Shelf-Life Study of a Yoghurt-Like Product from African Yam Bean

Amakoromo ER, Innocent-Adiele HC, Njoku HO

Department of Microbiology, University of Port Harcourt, Choba, P.M.B. 5323, Port Harcourt, Rivers State, Nigeria; worldclassasset@yahoo.com

ABSTRACT: The utilization of African yam bean for the production of yoghurt was studied. African yam bean milk was extracted from whole and dehulled seed, pasteurized and fermented with yoghurmet (a commercial yoghurt culture of *Streptococcus thermophilus* and *Lactobacillus bulgaricus*). Proximate composition and sensory properties of the yam bean yoghurt samples were evaluated to determine the shelf-stability of the products during refrigeration and room temperature storage.. The moisture, protein, fibre, fat, ash, carbohydrate and total solids of yam bean yoghurt from whole and dehulled seed differed significantly ($p<0.05$). The sensory properties of yam bean yoghurt samples were compared with soybean yoghurt. The sensory properties showed that sample stored at refrigeration temperature maintained good quality up to 21 days storage while samples stored at room temperature were of poor quality by the 4th day. The implication of these results is discussed.
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Keywords: African yam bean milk, *Streptococcus thermophilus*, *Lactobacillus bulgaricus*, shelf-stability, sensory properties

1. INTRODUCTION

Grain legumes constitute a good source of dietary protein in human nutrition and are cultivated for their seeds. They are eaten either alone or in combination with whole grains. They include groundnut (*Arachis hypogae*), cowpea (*Vigna unguiculata*) and African yam bean (*Sphenostylis stenocarpa*). In developing Countries and indeed in the Sub-Saharan Africa (except East Africa), the production of milk and milk-products is limited, scarce and expensive (Fashakin and Unokiwedi, 1992).These shortages have in no small measure affected the protein intake of both old and the young. Since legumes are important sources of relatively inexpensive protein, introduction of imitation milk products from legumes may contribute to the alleviation of protein malnutrition (Rao et al., 1998). Lactic acid fermentation of legume-based milk has been used as one of the approaches to prolong the shelf life of the products, create variety, improve the nutritional value as well as enhance the acceptability of the product.

Knowledge of the behaviour of yogurt during storage is important because its shelf life is based on whether the products display any of the physical, chemical, or sensory characteristics that are unacceptable for consumption. Studies of changes in these quality characteristics during storage would enable producers to predict the shelf life of the product more accurately. The shelf-life (defined as the length of time require for average acceptance of a product) of chilled fermented milks may not exceed 3 weeks and the starter culture must be viable and abundant in yoghurt (Robinson and Tamime, 1993). The storage properties of yoghurt-like substitute prepared from AYB has not been evaluated.

The aims of this study were to produce a yogurt-like product from African Yam Bean and evaluation of the shelf life of the yogurt-like product at 4^0C and at room temperature.

2. MATERIALS AND METHODS

2.1. SOURCE OF AFRICAN YAM BEAN (AYB)

The African yam bean (cream coloured variety) was purchased from Umuahia main market, Abia State. The bean was packaged in polyethylene bags, transported to the laboratory and kept at 4^0C until required. Yogourmet Freeze-dried yogurt starter (Lyo San Inc.,Canada) was gotten from Ariara market in Aba.

2.2. PRODUCTION OF AFRICAN YAM BEAN MILK AND YOGURT

African yam bean seed was divided into two portions and one portion was milled in a sample mill and passed through a 0.5mm screen to obtain flours. The African yam bean milk was prepared from the flour as described by (Aminigo et al, 2007). Each bean flour was blended with 85^0C hot water (1:4 seed : water) in a blender for 3min.The resulting slurry was filtered through two layers of double folded cheese cloth and coarse particles were removed by allowing the filtrate to settle for 10min. The second portion was soaked in 4% NaCl for 12hr, heated for 5min at 100^oC, dehulled and blended with water (1:4) for 3min.The slurry was filtered through two layers of double

cheese cloth. Soybean seed was milled and passed through a 0.5mm screen to obtain the flours and the milk was also prepared from the flour as described by (Aminigo *et al*., 2007). African yam bean milk and soybean milk were supplemented with 4% skim milk powder, 1.25% sucrose and 0.5% gelatine. The mixture was heated with stirring to 95^{o}C for 20 min and cooled to 43^{o}C. The milk was then inoculated with starter culture (5g in litre milk) and incubated at ambient temperature for 12hr. The yogurt was stored at 4^{o}C and at room temperature for 21 days.

