Proximate and Sensory Properties of Yoghurts Produced with Lactic Acid Bacteria Isolated from Diary and Non-Diary Sources

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Abstract: Yoghurt is one of the famous fermented milk preparations. It is the most widely available fermented milk in Western World where its popularity derives more from its flavor versatility. Lactic Acid Bacteria isolated from fermented cow and human Breast milk using MRS agar medium were used to produce yoghurt samples. LAB from commercially prepared yoghurt purchased from the market were used to produce yoghurt which was used as a control for comparison with yoghurts produced using LAB sourced from cow and human breast milk samples. Cow and breast-milk samples were serially diluted and plated out on the MRS Agar using pour plate method. The isolates and the commercially acquired Lactic Acid Bacteria were used to produce yoghurt samples from powdered milk in an 8 hours fermentation process. The fermented product was compared against the commercial product in terms of both nutritional and sensory attributes. The LAB were *Lactobacillus acidophilus*, *Lactobacillus plantarum*, and *Bifidobacteium*. The isolates were used singly as starter cultures. The optimum pH for the Yoghurt production was 5.5 while the optimum temperature is 40^{o}C. The Yoghurt sample C had the highest pH (6.60 ± 0.00; P≤0.05) and highest moisture content (88.10 ± 0.04; P≤0.05), the highest protein content was from sample A and D (control). Sample A had the highest crude fat (0.85 ± 0.00; P≤0.05) ash content was highest in sample D (control) (3.29 ± 0.05; P≤0.05) and the fibre content of the Yoghurt was: 0.14 ± 0.02; P≤0.05. We conclude that the protein content of the yoghurt produced with *L. acidophilus* has the same protein content with the commercially sourced yoghurt but with lower fats, ash and carbohydrate contents. So, the yoghurt produced with *L. acidophilus* will be a good source of protein to the consumers. The laboratory and commercially produced yoghurts had equal level of acceptability to the panelists.

Key words: fermentation, lactic acid bacteria, proximate, powered milk, sensory, yoghurt

INTRODUCTION

Yogurt is defined as 'a product resulting from milk by fermentation with a mixed starter culture consisting of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* ssp. Yogurt is well known for its nutritional value, health benefits, and popular as an original source of probiotic strains and bioactive metabolites (Aryana, K.J. and McGrew, 2007) . Lactobacilli and bifidobacteria are the most common probiotics found in yogurt. *L. delbrueckii* subsp. *bulgaricus* and *Streptococcus salivarius* subsp. *thermophilus* are widely used as starter cultures in products having yogurt as main ingredient.

Yoghurt's nutritional and therapeutic functions have been known in the Middle East, Far East and Eastern Europe for hundreds of years, but it has only been appreciated in the West in the Last few decades (Donkor, 2006). Yoghurt is one of the famous fermented milk preparations. The name yoghurt is derived from the Turkish word "jugurt: which means dense and thick (Adams and Moss, 2008). However, yoghurt is known by other name in many countries such as Turkey, India and the Balkam States. It is the most widely available fermented milk in Western World where its popularity derives more from as flavor and versatility than from keeping quantities.

A starter culture are those microorganisms that are used in the production of cultured products such as yoghurt and cheese. The natural microflora of the natural substrate is either inefficient, uncontrollable or unpredictable during fermentation and is destroyed altogether by the heat treatments given to the substrate. Traditional methods are still used in producing some products but advances in starter technology, especially in selection, maintenance, freezing and lyophilisation of commercial starter, have brought starter availability, flexibility and reliability to product manufacturers (Heller, 1996).

Lactobacilli are very fastidious microorganisms that require fermentable carbohydrates, vitamins and nucleic acids and minerals to grow regardless of the specific nutrient requirements of the strain (Gomes and Macata, 2014). Thus the substrate composition and nutritional requirements of the strain considerably affect the overall performance of the fermentation. A number of studies on the development of food fermentation process based on the use of cereal and vegetable substrates have been reported (Caralampopoulos *et al*., 2014; Yoon *et al*., 2016; Demir *et al*., 2017).

Microbial growth on these substrates depend on the environmental factors such as pH, temperature and accumulation of metabolic end products. However, as natural fermentation rely on microbial populations present in the raw material, these products exhibits substantial variations in flavor and quality (Giraud *et al*., 2011). The good adaptation of Lactic Acid Bacteria in cereals and vegetables suggests that utilization of a potential probiotic strain as starter culture in these substrate other than milk would produce a fermented food with defined and consistent characteristics and possibly health promoting properties.

