ISSN 2709-3409 (Online)

JOURNAL OF TERTIARY AND INDUSTRIAL SCIENCES

A MULTIDISCIPLINARY JOURNAL OF THE HIGHER TECHNICAL TEACHERS' TRAINING COLLEGE, KUMBA

VOLUME 3, NUMBER 2
JULY, 2023

PUBLISHER:
HIGHER TECHNICAL TEACHERS' TRAINING COLLEGE (HTTTC)
UNIVERSITY OF BUEA
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Journal of Tertiary and Industrial Sciences *Vol 3, No. 2, 2023*
ISSN 2709-3409 (Online)

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Journal of Tertiary and Industrial Sciences *Vol 3, No. 2, 2023*
ISSN 2709-3409 (Online)

Journal of Tertiary and Industrial Sciences *Vol 3, No. 2, 2023*
ISSN 2709-3409 (Online)

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FORMULATION OF A YOGHURT LIKE PRODUCT FROM CORN MILK, SOY BEANS MILK, SKIMMED MILK ENRICHED WITH BANANA FLAVOUR

By

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Abstract
Due to the increasing demand of milk alternatives, related to both health and ethics needs, plant-based yoghurt-like products are increasing in demand. This work sought to compare yoghurt made from skimmed milk with that from plant-based alternatives such as corn milk-banana, soy milk-banana and soy milk, corn milk-banana combinations. Fermentation at controlled condition was carried out. Data collected from sensory analysis with the aid of a hedonic scale were statistically analysed, and results presented. The results from four main samples comprising of yoghurt made from skimmed milk, corn milk enriched with banana, soy milk enriched with banana and a combination of corn milk and soy milk enriched with banana is presented. Mean values calculated from the hedonic scale for all the different attributes, such as taste, flavour, general acceptability, texture and colour, showed sample A > Sample C > sample D > sample B. The results showed yoghurt products can be produced from, corn milk, soy milk and a blend of soy milk. Yoghurt product from soy milk enriched with banana flavour has the highest quality which is preferred over normal yoghurt from skimmed milk. Results showed plant-based yoghurts can conveniently substitute for animal-based yoghurts.
Key words: soy milk, corn milk, Sensory analysis.

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ISSN 2709-3409 (Online)

1 Introduction

Yogurt is one of the oldest fermented milk products known in human history usually produced by inoculating milk with a mixed starter culture consisting of homofermentative lactic acid bacteria, streptococcus thermophilus and lactobacillus bulgaricus at 45 ^{o}C until the pH of about 4.0 is attained and cooled rapidly to 4^{O}C (Akusu and Wordu, 2017). Yoghurt is a popular dairy product around the world not only for its unique texture and flavour but also for its health benefit (Macori and Cotter 2018). The manufacture of yoghurt involves the acid gelation of milk which is induced by the fermentation of lactose of lactic acid bacteria. Different types of yogurts are manufactured by varying the processing conditions and the composition of the milk base. Set yogurt is incubated in retail containers, keeping the gel structure undisturbed). Yoghurt whose name comes from the Turkish word yoghurt, is the most widely available fermented milk in the western world today. Its popularity is derived from its flavour and versatility and its keeping quality. Yogurt is believed to have been originated in Balkan and the Middle East and in recent times becoming popular worldwide especially in Europe and American as well. Traditionally, yoghurt has been made from cream milk, skimmed milk, or fortified milk usually from cows and sometimes from other animals such as goat and sheep (Popola et al., 2010). Most industrialised yogurt production utilises milk from cow milk because cow milk gives yogurt its unique characteristic (Aniaku, and Ogunbodede, 2020). Yogurt has become a very popular fermented product for Indonesian and it was initially indented to prolong the shelf life of fresh milk through fermentation (Tamime and Robinson, 1989). Nowadays, most of the commercial yogurts in the market are cow milk based, because of its authentic taste and aroma, and its nutritional value which is very beneficial for health. As the consumers' awareness on health-related issues increase, the current development of yoghurt-based products has favoured the utilization of probiotic microorganism that is proven the growth of beneficial microbes in human gastrointestinal organs (Ataie-Jafari et al., 2009) and resulted into several therapeutic effects. Yogurt has been an important part of human diet for thousands of years. Owing to different health benefits of the yogurt, enormous studies have been done to developed novel types of yogurts such as yogurt fortified with fibres, minerals, and other nutrients (Stephen, F.A et al.). Several novel ingredients include prebiotics), quinoa flour and fruit flours have been used to improve the rheological and nutritional properties of yogurt. Yoghurts are important element of the human diet, due to their high nutritional value and their appealing sensory properties.

Plant derived protein consumption is continuously increasing worldwide, corn milk and soy milk is considered as an innovation especially in the making of a yogurt liked product as this will help to create an awareness of the different products that can be produced from corn and soy bean. The nutritional value of soybean and corn milk especially in the making of yogurt like products enriched with banana will help prevent certain diseases in children like malnutrition and see how to repair worn out tissues and help for strong bones, for the old to prevent weak bones and osteoporosis.

