QUALITY AND SUSTAINABILITY OF PRODUCTION OF YOHURT FROM SOYABEANS, TIGER NUT, AND DATE

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ABSTRACT

Yogurt, as also known as yoghurt, is one of the most known popularly fermented dairy products in the world, with a wide range of health benefits in addition to basic nutrition and was believed to have therapeutic powers and give long life to those who consumed it. This study aimed to evaluating the quality and suitability of production of yoghurt using blended tiger nut milk, soybeans milk and date milk. Proximate and microbiological analysis was used to determine nutrient composition and quality of the produced yoghurt. The study shows the mean scores ranges of proximate composition (moisture, ash, protein, fat, crude fibre and carbohydrate) of the formulated yoghurt: 75.83±1.44, 70.16±0.28, 81.00±1.73, 80.00±0.00, 0.61±0.02 – 0.76±0.02, 5.40±0.17 – 7.43±0.05, 5.33±0.03 – 6.40±0.00, 0.04±0.00 – 0.12±0.00, and for carbohydrate content, the mean score range from 4.27 ±1.81 – 17.16 ±0.54. The bacterial total plate count of the sample ranged from 1.6x10^2 – 9.7x10^2 cfu/ml. Sample A (1.3x10^2) had lowest growth while sample D (9.7x10^2) had highest growth. For appearance, the mean score ranged from 6.00±2.22 – 8.25±0.63. also for aroma, the mean score ranged from 6.45±2.41 – 7.50±0.94 and for overall acceptability, the mean score ranged from 6.40±2.37 – 8.00±0.64. This study revealed that soy milk, tiger nut milk and date palm juice produced can be effectively used for acceptable yogurt formulations.

Keywords: proximate, microbial, quality, sustainability, acceptability, sensory

INTRODUCTION

Yoghurt is a fermented milk product that evolved empirically some centuries ago by allowing naturally contaminated milk to sour at a warm temperature probably in the temperature range of 40 - 50°C (Ihekoroenyeg and Ngoddy, 1985). It is usually produced from whole or partially skimmed cow’s (El – Batawy et al., 2014). There have been a lot of improvements in the industry where starter cultures are used to ferment the milk for a specific period and desired flavours are achieved. As population keeps on growing in Nigeria and there is high demand of milk which the indigenous breed could not meet the demand of the teeming population. There is no adequate improved breed that could burst milk production, it is largely affected by a number of factors such as genetics make up in term of use of improve breeds selected for milk production, a favourable nutritional environment, and improved managerial practices (Samny et al., 2012); as such it increases the unit price of milk resulting in increase in the cost of production which could affect the profit margin (USDA, 2017). However this as to do with the prices for milk and dairy products which are volatile and change on a weekly and monthly basis based on a number of supply and demand factors as well as government policies. Milk prices at the farm level are determined fundamentally by wholesale commodity prices for cheese, butter, nonfat dry milk, and dry whey. Wholesale prices for cheese, butter, and most dried dairy products are determined by market supply and demand factors. Wholesale prices rise when supply is short relative to demand. On the other hand, prices fall when supply grows and/or demand falls. That said, it is not always immediately clear why wholesale dairy products rise and fall in a given weekly or monthly. The prices processors charge retailers and the retail prices of milk and dairy products, generally face very little government regulation, Thus, the market place sets the so called farm-to-retail price margin. For some dairy commodities, the farm price drives the retail price (e.g., butter and fluid milk) (USDA, 2017).

Most of the animal milk used by our industry in Nigeria is dry skim milk which is mostly imported which drains our foreign exchange earnings. Alternatives for cow milk were explored by most industry produce cheap and available milk and milk like products to the teeming population. The use of extracted milk from plant sources (imitation milk) to produce yoghurt as an alternative to animal milk with certain quality attribute (taste, flavour, texture, shelf life, stability), healthy benefit and variety in diet have been studied (Farinde et al., 2008, Bamishaiy et al., 2011). In general, yogurt is a nutrient-dense food because of its nutritional profile, and it is a high-calcium source that supplies considerable amounts of calcium in bio-available form and was believed to have therapeutic powers and give long life to those who consumed it (FSF, 2020).