This aim of the research was to determine the proximate and sensory properties of yoghurt produced with Lactic Acid Bacteria isolated from diary and non-diary sources

MATERIALS AND METHODS

Sample collection

Commercial yoghurt and powdered milk samples samples were purchased at Ubani Market, Umuahia, packed in a cooler containing ice cubes and taken to CES Laboratory and Research Centre Umudike, Umuahia for analysis. Fresh Cow Milk sample was aseptically collected from a cow in a cattle farm at Okigwe, Imo state and Human breast milk samples were collected from five volunteered nursing mothers. All the samples were processed immediately after collection.

Isolation of LAB

The fresh cow milk samples were kept on the laboratory table and allowed to ferment spontaneously for 3 days. Thereafter, the fermented milk and human breast milk were serially diluted and 0.1ml of the 3rd dilution was aseptically inoculated by Pour Plate method on De Man Rogosa Sharpe (MRS, HiMedia, India) (Barnett, 2003) prepared the previous day for the isolation of LAB and by spread plate method on M17 Medium (HiMedia, India) for the isolation of *Streptococcus*. The plates inoculated in duplicates were labelled appropriately and incubated at 37ºC under micro aerophilic condition using Excello Anaerobic Jar for 48 hrs (Fadela *et al.,* 2008).

Identification and characterization of bacterial isolates

Each of the isolates was sub-cultured on MRS to get the pure isolates which were later identified based on morphology, Gram stain reaction, biochemical and sugar fermentation tests. The identification procedure given in Bergey's Manual of determinative Bacteriology (Bergey, 2010) and Cowan (1974) were used to characterized and identify the isolates. The pure isolates were maintained as frozen stock culture at -70ºC in MRS (HiMedia, India) and M17 broth respectively containing 20 % glycerol (Merck, Germany) for further use.

Determination of the Physico-Chemical parameters of the samples

Measurement of pH

The pH of the fermented milk samples (yoghurt) was measured using a pH meter with a glass electrode.

Determination of Titratable Acidity (T.A)

This was determined by the alkaline titrimetric method of Sadler and Murphy (2003). Twenty grams of the sample was dispensed into conical flask and 3 drops of phenolphthalein indicator was added. This was titrated against diluent standard alkaline solution (0.01 N NaOH solution). Titration was done until a persistent faint pink colouration was obtained. The total Titratable Acidity was calculated using the formula below

$$\% \text{ Titratable Acidity (\%TTA)} = \frac{T \; x \; N}{W} = \frac{100}{1}$$

Where:
T = titre value
N = Normality of titrant
W = Weight of sample used.

Determination of Proximate composition of samples

The Proximate compositions of the samples (moisture, ash (mineral), fats, protein, carbohydrate and fibre) were determined.

Determination of Moisture Content

This was determined using the AOAC (2011) gravimetric method. A measured weight of the samples (5g) was weighed into a previously weighed moisture can. The sample in the can was evaporated to dryness over a steam bath and then dried in the oven at 105^{o}C for 3 hours in the first instance. It was cooled in a desiccator and weighed. It was then returned to the oven for further drying. Drying, cooling and weighing were repeated until a constant weight was obtained. By difference, the weight of the moisture lost was obtained and expressed as a percentage of the weight of sample analyzed.

$$\% \text{ Moisture (\% MC)} = \frac{W2 - W3}{W2 - W1} \times \frac{100}{1}$$

Where:
W_1 = Weight of empty moisture can
W_2 = Weight of can + sample before drying
W_3 = weight of can + sample after drying

Determination of Ash content

The Ash content was determined by the Furnace incineration Gravimetric Method (James, 2015). 5.0g of the sample was weighed into previously weighed crucible. It was evaporated to dryness over a steam bath and then burnt in a muffle furnace at 550^{o}C until it becomes grey ash. The ash in the crucible was carefully removed and cooled in a dessicator and reweighed. By weighed increased, the weight of ash was obtained and expressed as a percentage of the sample analyzed and calculated as shown below:

$$\% \text{ Ash} = \frac{W_2 - W_3}{\text{Weight of sample}} \times \frac{100}{1}$$

