African Journal of Applied Zoology & Environmental Biology. 2005. Vol. 7, 78 – 82
ISSN 1119-023X
www.uniportjournals.com/ajazeb

QUALITY EVALUATION OF YOGURTS PRODUCED COMMERCIALLY IN LAGOS, NIGERIA

[1]M. Dublin-Green and [2]S. N. Ibe*
[1]DEPARTMENT OF BIOLOGICAL SCIENCES,
UNIVERSITY OF LAGOS, LAGOS, NIGERIA.
[2]DEPARTMENT OF MICROBIOLOGY,
UNIVERSITY OF PORT HARCOURT, PORT HARCOURT, NIGERIA

ABSTRACT

Yogurt of the natural-stirred and pineapple-stirred varieties manufactured commercially in Lagos, Nigeria were analyzed to evaluate the nutritional quality of the fresh and stored product. The carbohydrate and protein contents were higher in the pineapple than in natural yogurt with an average percent content of 12.7 and 1.2 compared to 7.0 and 0.9 respectively. The fat content was the same, about 1.0 percent of each type. These values decreased with time during storage and the decrease was more rapid at 30°C than at 10°C. Natural yogurt was more acidic with an average pH of 3.8 and 3.0% lactic acid content compared to values of 4.2 and 2.4% respectively for pineapple yogurt. Titratable acidity and moisture content increased with storage time without any marked change in pH. Yogurt spoilage was evident from the yeast odour when yeast counts had reached 10^6-10^8 cfu ml^{-1}. A product shelf life of 6 days at 10°C and 48h at 30°C is recommended and the concentration of milk solids should be increased in order to produce a more nutritious yogurt.

Key words: Yogurts, quality evaluation, Lagos, Nigeria

INTRODUCTION

Yogurt consumption in Nigeria has increased during the last decade and is taken as dessert or snack mainly by city dwellers. The only native milk product closely related to yogurt is *nono*, a fermented or soured milk product consumed by people in northern Nigeria. Okoh *et al.* (1979) studied the energy value of certain Nigerian foods including *nono*, and found the protein, carbohydrate, fat and ash contents of *nono* to be 1.35 ± 0.21, 2.23 ± 0.19, 0.54 ± 0.13 and 0.35 ± 0.03 percent of the wet weight respectively.

The significant increase in the consumption of yogurts worldwide has been ascribed to the image of the product as a high protein convenient food (Robinson and Tamime, 1975) and a good substitute for milk in lactose intolerant individuals, since it is pre-digested (Goodenough and Kleyn, 1975). Yogurts, manufactured in various countries have been subjected to extensive chemical analysis (Davis, 1970a; Duitschaever, *et al.* 1972; Davis and Mclachlan, 1974; Kroger, 1975; Robinson and Tamime, 1975; Youanna *et al.* 2002; Salwa *et al.* 2004).

The protein content reported for yogurts in the United Kingdom varied from 3.33 to 5.33% (Davis and Mclachlan, 1974). Natural yogurts were usually found to contain about 3% fat, fruit and low fat yogurt about 1.5% and fat-free yogurts about 0.1% fat. Wide differences in milk solids-not-fat (SNF) contents have been observed for various yogurts marketed in different countries. Duitschaever *et al.* (1972) have emphasized the importance of having standards where a minimum percentage of milk solids –not-fat and/or fat is stipulated and adhered to both in terms of consumer expectation and nutritional quality.

Information is sparse on the nutritional quality of yogurts marketed in Lagos both after manufacture and during storage. Yogurts should be stored at chilling temperatures not higher than 5°C for a longer shelf life. On the contrary, they are usually held in storage compartments at about 10°C or left on open shelves in some supermarkets and are even sold by hawkers carrying the yogurts in open cartons exposed to the heat of the sun. Yogurts not properly refrigerated are prone to spoilage by yeast contaminants (Suriyarachchi and Fleet, 1981; Green and Ibe, 1987). Therefore the chemical quality and level of yeast contamination of fresh yogurts and yogurts stored at 10°C and 30°C have been examined.

