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Organoleptic Evaluation and Profitability Analysis of "Yoghurt-Like Product" Manufactured using Tiger Nut

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ABSTRACT

In this study, tiger nut milk was produced using a standard method and employed in yoghurt production. The following investigations were carried out on the tiger nut yoghurt produced; microbial analysis by plate count method, organoleptic evaluation using 9 point Hedonic scale and profitability analysis by cost per unit volume. The result of total plate counts were 3.5×10^1 cfu/ml, 4.2×10^1 cfu/ml, 3.7×10^1 cfu/ml and 4.4×10^1 cfu/ml for produced tiger nut yoghurt, Market yoghurt 1, Market yoghurt 2 and Market yoghurt 3, respectively. The result of yeast and mould counts were 3.7×10^1 cfu/ml, 4.3×10^1 cfu/ml, 3.8×10^1 cfu/ml and 4.4×10^1 cfu/ml for produced tiger nut yoghurt, Market yoghurt 1, Market yoghurt 2 and Market yoghurt 3, respectively. The coliform count showed no growth for all the samples. The results of the mean rating by the panellists for tiger nut yoghurt were 7.53, 6.80, 6.20, 7.80 and 7.50 for colour, taste, smell, mouth-feel and overall acceptability, respectively while the panellists mean rating for commercial yoghurts were 8.05, 6.72, 7.00, 7.40, 7.31 for colour, taste, smell, mouth-feel and overall acceptability, respectively. The economic analysis of the study revealed that it costs only ₦185 to produce 500ml of tiger nut yoghurt while commercial yoghurt of the same volume costs ₦215 on the average.

KEYWORDS: Yoghurt, Tiger nut, Organoleptic, Profitability Analysis

1. INTRODUCTION

Yoghurt is a coagulated milk product that results from the fermentation of lactic acid in milk by *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus* (Bataway and Khalil, 2018). Fermentation of lactose by these bacteria produces lactic acid, which acts on milk protein to give yoghurt its textures and characteristics tang (Sanful, 2009).

Yoghurts come in a variety of textures (liquid, set and stirred curd), fat contents (regular fat, low-fat and fat-free) and flavors (natural, fruit, cereal, chocolate), and can be consumed as a snack, part of a meal, as sweet or savory food (Reeta *et al.,* 2015). The versatility, together with their acceptance as healthy and nutritious food, has led to their widespread popularity across all populations (Mckinley, 2005).

Vegetable milk is a product of plant origin which presents aspects close to the milk of animal origin (Malik *et al*., 2012). It has been consumed for centuries in various cultures, both as a regular drink (such as the Spanish *horchata*) and as a substitute for dairy milk. The most popular varieties are soymilk, almond milk, rice milk, coconut milk and tiger nut milk (Ukwuru and Ogbodo, 2011; Sethi *et al.,* 2016). The protein content varies, it contains no lactose or cholesterol and is usually sold with added calcium and vitamins especially B12. According to Sethi *et al.* (2016), there are several reasons for choosing cow milk alternatives which include; cow milk allergy, lactose intolerance, veganism, calorie concern and prevalence of hypercholesterolemia. Plant milk is used to make plant cream, ice-cream, vegan cheese and yoghurt such as tiger nut yoghurt and soy yoghurt).

Tiger nuts are sweet nut-like vegetable root tubers of the perennial grass-like cyperaceous plant called *Cyperus esculentus* L. (Coskuner *et al*., 2002). The plant thrives in the tropical and Mediterranean regions; it's commonly grown in Nigeria, Ghana, Togo, Ivory Coast, Spain and Egypt where the root tubers are mainly used as a source of food nutrients (Pascual *et al*., 2000). Tiger nuts are rich in carbohydrate, lipids, fibre, some proteins, minerals, ascorbic acids and α-tocopherols (Ekeanyanwu and Ononogbu, 2010). To exploit their nutritional potentials, tiger nuts have recently been experimented for enriching the fibre content in gluten-free bread and biscuits (Aguilar *et al*., 2015; Zahra and Ahmed, 2014). Lactic acid fermentation of tiger nut milk is of particular interest because of the prospects to generate lactose-free, yoghurt-like products of improved microbial stability and extended shelf life with acceptable sensory properties. Such fermented systems might be promising as a valuable alternative source of food nutrients, especially in many developing countries where the population present a high prevalence of lactose intolerance and limited access to nutritious food (Vesa *et al*., 2000).

The continued diary milk shortage or absence in developing countries has led to the production of milk substitutes from vegetables. According to Harkins and Sarret (1967), the

development of milk substitutes extracted from cereals and legumes serve as an alternative way of producing acceptable nutritious food based on vegetables. Although yoghurts are produced in Nigeria, the need for cost-effective major raw material for yoghurt production as well as lactose-free yoghurt-like products cannot be overemphasized. The high cost of cow milk has led to explorations on local substrates that will serve as major raw material for yoghurt production. Considering the economic situation of the country, there is a need for the adoption of local and cheap materials for products that are cheaper and readily available for general consumption.