Where: W_1 = Weight of empty crucible; W_2 = Weight of crucible + Ash

Determination of Protein content

This was carried out by the Kjeldahl method in which the total nitrogen was obtained and multiplied with the factor 6.38 having a milk-based product to obtain the protein (James, 2015) and Chang (2003). 0.5g of the sample was boiled in 10mls of conc. H_2SO_4 with selenium as catalyst. Boiling (digestion) was done under a fume cupboard until a clear solution was obtained. This digest was transformed quantitatively to a standard flask and diluted to 100ml with distilled water. 10ml portion of the digest was mixed with equal volume 45% Na0H solution and distilled in a semi-micro-kjeldahl apparatus. The distillate was collected into 10% boric acid solution containing 3 drops of mixed indicator (methyl red and bromocresol green). A total of 50ml distillate was collected and titrated against 0.02N H_2So_4 solution. Titration was done from green to a deep red end-point. A reagent blank was also treated as described above. The N_2 content and hence protein was calculated as shown below:

$$\% N_2 = \frac{100}{W} \times \frac{14 \times N}{1000} \times \frac{Vf}{Va} \times T - \text{blank}$$

Where:
W = Weight of Sample
N = Normality of titrant
Vf = Total digest volume
Va = Volume of digest analysed
T = Sample titre
Bank = Reagent Blank Titre

Determination of Carbohydrate Content

Carbohydrate was calculated as Nitrogen free extractives using formula described by James (2015).

% CHO = 100 - % (protein + ash + fat + moisture content)

Determination of Fat Content

According to AOAC (2011), 5.0 g of yoghurt sample was mixed with 0.88 ammonia solution and 10mls of 95% ethanol was added to it and mixed well. 25mls of diethyl ether was added to it and shaken vigorously for 1 minute. 25ml of

petroleum ether was added and mixed well. The mixture was allowed to separate into phases and after standing for 1 hour. The fat extract (ether phase) was collected and the sample was re-extracted with the same solvent and the extracts pooled together.

The extract was then transferred to a weighed flask and the solvent recovered while the fat in the flask was dried in the oven. The weight of fat was determined and the amount of fat determined and expressed as a percentage of the sample analysed, it was calculated as shown below

$$\% \text{ fat} = \frac{W_2 - W_3}{\text{Weight of sample}} \times \frac{100}{1}$$

Where:

W_1 = Weight of flask alone

W_2 = Weight of flash and extract

Determination of sensory properties of yoghurt samples

Five panelists from Michael Okpara University of Agriculture, Umudike assessed the yoghurt (both the commercial control sample and the produced samples) to determine the taste, colour, flavour, texture and general acceptability. The yoghurt were rated 1 for "Like extremely", 2 for "Like very Much", 3 for "Like moderately", 4 for "Like slightly" 5 for "Neither like non dislike", 6 for "Dislike slightly" 7 for "Dislike moderately" 8 for "Dislike very much" for each parameter.

Statistical analysis

The data collected were subjected to analysis of variance (ANOVA). Means were separated using Duncan's new multiple range test (DNMRT) using the Statistical Package for the Social Sciences (SPSS) version 17.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

The Morphological and Biochemical characteristics of Lactic Acid Bacteria isolated from Cow milk and Breast Milk samples are presented in Table 1. The LAB include *Lactobacillus acidophilus*, *Lactobacillus plantarum*, and *Bifidobacterium* sp, *Lactobacillus bulgaricus* and *Streptococcus thermophilus*.

The percentage occurrence of LAB isolated from the two test sources, Cow milk and breast milk is presented in Table 2. *Bifidobacterium* sp was detected only in the breast milk sample (LAB3) with percentage occurrence of 50 but was not found in the Cow milk samples analysed. *Lactobacillus* (LAB 2) was not detected in the breast milk sample but was prevent in two Cow milk samples (83.3% occurrence). *Lactobacillus acidophilus* was present in the three Cow milk samples and in two of the three breast milk samples analysed (33.3% occurrence).

In Table 3, the Physico-chemical Characteristics of Yoghurt Produced with LAB starter cultures are shown. The pH of the yoghurts was in the range of 4.3-4.5 while the commercial yoghurts (control) had a pH of 6.30. The Total solids of the Laboratory produced yoghurts were between 11.90 and 12.03 while that of the control was 14.25%. The Total Titratable Acidity of the Yoghurts produced with the three LAB isolates was in the range of 0.82% to 0.87% while that of the Control was 0.87.

