Nutritional evaluation and microbiological analysis of yoghurt produced from full cream milk, tiger-nut milk, skimmed milk and fresh cow milk

Oladipo I.C. (Corresponding author)
Department of Science Laboratory Technology, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Tel: +2348032183477 E-mail: xtiecoker@gmail.com

Atolagbe O.O.
Department of Science Laboratory Technology, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria

Adetiba T.M.
Department of Science Laboratory Technology, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria

ABSTRACT

In this study, the possibility of using different milk source to produce yoghurt was investigated in a complete randomized design model in order to make a comparative analysis of the nutritional and microbiological components of the various yoghurt samples. The pH of the different yoghurt samples after fermentation processes were determined; yoghurt from tiger-nut milk had the lowest pH of 3.2 while skimmed milk yoghurt had the highest pH of 4.7. The organoleptic evaluation was conducted by ten panel members to assess: appearance, sourness, consistency, aroma, taste and general acceptance; all samples were acceptable and good, but the yoghurt sample from full cream milk yoghurts was rated best followed by tiger-nut milk yoghurt, skimmed milk yoghurt and cow milk yoghurt. Proximate analysis was carried out to evaluate nutritional composition such as: crude protein, fiber, fat, moisture and ash contents. The protein content of the samples ranged from 4.78 to 5.23%, skimmed milk yoghurt had the highest crude protein content (5.23%) while full cream yoghurt had the lowest (4.78%). Cow milk yoghurt had the highest fat content (0.73%); while skimmed milk yoghurt had the lowest fat content (0.59%). The shelf life of the various yoghurt samples were observed for six weeks; yoghurt from cow milk and skimmed milk had the lowest shelf of four weeks, while yoghurt sample from tiger-nut milk had shelf-life of five weeks, and yoghurt from full-cream milk had the shelf life of six weeks. Lactic acid bacteria and non-lactics isolates were isolated from the yoghurt samples. The isolates were characterized and identified as *Lactobacillus xylosus, Lactobacillus brevis, Lactobacillus plantarum, Lactobacillus casei, Pediococcus acidiclactici, Flavobacterium rigense, Flavobacterium aquatile, Pseudomonas putida, Enterobacter aerogenes*. The total bacteria colony count of each of the samples was monitored for six weeks and yoghurt from cow milk had the highest microbial load of 27×10^3 in the first week after production and increased to $>182 \times 10^8$ in the sixth week while yoghurt from full cream had the lowest microbial load of 14×10^3 in the first week after production and increased to $>110 \times 10^8$ in the sixth week. Tiger-nut milk with its inherent nutritional and therapeutic advantage could serve as a good alternative to milk from animal source in the production of yoghurt. Therefore, the high cost of milk from animal source could be overcome by the use of milk from plant source especially tiger-nut milk which has nutritional and therapeutic advantage over other milk sources. The use of tiger-nut milk in the production of yoghurt could also reduce the price of yoghurt and make it more affordable to many people

Key words: Yoghurt, tiger nut, cow milk, pH, crude protein,

1.0 INTRODUCTION

Yoghurt is a fermented dairy product obtained through anaerobic fermentation of lactose in milk by relevant microorganisms most of which are classified as pro-biotic (Tull, 1996). Lactose in evaporated whole milk, skimmed milk or fresh cow's milk is converted into lactic acid by a symbiotic bacteria culture of *Streptococcus thermophilus* and *Lactobacillus bulgaricus* growing at temperatures in the range

of 40– 45^{o} C (Wood, 1985). Yoghurt is becoming more popular in other parts of the world including Africa. Several factors account for the success of yoghurt: the fact that it is a natural drink, has good organoleptic characteristics (fresh, acidulated taste and characteristic flavour) and good nutritional value. It also has prophylactic and therapeutic properties (Roissart and Luquet, 1994). Yoghurt is a preferred dairy product in areas where people are prone to lactose- intolerance. It is preferred over milk because it contains lactic acid which is readily digested as compared to lactose in unfermented milk.