MATERIALS AND METHODS

YOGURT SAMPLES

Natural-stirred and pineapple-stirred yogurt varieties in 200-ml containers, certified to belong to the same production batch were obtained

***Correspondence author: S. N. IBE**
E-mail: sibe_ahs@yahoo.com

directly from the dairy factory. The samples were transported to the laboratory in a cooler and stored at 10°C. Six samples of each flavour were analyzed within 24 h of collection as zero day samples. The remaining samples were stored at 10°C and 30°C for 16 days. Samples for analysis were taken in quadruplicates every 4 days.

TOTAL COUNT OF YEASTS

The carton was cleaned with 70% (v/v) alcohol and a 5ml sample was withdrawn with a sterile 5ml pipette and mixed with 5ml of 0.1% sterile peptone water. Ten fold serial dilutions were prepared and 0. 2ml aliquots of the required dilution were spread-plated onto potato dextrose agar containing 100 ug of chloramphenicol per ml (PDAC). Plates were incubated at 30°C for 4 days before the total count of yeasts was obtained (Ingram, 1954; Suriyarachchi and Fleet, 1981). The average yeast count of the various containers was then calculated.

TOTAL SOLIDS, ASH AND MOISTURE CONTENT

Moisture was removed from the yogurt samples by heating at 98-100°C in a force-draught oven for 3h (AOAC, 1980). Five grams of the samples in a pre-weighed flat bottom dish were heated on a steam bath for 10-15 minutes before transfer to the oven. The dish was cooled in a desiccator and weighed. The weight of the residue was obtained and expressed as percentage total solids and the weight lost represented the moisture content. Ash content was determined by heating the residue in a muffle furnace.

DETERMINATION OF PROTEIN CONTENT

Crude protein was estimated by determination of the total nitrogen in five grams of sample, following the Kjeldhal method (AOAC, 1980). The conversation factor used was that recommended for milk products that is, 6.38, according to Davis and Mclachlan (1974).

DETERMINATION OF FAT

The fat content in ten grammes of sample was determined by the Reese Gottlieb method (AOAC, 1980).

DETERMINATION OF TOTAL CARBOHYDRATES

The Anthrone method (AOAC, 1980) was used for the determination of total carbohydrates in five grams of sample. The concentration of glucose was read off from a standard curve of glucose prepared as described by Yemn and Willis (1954).

MEASUREMENT OF pH

All pH measurements were taken with an L. Pusl Munchen 15 pH meter equipped with a glass combination electrode.

TITRATABLE ACIDITY

The method used was a described in the AOAC (1980).

SOLIDS-NOT-FAT (SNF) DETERMINATION

This parameter was calculated as the arithmetic difference between the values for the total solids and the fat (AOAC, 1980).

RESULTS AND DISCUSSION

Chemical analysis carried out on samples of the more popular natural and pineapple stirred yogurts during storage at 10°C and 30°C are shown in Figures 1, 2 and 3.

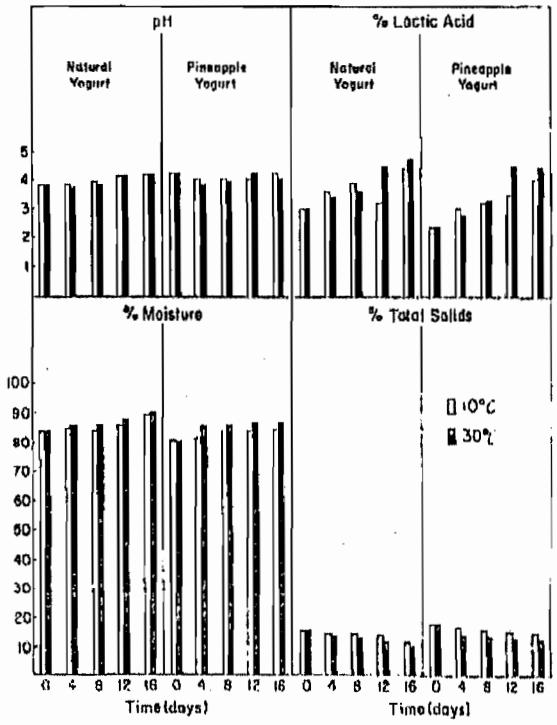

FIG. 1: CHANGES IN PH, % LACTIC ACID, % MOISTURE AND TOTAL SOLIDS OF NATURAL – STIREED AND PINEAPPLE – STIRRED YOGURTS DURING STORAGE AT 10°C AND 30°C

