PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 10 (10): 914-918, 2011
ISSN 1680-5194

Physico-chemical and Sensory Evaluation of Market Yoghurt in Nigeria

Joseph A.O. Olugbuyiro and Joy E. Oseh
Department of Chemistry, College of Science and Technology,
Covenant University, Ota, Ogun State, Nigeria

Abstract: This study examined the quality of some yoghurts made and sold in the Nigerian market. Nine commercially available brands of yoghurt drinks which represent seven different manufacturers were randomly selected. The samples included seven plain yoghurt and two fruit yoghurt samples. All yoghurt samples were analyzed for chemical properties (moisture%, ash %, total solids, SNF, fat, pH and titratable acidity) and the organoleptic tests (color, thickness, appearance, body, texture, taste, smell, flavor and over all acceptability). The results of the study showed that the physico-chemical composition of the manufactured yogurts was different. The pH values of the samples ranged between 3.70-4.33 which were reasonably suitable for yoghurt marketed in tropical areas. No direct relationship was observed between pH values and titratable acidity. There was marked variation in the % fat content of the products. The results of the sensory evaluation revealed that flavor with respect to taste and smell had significant influence ($p<0.05$) on overall acceptability of yogurt product. So, the yogurt manufacturers need to improve on the sensory properties in particular flavor and taste for better consumer acceptability. Also, they may improve on packaging by labeling to specifications that precisely represent the content and type.

Key words: Yogurt, chemical evaluation, sensory properties, consumer acceptance

INTRODUCTION

Yoghurt is a fermented milk product and consumed by large segments of our population either as a part of diet or as a refreshing beverage. It is a nutritiously balanced food containing almost all the nutrients present in milk but in a more assimilable form. It is obtained by lactic acid fermentation of milk through the action of a starter culture containing *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. (Adolfsson *et al*., 2004). Human consumption of yoghurt has been associated with tremendous health benefits due to improvement of gastrointestinal functions and disease risk reduction (Heyman, 2000).

Different forms of yoghurt are available in the market like sweetened or flavored, stirred, strained, set, frozen and liquid yoghurt. The consumption of yoghurt in Nigeria has increased during the last decade and is taken as dessert or refreshing beverage drink. The quality of yoghurt in local market varies from one producer to another. Poor quality milk, unhygienic practices associated with the process involved and the use of "wild type" of starter culture give rise to poor grade (Younus *et al*., 2002) However, the inclusion of non-diary ingredients have been found to improve yogurt quality, create new brands of yogurts and modulate perception of consumers (Karagul-Yuceer *et al*., 1999; Iwalokun and Shitu, 2007). It is therefore important to carry out an investigation on the characteristics of the yogurt sold in local markets to ascertain their quality in relation to consumer preference. Therefore, this present study evaluated some types of yoghurt in the Nigerian market for chemical and organoleptic properties with the view of assessing the quality of the yoghurt with reference to standards and to determine the consumer acceptance of such product.

MATERIALS AND METHODS

Yoghurt samples: Nine commercially available brands of yoghurt drinks in the Nigerian market were randomly selected (Table 1). The samples were registered by National Agency for Food and Drug Administration and Control (NAFDAC) at the time of this study. The trade and manufacturers' names, ingredients and packaging methods of the yoghurt products were obtained from the labels on the products and recorded. Samples were evaluated by a random experiment with 3 repetitions for each sample and the mean of the three values was recorded.

pH measurement: The pH was determined at room temperature (27^{0}C) using a digital pH meter (JENWAY 3505). The pH meter was calibrated with buffer standards of pH 4 and pH 10 prior to use. 50 ml of each yoghurt drink was placed in a beaker, the probe of the pH meter was inserted and pH value was recorded. This measurement was done on opening of the yoghurt. The probe was rinsed thoroughly with distilled water before used on sample.

