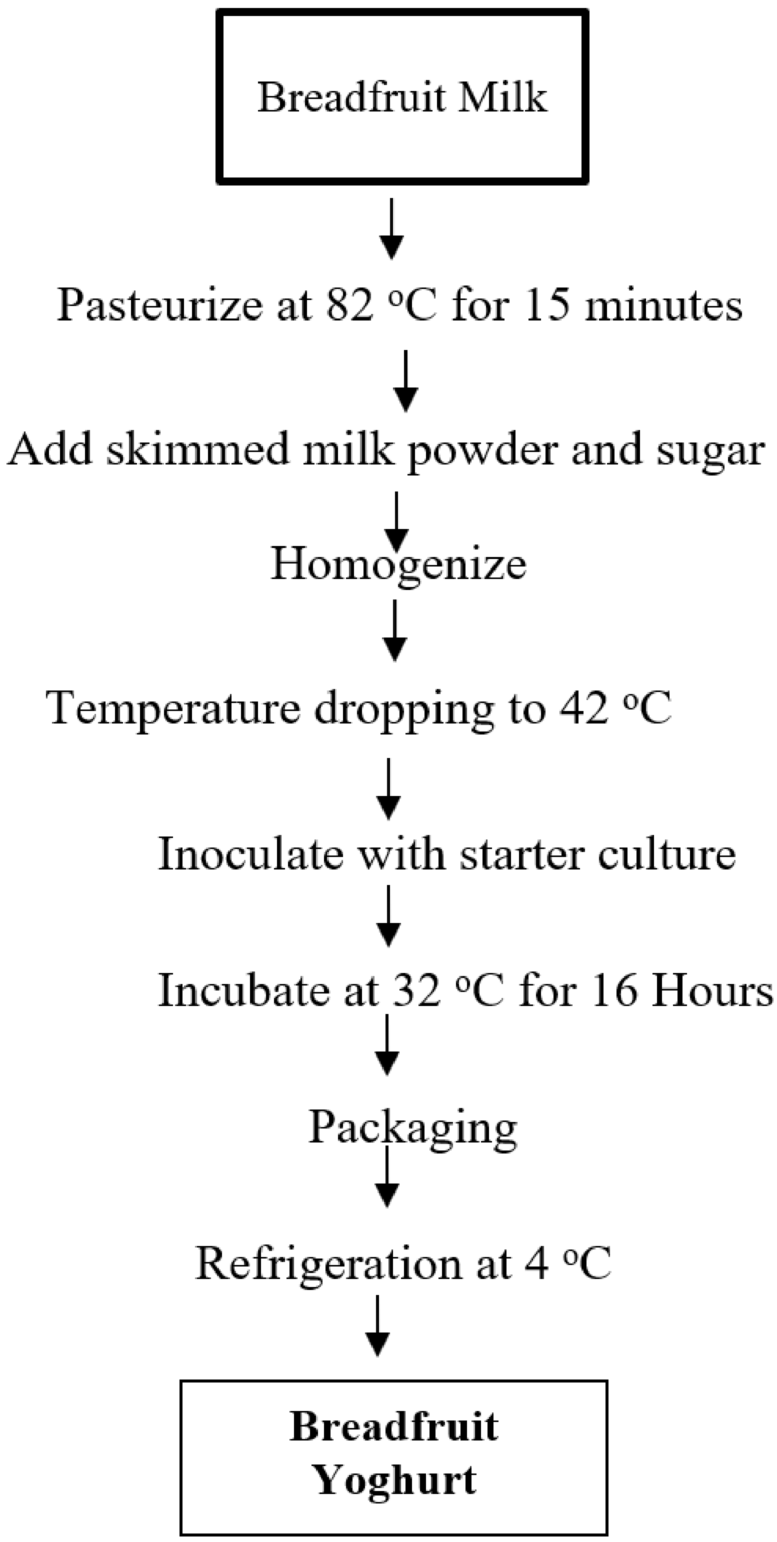

Figure 2. Flow chart for production of yoghurt from breadfruit milk.