2 Materials and method

This section presents the material and methods used to produce yoghurt like products from corn milk, soy milk and corn-soymilk from a blend of skinned milk enriched with banana puree.

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2.1 Materials

½ kg of white sugar, 5 cups soy beans, 3 cups corn kennel, 10 litter of water, 1kg of banana puree, A blender, aluminium and stainless pot, large plastic bowls, Measuring scale, refrigerator, Food thermometer, Knives, Cup, spoon, Gas cooker, Skimmed milk. The nutritional values of the major elements are described below.

2.1.1 Nutritional value of soy milk

Soy milk, which is derived from whole soybeans, is one of the most popular functional beverages. Soy milk is an aqueous, white creamy extract produced from soy beans which is like cow milk in appearance and consistency. It is highly nutritious which contain protein, fat, carbohydrate, vitamins, and minerals. It is because of this nutritious value and comparative low cost, that soy milk plays an important role in the dietary pattern of people in most developing countries. The nutrient content is eight ounces of plain soymilk are 140 gm calories, 10g protein, 4gm fat, 14gm carbohydrate, 120mg sodium, 1.8mg iron, 0.1mg riboflavin and 80mg calcium (Cruz et al., 2007). It has about the same amount of protein as cow milk, though the amino acid profile differs (Dauda and Adegoke, 2021). Due to its high nutritional value, soy milk is a suitable milk-substitute for vegans/vegetarian and those who suffer from milk allergy or lactose intolerance. It is also regarded as a low-cost and high-quality source of protein and energy for malnourished subjects, as well as in populations with an insufficient supply of cow Soy milk contains some beneficial component such as isoflavones, and polyphenols which can exert favourable effect on the cardiovascular health. Moreover, as a rich source of isoflavones, soy milk intake is associated with a lower incidence of cancer, osteoporosis, menopausal symptoms, and cardiovascular diseases (Woodside et al., 2016). The potential health-promoting effects of soy milk consumption on several cardiometabolic risk factors have been examined in several interventional studies (Swapna et al., 2020). The increasing popularity of soy milk as a beverage worldwide is credited to health benefits e.g., low cholesterol and lactose, its ability to reduce bone loss and menopausal symptoms, prevention and reduction of heart disease and certain cancer. As this drink is cholesterol free and low in energy, it could enhance health benefit in terms of reducing body weight and blood lipids (Kabiru et al., 2012) with its unique nutty flavour and rich nutrition, soy milk can be used as supplementary way to diary milk. It is available as plain, unflavoured beverages or in a variety of flavoured beverages including chocolate, vanilla, and almond.

2.1.2 Nutritional value of corn milk

Sweet corn is rich in carbohydrate and sugar and contain useful amounts of vitamins A, B3 (which support metabolism, the nervous and digestive system) and vitamin C and contain folic acid, fibre, minerals, and protein. The total sugar in corn ranges from 25-30 % (Ramachandrappa and Nanjjappa, 2006). Perhaps the most surprising is that it offers even greater health benefits when cooked, helping to battle with cancer, heart disease as sweet corn contains antioxidant activity, despite the loss of vitamin C. The nutritional value of sweet corn kernels is related to the content of water (72.7%) and to the total content of solid parts (27.3%), solid part includes hydrocarbons (81%), protein (13%), lipids (3.5%) and other 2.5% starch is the dominant hydrocarbon component (Swapna et al., 2020).

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2.1.3 Nutritional value of banana

Cholesterol- lowering effect Studies have shown that banana has the potential to lower cholesterol. It was suggested that the dietary fibre component in banana pulp was responsible for its cholesterol lowering effect. The amount of dietary fibre in banana is relatively constant during banana ripening. Bananas may be beneficial for heart health due to their high levels of potassium and antioxidants. What is more, their resistant starch and pectin may promote colon health. Bananas are among the world's most consumed fruits. Primarily composed of carbs, they contain decent amounts of several vitamins, minerals, and antioxidants. Potassium, vitamin C, catechin, and resistant starch are among their healthy nutrients. Bananas may have numerous benefits including improved heart and digestive health when consumed regularly as a part of a healthy lifestyle.

2.2 Method

Yoghurt is usually classified in two basic types according to its physical state in retail container; set yoghurt and stirred yoghurt. Set yoghurt is fermented in retail container, which is filled after milk inoculation and is incubated in an incubation room at a suitable temperature, normally 40 to 43^{o}C for approximately 2-4 hours. Stirred yoghurt, milk is inoculated and incubated in fermentation tank, the yoghurt gel being broken up during the stirring, cooling, and packaging stages. Variation in the rheological properties of stirred yoghurt may be due to several factors. These can be of a physical nature such as those related with total solid content, milk composition and types of starter culture, or processing conditions-related, such as homogenization, thermal pre-treatment of milk and post-incubation stages (including; stirring, pumping, cooling, and packaging) (Tamine and Deeth, 1980; Tamine and Robinson, 1988). Several studies have been reported on yoghurt gels and several methods have been introduced to evaluate their rheological properties

2.2.1 Method one: To produce milk from corn

To prepare the corn milk, the corn cobs was firstly husked, the silks removed and washed with water, the kneel was separated from the cobs using a knife. The corn grinded using a grinder with 2 litres of water that was added to 200 g of corn seed during the grinding process, it was then filter using a muslin cloth to extract the milk and to remove the residue. The corn milk solution was then heated to 80 ^{O}C for 10 minute and stored at 18 ^{o}C until use.