Corresponding Author: Joseph A.O. Olugbuyiro, Department of Chemistry, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria

Table 1: Commercial yoghurt drinks investigated

Sample	Trade name	Manufacturer	Ingredient	Packaging
1	Holandia Strawberry Yoghurt (HS)	CHI Limited, Nigeria	Yoghurt base, sugar, strawberry concentrate, stabilizer (E440), water, colour (E124)	Tetra pack
2	Holianda pineapple/coconut Yoghurt (HC)	CHI Limited, Nigeria	Yoghurt base, sugar, pineapple concentrate, coconut juice, natural pineapple, coconut flavor, stabilizer and water	Tetra pack
3	Mr Cream Yoghurt (MC)	TOB-TECH Enterprises, Nigeria	Full cream milk powder, sugar, vanilla flavor, treated water and yoghurt culture	Plastic
4	De Thirsty Yoghurt (DT)	Thirsty Drink NIG. ENT.	Milk, sugar, yoghurt culture, water and flavor	Plastic
5	Finest Yoghurt (FN)	Finest Foods, Chemicals and Allied product LTD.	Water, skimmed milk, sucrose and stabilizer	Plastic
6	Splenda Yoghurt (SP)	Slenda Food	Water, sugar, milk, yoghurt culture and flavor	Plastic
7	Holianda plain Sweetened Yoghurt (HP)	CHI Limited, Nigeria	Yoghurt base, sugar, stabilizer, water	Tetra pack
8	Superyogo (SY)	Fan milk PLC	Milk solid not-fat, starter culture, sugar, vegetable fat, stabilizer (E1422, E471, E401, E412)	Sachet
9	Cedar Yoghurt (CD)	Cedar 'D' Vine LTD.	Milk, calcium, protein, vitamins, minerals, carbohydrate, essential fatty acids	Plastic

Titratable acidity: The titratable acidity was measured by titrating 15 ml of the yoghurt with 0.1 M sodium hydroxide until the substance reached a pH value 8.2, corresponding to the end point of the phenolphthalein. Readings were done with pH meter (JENWAY 3505). When this value was reached, the spent NaOH volume was recorded and the acid percentage of the substance was calculated using the formula:

$$\text{Titratable acidity} = \frac{\text{Titre value x M x 90 x 100}}{\text{Volume of sample x 1000}}$$

Where, M = Molar concentration of NaOH

Moisture content determination: The moisture content of the yogurt products was determined according to the Association of Official Analytical Chemists method (AOAC, 1995). Each yoghurt product (10 g) was placed in an oven at 105°C for 3 h. Reading was taken at a constant weight. The moisture content was then expressed as the percentage (%) of the dry weight of sample.

Total solids: The weight of the residue obtained from moisture content analysis was expressed as percentage total solids using the formula below:

$$\text{Total solids (\%)} = \frac{(\text{Weight of dish} + \text{Dry yoghurt}) - (\text{Weight of dish})}{\text{Weight of the sample}} \text{ x } 100$$

Ash content determination: The ash content of each of dry yoghurt samples was determined at 550°C according to AOAC (1995). The ash content is expressed as the inorganic residue left as a percentage of the total weight of yoghurt incinerated.

Fat determination: The fat content was determined by the modified Mojonnier ether extraction method (AOAC, 1995). The extracted fat is dried to a constant weight and expressed as percent fat per weight.

Solids-not-fat: Solids-not-fat was determined by conducting total solids and fat analyses. Percent fat was subtracted from percent total solids to obtain percent solids-not-fat.

Sensory evaluation: All the samples were evaluated for organoleptic characteristics and overall acceptability by 15 panelists that comprised undergraduate, graduate students, teaching and non-teaching staff members of Covenant University, Ota, Nigeria; using nine point hedonic scale ranging from excellent (score = 9) to very poor (score = 0) as extremes (Obi *et al*., 2010).

Statistical analysis: The data obtained were computed as mean±standard deviation and analyzed by Analysis of Variance (ANOVA).