Studies have been carried out in an effort to improve the nutritional quality and need of consumers (Amanze and Amanze, 2011). In such case, protein from other rich plant sources is used to improve other deficient diet for nutritional and economic reasons. Yoghurt from imitation milk extracted from soybeans, tiger nut and milk extract from other plant sources recorded only few successes. Even when a good imitation milk is produced from these sources, it has never yielded desired good quality yoghurts and even if a good one is produced, it has to carry a lot food additives such as preservatives, flavours, colours, and thickeners (Chap et al., 2019). Which is not the same as yoghourt from cow’s milk. The need to add cow’s milk to imitation milk to incorporate the flavour characteristics of yoghurt from cow’s milk cannot be over emphasized (Amanze and Amanze, 2011).

Soybean is another locally available material that can be used as alternative to cow milk in the production of yoghurt. It is a member of the Leguminosae family, the Papilionoideae subfamily, and the genus Glycine, L. Soybean (Glycine max), a plant protein which is cheaper and could also serve as an alternative to cow milk (Amin et al., 2015). Consumption of fermented soymilk improves the intestinal ecosystem by increasing the number of probiotics. Soybean protein content...
Tiger nut (Cyperus esculentum) is a perennial plant abundantly cultivated in Nigeria (Oke, 2019). Tiger nut is Akiausa in Igbo, Ofio in Yoruba and Aya in Hausa. The tubers are about the size of peanuts and are available in Nigeria as fresh, semi-dried, and dried forms in the markets where they are sold locally. Milk extracted from tiger nut, apart from being nutritious (Oke, 2019), has been recommended for persons that do not tolerate gluten or are allergic to cow milk and its derivatives (Belewu and Abodurin, 2006). The abundant availability of tiger nuts in Nigeria and the unique qualities of tiger nut milk necessitates further exploration of the milk as a potential resource for cheaper production of yoghurt of acceptable quality.

Dates are consumed fresh or in the dried form. Besides being a rich source of carbohydrates, dietary fibers, some essential vitamins, and minerals, and a variety of phytochemicals, e.g., phenolics, carotenoids, anthocyanins, and flavonoids. Even date pits are an excellent source of dietary fiber, minerals, lipids, and protein. In addition to their pharmacological properties, phytochemicals also contribute to nutritional and sensorial properties of dates. In date producing countries, this fruit has been used for centuries to treat a variety of ailments in the various traditional systems of medicine. In recent years, research to assess the health benefits of dates has interfaced and a number of studies have reported on the positive contribution dates to human health (Jasim et al., 2014).

A study revealed that over the years that yoghurt is being produced from milk gotten from diary product (Kim, 2021). However, milk is expensive that is not easily affordable and produced from milk gotten from diary product. In recent years, processing and judicious blending of locally available foods could result in improved intake of nutrients to prevent malnutrition problems. Therefore, there is need to produce yoghurt from milk extracts of soybeans, tigernut, and date compared with that of cow milk.

**MATERIALS AND METHODS**

**Materials**

The materials used for the production of yoghurt include: Tiger nut, soybeans, date, MacConkey agar/nutrient agar, Potato dextrose agar, 10% tartaric acid, sterilized ringer’s solution. Ringer’s solution, plate count agar, measuring cylinder and weighing balance, atomic absorption spectrophotometer (AAS) and starter culture.

**Methodology**

**Sample preparation (Soyabean)**

Wet extraction of milk from soybean: whole soybeans was first sorted and washed to remove contaminant. It was soaked in clean water for overnight and were dehulled in between two palms. This was further washed and drained repeatedly until the seed coats were removed. The wet soybean bran was milled with milling machine and mixed in clean water and was strained through muslin cloth to obtain the soymilk (Bamishaiye and Bamishaiye, 2011).

**Preparation of Samples (Tiger nut)**

Wet extraction of milk from tiger nut: Whole tiger nuts were also sorted and wash to remove contaminants. It was soaked in clean water overnight. The wet tiger nuts were drained and wet mill with milling machine and then strained through muslin cloth to obtain the tiger nut milk (Bamishaiye and Bamishaiye, 2011).