2.2.2 Method two: To produce milk from soy beans

To prepare soy beans milk, soy beans was bought from the Kumba main market and the bad grains were removed, soy bean was soaked in 3 to 5 cups of 250 mls water, and the water was changed after 3 hours to prevent fermentation from taking place. This helps to soften the soybeans and make it ready for blending.

Water was discarded and soy beans were rinsed in clean water as this help to get rid of any dirt or contaminant that was on the beans. The beans were pilled, by rubbing in between the palms. Water separated from the soy beans and the soy beans s put in to the blender where 4 cups 100 mls of water was added to blend. The soybeans were blended until smooth, as this step exposes the entire bean to the water, ensuring all the nutrient is presents. The mixture was extracted using a muslin cloth as this cloth have a great balance of tight woven that keeps the pulp inside, porous enough to let the milk flow freely. The strained milk was heated in a stainless pan to 100

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^{o}C at the temperature of 20 minutes with continuous stirring to prevent it from getting sticking on the pan. The milk was then been filtered and pasteurize.

2.2.3 Method 3: Transformation of the milk from corn and soy beans with skimmed milk to a yoghurt like product.

The objective of the study was to develop a yogurt like product from corn milk, soy milk, skimmed milk enriched with banana flavour. The first stage was soy milk inclusion into yogurt tried on 5 percent milk, 10 percent corn milk and 30 percent soy milk, and will be optimised up to 35% that will be included to improve the protein value of the yogurt without affecting the other physio–chemical and sensory quality of the yoghurt. The second stage will be 5, 10, 15 that is 5% milk, 10% corn milk and 15% corn milk. The third stage will be 5, 15, and 20 that is 5% banana puree and 15 percent corn milk, and 5% of banana. The fourth stage was comprised of 30% soy milk, 15% of corn milk 5% of dairy milk, 5% of banana puree. The level and method of banana puree was optimised as this was incorporated at time of inoculation and allowing it to set up for the yoghurt and the stirred type of value enriched yoghurt was used to manufacture.

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ISSN 2709-3409 (Online)