RESULTS AND DISCUSSION

Ingredient and packaging of yogurt products: Table 1 shows the trade names, ingredients, manufacturers and packaging of the nine yoghurt samples. Two (HS and HC) of the products were fruit stirred yoghurts while the remaining seven (MC, DT, FN, SP, HP, SY and CD) were plain yoghurts. All the products contained two or more additives such as sucrose, flavor, color and stabilizer. Three of the products (HS, HC and HP) were enclosed in tetra pack; one in sachet (SY) and the remaining five (MC, DT, FN, SP and CD) were packed in plastic containers.

pH: The pH of the yogurt samples are summarized in Table 2. Sample DT showed the highest average pH of

Table 2: pH and Titratable acidity (Mean±SD) of the yoghurt samples

Sample	pH	SD	Titratable acidity (%)	SD
1. HS	4.11	0.01	0.30	0.03
2. HC	4.10	0.02	0.36	0.02
3. MC	4.08	0.02	0.50	0.07
4. DT	4.33	0.02	0.22	0.04
5. FN	3.85	0.01	0.43	0.04
6. SP	3.81	0.01	0.50	0.05
7. HP	4.06	0.03	0.31	0.03
8. SY	4.00	0.01	0.33	0.06
9. CD	3.70	0.03	0.39	0.04

Table 3: Chemical composition of yoghurt samples in percent

Sample	Moisture content	Ash content	Total solids	Fat content	Solids not-fat
HS	79.1	0.26	20.9	2.75	18.15
HC	80.0	0.26	20.0	2.07	17.93
MC	78.2	0.71	21.8	3.03	18.77
DT	87.1	0.31	12.9	3.41	9.49
FN	86.8	0.40	13.2	3.18	10.02
SP	83.5	0.36	16.5	4.00	12.50
HP	82.9	0.38	17.1	2.04	15.06
SY	80.8	0.31	19.2	2.05	17.15
CD	86.3	0.33	13.7	1.88	11.82

4.33 with standard deviation of 0.02 while CD shows the lowest average pH of 3.70 standard deviation of 0.03. With the exception of DT, the plain yogurts were more acidic with mean pH range from 4.08-3.70 as against 4.11-4.10 of lactic acid content for fruit yoghurt. The variation in the pH of DT (4.33) when compared with other samples could be due to its composition during production. The pH values observed in this study are comparable to other workers (Dublin-Green and Ibe, 2005; Hassan and Amjad, 2010). All the same, the pH results are in accordance with FDA specifications for the pH of yoghurt (4.6 or lower).

The pH values of the samples were reasonably justified and suitable for yoghurt marketed in tropical areas because of the expected effect of bad storage conditions such as high temperatures encountering in some zones in Nigeria which can affect the acidity of yoghurt.

Titratable acidity: The titratable acidity of the yoghurt is shown in Table 2. Samples MC and SP had the highest titratable acidity of 0.50 while sample DT had the lowest titratable acidity of 0.22. The values obtained for titratable acidity are generally below the standard which is 0.7% (FDA, 2009). No direct relationship was observed between pH values and titratable acidity as has been previously reported (Dublin-Green and Ibe, 2005).

Moisture content and Ash content: As shown in Table 3, the moisture content of the samples ranged from 78.2-87.1%. MC had the least percent of moisture content this justified its thickness which the panelists averagely rated very thick. The values obtained for ash content of the yoghurt samples had a range between 0.26-0.71%.

Total solids content: The total solids content of each sample is shown in Table 3. Sample MC had the highest total solids of 21.8% this value supported its firm, custard-like body (table). Apart from MC, the two fruit yoghurts contained more total solids (20.9% and 20.0%) than plain yoghurts which ranged from 12.9-19.2%. Dublin-Green and Ibe (2005) reported values for fruit and natural yoghurts ranging from 15.0-22.8% and 13.6-18.8% respectively these were in close range with our findings.

Fat content: The fat content of the yoghurt samples are shown in Table 3. There was variation in the percent fat content. The highest average fat content is 4.00% while the lowest average fat content is 1.88%. According to USDA (2001), yoghurt with less than 0.5% fat content should be labeled as" not fat yoghurt", those with fat content within the range of 0.5-2.0% before the addition of bulky should be labeled "low fat yoghurt" and those with fat content above 3.25% should be labeled" yoghurt.

Solids-not-fat: The SNF of the yoghurt samples are shown in Table 2. The average range is from 9.49-18.77% According to USDA specification (2001) and FDA (2009), yoghurt should contain not less than 8.25% SNF before the addition of bulky flavour the present findings conform to this specification.

Sensory properties: Table 4 displays the observed attributes of the yogurts with reference to USDA specifications (2001) whereas the mean scores for sensory evaluation of sample yoghurts are shown in Table 5. Sample 1 (Table 4) had a clean pink color while all other samples presented natural color ranging from bright white to off-white color. There is no significant difference ($p>0.05$) in the mean color scores (Table 5). The results demonstrated that there was uniformity in color distribution of the test products.