**Sample Preparation (Date Juice)**

The whole of the fruit flesh was obtained by splitting the fruit open to remove the seed. The date flesh was soaked for 2hours and then blended with small water to a fine juice (Bamishaiye and Bamishaiye, 2011).

**Sample Formulation**

**Table 1: Blend formulation of Soyabean, Tiger nut, and Date**

<table>
<thead>
<tr>
<th>Materials</th>
<th>A(%)</th>
<th>B(%)</th>
<th>C(%)</th>
<th>D(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean</td>
<td>30</td>
<td>30</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>Tiger nut</td>
<td>40</td>
<td>50</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>Date</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Control</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
</tr>
</tbody>
</table>

**Proximate Analysis**

The samples were evaluated for proximate analysis. It was analysed for moisture content, fat, crude protein, crude fibre, ash, carbohydrate and energy content as describe in the method of (AOAC, 1990).

**Microbiological Analysis**

**Preparation of sample**

Well mixed samples of 10 mls was measured and poured into a sterilized blended jar and 90 mls of sterilized ringer’s solution was added. It was blended at a speed of 1500-2000 rpm for not more than 2.5 minutes.

**Pour plating**

Plate count agar (PCA), eosin methylene blue agar (EMBA), potato dextrose agar (PDA) (15 ml) was poured into the petri-
dish each. (kept at 45°C + 1°C in a water bath) within 15 minutes of the time of original dilution and 14 ml, 10% tartaric acid was added to potato dextrose agar (PDA) before pouring to inhibit/ destroy microbes present in the medium. The sample dilution and agar medium was mixed thoroughly and uniformly and allowed to solidify.

**Preparation of formulated yogurt blended from tiger nut milk, soymilk and date juice homogenate**

*The sample (10 ml)* which is well mixed was weighed into a sterilized blended jar and 90 ml of sterilized ringer’s solution was added. It was blended at a speed of 1500-2000 rpm for 2 minutes in a blender for 20 minutes.

**Dilution**

The sample homogenate was mixed by shaking and 1.0 ml was pipette into a tube containing 9 ml of the sterilized ringer’s solution. The pipette was used to mixed the sample carefully by aspirating it 10 times. 1 ml was transferred from the first dilution with the same pipette to the 2nd dilution tube containing 9 ml of the sterilized ringer's solution, it was mixed with a pipette and repeated using the 3rd-4th tube or more until the required number of dilution is made, all dilutions were shaken carefully. The sample (1 ml) homogenate was pipette and each dilution of the homogenate was transferred into each of the appropriately marked duplicate dishes. Plate count agar, eosin methylene blue agar, potato dextrose agar (15 ml) was poured into a petri dish each (kept at 45°C + 10°C in a water bath) within 15 minutes of the time of original dilution. The sample dilution was smeared in the agar medium thoroughly and uniformly and was allowed to solidify.

**Counting of colonies**

Count all colonies that have greenish metallic sheen, dark or even black centre in transmitted light and those that appear grey-brown centre without metallic sheen in the transmitted light. If no MacConkey agar count colonies that appear large, rod, surrounded by turbid zone and large, pink mucoid colonies

**Preparation of sample homogenate**

A well-mixed sample (10 ml) was weighed ascetically into a sterilized blended jar and 90 ml of sterilized ringer’s solution was added.

**Dilution**

The food homogenate was mixed by shaking and 1.0 ml pipette into a tube containing 9 ml of the ringer’s solution. It was mixed with a pipette carefully by aspirating 10 times. A dilution of the sample (1 ml) was transferred with the same pipette into the 2nd sample containing 9 ml of the sterilized ringer's solution. It was then mixed with a pipette and then repeated using a 3rd-4th tube, dilution was shaken carefully.

**Pour plating**

Tartaric acid (14 ml) of 10% was added into 1-liter potato dextrose agar (PDA) and kept at 44-45°C, just before pouring 15 ml amounts into plates containing 1 ml serial diluted samples approximately. The dishes were gently rubbed clockwise and anti-clockwise to thoroughly mix the sample agar and was allowed to set and solidify.