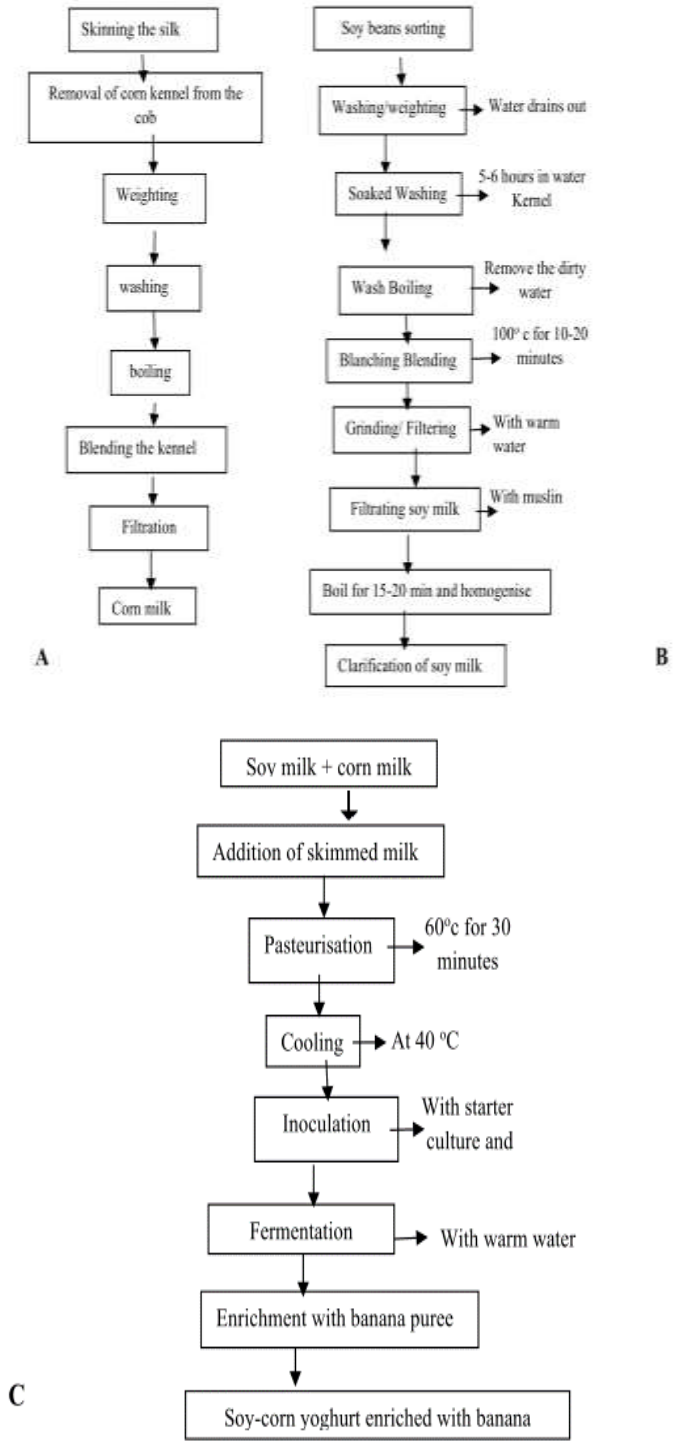

Figure 1: A-Flow chart of corn milk process, B-Flow chart of soymilk process, and C- yoghurt from corn milk, soy milk, and skimmed milk enriched with banana flavour. Methods adopted from Otolowo et al. (2021)

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3 Results and discussions

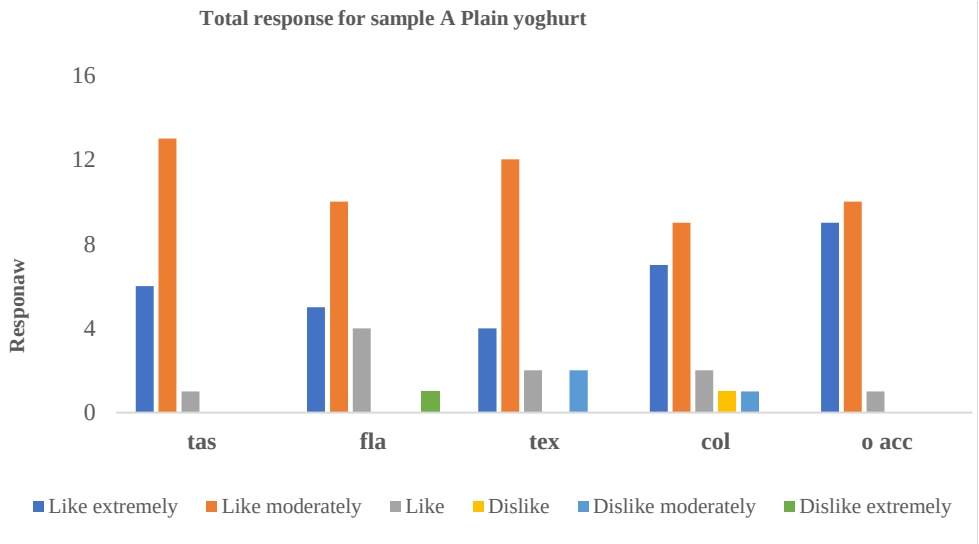
The experimental analysis of this study revealed that, sample A underwent a period of 7 to 8 hours under a temperature of 40 ^{O}C to attain full fermentation, sample C 8 to 9 hours for complete fermentation under same temperature condition and sample D show a fermentation rate close to that of sample C. Sample A took 10-12 hours while sample B took the longest time for fermentation. The data collected from sensory analysis of the different attributes s processed and presented in this section. As this is mostly a comparative study, comparison between standard yoghurt and yoghurt made from a combination of different components such as corn milk and soy milk enriched with banana is made. The different combinations will be presented graphically and numerically for a better understanding. Sensory evaluation is a scientific discipline that is used to invoke, measure, analyses and interpret reactions to characteristics of foods and materials as they are perceived by the human senses (sight, smell, taste).

Table one below, represent the number of responses from a panellist of 20 people who were selected and prepared to carry out the different attributes as shown on the table. The results of the different settings represented by sample.

A- Skimmed milk alone
B- Yoghurt product from corn milk enriched with banana
C- Yoghurt product from soy milk enriched with banana
D- Yoghurt product from a blend of soy and corn milk enriched with banana

3.1 Presentation of Responses from the Panellist on the Different Samples

Sensory analysis data is presented in the clustered column charts below:



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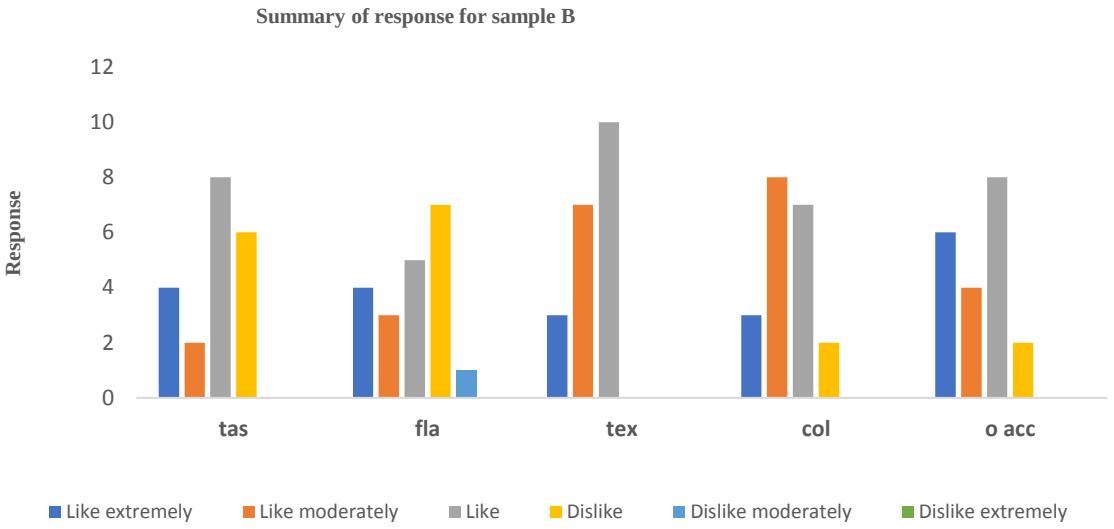

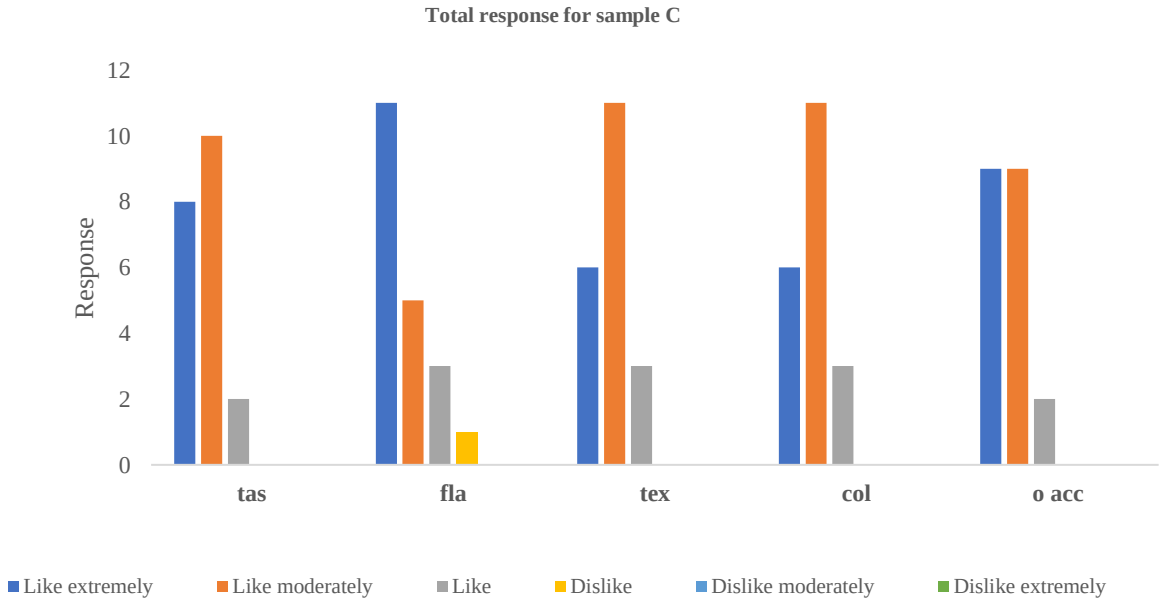

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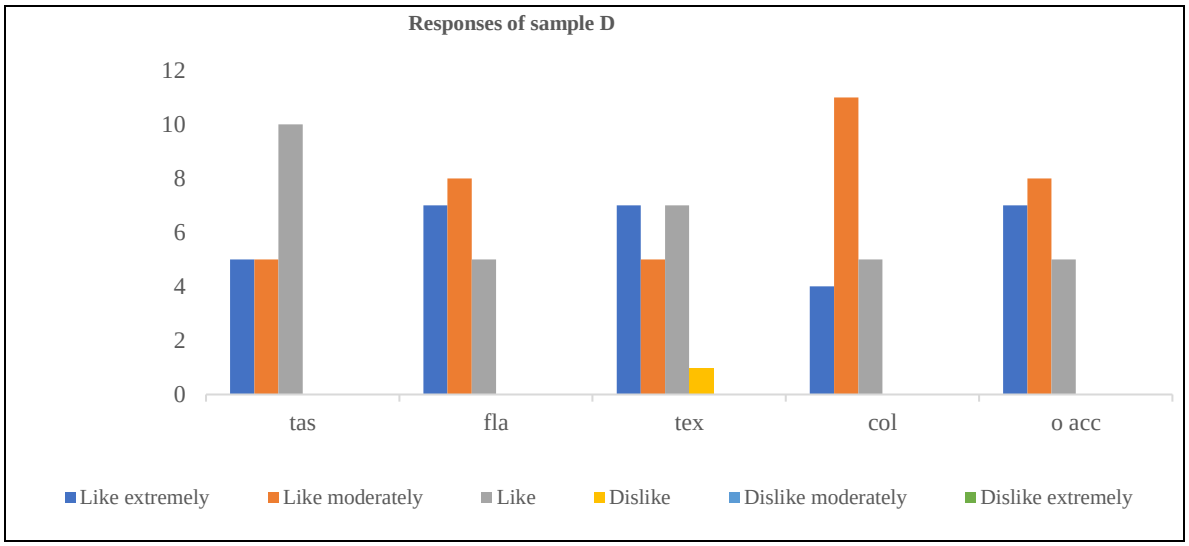