The appearance of samples 3, 5, 6 and 9 (Table 4) lacked velvety feeling and were not fully homogenous in texture compared to others this is in agreement with their mean appearance scores (4.2, 5.1, 4.4 and 4.3 respectively) which were below average (5.7).

The mean scores for thickness had a range of 4.3 to 7.7 (Table 5) on a 9-point scale. In Table 4, items 3 and 5 exhibited good custard-like body; their mean thickness scores (7.7 and 7.5) are significantly different from other products ($p<0.05$). Samples 4, 6 and 9 were evaluated thick liquids while the remaining products 1, 2 7 and 8 had no significant difference in mean scores ($p>0.05$) and rated low in thickness compared to others (Table 5) in conjunction with Table 4 they are simply liquid yogurts. Karagul-Yuceer *et al*. (1999) stated that some yogurts exhibit a heavy consistency that closely resembles custard or milk pudding. In contrast, other yogurts are

Table 4: Sensory characteristics of the yogurts

	Sensory quality				
Sample	Color	App/texture	Body	Taste	Smell
1	Pink	Smooth	Watery	Sweet with sour	Pleasant
2	Natural	Smooth	Watery	Sweet	Pleasant
3	Natural	Rough	Firm	Sweet with sour	Pleasant
4	Natural	Smooth	Thick	Sour	Fair
5	Natural	Fairly smooth	Firm	Sour	Unpleasant
6	Natural	Wheyey	Thick	Harsh	Fair
7	Natural	Smooth	Watery	Sweet with sour	Pleasant
8	Natural	Smooth	Watery	Sweet with sour	Pleasant
9	Natural	Rough	Thick	Sweet with sour	Pleasant

Table 5: Mean scores of sensory properties and overall acceptability of the yogurts

	Sensory property						
Sample	Color	App	Thickness	Flavor	Taste	Smell	O.A
1	6.5^{a} (0.3)	6.9^{a} (0.4)	4.4^{a} (0.3)	7.2^{a} (0.3)	6.9^{a} (0.3)	7.0^{a} (0.3)	7.1^{a} (0.2)
2	6.6^{a} (0.2)	7.0^{a} (0.3)	4.4^{a} (0.3)	6.1^{b} (0.4)	6.0^{b} (0.3)	6.2^{b} (0.4)	6.7^{a} (0.2)
3	6.8^{a} (0.3)	4.2^{b} (0.3)	7.7^{b} (0.2)	5.7^{b} (0.4)	5.8^{b} (0.4)	5.3^{c} (0.4)	5.9^{b} (0.4)
4	6.5^{a} (0.2)	6.0^{c} (0.4)	6.3^{c} (0.2)	4.7^{c} (0.3)	4.3^{c} (0.2)	4.9^{c} (0.4)	4.3^{c} (0.3)
5	6.4^{a} (0.3)	5.1^{c} (0.4)	7.5^{b} (0.3)	2.9^{d} (0.4)	4.5^{c} (0.4)	3.1^{d} (0.5)	2.6^{d} (0.4)
6	6.5^{a} (0.3)	4.4^{b} (0.4)	6.4^{c} (0.3)	4.5^{c} (0.4)	2.6^{d} (0.3)	5.1^{c} (0.4)	3.0^{d} (0.3)
7	6.9^{a} (0.3)	6.4^{c} (0.4)	4.3^{a} (0.3)	6.0^{b} (0.3)	7.0^{a} (0.4)	6.2^{b} (0.3)	6.9^{a} (0.3)
8	6.8^{a} (0.3)	6.4^{c} (0.3)	4.4^{a} (0.3)	6.8^{a} (0.3)	6.9^{a} (0.4)	6.9^{a} (0.4)	6.8^{a} (0.3)
9	6.5^{a} (0.2)	4.3^{b} (0.3)	6.5^{c} (0.2)	6.5^{b} (0.3)	6.7^{a} (0.3)	6.3^{b} (0.4)	6.5^{a} (0.2)

1-9 = Yoghurt samples, App = Appearance, OA = Overall acceptability, Figures in parentheses represent. SEM of the mean values of data. Means within a column without a common superscript differ ($p<0.05$)

purposely soft-bodied and are essentially drinkable. The differences observed in product thickness agree with that statement.