2.5. Physicochemical Analysis

2.5.1. pH

The laboratory pH meter (Hanna model HI991300) was used to measure the sample's pH electrometrically. After rinsing the pH electrode with distilled water and blotting it dry, a tiny amount of the sample was added to a small beaker. A suitable amount of the sample was added to a tiny beaker so that the electrode tips could be submerged at least 2 cm below the surface. The electrode was at least 1 centimeter from the beaker's bottom and edges. After activating the pH meter, the sample's pH was noted [15, 18, 26].

2.5.2. Titratable Acidity

The approach outlined by AOAC [41] was used. One hundred milliliters of distilled water were combined with ten milliliters (10 ml) of yoghurt-like samples. After adding phenolphthalein (1%) indicator, 0.1 N NaOH was used to titrate the mixture until a persistent pink hue was achieved. Using 1 ml of 0.1 N NaOH = 0.0090 g of lactic acid, the titratable acidity was expressed as a percentage of lactic acid by weight [18, 26].

2.5.3. Viscosity

Approximately 30 ml of the sample was filled into a 50 ml beaker. Viscosity was measured using an Oswald-type viscometer [8, 31, 42].

2.5.4. Determination of Specific Gravity

Specific gravity is the mass of a particular volume divided by the mass of an equivalent volume of water. For similar compositions, the specific gravity marginally reduces when viscosity drops and decreases with increasing temperature [43]. Using a weighing balance, ten milliliters of distilled water were placed in a container with a specific gravity. The weight was noted as W_1. On the weighing balance, ten milliliters of the yoghurt sample were likewise weighed, and the weight was noted as W_2. In triplicate, the yoghurt samples' specific gravities were determined [44].

$$\text{Specific Gravity} = \frac{W_2}{W_1}$$

2.6. Sensory Evaluation of Samples

Taste, aroma, appearance, mouthfeel, and overall acceptance were assessed for the breadfruit milk, dry-milled yoghurt, and wet-milled yoghurt samples. Each organoleptic trait was rated on a 9-point hedonic scale, with 9 representing "strongly dislike" and 1 representing "strongly like," by 50 panelists knowledgeable about the organoleptic properties of yoghurt [15, 19]. The control was a commercial yoghurt beverage [8, 45].

2.7. Statistical Analysis

The acquired triple data was statistically analyzed using SPSS software version 23. Following the calculation of mean values and One-Way ANOVA, Fisher's Least Significant Difference was used to determine the separation of the means at ($p \leq 0.05$) [46].