Source: field work 2022
Figure 2: Distribution of attributes for sample A, B, C and D respectively

Table 1: Responses from panellist for the different attributes for sample A, B, C and D

	Sample	Taste	Flavour	Texture	Colour	overall acceptability
Like extremely	A	6	5	4	7	9
	B	4	4	3	3	6
	C	8	11	6	6	9
	D	5	7	7	4	7
Like Moderately	A	13	10	12	9	10
	B	2	3	7	8	4
	C	10	5	11	11	9
	D	5	8	5	11	8
Like	A	1	4	2	2	1
	B	8	5	10	7	8
	C	2	3	3	3	2
	D	10	5	7	5	5
Dislike	A	0	0	0	1	0
	B	6	7	0	2	2
	C	0	0	0	0	0
	D	0	0	1	0	0
Dislike moderately	A	0	0	2	1	0
	B	0	1	0	0	0
	C	0	0	0	0	0
	D	0	0	0	0	0
Dislike extremely	A	0	0	2	1	0
	B	0	1	0	0	0
	C	0	0	0	0	0
	D	0	0	0	0	0

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Table 2: Summary of sensory analysis, values represent mean values for each attribute considered. A, B C and D designate the different samples respectively

	Attributes						
	Appearance	**Taste**	**Flavour**	**Texture**	**Colour**	**Overall acceptability**	**Total**
A.	5.4	5.25	4.9	4.8	5	5.4	**30.75**
B.	4.55	4.2	4.1	4.7	4.6	4.7	**26.85**
C.	5.4	5.3	5.3	5.3	5.2	5.4	**31.9**
D.	5.0	4.75	5.1	4.9	5.1	5.1	**29.95**

3.2 Analysis of sensory properties

Sensory evaluation is a science that measures, analyses, and interprets the reactions of people to products as perceived by the senses. It is a means of determining whether product differences are perceived, the basis for the differences, and whether one product is liked more than another. The value of the science lies in its use of limited numbers of consumers to reach decisions that can be extrapolated to larger populations with confidence. This means that the subjects are representative of the consumer population for whom the product is intended and have the necessary sensory skills. In practical terms, it enables one to evaluate products in a relatively short time and at low cost. The sensory evaluation of the different samples from A to D were analysed using a 6-point Linkert scale of: "Like extremely", "Like moderately", "Like", "Dislike", "Dislike moderately" and "Dislike extremely" with a point 6:5:4:3:2:1 with a mean value 3.5. Results from a hedonic test tell us the degree of liking for the different products produced. It is used primarily for determining which product is best liked from an array of options. The different sensory properties under investigation were: appearance, taste, flavour, texture, colour and general acceptability of the different samples. Analysing the results for taste of the 20 panellist 20 liked the product of samples A, C and D, whereas 14 did like sample C. A general view of the results show that, taking into consideration those who responded to liking the products from the different samples there was no significant difference. However, the main difference arises from those who expressed extreme likeness of the products for all four samples. Taking taste for example, results showed that those who expressed extreme likeness is in the following order Sample C > A > D > A. Table 1 above presents the sensory analysis of taste. Results from the analysis showed that more than 85% of the total count of responses like every attribute of the products considering all the samples. Considering the overall acceptability, (a general appreciation on the products taking into consideration the rest of the other attributes) 92 % expressed their general apperception of the products from the different samples. In the context of this study the results show that there is a general acceptance of the products from sample

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B, C, and D, it is therefore important to note that alternatives to Skimmed milk in the production of yoghurt drinks is possible. As a comparative study of yoghurt made from skimmed milk Sample A and yoghurts from other sources, the aim is to see how standard yoghurt compares with derivatives of yoghurt from other raw materials such as corm milk and soy milk. Taking taste as an example the taste of standard yoghurt 100 percent skimmed milk was 100% like (like extremely + like moderately + like) which is the same for samples C and D. Also taking into consideration the texture as shown on figures 2 sample A did not record any dislike for taste however Sample B recorded 6 dislikes for taste and flour. These results are important to give the industry reason to work on the taste and texture on yoghurt produced from corn milk. Mean values of the values of the different attributes have been calculated taking into consideration 6-point Linkert scale of: "Like extremely", "Like moderately", "Like", "Dislike", "Dislike moderately" and "Dislike extremely" with a point 6:5:4:3:2:1 and used in a comparative study as presented in figure 3 below.