**Counting of colonies**

All colonies that have greenish metallic sheen, dark or even black centre in transmitted light were counted. If no MacConkey agar count colonies that appear large, rod surrounded by turbid and large, pink mucoid colonies

**Sensory Evaluation**

Sensory evaluation of the sample was carried out for consumer acceptance using 20 untrained judges at random selection with a 9-point hedonic scale according to Larmond (1997). The panelists were given samples to assess the quality attributes in terms of colour, taste, texture, flavor and overall acceptability.

**Statistical Analysis**

All values were expressed as mean +SD. Data was subjected to analysis of variance (ANOVA) and Duncan's new multiple range test was used to assess the significance difference among mean (<0.05).

**Proximate Composition of Yoghurt from Blended Soymilk, Tiger nut Milk and Date Palm Juice**

The Proximate Composition of yoghurt from blended soymilk, tiger nut milk and date palm juice were determined and presented in ± standard deviation as shown in the table 1.

### Table 1: Proximate Composition of yoghurt from blended soymilk, tiger nut milk and date palm juice

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>MOISTURE</th>
<th>ASH</th>
<th>PROTEIN</th>
<th>FAT</th>
<th>CARBOHYDRATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>75.8±1.44a</td>
<td>0.71±0.02a</td>
<td>7.00±0.03a</td>
<td>5.66±0.23a</td>
<td>10.71±1.69ab</td>
</tr>
<tr>
<td>B</td>
<td>70.16±0.28a</td>
<td>0.66±0.00a</td>
<td>6.30±0.17b</td>
<td>5.63±0.0ab</td>
<td>17.16±0.54cb</td>
</tr>
<tr>
<td>C</td>
<td>81.00±1.73c</td>
<td>0.76±0.02a</td>
<td>7.43±0.05d</td>
<td>6.40±0.00a</td>
<td>4.27±1.81a</td>
</tr>
<tr>
<td>D</td>
<td>80.00±0.00c</td>
<td>0.61±0.02a</td>
<td>5.40±0.17b</td>
<td>5.33±0.05a</td>
<td>8.60±0.26b</td>
</tr>
</tbody>
</table>

Mean of samples in the same column with same superscripts are not significantly (p>0.05) different.

**Key Word:**

Sample A: 50% Soybeans, 30% tiger nut, 20% date palm
Sample B: 30% Soybeans, 50% tiger nut, 20% date palm
Sample C: 40% Soybeans, 40% tiger nut, 20% date palm
Sample D: control (diary yogurt)

### Table 2: Microbial analysis of yoghurt from blended soymilk, tiger nut milk and date palm juice

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>COLONIES COUNTEd</th>
<th>CFU/ML</th>
<th>GRAM STAINING</th>
<th>ORGANISM ISOlATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>16 x 10⁴</td>
<td>1.6 x 10⁵</td>
<td>Gram +ve shining light yellow</td>
<td>Bacillus species</td>
</tr>
<tr>
<td>B</td>
<td>42 x 10⁴</td>
<td>4.2 x 10⁵</td>
<td>Gram +ve white shining</td>
<td>Staphylococci species</td>
</tr>
<tr>
<td>C</td>
<td>94 x 10⁴</td>
<td>9.4 x 10⁵</td>
<td>Gram +ve white shining</td>
<td>Staphylococci species</td>
</tr>
<tr>
<td>D</td>
<td>97 x 10⁴</td>
<td>9.7 x 10⁵</td>
<td>Gram +ve white shining</td>
<td>Staphylococci species</td>
</tr>
</tbody>
</table>
The primary concerns associated with the

The texture of the calcium may be due to variation in inorganic compounds especially minerals in a food commodity. The variation in ash content by yoghurt contain more minerals than other samples. The lowest value having the highest value, suggesting that this sample may magnesium, calcium, zinc and iron, are represented by the ash

The entire amounts of minerals, including sodium, potassium, soli

Soybeans, 50% tiger nut, 20% date palm) will have superior

Soybeans, 50% tiger nut, 20% date palm), while the highest

Sample B (30% Soybeans, 40% tiger nut, 20% date palm)