The Proximate Composition of the yoghurts produced with the three LAB isolates is presented in Table 4. The Protein content of the yoghurts produced with the three LAB isolates was in the range of 2.56% to 2.80% while that of the control was 2.80%. The Moisture content of the yoghurts produced with the three LAB isolates was in the range of 87.97 – 88.10% while that of the Control was 85.46%.

The moisture content of the yoghurts produced with the three LAB isolates was in the range of 87.97 - 88.10. However, only the moisture content of the control (85.46) was significantly different from the other three yoghurts. The fat contents of the yoghurts produced with the three LAB isolates were not statistically different from each other, but that of the control was significantly different from others. The result of the fibre content shows that the four yoghurt samples had the value of 0.14 which was not significantly different. The carbohydrate content of the control yorghut (7.21) was significantly different from the other

three yoghurts who had the same values statistically. For ash content, yoghurt made with LAB1 had a significant value from yoghurts made using LAB 2 and 3 which are significantly the same with each other. But the Control yoghurt has the highest ash content (3.29).

The result of the G-point Hedonic 9 Point Scale for Mean Sensory Evaluation of Yoghurts produced with LAB Starter cultures is presented in Table 5. Result shows that all the produced yoghurt had high level of colour acceptability which statistically was the same for the four yoghurts, however, the control had the highest acceptability for aroma (8.00). The acceptability level for taste was also highest for the Control Yoghurt (8.00). For the Mouth feel rating, yoghurt produced with LAB 1 had the highest value (6.73) while that produced with LAB 2 had the lowest rating (5.90). On overall general acceptability rating, the four yoghurts had the same mean value statistically (7.62±0.21).

Table 1: Morphological and Biochemical characteristics of Lactic Acid Bacteria isolated from Cow and Breast Milk samples

Colony morphology	Cell arrangement	Catalase	Galactose	Sucrose	Glucose	Mortility	Maltose	Lactose	Fructose	Nitrate	Oxidase	Gram Reaction	Mannito	Suspected organisms
Convex, opaque, smooth, whitish and without pigments	Rod-shaped in short to long chains	-	+	-	-	-	+	+	+	-	-	+	+	*L. acidophilus*
Smooth, circular raised and whitish	Pairs or chain	-	+	-	-	-	-	+	+	-	-	+	+	*L. plantarum*
Smooth, translucent, gray white, sticky soft and spherical with irregular edges, raised, creamy with whitish colony Raised, Umbonate	Branched rod-shaped	-	+	-	+	-	+	+	+	-	-	+	+	*Bifidobacterum* sp
Colony	Rod in singles	-	+	-	+	-	-	+	+	-	-	+	+	*Lactobacillus bulgaricus*
	Cocci in clusters	-	+	+	+	-	-	+	+	-	+	+	+	*Streptococcus thermophilus*

Key: + = Positive; - = Negative

Table 2: Percentage occurrence of LAB isolates in Cow and breast milk samples

		LAB 1 *L. acidophilus*	**LAB 2** *L. plantarum*	**LAB 3** *Bifidobacterum* **sp**
Cow milk	a.	+	+	-
	b.	+	-	-
	c.	+	+	-
Breast Milk	a.	-	-	+
	b.	+	-	+
	c.	+	-	+
Total		6	6	6
No. +		5	2	3
%		83.3%	33.3%	50.0%

% occurrence = $\frac{No\ +ve}{Total\ No}$ x $\frac{100}{1}$

Key: LAB 1: *L. acidophilus,* LAB 2: *L. plantarum and* LAB 3: *Bifidobacterum* sp

Table 3: Physico-chemical Characteristics of Yoghurt Produced with LAB Starter Cultures

Product Source	**pH**	**TS (%)**	**TTA (%)**
LAB 1	4.43^{b} ±0.06	12.06^{b} ±0.06	0.81^{a}±0.03
LAB 2	4.42^{b} ±0.00	12.06^{b}±0.13	0.88^{a}±0.03
LAB 3	4.45^{a} ±0.00	11.90^{b} ±0.04	0.82^{a} ±0.03
Control	4.43^{c}±0.00	14.28^{a} ±0.54	0.87^{a}±0.03

Values show means of triplicate analysis ± standard deviation. Figures with different superscripts in the column are significantly different (P. < 0.05).