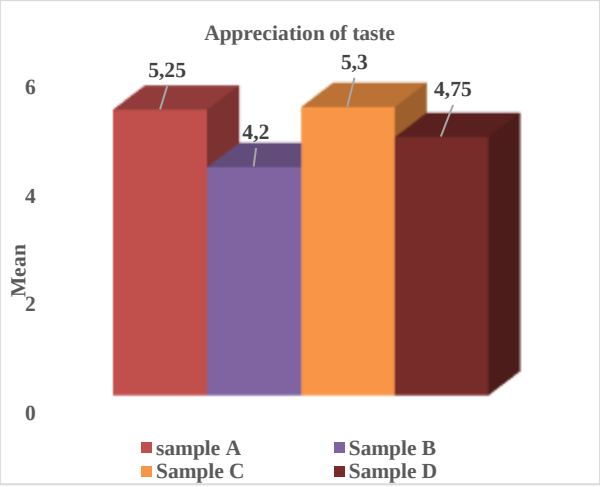

Figure 3: Taste appreciation

From the results in figure 3, sample A and Sample C show same appreciation in terms of taste. Taste is one of the most important attributes of foods and drinks as such results show that yogurts derived from Soy milk can serve as a substitute for skimmed milk, as shown on figure 3- taste appreciation. In terms of texture, sample C has the best texture as expressed by the panellist.

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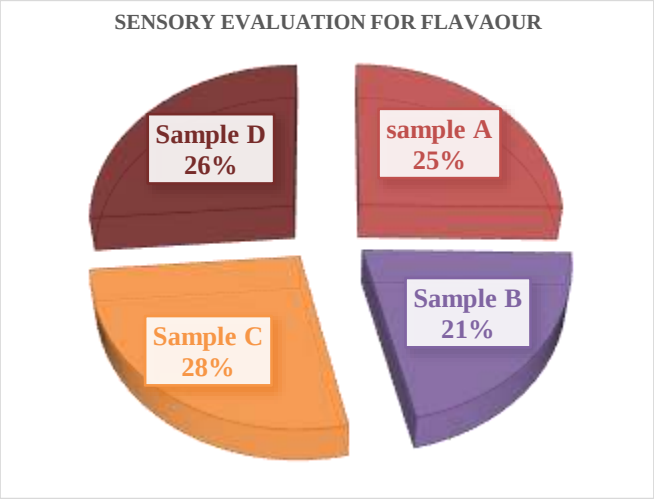
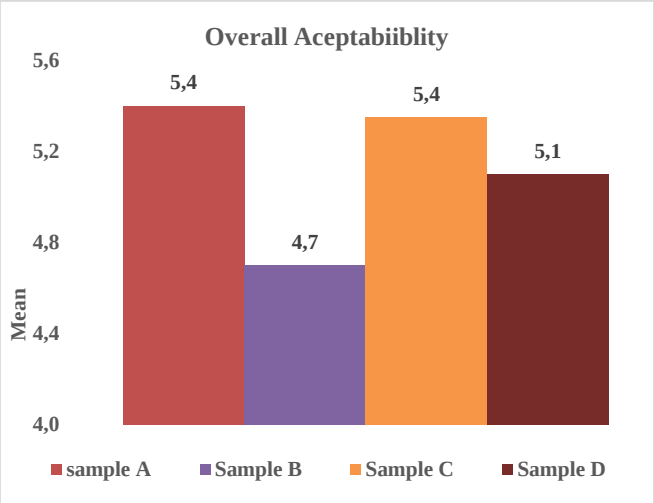
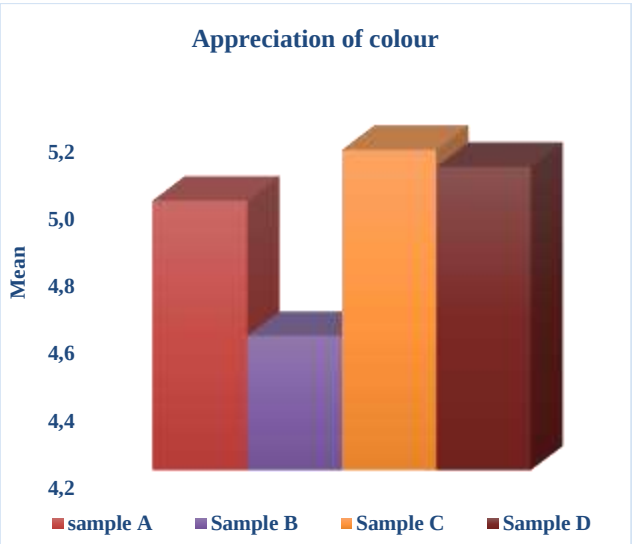
ISSN 2709-3409 (Online)