The result clearly indicates that yoghurt from sample B (30% Soybeans, 50% tiger nut, 20% date palm) will have superior solidity (in terms of firmness) since it had the lowest moisture content. Food quality, preservation, and resistance to degradation are the primary concerns associated with the moisture content of food (Nielsen, 2010). The texture of the yoghurt is significantly influenced by this key factor (moisture). For instance, if the moisture content is low, the yoghurt’s firmness will increase. This agrees with the study done by (Igbabul et al., 2014), who revealed that the moisture content of yoghurt ranged between 78.62 to 82.41%, suggesting that the moisture content of all plant-based yoghurts was on the normal level. According to (Matela et al., 2019), yoghurt’s moisture level should be less than 84%, as higher moisture contents impair the texture and mouth feel. The entire amounts of minerals, including sodium, potassium, magnesium, calcium, zinc and iron, are represented by the ash content (Lakshmipathy and Sarada, 2013). The ash content of all the samples from this work ranged from 0.61 – 0.76, with sample C (40% Soybeans, 40% tiger nut, 20% date palm) having the highest value, suggesting that this sample may contain more minerals than other samples. The lowest value was sample D (control). The ash content of the formulated yoghurt was lower than the ash content of 1.5% as reported by (Ukwuru et al., 2011). Ash indicates the measure of minerals in a food commodity. The variation in ash content may be due to variation in inorganic compounds especially calcium and iron present in milk extracted from soybeans. With regard to crude protein content in this research, the values were significantly (p>0.05) different from each other, highlighting the nutritional value of plant-based milk. Yoghurt formulation from 40% Soybeans, 40% tiger nut, 20% date palm sample had the highest crude protein content whereas sample D (control) had the lowest (5.40) value. The protein content of the formulated yoghurt was higher than the protein content of 2.45 – 3.64% reported by (Awonorin and Udezozor 2014) in a study “Chemical Properties of Tiger nut – Soy Milk Extract”. The result also was higher than the report of (Belew et al., 2005; Belew et al., 2010). The fat content of the formulated samples and control ranged from 5.33 – 6.40%. The fat contents of the formulated samples in this work were higher than the 1.88 – 4.00% fat content reported by (Olugbubyio and Oshe 2011) for some market yoghurt in Nigeria, but were within the fat content range of 5.1 – 9.7% reported by (Ajibade et al., 2015) for yoghurt produced from tiger nut alone and those produced from combinations of tiger nut milk with either cow milk, soy bean milk, or coconut milk. The fat content of the formulated samples were higher than the control. All the formulated fat content of the samples including the control were within the FAO standard as reported by (Omola et al., 2014). In the FAO standard, yoghurts with fat content of 3.0% are said to be the best. In terms of fat content, yoghurts can be placed into three

Table 3: Coliform count

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>COLONIES COUNTED</th>
<th>CFU/ML</th>
<th>GRAM STAINING</th>
<th>ORGANISM ISOLATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>B</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>C</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
<tr>
<td>D</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Table 4: Yeasts and Mould count of yoghurt from blended soymilk, tiger nut milk and date palm juice

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>COLONIES COUNTED</th>
<th>CFU/ML</th>
<th>GRAM STAINING</th>
<th>SPECIES ISOLATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>19x10^2</td>
<td>1.9x10^-2</td>
<td>Gram +ve fibric white</td>
<td>Mould species</td>
</tr>
<tr>
<td>B</td>
<td>27x10^-1</td>
<td>2.7x10^-2</td>
<td>Gram +ve fibric white</td>
<td>Mould species</td>
</tr>
<tr>
<td>C</td>
<td>55x10^-1</td>
<td>5.5x10^-2</td>
<td>Gram +ve fibric white</td>
<td>Mould species</td>
</tr>
<tr>
<td>D</td>
<td>79x10^-1</td>
<td>7.9x10^-3</td>
<td>Gram +ve fibric white</td>
<td>Mould species</td>
</tr>
</tbody>
</table>

Table 5: Sensory Evaluation of yoghurt from blended soymilk, tiger nut milk and date palm juice