Many researchers have advocated the consumption of some cultured dairy products such as yoghurt in the prevention and treatment of several diseases; prophylaxis against the treatment of gastrointestinal infection, management of lactose intolerance and of hypercholesterolemia, the prevention of neoplastic disease (Fernandes *et al*., 1987; Fernandes and Shahani, 1990) and treatment of antibiotic associated colitis (Colombel *et al*., 1987). For these reasons probiotic organisms are increasingly incorporated into food as dietary adjuncts to help maintain a healthy microbial gastrointestinal balance and their availability in yoghurt has made it increasingly popular in many parts of the world (Furst *et al.*, 1996). The increasing demand from consumers for dairy products with functional properties is a key factor driving value sales growth in developed markets. This led to the promotion of added-value products such as probiotic and other functional yoghurts, reduced fat, full fat milk and production from other plant sources such as tiger- nut milk, coconut milk, soy bean milk and organic cheese (Rudrello, 2004).

Tiger-nut is a cosmopolitan perennial crop found all over the world, the nut was found to be rich in myristic acid, oleic acid, linoleic acid (Eteshola and Oradelu,1996).The nut is also rich in mineral and oil contents, the oil was implicated as lauric acid, the nut was valued for the high starch dietary fibre and carbohydrate (mono, di and polysaccharides).Tiger-nuts are regarded as digestive tonic and also helps in the treatment of indigestion, colic diarrhea, dysentery and excessive thirst(Martinez, 2003). The nut was found to be useful in preventing heart attack, thrombosis and activates blood circulation; it also helps in preventing cancer due to high content of soluble glucose. It was reported that tiger- nut helps reducing the risk of colon cancer. Additionally, the suitable for diabetic persons and also helps in losing weight (Martinez, 2003). These numerous advantages and health benefits associated with the yellow varieties of tiger-nut makes it more attractive as an alternative source of milk in yoghurt production (okarfor *et al*., 2003).

For a long time fermented dairy products have been consumed for human's nutrition and health (Penna *et al*., 2006).Yoghurt is very popular among fermented dairy product all over the world. Recently, consumption of whole dairy products has declined due to the awareness of the probable harmful effect of fat on consumer's health, thus dietary habits of consumers have been changed and market interest has tended to change in favour of skimmed milk (Brennan and Tudorica, 2006). The costs of milk from animal sources are more expensive in developing countries, due to scarcity, which has led to a decrease in the consumption of yoghurts made from animal sources leading to the use of milk from plants sources such as soy- bean milk, tiger-nut milk and coconut milk. Milk from these plant sources are readily available, cheap and highly nutritious; tiger-nut could serve as a good alternative to milk from animal sources.

Therefore, this research is aimed at evaluation of the microbiological and nutritional quality of yoghurt produced from different milk sources. The analysis and documentation of the nutritional value of yoghurts from different milk sources will enhance its popularity among people and enable them to make choices based on quality of the products.

2.0 MATERIALS AND METHODS

2.1 Sample collection

Full cream milk, skimmed milk and commercially prepared starter culture were purchased from a supermarket in Ilorin metropolis, kwara state, Nigeria. Tiger-nut (Khawu type) was bought from a local market in Ogbomosho, Nigeria and Cow milk was also bought from a Fulani settlement in Ogbomosho, Nigeria.

2.2 Culture media

The media used for microbiological isolation of microorganism were nutrient agar, MRS agar and nutrient broth. The media were prepared according to the manufacturer's specification. These media were sterilized in an autoclave at 121^{O}C for 15minutes.

2.3 Extraction of tiger- nuts milk

Modified method of Sanful (2009) was used for the extraction of milk from tiger-nuts. Briefly, the tiger-nut milk was prepared by picking out foreign particles and bad nuts that could affect taste and keeping quality of the yoghurt. The tiger-nut was washed and rinsed in distilled water; it was then soaked overnight to soften the fiber. Nine hundred grams of tiger-nut was added to 2 liters of warm water and

blended several times with a blender. The mash was filtered through a muslin cloth to separate the milk from the mash; it was further strained to obtain a fine consistency. This was transferred into a sterile container and pasteurized at 90^0C for 15 minutes and later cooled to a temperature of 45^0C. The filtrate was poured into sterile container for further processes