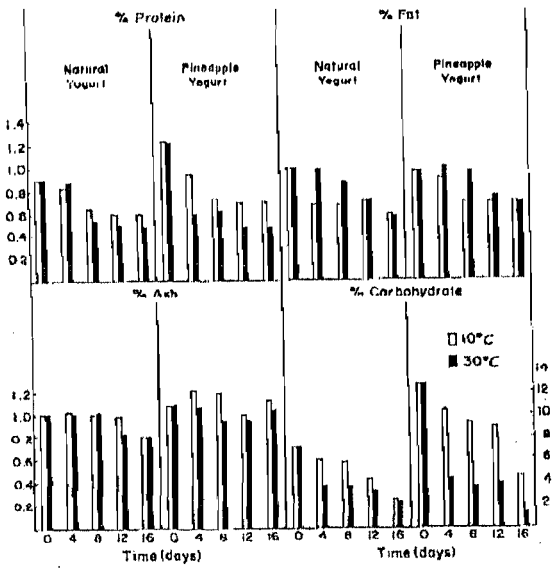

Fig. 2: Changes % Protein, % Fat, % Ash and % Carbohydrate A Natural-Stired And Pineapple-Stirred Yogurts During Storage At 10°C And 30°C.

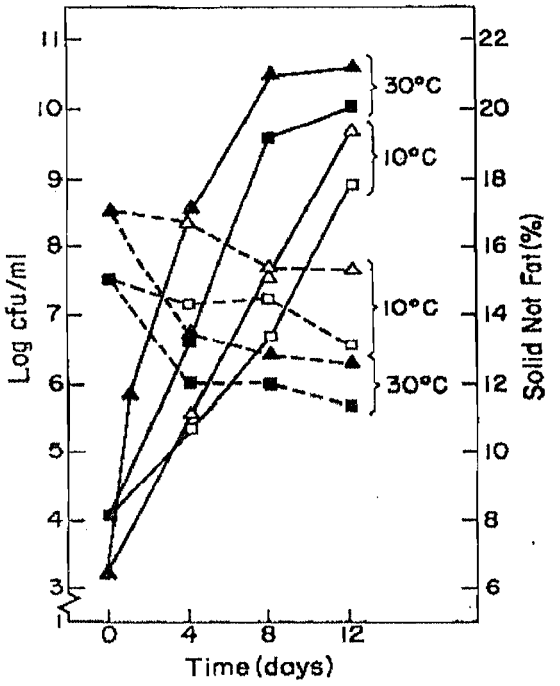

Fig. 3: Changes In Total Yeast Cell Count And Solids-Not-Fat (Snf) Of Natural-Stirred And Pineapple-Stirred Yogurts During Storage At 10°c and 30°c. Total Yeast Cell Count (Continuous Line); Solids-Not-Fat (Broken Lines); Natural Yogurt (△;▲); Pineapple Yogurt (□;■); 10°c (Open Symbols), 30°c (Closed Symbols).

pH AND TITRATABLE ACIDITY (% LACTIC ACID)

The natural yogurt was more acidic with a mean pH value of 3.82 and 3.0% lactic acid as against a pH value of 4.17 and 2.4% lactic acid content for pineapple yogurt (Fig. 1). The lactic acid content increased during storage up to the 8th day and increase was more rapid at 30°C than at 10°C. However, no appreciable increase in pH values was observed. The pH ranges observed in this work are comparable to those of other workers (Davis and Mclachlan, 1974; Duitschaever *et al.* 1972). Younua *et al.* (2002) however recorded higher pH values between 4.35 ± 0.03 and 4.57 ± 0.03 for market yogurts in Islamabad, Pakistan. Selwa *et al.* (2004) observed that 20% carrot yogurt had lower pH value of 4.90 compared to plain yogurt with pH of 5.15.