Table 4 shows that samples 1, 3, 7, 8 and 9 had sweetness with clean acid taste undertone. Product 2 possessed plain sweet taste in contrast with samples 4 and 5 which had sharp sour taste. However, sample 6 possessed unpleasant taste with reference to other products. Products 1, 2, 3, 7, 8 and 9 scored (Table 5) higher than the average mean scores for flavor and taste (5.7 and 5.6 respectively). The mean flavor and taste scores for samples 4, 5 and 6 (Table 5) are significantly below average ($p<0.05$). The results from the two tables of sensory properties in conjunction with pH values (Table 2) indicate that a perceptible sensation of product sweetness coupled with a pleasant taste of acidity is more preferred to ordinary acid taste yoghurt. Sample 5 had no flavor and the smell was unpleasant to consumer. The means scores (2.9 and 3.1 respectively) are significantly very low ($p<0.05$) compared to other products which averagely displayed pleasant smell.

Although color, appearance, texture and thickness of yogurt are important quality characteristics, the flavor of the product is generally considered the most critical and important indicator of consumer acceptance (Bodyfelt *et al*., 1988). Results (Table 5) of the consumer acceptance evaluation showed that flavor with respect to taste and smell had over whelming influence in overall acceptability of each product. The three products (4, 5 and 6) that were significantly scored low ($p<0.05$) in overall acceptability showed a direct relationship with their mean scores for flavor, taste and smell.

Conclusion: The results of this research showed that though consumer might have preference for variation in yogurt consistencies, a pleasant flavor coupled with a perceptible sensation of product sweetness had significant influence on overall acceptability of the product. So, the yogurt manufacturers need to improve on the sensory properties in particular flavor and taste for better consumer acceptability. Also, they may improve on packaging by labeling to specifications that precisely represent the content and type.

REFERENCES

Adolfsson, O., S.N. Meydani and R.M. Russel, 2004. Yogurt and gut function. Am. J. Clin. Nutr., 80: 245-256.

AOAC, 1995. Official Methods of Analysis of the Association of Official Analytical Chemists. Vol II 16th ed.,AOAC Arlington, VA.

Bodyfelt, F.W., J. Tobias and G.M. Trout, 1988. Sensory Evaluation of Dairy Products. Van Rostrand Reinhold, New York.

Dublin-Green, M. and S.N. Ibe, 2005. Quality evaluation of yogurts produced commercially in Lagos, Nigeria. Afr. J. Applied Zool. Environ. Biol., 7: 78-82.

FDA, 2009. Milk and cream products and yogurt products. Food and Drug Administration Federal Register, 74: 2448.

Hassan Ammara and Amjad Imran, 2010. Nutritional evaluation of yoghurt prepared by different starter cultures and their physiochemical analysis during storage. Afr. J. Biotech., 9: 2913-2917.

Heyman, M., 2000. Effect of lactic acid bacteria on diarrheal diseases. J. Am. Coll. Nutr., 19: 137S-146S.

Iwalokun, B.A. and M.O. Shitu, 2007. Effect of hibiscus Sabdariffa (Calyce) extract on biochemical and organoleptic properties of yogurt. Pak. J. Nutr., 6: 172-182.

Karagul-Yuceer, Y., P.C. Coggins, J.C. Wilson and C.H. White, 1999. Carbonated yogurt-sensory properties and consumer acceptance. J. Dairy Sci., 82: 1394-1398.

Obi, T.E., F.O. Henshaw and O.O. Atanda, 2010. Quality evaluation of plain-stirred probiotic yoghurt produced from skim and whole milk powder during refrigerated strorage. EJEAFChe, 9: 1203-1213.

USDA, 2001. Specifications for Yogurt, Nonfat Yogurt and Lowfat Yogurt. Document 21CFR, Part 131.200-203.

Younus, S., T. Masud and T. Aziz, 2002. Quality evaluation of market yoghurt/Dahi. Pak. J. Nutr., 1: 226-230.