<table>
<thead>
<tr>
<th>Sample</th>
<th>TASTE</th>
<th>TEXTURE</th>
<th>FLAVOUR</th>
<th>APPEARANCE</th>
<th>OVERALL ACCEPTABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8.10 ± 0.64^a</td>
<td>7.65 ± 0.81^a</td>
<td>8.00 ± 0.86^b</td>
<td>8.15 ± 0.75^b</td>
<td>8.45 ± 0.69^b</td>
</tr>
<tr>
<td>B</td>
<td>8.20 ± 0.77^a</td>
<td>7.95 ± 0.89^a</td>
<td>8.35 ± 0.59^a</td>
<td>7.90 ± 0.97^a</td>
<td>8.40 ± 0.75^a</td>
</tr>
<tr>
<td>C</td>
<td>7.65 ± 0.81^a</td>
<td>7.95 ± 0.76^a</td>
<td>7.55 ± 0.94^a</td>
<td>7.80 ± 0.89^a</td>
<td>8.05 ± 0.76^a</td>
</tr>
<tr>
<td>D (Control)</td>
<td>7.90 ± 0.64^a</td>
<td>7.85 ± 0.75^a</td>
<td>7.65 ± 0.67^a</td>
<td>7.85 ± 0.81^a</td>
<td>7.75 ± 0.64^a</td>
</tr>
</tbody>
</table>

Mean of samples with the same superscript in the same column do not differ significantly (P<0.05).

Key Word:

RESULTS AND DISCUSSION

Sample A: 50% Soybeans, 30% tiger nut, 20% date palm
Sample B: 30% Soybeans, 50% tiger nut, 20% date palm
Sample C: 40% Soybeans, 40% tiger nut, 20% date palm

Sample A: 50% Soybeans, 30% tiger nut, 20% date palm
Sample B: 30% Soybeans, 50% tiger nut, 20% date palm
Sample C: 40% Soybeans, 40% tiger nut, 20% date palm

The ash content of the samples including the control were within the FAO standard as reported by (Omola et al., 2014). In the FAO standard, yoghurts with fat content of 3.0% are said to be the best. In terms of fat content, yoghurts can be placed into three categories. Yoghurts with less than 0.5% fat content are to be labeled ‘non-fat yoghurt’, those with fat content of 0.5 – 3.25% are termed ‘high fat yoghurts’ (USDA, 2001 as cited by Olugbubyio and Oshe, 2011). The formulated yoghurts in this study fall within the category of high fat yoghurts. The crude fibre content obtained from this study ranged from 0.04 – 0.12. Sample C (40% Soybeans, 40% tiger nut, 20% date palm) had the highest crude fibre content. Processing, however could have affected the crude fibre content of all samples as they were very low. Although, the increase in the crude fibre content of sample C (100% coconut milk) could be due to the high fibre content present in coconut. The
carbohydrate content ranged from 4.27 – 17.16%. Sample C (40% Soybeans, 40% tiger nut, 20% date palm) had the least (4.27%) carbohydrate while sample B (30% Soybeans, 50% tiger nut, 20% date palm) had the highest (17.16%) carbohydrate. The carbohydrate of sample C (40% Soybeans, 40% tiger nut, 20% date palm) and sample D (control) were within the range of 3.77 – 9.27 reported by (Bristone et al., 2015). However, according to a report from United State Department of Agriculture, yoghurt should contain carbohydrate content of 13.7 to 17.7% (USDA, 2001). This implies that only yoghurt formulation from (30% Soybeans, 50% tiger nut, 20% date palm) sample B with the carbohydrate content of 17.16% is in good agreement with this standard (USDA, 2001).