3. Results and Discussion

3.1. Physico-Chemical Compositions of Milk and Yogurt from Fresh and Dried African Breadfruit Seeds

3.1.1. pH

Fresh and dried African breadfruit seeds yielded milk with pH values of 5.95 and 5.88, respectively (Table 1). The pH of the two milk samples did not differ significantly ($p \leq 0.05$). Table 2 displayed the pH values of the yoghurt samples made from fresh African breadfruit seeds (YFABS, 5.24), dried African breadfruit seeds (YDABS, 5.01), and commercial yoghurt (CY, 4.71). The pH variations of the yoghurt samples were significant ($p \leq 0.05$). A necessary pH range for yoghurt is not stated directly in the Nigerian Food Law, especially in the Milk and Dairy Products Regulations (S. I. No. 80 of 2021) [47], issued by the National Agency for Food and Drug Administration and Control (NAFDAC). All milk and dairy products, including yoghurt, must be registered with NAFDAC and adhere to rules on composition, safety, and labeling. Although a pH range is not specified in the laws, research indicates that yoghurt samples registered with NAFDAC often have pH levels between 4.01 and 4.79, whereas unregistered samples have higher pH values between 5.28 and 5.63 [48]. The bacterium *Lactobacillus acidophilus* is frequently used in yoghurt manufacturing. Lactase, which converts lactose, a sugar present in milk, into lactic acid, is produced by *Lactobacillus acidophilus*, which has a pH of 4. According to Ademosun et al. [27], the conversion of lactose to lactic acid raises the pH value of yoghurt, making it more acidic than milk. Lactose in the skim milk caused the commercial yoghurt sample's pH to drop [18]. The concentration of lactose that enzymes in the starting culture can break down to produce lactic acid increases when skimmed milk powder is added [49]. Thus, this acid naturally lowers the pH and makes the solution more acidic [42]. Since Elsamani and Ahmed [50] also found that the sample with the highest addition of skim milk powder had a lower pH, the presence of skim milk powder may be the cause of the lower pH of the commercial milk. The pH of yoghurt analogues, including pectin, maize starch, and locust bean gum at both concentrations, ranges from 4.00 to 4.7, according to Mohd Fazla et al. [19]. This aligns with the Food and Drug Administration's (FDA) recommendation that yoghurt has a pH of 4.6 or lower [51]. Commercial yoghurt may become more acidic with the addition of citrus fruits and other acidulants, as well as with longer fermentation times. Therefore, the pH level is not solely dependent on fermentation but can fluctuate [52]. According to Gibson et al. [53], adding prebiotics can provide a source of energy to enhance probiotic growth during fermentation. Herbal plants are among the natural sources of prebiotics. Because of its useful qualities, including fibre and carbohydrates with sugar groups, particularly glucose, gotu kola leaf extract can be used as a prebiotic [54]. Lactic acid bacteria (LAB) will use available carbohydrates during fermentation to produce lactic acid and organic acids, which lower the pH value [55]. The type of starter employed also impacts the pH value drop [8].

3.1.2. Total Titratable Acidity, TTA

The total quantity of acid in a sample as measured by titration with a standard NaOH solution, is known as titratable acidity. The freshness of yoghurt and other fermented beverages is also determined by this metric, which depends on how well the protein or salts in the yoghurt absorb hydroxyl ions [52]. Bacterial acidification and the release of fatty acids, resulting from the degradation of fats and other lipids, increase titratable acidity [27]. The TTA of Milk from Dried African Breadfruit Seeds, MDABS (0.31 %), and Milk from Fresh African Breadfruit Seeds, MFABS (0.34 %) differed significantly ($p \leq 0.05$), according to Table 1. Table 2 shows that the TTA of YFABS (0.85%) and YDABS (0.68%) differed significantly ($p \leq 0.05$), although the TTA of YFABS (0.85%) and CY (0.81%) did not differ significantly ($p \leq 0.05$). One important indicator of the fermentation process is the notable difference in

TTA between milk and yoghurt samples. Since milk is fresh and unfermented, its TTA is low. Natural components and minimal microbial activity are primarily responsible for acidity [26]. The yoghurt samples' lactic acid bacteria convert lactose into lactic acid, significantly increasing TTA. Jamalullail et al. [15]. Akwasiam et al. [18] reported that anaerobic microbial activities contribute to the rise in titratable acidity, resulting in lactic acid production, which depends on the type of lactic acid bacteria used [56]. Therefore, the higher TTA in yoghurt samples is a direct result of microbial fermentation and serves as a key parameter for monitoring yoghurt quality and shelf life.

3.1.3. Specific Gravity

There was no significant difference ($p \leq 0.05$) between the specific gravities of MFABS (1.013) and MDABS (1.011) (Table 1). YDABS (1.04) and YFABS (1.03) had specific gravities that were considerably ($p \leq 0.05$) different from CY (1.07), but not significantly ($p \leq 0.05$) different from one another (Table 2). Protein, lactose, and minerals were among the dissolved particles in liquid form found in milk samples. Because of the synthesis of lactic acid and protein coagulation, which can marginally raise specific gravity, yoghurt samples had denser structures than milk samples. Nonetheless, the growth is typically modest and not abrupt, with slight rises in yoghurt as a result of the production of protein gel and increased solid content. In line with the findings of Elsamani and Ahmed [50], who reported an increase in total solids of peanut milk-based yoghurt with the addition of skimmed milk powder [18, 52], the higher total solids value in commercial yoghurt may be attributed to the skimmed milk powder from which it was produced. According to Obasi et al. [52], *Lactobacillus bulgaricus* development would be significantly inhibited at a total solids concentration level of 24% and higher. However, yoghurt's low total solids content may cause the starting culture to malfunction [57].