The values obtained in this study for percent titratable acidity were higher than those reported by Davis and Mclachlan (1974) and Younua *et al.* (2002) who reported mean values in the range of 0.87 ± 0.04 to 1.13 ± 0.05. No direct relationship was observed between pH values and titratable acidity as has been reported by other workers (Davis, 1970; Robinson and Tamime, 1975) and this has been attributed to the presence of milk powder which not only increases the titratable acidity but also increases the buffering capacity of the product.

TOTAL SOLIDS

Fig. 1 shows that pineapple yogurt contained more total solids, ranging from 15.0% to 22.8%, with an average of 18.1%, than natural yogurt, 13.6 – 18.8% with a mean of 16.1%. Younua *et al.* (2002) reported values for natural yogurt which were in the same range, from 12.93 ± 0.05% to 15.73 ± 0.18%, as in this study. Duitschaever *et al.* (1972) also reported mean values of 20.94% and 15.86% for total solids in fresh flavoured and natural yogurts respectively, produced in Ontario, Canada. Davis and Mclachlan (1974) reported values ranging from 10.53 – 26.37% for blackcurrant yogurt and a lower value of 11.56 – 17.39% for natural yogurt. When fresh fruits were used for fruit yogurt by these workers, a higher total solids value of 19.53 – 26.37% was obtained. The value obtained in this work can be considered as a satisfactory judging from the above reports and that of Davis (1970) in which it was observed that *Lactobacillus bulgaricus* was severely inhibited at total solids concentration levels of 24% and over.

CARBOHYDRATE, PROTEIN, FAT AND SOLID-NOT-FAT (SNF)

Figure 2 shows the carbohydrate and protein contents of the fresh product were also higher in pineapple than in natural yogurt with mean values of 12.7% and 1.2% compared to 7.0% and 0.9% respectively. The protein content observed was less than the 3.33 – 5.33% reported for yogurts produced in the United Kingdom (Davis and Mclachlan, 1974). The lower protein values correlated with the lower total solids observed and it is assumed that the concentration of milk powder used by the Nigerian manufacturer is low, since this ingredient is imported and not locally available in high quantities. Thus the Nigerian yogurts are less nutritious than those manufactured in the United Kingdom. The value for the protein content was however, similar to the value of 1.35 ± 0.21 reported for *nono* the native soured milk (Okoh *et al* 1979).

The mean values for fat content of fresh natural and pineapple yogurts were the same, 1.0%. A higher value of 1.98% was observed by Duitschaever *et al.* (1972). The fat composition of the yogurts in this study implies that the yogurts can be classified as medium fat yogurts as suggested by Robinson and Tamime (1975) for yogurts containing 0.5 – 2.9% fat.

The solids –not-fat values on the fresh yogurts were lower in natural yogurt as expected with a mean value of 15% compared to 17% for pineapple yogurt. During storage of the yogurts there was a decrease in total solids value which was reflected by decrease in carbohydrate, protein and fat content. The decrease was more rapid at 30°C than at 10°C.

EFFECT OF YEAST CONTAMINANTS ON CHEMICAL COMPOSITION OF THE YOGURTS

Previous studies have shown that yeasts are the primary contaminants of yogurts, due to the low pH and high sugar content (Keogh, 1975; Suriyarachchi and Fleet, 1981). The three predominant yeast contaminants found in yogurts manufactured in Lagos, Nigeria were *Candida lusitaniae, Candida krusei*, and *Kluveromyces fragilis* (Green and Ibe, 1987). Figure 3 shows the total counts of yeast contaminants and the solid-not-fat content of the yogurts during storage. The solids-not-fat content decreased as the yeast cell counts increased indicating utilization of the yogurt solids for growth by the yeast cells. On the contrary Selwa *et al.* (2004) found that carrot juice was inhibitory to coliforms and yeasts in carrot yogurt and inhibited production of aflatoxin M1.