2.3. PROXIMATE ANALYSIS

Samples of yogurt were analysed for moisture content, total solids, carbohydrates, protein, fibre, lipid and ash content according to the methods of AOAC (1980), Fishwick and Wright method of 1977, Osborne and Voogt method of 1978, Macro Kjeldahl method of Osborne and Voogt, 1978.

2.4. SENSORY EVALUATION

Yogurt samples (freshly prepared and stored) were evaluated by a panel of 5 judges for taste, aroma, colour, texture and overall acceptability. A hedonic scale of 1-5 was used (Williams, 1982).

2.5. STATISTICAL ANALYSIS

The data obtained were subjected to analysis of variance (ANOVA) using Graph Pad Prism Software, version 5.01. Significant difference between means were determined at $p<0.05$.

3. RESULTS ANALYSIS

3.1. PROXIMATE COMPOSITION OF AFRICAN YAM BEAN YOGHURT

The African yam bean from whole seed had high protein, fibre, fat, ash, carbohydrate and total solids. The proximate composition of African Yam Bean (AYB) yoghurt samples stored at room temperature is presented in Table 1. The crude protein content of AYB yoghurt from whole seeds decreased from 6.44 to 6.38%, during 4 days of storage at room temperature while the sample from dehulled seeds decreased from 5.40 to 5.10%. Total carbohydrates and total solids decreased significantly ($p<0.05$), during storage. The carbohydrate content of AYB yoghurt prepared from whole seeds and dehulled seeds decreased from 17.24 to 12.54% and 14.24 to 12.46% respectively. The corresponding values for total solids reduced from 27.40 to 22.74% and 21.54 to 19.45%, respectively. The crude fibre content of AYB yogurt from whole seeds also decreased from 3.89 to 2.28%. On the other hand, the moisture content of the AYB yoghurt samples increased significantly ($P<0.05$) during storage. The sample prepared from whole seeds increased from 72.60 to 77.26%, whereas that from dehulled seeds increased from 78.46 to 80.55% during 4days of storage. The fat content of the AYB yoghurt samples remained the same during storage while the ash content varied slightly.

Table 1: Percent proximate composition of yam bean yoghurt samples stored at room temperature (29 ± 2^{o}C)

Storage Period (Days)				
	0		4	
	Yam bean yoghurt from whole seeds	Yam bean yoghurt from dehulled seeds	Yam bean yoghurt from whole seeds	Yam bean yoghurt From dehulled seeds
Moisture (%)	72.60^{d}	78.46^{b}	77.26^{c}	80.55^{a}
Protein (%)	6.44^{a}	5.40^{b}	6.38^{a}	5.10^{c}
Crude Fibre (%)	3.89^{a}	0.20^{c}	2.28^{b}	0.25^{c}
Fat (%)	2.52^{a}	1.05^{b}	2.52^{a}	1.05^{b}
Ash (%)	1.20^{a}	0.85^{b}	1.30^{a}	0.84^{b}
Carbohydrate (%)	17.24^{a}	14.24 ^{b}	12.54^{c}	12.46^{c}
Total Solids (%)	27.40^{a}	21.54^{c}	22.74^{b}	19.45^{d}

Values are means of three replicates. Mean values having different superscript letters in a row for each sample are significantly different ($p<0.05$).

The proximate composition of the African yam bean yoghurt samples stored at refrigeration temperature from 0 to 21 days is presented in Table 2. The results indicated a similar trend of decrease in total solids, crude protein, and total carbohydrate as observed during storage at room temperature storage. There were fluctuations in the fat contents of the samples during storage but the values were not significantly different ($p<0.05$) from the freshly prepared samples.