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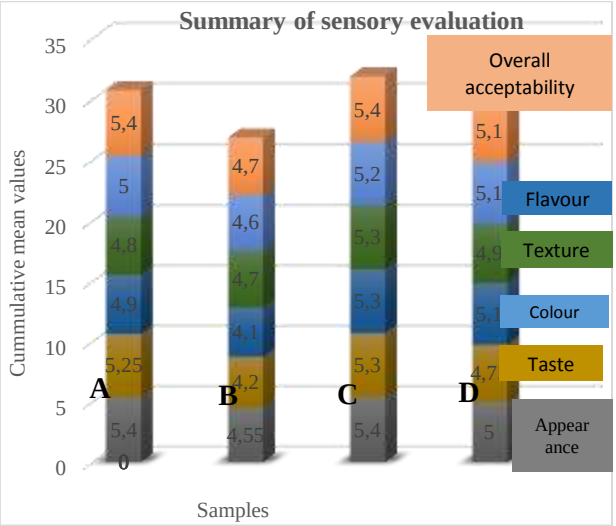
Source: Field work 2022

Figure 4: Comparative respresentation of the different attributes for sample A, B, C and D respectively using comparative mean values,

From figure 4 above, Sample C is the most appreciated in terms of flavour a mean of 5.3, followed by sample D with a mean value of 5.1, and thirdly by sample A with nineteen like over one dislike and a mean of 4.9 and lastly sample B with twelve like and eight dislike and a mean of 4.1 respectively.

The summary shows sample C Yoghurt product from soy milk enriched with banana flavour toping all six sensory attributes, while sample B Yoghurt product from corn milk enriched with banana, came last (least accepted) in all six attributes and sample A yoghurt from skimmed milk and sample D Yoghurt from a blend of soy and corn milk enriched with banana flavour shared the second place.



Source: Field work 2022
Figure 5: Summary of sensory evaluation

4 Conclusion and Discussions

4.1 Discussions

The main objective of this study was to produce homemade yoghurt like products from corn milk, soy milk and a blend of soy-corn milk enriched with banana flavour. Basically, the study made used of four set of samples of homemade yoghurt. Sample A consisted of the production of homemade plain yoghurt from skimmed milk, sample B homemade yoghurt from corn milk enriched with banana flavour, sample C homemade yoghurt from soy milk enriched with banana flavour while sample D consisted of homemade yoghurt from a blend of soy-corn milk enriched with banana flavour. Taking respondent's appreciation of overall acceptability of sample A

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homemade plain yoghurt, and sample C (table 2 and figure 4 above) revealed that out of a total of twenty respondents, all the twenty respondents liked and accepted the samples.

5 Conclusion

From table 2, data showed yoghurt products can be produced from corn milk enriched with banana flavour which falls in line with the research of who showed yoghurt products can be produced from corn milk and suggest yoghurt from corn milk is rich in carbohydrate and sugar and contain useful amounts of vitamins A, B3 (which support metabolism, the nervous and digestive system) and vitamin C and contain folic acid, fibre, minerals, and protein. Sample C yoghurt product from soy milk enriched with banana flavour saw a high acceptance of the product. The research results for this sample are in accordance with the study of Anderson and, Adlercreutz (1997) who in their research said because of the nutritious value and comparative low cost of soy milk, soy milk plays an important role in the dietary pattern of people in most developing countries. They further defined Soy milk as an aqueous, white creamy extract produced from soy beans which is like cow milk in appearance and consistency. It is highly nutritious which contain protein, fat, carbohydrate, vitamins, and minerals. In line with the statistics revealed in table nine, yoghurt from soy milk enriched with banana was highly competing with yoghurt from skimmed milk and was the most appreciated even above normal yoghurt from skimmed milk. Lastly sample D, yoghurt product from a blend of soy and corn milk enriched with banana flavour saw numerous appreciations from different sensory attributes. Others parts of the research show this sample highly appreciated over yoghurt from skimmed milk in three attributes. This is in line with the work of Erdman and Fordyce (1997) who talked on wide range use of soy and corn milk in beverage. To conclude, Yoghurt product can be produced from, corn milk, soy milk and a blend of soy milk. Yoghurt product from soy milk enriched with banana flavour has the highest quality which is preferred over normal yoghurt from skimmed milk.

Yoghurt product from a blend of corn and soy milk enriched with banana flavour is almost equal in acceptance to yoghurt product from skimmed milk while yoghurt product from corn milk shows the least acceptance (table 2) below yoghurt from skimmed milk and yoghurt from a blend of corn and soy milk. Based on the findings and considering the conclusion drawn, the following recommendations were made. Although, Sample A and C had the highest mean score, the study recommend that the consumers should go in for Sample C since it has the highest nutritive value. When home-made yoghurt stays more than recommended time, it develops a sour taste so it is recommended home-made yoghurt be stored at most 2 weeks.

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Journal of Tertiary and Industrial Sciences *Vol 3, No. 2, 2023*
ISSN 2709-3409 (Online)