3.1.4. Viscosity

Table 1 shows that the viscosity of MDABS (352 cP) and MFABS (244 cP) differed significantly ($p \leq 0.05$). As seen in Table 2, there were also notable ($p \leq 0.05$) variations in the viscosity of the yoghurt samples YFABS (417 cP), YDABS (473 cP), and CY (495 cP). In the yoghurt samples (Table 2), the acidic pH causes the casein micelles to coagulate into a three-dimensional gel, increasing viscosity. In contrast, the milk samples had low viscosity (thin fluid) due to the scattered casein and whey proteins that do not form a gel network. Additionally, the thickness is increased by exopolysaccharides that certain bacteria make during fermentation. According to Kumalasari et al. [8], yoghurt samples had viscosities ranging from 418.84 cP to 483.60 cP. As a result, all yoghurt samples were categorized as having high viscosities. Milk type, protein level, and total solids can all impact the viscosity of yoghurt [58]. The carbohydrate content may be the reason for the high viscosity value in the yoghurts made from African breadfruit samples [37]. The viscosity value of African breadfruit yoghurt samples may rise as a result of this high carbohydrate content. The viscosity value generated is likewise impacted when skim milk is added to a commercial yoghurt sample [8]. Because skim milk increases protein levels and creates an acidic environment below the isoelectric point of milk protein, it can change the viscosity of yoghurt [59]. Proteins have the ability to aggregate and create gels in an acidic environment [60]. The pasteurization procedure used to make cowpea milk also impacts the viscosity of the yoghurt. High temperatures (80 °C) and prolonged pasteurization might increase the solids, causing starch granules to bind the milk's water content and produce swelling [8]. Protein coagulation and gel network formation during fermentation cause a large increase in viscosity [26].

3.2. Organoleptic Properties of Fresh and Dried African Breadfruit Yoghurt Samples

Table 3 displays the average organoleptic property scores for various yoghurt samples. Their general acceptability, taste, texture, scent, and appearance are among the qualities assessed.

3.2.1. Appearance

The commercial yoghurt sample's mean appearance score (6.42 = liked slightly) was substantially ($p \leq 0.05$) higher than that of YDABS (5.67 = approximately liked slightly) and YDABS (4.79 = approximately neither liked nor disliked), according to Table 3. According to Uzoukwu et al. [61], this relates to the yoghurt samples' general physical appearance. The commercial yoghurt sample showed no phase separation and had a consistent, glossy surface with a bright, creamy hue. The YDABS and YFABS showed slight sedimentation and appeared a little drab or less shiny. Consumer approval of the two African breadfruit seed yoghurts is better measured by commercial yoghurt [15]. There may have been a few reasons why the panelists were neither particularly fond nor distasteful of the yoghurt samples' look.