Table 2: Percent proximate composition of yam bean yoghurt samples stored at 4°C

Storage Period (Days)										
	0		4		7		14		21	
	A	B	A	B	A	B	A	B	A	B
Moisture (%)	72.56^{i}	78.46^{e}	73.84^{h}	78.36^{f}	73.84^{h}	80.15^{c}	76.32^{g}	81.25^{b}	79.54^{d}	82.30^{a}
Protein (%)	6.44^{a}	5.40^{c}	5.95^{b}	5.40^{c}	5.90^{b}	5.36^{d}	5.42^{c}	5.22^{c}	5.12^{e}	5.04^{e}
Crude Fibre (%)	3.89^{a}	0.20^{f}	2.88^{c}	0.21^{f}	2.88^{c}	0.25^{e}	2.90^{b}	0.30^{d}	2.91^{b}	0.31^{d}
Fat (%)	2.52^{a}	1.05^{b}	2.52^{a}	1.06^{b}	2.52^{a}	1.05^{b}	2.53^{a}	1.06^{b}	2.55^{a}	1.06^{b}
Ash (%)	1.20^{d}	0.85^{g}	1.30^{a}	0.84^{h}	1.21^{d}	0.86^{f}	1.22^{c}	0.88^{e}	1.24^{b}	0.89^{e}
Carbohydrate (%)	17.28^{a}	14.24^{e}	16.39^{c}	14.34^{e}	16.53^{b}	12.58 ^{f}	14.54^{d}	11.59^{g}	11.55^{g}	10.71^{h}
Total Solids (%)	27.44 ^{a}	21.54^{d}	26.16^{b}	21.64^{d}	26.16^{d}	19.85^{f}	23.68^{c}	18.75^{g}	20.46^{e}	17.70^{h}

Key: A = Yam bean yoghurt from whole seed; B = Yam bean yoghurt from dehulled seed. Values are means of three replicates. Mean values having different superscript letters in a row for each sample are significantly different ($p<0.05$).

3.2. SENSORY PROPERTIES OF LEGUME-BASED YOGHURT SAMPLES

The sensory properties of AYB yoghurt and soybean yoghurt samples stored at room temperature are presented in Table 3. The taste was rated pleasant for the three freshly prepared samples; AYB yoghurt from whole seeds, AYB yoghurt from dehulled seeds and Soybean yoghurt had 4.5, 4.4 and 4.4 respectively on a hedonic scale of 1-5. The legume-based yoghurt samples were also comparable in terms of aroma, colour and overall acceptability. The texture of the freshly prepared AYB yoghurt from whole seed was significantly higher than values of the other samples. The taste, texture and general acceptability of the samples were significantly different ($p<0.05$) after the 1st day of storage. On the other hand, the aroma of the samples was lowered significantly ($p<0.05$) after the second day of storage. All the parameters were rated extremely poor by the 4th day of storage, with the exception of taste which was not analyzed from the 2nd day.

Table 3: Sensory properties of yam bean yoghurt samples stored at room temperature (29± 2°C)

Storage Period (Days)															
	0			1			2			3			4		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Taste	4.6^{a}	4.4^{a}	4.5^{a}	3.2^{b}	3.1^{b}	3.3^{b}									
Aroma	4.4^{a}	4.5^{a}	4.6^{a}	4.3^{a}	4.3^{a}	4.4^{a}	3.9^{b}	3.6^{c}	3.9^{b}	3.0^{d}	2.5^{e}	3.3^{d}	1.4^{f}	1.3^{f}	1.3^{f}
Colour	4.3^{a}	4.4^{a}	4.4^{a}	4.2^{a}	4.3^{a}	4.3^{a}	3.7^{b}	3.8^{b}	4.2^{a}	3.4^{c}	3.5^{c}	3.5^{c}	1.1^{d}	1.1^{d}	1.2^{d}
Texture	4.7^{a}	4.3^{b}	4.4^{b}	4.4^{b}	4.2^{b}	4.4^{b}	4.3^{b}	4.1^{c}	4.1^{c}	4.0^{c}	3.7^{cd}	3.9^{c}	1.3^{f}	1.2^{f}	1.6^{e}
Overall acceptability	4.5^{a}	4.4^{a}	4.5^{a}	4.0^{b}	4.0^{b}	4.1^{b}	4.0^{b}	3.8^{bc}	4.1^{b}	3.5^{d}	3.3^{de}	3.6^{d}	1.3^{f}	1.2^{fg}	1.4^{f}

Key: A = Yam bean yoghurt from whole seed; B = Yam bean yoghurt from dehulled seed; C = Soybean yoghurt. Values are means of three replicates. Mean values having different superscript letters in a row for each sample are significantly different ($p<0.05$).

The sensory properties of legume-based yoghurt samples stored at refrigeration temperature are presented in Table 4. The results obtained showed that the parameters also decreased with increase in storage time except that the samples did not show sign of spoilage as observed during storage at room temperature.