One of the by-products of metabolism, lactic acid, increased sharply between the 8th and 12th day coinciding with the period of maximum yeast growth. Similarly the decrease in fat content was prominent on the 4th day at 30°C and 8th day at 10°C. The decrease in total solids during storage was seen as increase in moisture content of the product (Fig 1) with the yogurts becoming less viscous. Yogurt spoilage was evident when yeast counts reached 10^6 –10^8 cells/ml and this occurred after 3-4 days of storage at 30°C and 8 –12 days at 10°C. The packets appeared bloated and leaked from the sides and the product had a characteristic 'yeasty' odour, as has been observed by Davis and Mclachlan (1974). Suriyarachchi and Fleet (1981) also reported that yogurts stored at 20°C became unacceptable after 7 days. These observations illustrate the importance of storage of yogurts at low temperature in order to increase the shelf life.

In conclusion, a product shelf life of 6 days at 10°C and 48 h at 30°C is therefore recommended for yogurts marketed in Lagos, Nigeria and the concentration of milk solids should be increased so as to increase the protein content and produce a more nutritious yogurt.

REFERENCES

Association of Official Analytical Chemists (AOAC) (1980) *Official Methods of Analysis.* 14th ed. Washington D.C.

Davis, J.G. (1970) Laboratory content of yogurt. *J. Dairy Ind.* **35**: 139 –144.

Davis, J.G. (1975) Fruit yogurt. *J. Dairy Ind.* **35**: 676 –680.

Davis, J.G. and Mclachlan, T. (1974) Yogurt in the United Kingdom Chemical and Microbiological analysis. *J. Dairy Ind.* **39**: 149 –177.

Duitschaever, C. L., Arnott, D. R. and Bullock, D. H. (1972) Quality evaluation of yogurt produced commercially in Ontario. *J. Milk Food Technol.* **35**: 173 –175.

Goodenough, E. R. and Kleyn, D. H. (1975) Qualitative and quantitative changes in carbohydrates during the manufacture of yogurt. *J. Dairy Sci.* **59**: 45-47.

Green, M. and Ibe, S.N. (1987). Yeasts as primary contaminants of yogurts produced

commercially in Lagos, Nigeria. *J. Food Protect.* **50**: 193-198

Ingram, M. (1995) Comparison of different media for counting sugar tolerant yeasts in concentrated orange juice. *J. Appl. Bacteriol.* **22**: 234 –247.

Keogh, B. P. (1975) Microorganisms in dairy products –Friends and foes. *J. Soc. Diary Technol.* **28**: 41-45.

Okoh, P. N., Eka, D. U. and Hallaway, H. M. (1979) A comparison of classical methods for the estimation of energy value of foodstuffs as applied to Nigerian foods and ingredients. *Nigerian J. Sci.* **13**. 277 – 283.

Robinson, R. K. and Tamime, A. Y. (1975 Yogurt – A review of the product and its manufacture. *J. Soc. Dairy Technol.* **28**: 149 –162.

Selwa, A.A., Galal, E.A. and Neimat, A.E. (2004) Carrot yoghurt: Sensory, chemical, microbiological properties and consumer acceptance. *Pakistan Journal of Nutrition* **3**: 322-330.

Suryarachchi, V. R. and Fleet, G. H. (1981) Occurrence and growth of yeasts in yogurts. *J. Appl. Environ. Microbiol.***42**: 574 –579.

Yemn, E. W. and Willis, A. J. (1954) The estimation of carbohydrates in plant extracts by anthrone. *Biochem. J.* **57**: 508 –514.

Younua, S, Masud, T. and Aziz, T. (2002) Quality evaluation of market yoghurt/ Dahl. *Pakistan Journal of Nutrition* **1**:226-230.