3.2.2. Aroma

This is a measurement of the characteristic, all-encompassing odour of yoghurt or fermented milk. Table 3 shows that the commercial yoghurt's scent (6.88 = roughly liked moderately) was substantially ($p \leq 0.05$) stronger than that of YDABS (5.64 = roughly liked slightly) and YFABS (5.43 = roughly neither liked nor hated). Different amino acids and organic acids may contribute to the higher CY aroma score by producing more lactic and aromatic molecules [62, 63]. Low ratings for aroma qualities for YFABS and YDABS suggest that the panelists did not approve of them because of the unwanted volatile molecules they created, Jamalullail et al. [15]. Uzoukwu et al. [61] claim that the different volatile chemicals that the fermenting lactic acid bacteria release during their metabolism are what give yoghurt samples their characteristic scent. Legumes will produce volatile organic molecules during fermentation, which could affect how their scent is released [63]. Lactic acid is the main contributor to the aroma of yoghurt, although there are additional components that also contribute to its aroma. According to Ifediba and Nwafor [64], acetaldehyde and diacetyl are essential aroma compounds of typical yoghurt, and *S. thermophilus* and *L. bulgaricus*, the most common lactic acid bacteria cultures used in yoghurt manufacturing, work together and synergistically to provide volatile metabolites that determine the flavour of yoghurt. To ensure that the yoghurt meets the standard scent quality that is generally acceptable, particularly to the ultimate consumer, it is crucial to determine the yoghurt's aroma using the nose [65].

Table 1. Physico-chemical composition of milk from fresh and dried African breadfruit seeds.

Sample	Parameters			
	pH	TTA	SG	VI (cP)
MFABS	5.95 ± 0.00^{a}	0.34 ± 0.00^{a}	1.013 ± 0.02^{a}	244 ± 0.1^{b}
MDABS	5.88 ± 0.02^{a}	0.31 ±0.01^{b}	1.011 ± 0.02^{a}	352 ± 0.1^{a}
LSD	0.11	0.02	0.0022	72.44

Note: Means with the same superscripts in the same column are not significantly (p≤ 0.05) different from each other
MFABS = Milk from Fresh African Breadfruit Seeds
MDABS = Milk from Dried African Breadfruit Seeds
TTA = Total Titratable Acidity
SG = Specific Gravity
VI = Viscosity

Table 2. Physico-chemical composition of fresh and dried African breadfruit yoghurt.

Sample	Parameters			
	pH	TTA	SG	VI (cP)
YFABS	5.24 ± 0.03^{a}	0.85 ± 0.04^{a}	1.03 ± 0.11^{b}	417 ± 4.78^{c}
YDABS	5.01 ± 0.11^{b}	0.68 ± 0.07^{b}	1.04 ± 0.02^{b}	473 ± 6.39^{b}
CY	4.71 ± 0.12^{c}	0.81 ± 0.04^{a}	1.07 ± 0.03^{a}	495 ± 8.49^{a}
LSD	0.22	0.13	0.021	21.44

Note: Means with the same superscripts in the same column are not significantly (p≤ 0.05) different from each other
YFABS = Yoghurt from Fresh African Breadfruit Seeds
YDABS = Yoghurt from Dried African Breadfruit Seeds
CY = Commercial Yoghurt (Control)
TTA = Total Titratable Acidity
SG = Specific Gravity
VI = Viscosity

Table 3. Mean score of organoleptic properties of fresh and dried African breadfruit yoghurt samples.

Sample	Attribute				
	Appearance	Aroma	Taste	Mouthfeel	Overall Acceptability
YFABS	5.67 ± 0.11^{b}	5.43 ± 0.13^{b}	6.33 ± 0.21^{b}	6.23 ± 0.20^{b}	5.92 ± 0.31^{b}
YDABS	4.79 ± 0.12^{c}	5.64 ± 0.14^{b}	6.67 ± 0.21^{b}	5.87 ± 0.21^{b}	5.74 ± 0.30^{b}
CY	6.42 ± 0.11^{a}	6.88 ± 0.14^{a}	7.53 ± 0.21^{a}	7.11 ± 0.20^{a}	6.99 ± 0.32^{a}
LSD	0.52	0.43	0.48	0.42	0.51

Note: Mean values within a column with the same superscript are not significantly (p≤ 0.05) different
YFABS = Yoghurt from Fresh African Breadfruit Seeds
YDABS = Yoghurt from Dried African Breadfruit Seeds
CY = Commercial Yoghurt (Control)
LSD = Least Significant Difference