Table 4: Sensory properties of yam bean yoghurt samples stored at 4°C

Storage Period (Days)															
	0			**4**			**7**			**14**			**21**		
	A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Taste	4.6^{a}	4.5^{a}	4.6^{a}	4.5^{a}	4.6^{a}	4.6^{a}	4.4^{b}	4.3^{b}	4.3^{b}	3.9^{c}	3.3^{d}	3.9^{c}			
Aroma	4.4^{a}	4.4^{a}	4.5^{a}	4.3^{a}	4.3^{a}	4.5^{a}	4.0^{b}	4.2^{a}	4.3^{a}	3.8^{c}	3.9^{c}	4.0^{c}	3.6^{d}	3.5^{d}	3.7^{d}
Colour	4.2^{ab}	4.3^{a}	4.5^{a}	4.2^{a}	4.3^{a}	4.4^{a}	4.0^{b}	4.1^{b}	4.2^{b}	3.8^{c}	3.8^{c}	3.9^{c}	3.5^{d}	3.5^{d}	3.6^{d}
Texture	4.6^{a}	4.3^{b}	4.3^{b}	4.4^{b}	4.2^{bc}	4.1^{c}	4.4^{b}	4.1^{c}	4.1^{c}	4.0^{c}	3.8^{d}	3.8^{d}	3.2^{e}	3.1^{ef}	3.4^{e}
Overall acceptability	4.5^{a}	4.4^{a}	4.5^{a}	4.4^{a}	4.4^{a}	4.4^{a}	4.2^{b}	4.2^{b}	4.2^{b}	3.9^{c}	3.7^{d}	3.9^{c}	3.4^{f}	3.4^{f}	3.6^{e}

Key: A = Yam bean yoghurt from whole seed; B = Yam bean yoghurt from dehulled seed; C = Soybean yoghurt. Values are means of three replicates. Mean values having different superscript letters in a row for each sample are significantly different ($p<0.05$).

4. DISCUSSION

The quality of AYB yogurt during storage at 29 ± 2^0C and at 4^0C was evaluated. The increase in moisture content of yoghurt samples during storage was seen as a decrease in total solids with the yoghurt becoming less viscous. The moisture content obtained for samples stored at room temperature is lower to the value of 87.7% reported by Trema and Musa (1998), for commercial yoghurts. The decrease in the percentage of total solids could be due to the utilization of organic compounds present in yoghurt samples as reported by (Tamime and Deeth, 1980). Muhammad *et. al*. (2009) reported decreases in the total solids content of cow milk yoghurt from 17.71 to 7.90% and 18.7 to 9.96% during 21 days of storage at room temperature and refrigeration temperature respectively.

The total solids content of freshly prepared and stored AYB yoghurt ranged between 17.7 and 27.4%. These are higher than the values (12.4 to 14.5%) reported by Osundahunsi *et. al*. (2007) for soy yoghurt. Generally, the fat contents obtained for AYB yoghurt were higher than values reported by Brauss *et. al*. (1999) who noted that low fat yoghurts (0.2%) release volatiles more quickly and at higher intensity but with less persistence than whole fat yoghurts. The fat composition of the yogurt samples in this study indicates that the yogurts could be classified as medium fat yogurts as suggested by Robinson and Tamime (1975) for yogurts containing 0.5-2.9% fat.

The trend of decrease in total carbohydrates observed during storage at refrigeration temperature is in agreement with the work by Muhammad *et al.* (2009) who reported similar decrease in total solids (18.87 to 9.96%) and crude protein (3.64 to 2.33%) for 0 to 21day storage at refrigeration temperature respectively. Generally, this is comparable to the findings of Dublin-Green and Ibe (2005) who reported that during storage of yoghurts, there was a decrease in total solids value which was reflected by decrease in carbohydrate and protein contents, and this was more rapid at room temperature (30^oC) than at refrigeration temperature. The increase in the ash content was not in line with the work of Muhammad *et al*., 2009 who reported a decrease in the ash content from 0.85 to 0.81 for soy milk yogurt. The higher content of ash and crude fibre in AYB yogurt from whole seed could be due to higher mineral and fibre concentrations in the hulls. The reduction in the crude protein during the storage period could be attributed to microbial activities, since microorganisms utilize proteins as nitrogenous sources

There was a significant difference ($p< 0.05$) between the moisture content, protein, total solids, crude fibre, ash and fat contents of yam bean yogurt from whole seed and yoghurt from dehulled seed. This difference was obvious in freshly prepared sample as well as stored samples. The carbohydrate content of the two yoghurt samples was only significantly different ($p<0.05$) on the zero day of storage while the solid non-fat content was insignificant on both days. Similarly, yam bean yoghurt from whole seed and yoghurt from dehulled seed stored at refrigeration temperature differed significantly ($p<0.05$) in terms of moisture content, total solids, carbohydrate, crude fibre, ash and fat content throughout the storage period while the solid non-fat was not significant.