The microbial examination was to evaluate the finished product for the survival of starter organism and the presence of undesirable spoilage organisms. The microbial analyses of the formulated samples including the control in this study are shown on table 2. Result of the total plate count in this study ranged from 1.6 x 10^2 to 9.7 x 10^2 CFU/ml and for mould and yeast count, it ranged from 1.9 x 10^2 to 7.9 x 10^2 CFU/ml. The sample D (control) from cow milk had the highest number of count both total count, mould and yeast count. Probably, cow milk is a good medium for microbial growth. The yoghurt formulation sample A (50% Soybeans, 30% tiger nut, 20% date palm) had the lowest total plate count, mould and yeast count. The lower microbial count observed in this study was probably due to proper handling and maintenance of good sanitary standards at all stages of the yoghurt production process, differences in fermentation time, and type of starter used. The highest count obtained from sample D (control) produced from cow milk indicated high rate of microbial action. The total plate count, mould and yeast count of the yoghurt produced in this study were within the acceptable safety limit (<10^3 and <10^2cfu/ml for total plate count, mould and yeast count respectively) specified by the International Commission on Microbiological Specifications for Foods (ICMSF, 1986). There were no microbial growths on the coliform count. The absence of coliform is an indication that all the samples observed were free from fecal contamination. Absence of coliform counts observed in the study showed that the yoghurt samples are of acceptable microbial quality.

Sensory evaluation of the yoghurts produced indicated that there were significant (p<0.05) difference in the acceptability ratings for appearance, aroma, taste, thickness and overall acceptability. Sample D (control) yoghurt was the most preferred yoghurt in terms of appearance, taste, overall acceptability and in conjunction with sample A in terms of thickness, had somewhat different findings (Akoma et al., 2000). The authors reported that yoghurt produced from tiger nut milk alone had higher appearance and taste acceptability over yoghurt produced from tiger nut + cow milk (3:2 w/v) composite. Sample C (40% Soybeans, 40% tiger nut, 20% date palm) was the most preferred yoghurt in terms of aroma acceptability. Observed differences in aroma score acceptability score were statistically (p<0.05) significant which implies that yoghurt aroma contribute significantly to the panelists’ preference to the yoghurt produced. The finding on aroma in this study is in contrast with that of (Akoma et al., 2000) who reported non-significant differences in the aroma of yoghurt produced from cow milk, tiger nut milk, coconut milk and their composites. Sample A (50% Soybeans, 30% tiger nut, 20% date palm) and sample D (control) were the most preferred in terms of thickness acceptability, in contrast to this finding. (Akoma et al., 2000, Ajibade et al., 2015), in similar studies, reported that thickness had no significant effects on the preferences of panelists for different yoghurt products.

In terms of overall acceptability, sample D (control) was most preferred by the panelists, followed by sample C (40% Soybeans, 40% tiger nut, 20% date palm). This finding is in contrast with that of (Ajibade et al., 2015) who evaluated the nutritional qualities of yoghurt prepared from different plant milk sources. The authors reported that yoghurt produced from 50% cow – 50% soybeans composite milk had the highest overall acceptability over 100% cow milk yoghurt (diary). The result for overall acceptability in this study may be explained by the fact that people (panelists) are accustomed to the quality characteristics of commercially available yoghurts, which are typically made from 100% cow- milk. Throughout the sensory evaluation, it was found that the yoghurt formulations made from 40% Soybeans, 40% tiger nut, 20% date palm (sample C) and 50% Soybeans, 30% tiger nut, 20% date palm (sample A) scored significantly closer to the control formulation 100% cow milk (sample D) than 30% Soybeans, 50% tiger nut, 20% date palm (sample B), indicating that these two samples (A and C) may produce a plant-based yoghurt that can compete favourably with the diary yoghurt which is in similar with a study conducted by Henry-Unameze, and Ezeugwu, (2022).

**CONCLUSION**

The study shown that yoghurt formulations from mixtures of soybeans milk, tiger nut milk and date palm juice have nutritional qualities similar to yogurt made entirely from cow milk and had the lowest microbial load and were within the acceptable safety (<10^3 and 10^2 cfu/ml for total plate count, yeast and mould respectively). This study has shown that soy milk, tiger nut milk and date palm juice produced can be effectively used for acceptable yogurt formulations.

**REFERENCES**


Specifications for Foods

and functional properties of wheat, sweet potato and Igbabul

London

Ihekoronye, A.

FSF

Agboola, World Journal of Dairy and pomegranate peelssupplementation

EP

Chap, T. Y. Morya, A.

Agriculture, Nutrition and Development, 11: 5157-5169


ICMSF. “International Commission on Microbiological Specifications for Foods”, 1986


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