2. MATERIALS AND METHODS

Sample Collection

Tiger nut for milk production was purchased from Eke-Awka market in Awka, Anambra State.

Starter cultures *Streptococcus thermophilus* and *Lactobacillus bulgaricus* were purchased from Onitsha main market, Anambra State.

Equipment and Reagents

Processing facilities which include homogenizer, water bath, Waring blender, refrigerator and other equipment, as well as reagents, were provided by the Department of Applied Microbiology and Brewing, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

Milk Extraction Method

The extraction of milk (Figure 1) was carried out by the modification of the traditional method of milk extraction as described by Ofori-Anti (2000). One kilogram (1kg) of tiger nut was milled with 2000ml of distilled water in a Waring blender at high speed for 10 minutes. The milk slurry was pressed through cheesecloth; the milk obtained was fortified with 2g of glucose and was used for yoghurt production.

Figure: 1: Flow Diagram for milk production from tiger nut tubers (Ofori-Anti, 2000).

Preparation of Yogurt

The tiger nut milk was filtered of impurities using cheesecloth. The temperature of the milk was gradually increased to 80°C for 60 min to ensure proper pasteurization. Pasteurized tiger nut milk was rapidly cooled to 44°C for purpose of starter culture addition; 5g of starter culture was added and stirred for 4 min. Thereafter, sterilized bottle jar with a tight seal was filled with milk and incubated in a water bath at 44°C for 4 h until complete coagulation. Manufactured yoghurt was stored in a refrigerator at 5°C as described by Tamime and Robinson (1985).

Microbiological Analysis

Microbiological analysis was done on the tiger nut yoghurt produced and purchased yoghurt samples to give an indication of their microbial load. 5ml each of the produced and market yoghurts were homogenized for 1 min in an electromechanical homogenizer (Stomacher, Lab-blender 3500, Seward Medical, London, UK). Serial dilutions of the samples were prepared for plating. Plate Count Agar (PCA) was used for enumeration of total plate count and the plates were incubated at 37°C for 24 h. Yeast Extract Agar (YEA) was used for yeast and mould enumeration; the plates were incubated at 25°C for 48 hours, according to Marshall (1992). Violet Red Bile Agar was used for the enumeration of coliforms and the plates were incubated at 37°C for 24 h, according to Marshall (1992).

Organoleptic Evaluation

The overall acceptability of tiger nut yoghurt manufactured was carried out by 20 panellists according to the method described by Sameen *et al.* (2016). Appearance, colour, taste, smell, mouth-feel and general acceptability ranking were assessed for organoleptic evaluation; the mean of the manufactured yoghurt and of three popular market yoghurts was taken. The organoleptic evaluation was done using 9 point Hedonic scale. The ratings were as shown below:

Rating Acceptability	Score
Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

Profitability Analysis

Profitability analysis was carried out to ascertain the cost of producing a 500ml bottle of the yoghurt and those of some popular yoghurts of the same quantity in the market.

The cost of the following was found and recorded:

1. Tiger nut per kilogram
2. Flavour used (Vanilla) per ml
3. Sucrose sugar per gram
4. Cost of water per 2 litres
5. Cost of other inputs used

The total unit cost of producing 500ml of yoghurt using tiger nut was compared to the mean cost of three commercial yoghurts popular in the market.

3. RESULTS

Microbial Counts of Yoghurt Products

Table 1: Aerobic Plate Count-Total Viable Count of the Finished Product and Market Yoghurts

Samples	Count(s) (Cfu/ml)
Produced tiger nut yoghurt	3.5×10^1
Market yoghurt 1	4.2×10^1
Market yoghurt 2	3.7×10^1
Market yoghurt 3	4.4×10^1

Table 2: Yeast and Mould Counts of the Finished Product and Market Yoghurts

Samples	Count(s) (Cfu/ml)
Produced tiger nut yoghurt	3.7×10^1
Market yoghurt 1	4.3×10^1
Market yoghurt 2	3.8×10^1
Market yoghurt 3	4.4×10^1

Table 3: Coliform Counts of the Finished Product and Market Yoghurt

Samples	Count(s) (Cfu/ml)
Produced tiger nut yoghurt	0
Market yoghurt 1	0
Market yoghurt 2	0
Market yoghurt 3	0

Results of Organoleptic Analysis

The panellists comprised of 40% women and 60% men, majorly postgraduate students and staff of Department of Applied Microbiology and Brewing, Nnamdi Azikiwe University, Awka. Majority of them reported that they consume yoghurt at least once in a month and just a few of them reported that they consume yoghurt at least once every week. The results of the organoleptic evaluation conducted were shown in Table 4 as mean scores ± standard deviation.