The results of sensory evaluation showed that supplementation of AYB milk with skim milk powder and the use of the cream coloured variety of the bean improved its sensory parameters and thus its overall acceptability. This product compared favourably with soybean yoghurt. Freshly prepared yam bean yoghurt from whole seed was more like soybean yoghurt in taste and general acceptability while yam bean yoghurt from dehulled seed was more like soybean yoghurt in colour. Soybean yoghurt was however more preferred. The stirring of the milk during pasteurization was necessary to disperse the protein and starch evenly to avoid gelatinization of starch during heating. The addition of stabilizer could account for the uniformity and smoothness in the body texture of the product. Microbial hydrolysis of yoghurt component during storage was found to be the key deteriorating factor to taste, colour, flavour, and texture (El-gazzar and Hafez 1992).The significant differences seen implies that processing and the storage condition induced a positive change on the yoghurt samples.

At room temperature storage, yoghurt from whole AYB seed and dehulled AYB seed differed significantly ($p< 0.05$) in aroma on days 2 and 3 and in texture on days 0, 2 and 3. They also differ significantly ($p<0.05$) in overall acceptability on day 3.Yam bean yoghurt from whole seed and soybean yoghurt differed significantly ($p<0.05$) in texture on days 0, 2 and 4 and in colour on day 2. Yam bean yoghurt from dehulled seeds and soybean yoghurt differed significantly ($p<0.05$) in overall acceptability on days 2, 3 and 4. They also differ significantly ($p<0.05$) in texture on day 4 and in colour on day 2.

At refrigeration temperature, yoghurt from whole AYB seed and dehulled AYB seed differed significantly ($p<0.05$) in taste on day 14 and in aroma on day 7. They also differed significantly ($p<0.05$) in texture on days 0, 7 and 14 and in overall acceptability on day 14. Yam bean yoghurt from whole seed and soybean yoghurt differed significantly ($p<0.05$) in aroma on day 7; in colour

on day zero and in texture on days 0, 4, 7 and 14. They also differed significantly ($p<0.05$) in overall acceptability on day 21. Yam bean yoghurt from dehulled seed and soybean yoghurt differed significantly ($p<0.05$) in taste on day 14; in aroma on day 21 and in texture on day 21.They also differed significantly ($p<0.05$) in overall acceptability on days 14 and 21.

5. CONCLUSION

The study showed that it is possible to prepare yogurt substitute from the yam bean which could compare favourably with soybean yogurt. AYB yogurt prepared either from whole seed or dehulled seed and stored at 4^0C for up to 21 days had good quality while that stored at room temperature got spoilt after the third day as indicated by sensory properties. Contamination by yeast characterized the samples stored at room temperature. Nutrient composition of the yam bean yoghurt samples changed during storage. In terms of the protein content, AYB yogurt from whole seed had a higher quantity compared to that from dehulled seed. Supplementation enhanced the acceptability of the products.

Based on the findings from this research work, the following recommendations are made: The general public should try to adapt these new products in other to ensure a continuous production of yogurt even when there is scarcity in the production of cow milk for cow milk yogurt production which has formed part of the food culture of the populace. More work should be carried out on how to extend the shelf life of the product stored at room temperature using chemical preservatives as most families either do not have refrigerators or do not have constant power supply. Creation of more awareness as there has always been a low patronage of locally produced food products relative to imported ones.

CORRESPONDENCE TO
Mrs. Innocent-Adiele HC,
Department of Microbiology,
University of Port Harcourt,
P.M.B. 5323, Choba, Port Harcourt,
Rivers State, Nigeria;
worldclassasset@yahoo.com