Key:

LAB 1: *L. acidophilus,* LAB 2: *L. plantarum,* LAB 3: *Bifidobacterum* sp

Table 4: Proximate composition of Yoghurts produced with LAB starter cultures

Product source	**Moisture Content**	**Protein**	**Fat**	**Fibre**	**Ash**	**Carbohydrate**
LAB 1	87.97^{a}±0.06	2.80^{a}±0.10	0.85^{b}±0.01	0.14^{a}±0.02	3.09^{b}±0.02	5.84^{b}±0.09
LAB 2	87.97^{a}±0.13	2.58^{b}±0.07	0.77^{b}±0.01	0.14^{a}±0.04	2.99^{c}±0.04	5.66^{b}±0.05
LAB 3	88.10^{a}±0.04	2.56^{b}±0.10	0.76^{b}±0.02	0.14^{a}±0.04	2.93^{c}±0.03	5.68^{b}±0.06
Control	85.46^{b}±0.40	2.80^{a}±0.10	1.04^{a}±0.11	0.14^{a}±0.02	3.29^{a}±0.05	7.21^{a}±0.50

Values show means of triplicate analysis ± standard deviation. Figures with different superscripts in the column are significantly different (P>0.05).

Key:

LAB 1: *L. acidophilus,* LAB 2: *L. plantarum;* LAB 3: *Bifidobacterum* sp

Table 5: Mean Sensory scores of acceptability of yoghurts produced with LAB starter cultures

Product	Colour	Aroma	Taste	Mouth feel (texture)	General acceptability
LAB 1	$7.87^{a} \pm 0.12$	$7.20^{b} \pm 0.20$	$7.87^{a} \pm 0.15$	$6.73^{a} \pm 0.25$	$7.63^{a} \pm 0.12$
LAB 2	$7.90^{a} \pm 0.10$	$6.80^{c} \pm 0.27$	$6.80^{c} \pm 0.17$	$5.90^{c} \pm 0.17$	$7.27^{a} \pm 0.46$
LAB 3	$7.67^{a} \pm 0.58$	$6.93^{bc} \pm 0.12$	$6.83^{b} \pm 0.06$	$6.23^{b} \pm 0.12$	$7.90^{a} \pm 0.10$
Control	$7.67^{a} \pm 0.58$	$8.00^{a} \pm 0.00$	$8.00^{a} \pm 1.00$	$6.00^{bc} \pm 0.00$	$7.67^{a} \pm 0.58$

Values show means of ten man panel assessment scores ± standard deviation. Figure bearing different superscripts in the column are significantly different (P>0.05).

Key:

LAB 1: *L. acidophilus;* LAB 2: *L. plantarum;* LAB 3: *Bifidobacterum* sp

DISCUSSION

Samples of cow and human breast milk samples obtained from Umahiaa were found to contain *Lactobacillus* spp which were identified to be *Lactobacillus acidophilus*, *Lactobacillus* Yoghurt, which is a fermented milk product, presents a good nutrient base for the growth of the lactic acid bacteria (Iwe, 2010). The absence of *L. plantarum* in the breast milk and the corresponding absence of *Bidifobacteria* sp in the cow milk both show selectivity in habitats. *Bifidobacteria* sp belong to natural flora of breast milk (Onwuka, 2015) and as such was found present in all the tested breast milk samples and also in cow milk sample.

The quality of LAB produced yoghurts did not vary much. The use of *Lactobacillus plantarum* and *Lactobacillus acidophillus* in yoghurt production has been reported (Edem and Elijar, 2016). The slight acidity found in the yoghurt will discourage the growth of undesired bacteria in the yoghurt thus promoting food safety (Thomas, 2018). The variation recorded in the Titratable acidity was seen as a reflection in the changes in the pH values of the different yoghurt samples which is the extent the starter cultures could convert the sugar in the substrates to organic acid.