3.2.3. Taste

This analysis will help determine whether the yoghurt has a sweet, salty, bitter, sour, or umami taste by measuring its distinctive flavor using the sense of the tongue, where the taste buds are located [61]. The yoghurt's unique taste is attributed to compounds such as acetaldehyde, diacetyl, and acetic acid. The taste values ranged from 6.33 to 7.53, with the commercial yoghurt having a mean taste value of 7.53 (approximately liked very much), the YFABS sample having a mean taste value of 6.33 (approximately liked slightly), and the YDABS sample having a mean taste value of 6.67 (approximately liked moderately). Furthermore, the greater taste score may have been influenced by CY's increased fat content [37]. Although the taste of YDABS was greater than that of YFABS, there was no discernible difference between the tastes of YFABS and YDABS. The commercial yoghurt had a much higher taste score than YFABS and YDABS. This guarantees that the yoghurt meets the required standards for taste quality, which are often regarded favorably, particularly by the end user.

3.2.4. Mouthfeel

Table 3 shows the mean mouthfeel values for the commercial yoghurt, which was 7.11 (approximately liked moderately), the YFABS sample, which was 6.23 (approximately liked slightly), and the YDABS sample, which was 5.87 (approximately liked slightly). While there was no significant difference between the mean values of YFABS and YDABS, the mouthfeel value for CY was considerably higher than the mean values for YFABS and YDABS. According to Ifediba and Nwafor [64], fat has been shown to improve mouthfeel, which may have enhanced the commercial yoghurt's mouthfeel. Because of the difference in gel consistency, the panelists might have preferred the texture of the commercial cow milk yoghurt over the breadfruit yoghurt samples. Several variables, including composition and production procedures, influence the gel network's structural configuration, which determines the textural properties of coagulated dairy products [64]. According to Akalın et al. [66], non-dairy yoghurts are notorious for having decreased water-holding capacity, resulting in excessive syneresis and poor texture. These factors may have contributed to the improved texture of the CY [64]. Other factors impacting the final product's body include the amount of fat and total solids in the milk, heat treatment before inoculation, homogenization, the presence of stabilizers, and incubation conditions [67].

3.2.5. Overall Acceptability

The subjective metric of acceptability is based on hedonics, which is impacted by the food's sensory qualities. Consumer perception of a food product as a whole is known as overall acceptability. It includes all of the food product's sensory attributes [61]. The panelists' preference for the CY sample over the YFABS and YDABS samples was 6.99, indicating that it was moderately liked. In contrast, YFABS received a score of 5.92, indicating that it was slightly liked, and YDABS also received a score of 5.74, indicating that it was slightly liked. Therefore, the overall acceptance of the yoghurt samples was not significantly impacted by the drying of African breadfruit.

4. Conclusion

Yoghurt can be produced at minimal cost using simple processing techniques from breadfruit milk, a plant protein readily available to rural populations. While the pH and specific gravity of the milk samples remained unaffected, the TTA and viscosity of the extracted milk were significantly influenced by the freshness and drying of African breadfruit seeds. The TTA, specific gravity, and viscosity of the yoghurt samples increased, while the pH significantly decreased. The specific gravities of the YFABS and YDABS samples were unaffected by the freshness and drying of the seeds, but they did significantly alter the pH, TTA, and viscosity of the two samples. The varying moisture content of the African breadfruit seed is the cause of these effects. The organoleptic characteristics of the yoghurt samples showed that panelists preferred commercial yoghurt over trials made with African breadfruit seeds and were more familiar with cow's milk yoghurt. It was evident that, compared to African breadfruit yoghurt samples, the commercial yoghurt's organoleptic qualities were noticeably superior. The only notable difference between the African breadfruit yoghurt samples was their appearance; everything else, including taste, scent, texture, and overall acceptance, was identical. Incorporating sweeteners, flavor enhancers, and stabilizers will improve the physico-chemical properties and organoleptic acceptability of breadfruit yoghurt compared to cow's milk yoghurt. The primary goal of this strategy is to improve the standard and nutritional condition in emerging nations.

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