REFERENCES

1. Aminigo, E. R., Lehtola, P. S. & Metzger, L. E. (2007). Nutritive Composition and Physical Characteristics of supplemented imitation milk from African Yam Bean *(Sphenostylis stenocarpa). Global Journal of Pure and Applied Sciences* 13: 457-462.
2. Association of Official Analytical Chemists (AOAC) (1980). *Official Methods of Analysis.* 14th Ed. Washington D.C.
3. Brauss, M. S., Linforth, R. S. T., Cayeux, I., Harvey, B. and Taylor, A. J. (1999). Altering fat content affects flavor release in a model yoghurt system. *Journal of Agriculture and Food Chemistry* 47: 2055 – 2059
4. Buono, M. A., Setser, C., Erikson, L. E. and Fung, D. Y. C. (1990).Soymilk yoghurt: Sensory evaluation and chemical measurement. *Journal of Food Science* 55: 528-551.
5. Dublin-Green, M. and Ibe, S. N. (2005). Quality Evaluation of Yoghurts produced commercially in Lagos, Nigeria. *African Journal of Applied Zoology and Environmental Biology* 7:78-82.
6. El-Gazzar, E. and Hafez, E. H. (1992). Physicochemical properties of yoghurt-like product from soya milk fortified with skim milk powder. *Egyptian Journal of Food Science* 20:25-36.
7. Fashakin, J.B. and Unokiwedi, C.C. (1992). Chemical analyses of warankasi prepared from cow milk partially substituted with melon milk. *Nigerian Food Journal 10: 103-109.*
8. Fishwick, W. G. and Wright, A. Y. (1977). Comparison on methods for the extraction of plant Lipids. *Phytochemistry* 16: 1507 -1510
9. Grover, U., Sing, S. and Mital, B. K. (1983). Studies on extending the shelf life of soybean curd. *Journal of Food, Science and Technology* 20: 298 – 301.
10. Kine, B. B., Eka, O. U., Aremu, C. Y. and Esien, U. (1991). Comparative Studies on Food qualities of African Yam Bean (*Sphenostylis stenocarpa*) and cowpea (*Vigna unguiculata*). *Tropical Journal of Applied Science* 40: 65-70.
11. Kinsella, J. E. (1985). Functional criteria for expanding utilization of soy proteins in foods. World soybean Research Conference 111: proceedings. Shibles, R. (Ed.), Westview press pp34-39.
12. Liener, I. E. (1989). Control of antinutritional and toxic factors in oil seeds and legumes. In: *Food Uses of Whole Oil and Protein Seed* (edited by E. W. Lusas, D. R. Erikson and W. Nip). Champaign: *American Oil Chemists Society* Pp. 344-349.
13. Muhammad, B. F., Abubakar, M.M. and Adegbola, T. A. (2009). Effect of period and condition of storage on properties of yoghurt produced from cow milk and soymilk

materials. *Research Journal of Dairy Scence2: 18 – 24.*

14. Nnam, N. M. (1997). Chemical and Sensory evaluation of vegetable milk from African Yam Bean *Sphenostylis Stenocarpa* (Hoschst ex A Rich) harms and maize (Zeamays L.). *Plant Foods for Human Nutrition* 51: 265-274.
15. Ofuya, C. O., Njoku, H. O. and Eli, I. (1991). Development of a cheese-like product from African Yam Bean. *Food Chemistry* 39: 197-204.
16. Ojewola, G. S., Otteh, J. O. and Abasiekong, S. F., (2006). Effect of African Yam Bean Meal-Based Diets Supplemented at varying levels with Nutrase – Xyla Enzyme on Broiler Starter. *Agricultural Journal* 3: 172-175.
17. Osborne, D. and Voogt (1978). Analysis of nutrients in foods. Academic press, London N. Y. San Francisco. pp100-159.
18. Osundahunsi, O.F., Amosu, D.and Ifesan, B.O.T. (2007). Quality Evaluation and Acceptability of Soy-yoghurt with different colors and fruit flavours. *American Journal of Food Technology* 2:273-280.
19. Rao, D.R., Pulussani, S.R. and Chawan, C.B. (1988). Preparation of a yogurt-like product from cowpeas and mung beans. *International Journal of Food Science and Technology 23:195-198.*
20. Robinson, R. K. and Tamime, A. Y. (1993). Manufacture of yoghurt and other fermented milks. In: *Modern Diary Technology. Advances in Milk Products,* vol. 2 (edited by R. K. Robinson) London: Elsevier Applied Science pp1-48.
21. Robinson, R. K. and Tamime, A. Y. (1975). Yoghurt- a review of the product and its manufacture. *Journal of Social Diary Technology* 28: 149-163.
22. Speck, M. L. (1976). Compendium of Methods for Microbiological Examination of Foods.American Public Health Association, Washington D. C.pp550-559.
23. Tamime, A. Y. and Deeth, H. C. (1980). Yoghurt: technology and biochemistry. *Journl of Food Protocol* 43: 939-977.
24. Trema, A. and Musa, A. (1998). Soyabean yoghurt production using starter culture from nono. *Nigerian Journal of Biotechnology* 9 : 17 – 22
25. Williams, A. A. (1982). Scoring method used in sensory evaluation analysis of foods and beverages at Long Ashton Station. *Journal of Food Technology* 17: 163-175.

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