The proximate composition of the yoghurts produced with locally isolated strains showed statistically significant variations. The low fibre content of the products was attributed to the raw materials (milk) which contained low fibre and the sieving of the milk during the *plantarum* and *Bifidobacterium* sp. The high level of occurrence of *Lactobacillus acidophilus* in cow milk and breast milk showed versatility and ubiquity of habitats of the organism. Laboratory work using muslin cloth also reduced the fibre of the yoghurt. However, this result was in agreement with Tulay and Okan (2014) who opined that fibre is naturally present in cereals, vegetables, fruits and nuts and less in milk product. According to Onwuka (2015), fibre is important in foods as it improves bulk, aid absorption and make for good bowel movement. They reduce transit time to intestine, increase capacity of faeces and make faeces softer and reduce constipation. It delays gastric emptying, reduce the absorption of glucose and lowers Serum cholesterol levels. In Yoghurt, they are used for increasing the viscosity of the product as a stabilizer, preventing syneresis and improving textural properties as creaminess. It is effective tool for reducing calories and fat (Deliza and MacFie, 2016).

There was a slight but significant variation in the fat content of the LAB produced Yoghurt which was in the range of 0.76% to 0.85% as against the 1.04% recorded for the commercial Yoghurt. This was in agreement with the work of Deliza and MacFie (2016) who also reported low fat in yoghurt. There is a general demand in low fat yoghurts by the consumers (Deliza and MacFie, 2016). Fat in food plays important role in the firmness, viscosity and perceived

creaminess of Yoghurt due to the formation of large number of small fat particles during homogenization, when they are stabilized by milk proteins and interact with the protein matrix. Total removal of fat in a Yoghurt formulation can cause some deficiencies such as weak body texture, higher whey, separation and poor sensory quality (Ali *et al.*, 2017). Fats in food is desirable due to the important roles they play including acting as insulation for the body, source of energy and as solvent for important fat soluble vitamins as well as enhancing retention of flavor in foods (Malomo, 2012; Okpala *et al.*, 2013).

The carbohydrate content was generally low in all the yoghurt but was higher in the commercial Yoghurt (7.21%) than in the LAB produced Yoghurt (5.34% - 5.68%). The differences in the percentage of carbohydrate as compared with the various produced yoghurt samples may be due to differences in the ability of starter strains to utilize sugars present in the Protein content did not show significant difference ($p<0.05$) with the protein content of commercial Yoghurt. The changes in the percentage of protein is compared among the various Yoghurts could be as a result of hours of fermentation during processing. The yoghurts produced with the LAB isolates enjoyed the same level of acceptability with the test commercial yoghurts even though there were variation in their relative assessment in the different sensory attributes of colour, aroma, taste and mouthful. The colour ratings was very high and did not show significant variations ($P<0.05$) relative to the commercial yoghurts. Colour is an attribute that promotes aesthetism in foods and attraction to consumers. The high sensory scores for the mouth feel of the LAB-Produced yoghurts over the commercial product is indicative of their relative good quality. Mouth feel of foods is a sensory attribute that is felt by the mouth and which decides to a large extent, the consumers' enjoyment, acceptability and hence acceptability and market value (Okwunodulu *et* milk used in producing the yoghurt. The carbohydrate value obtained here is within the same range as obtained by Osundahunsi *et al.* (2017).

The differences in the moisture content can be due to the water utilization ability of the various starter cultures in the medium. Yoghurt samples will require cold storage because high water activity which supports high microbial growths consequently will lead to a reduction in the shelf life of yoghurt samples. The moisture content of the Yoghurt sample studied was in agreement with the result of Heaney *et al.* (2015).

The Ash content of the produced yoghurt samples did not vary statistically. The ash content of food gives an insight of its mineral content. The slight changes in ash content could be attributed to the fact that fermented food constitutes a product of microbial metabolism resulting in mineralization of the higher compounds (Tamine, 2017)

al., 2019). This implies that the LAB produced yoghurts compared very favourably with commercial produced yoghurts.

CONCLUSION

Following the evaluation of the proximate content and sensory properties of yoghurt produced with Lactic acid bacteria isolated from diary and non-diary sources, we conclude that the protein content of the yoghurt produced with *L. acidophilus* has the same protein content with the commercially sourced yoghurt but with lower fats, ash and carbohydrate contents. So, the yoghurt produced with *L. acidophilus* will be a good source of protein to the consumers. The laboratory and commercially produced yoghurts had equal level of acceptability to the panelists.

RECOMMENDATION

It is therefore recommended that production of yoghurts with *L. acidophillus* be encouraged as the protein content will help in remedying malnourishment.

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