Table 4: Organoleptic Evaluation of Tiger Nut Yoghurt Produced and Market Yoghurts

Organoleptic Attributes	Tiger Nut Yoghurt	Market Yoghurt (1,2and 3)
Colour	7.53^b ±0.43	8.05^a ± 0.34
Taste	6.80^a±0.23	6.72^a± 0.03
Smell	6.20^b ±0.03	7.00^a± 0.01
Mouth-feel	7.80^a±0.41	7.40^a± 0.34
Overall acceptability	7.50^a±0.33	7.31^a± 0.32

Key:

1. Results are means of twenty organoleptic scores ± Standard deviation
2. Means in the same column with the same superscript are not significantly different (p>0.05)

Profitability Analysis

Table 5 represents the total cost of raw materials purchased for tiger nut yoghurt production and their unit price per gram; this was to deduce the quantity and price of the raw materials involved in producing 500ml of yoghurt.

Table 5: Prices of Materials for Yoghurt Production

S/N	Material	Quantity	Total Cost for 2 litres	Unit price/500ml	Mean price of 3 market yoghurts
1	Tiger nut	1kg	₦300	₦75	
Other Ingredients					
2	Starter culture (yogourmet)	One packet(5g)	₦300	₦75	
3	Sugar	2g	₦20	₦5	
4	Flavour (vanilla)	5ml	₦20	₦5	
5	Water	2 litres	₦20	₦5	
6	Packaging container	4 bottles (500ml each)	₦80	₦20	
	The total amount per 500ml			**₦185**	**₦215**

4. Discussion

Aerobic plate count is used as an indicator of bacterial populations in a food sample (Belewu and Abodunrin, 2006). The population of bacteria in the yoghurt samples ranged from 3.5×10^1 to 4.4×10^1. Garbutt (1997) stated that microbial count less than 30 colonies or less than 2.4×10^4 colony forming units per ml for the viable bacterial count in a mixed culture is negligible or insignificant in food quality and safety assessment, thus, the tiger nut yoghurts were suitable for human consumption. The yeast and mould counts for the samples did not exceed the microbiological counts of 1.0×10^4 cfu/ml (Table 2) indicating that they were safe for consumption. No coliforms were detected in the samples, which is in accordance with the microbiological standards (Table 3). This indicates that the samples were within acceptable limit hence safe for consumption.

The organoleptic scores for tiger nut yoghurt produced in comparison with commercial yoghurts in the market were shown in Table 4; all the panellists rated the product considerably high in almost all the attributes evaluated. The result showed that the colour of the produced tiger nut yoghurt recorded high mean score of 7.53 which translates to "like moderately" on the 9-point hedonic scale while commercial yoghurt recorded a mean score of 8.05 which translates to "like very much" on the same scale. The colour was based on how the appearance appealed to the panellists. There was a significant difference between the tiger nut yoghurt and commercial yoghurt based on colour ($p<0.05$). The rating for Taste followed almost the same trend as it has a mean rating score of 6.80 while commercial yoghurt recorded 6.72 which translates to "like moderately". The results showed that tiger nut yoghurt can give a good taste of yoghurts. There was no significant difference between the tiger nut yoghurt and commercial yoghurt based on taste ($p>0.05$). The smell of the tiger nut yoghurt was also accepted by the panellists as it recorded reasonable high mean score of 6.20 which translates to "like slightly", although the commercial yoghurt recorded a higher mean score of 7.0 which translate to "like moderately". There was a significant difference between the tiger nut yoghurt and commercial yoghurt based on smell ($p<0.05$).

The score for mouth-feel recorded a high score of 7.80 which translates to "like very much" compared to commercial yoghurt that recorded a mean score of 7.40 which translates to "like moderately" on the 9-point hedonic scale. There was no significant difference between the tiger nut yoghurt and commercial yoghurt based on mouth-feel ($p>0.05$). On the general acceptability, tiger nut yoghurt was most preferred as it had the highest mean score of 7.50 translating to "like very much" while the commercial yoghurt had the mean score of 7.31 translating to "like moderately". Many of the panellists after the evaluation declared interest to buy the product if brought to the market. Results of the profitability

analysis showed that it costs only ₦185 to produce 500ml of tiger nut yoghurt while commercial yoghurt of the same volume cost ₦215 on average. The results of the study showed that tiger nut yoghurts are more economical to produce in comparison to commercial yoghurts produced using cow milk.

5. CONCLUSION

Based on the findings of this work, it is concluded that yoghurt production from tiger nut milk is feasible and could be most appreciated by low-income earners and lactose intolerant patients. Also, the product is safe for human consumption and can compete favourably with commercial yoghurts in terms of organoleptic evaluation and cost.

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