2.4 Production of yoghurt

The first step was preparation of starter culture, which was prepared by adding 200g of milk to 400ml of water at about 40-45^{o}C and homogenized 5g of the commercial starter culture was added to the milk solution and incubated at temperature between 40- 45^{o}C for 24 hours before it was used. Reconstitution of the milk was the second step, this involved preparation of the milk solution. Two liter of water heated to 90^0C was used to reconstitute 600g each of full-cream milk and skimmed milk while two liter of raw cow milk was also heated to 90^0C. This high temperature allowed pasteurization of the milk. The milk solutions including tiger nut milk were stirred very well in order to avoid lump formation which can affect consistence of the yoghurt. Fermentation followed reconstitution, 100mL of starter culture was introduced into each milk solution aseptically at a temperature between 40-45^{O}C then incubated at 44^{o}C for approximately 8 hours. The pH of the milk was determined at interval of two hours using automatic pH meter (Oladipo and Oginni, 2013).

2.5 Organoleptic test

A total numbers of 10 panels were selected to evaluate the quality of the yoghurt samples through sensory evaluation. The qualities assessed were, appearance, sourness, consistency, aroma, taste and general acceptance. The yoghurt samples were rated successively on a scale 0-4, 0 being regarded as poor, 1 as fair, 2 as good, 3 as very good and 4 been the highest point for each parameter as excellent (Oladipo and Oginni, 2013).

2.6 Isolation procedures

One milliliter of each yoghurt sample was serially diluted, 1ml of an appropriate dilution was inoculated on nutrient and MRS agar plates and the plates were incubated for 24 hours at 30^OC. After 24 hours sterile wire loop was used to pick the isolate from the plate and was streaked on a freshly prepared sterile nutrient agar and MRS agar plates, then incubate for 24 hours at 30^OC in order to get pure cultures. Pure cultures were then stored in a refrigerator at 4^OC. The routine laboratory method of Cruickshank *et al*. (1975) was used to characterize different isolates. The isolates were identified using their macroscopic, cultural, physiological and biochemical characteristics.

2.7 Total Colony Count

One milliliter of each sample was dissolved in sterile de-ionized water and serially diluted. One milliliter of appropriate dilutions was seeded on plate count agar using spread plate method, and the medium was then incubated at 37°C for 24 hours. The plate count agar was examined and colonies present were counted and recorded after incubation at 37°C for 24 hours, to get the total colony count in CFU/mL. This was done to monitor the microbial load for 6 weeks at 7 days interval and the shelf-life of each sample was also monitored

2.8 Proximate analysis

This refers to the determination of the major constitute of a food and it is used to determine if a food is within its normal compositional parameters. This method partitioned nutrient of food into 6 components, moisture content, ash content, crude protein, fat content, crude fiber and total solid.

2.8.1 Determination of Moisture content

Two gram (2g) of the yoghurt sample was weighed into previously dried and weighed glass crucibles. The crucibles with the samples were then placed in a thermostatically controlled oven at 105^0C till a constant weight of solid material was obtained after 5 hours. The crucibles were then removed and cooled in a desssicator and then weighed. The moisture content of the samples was calculated by difference in weights and expressed as a percentage (Oladipo and Jadesimi, 2012).

2.8.2 Determination of Crude Ash Content

Modified method of Oladipo and Jadesimi (2012) was used to determine the crude ash content of the samples. Briefly, two gram (2g) of homogenized yoghurt sample was weighed into each of three previously dried and weighed porcelain crucibles and heated for about 20 minutes over a boiling water bath till they were visibly dry. The crucibles with their content were then transferred into a muffle furnace at 600^0C and incinerated for 2hours. The crucibles were removed, placed in a desssicator to cool then weighed and the ash content was calculated and expressed as a percentage.

2.8.3 Determination of Crude Protein Content

Two grams (2g) of the sample was placed in a kjeldahl digestion flask containing a selenium based catalyst and 25ml of concentrated H_2SO_4 added in a fume chamber until digestion was completed after 5 hours. The digest was cooled and transferred into a 100ml volumetric flask and made up to the

mark with distilled water. 10ml of the diluted digest was put in the steam distillation unit, which was previously flushed with distilled water. 18ml of 40% of NaOH was then added to the solution in the steam distiller, 25 ml of 2% boric acid pipette into a conical flask and two drops of bromocresol green methyl red mixed indicator added. This mixture was placed under the condenser outlet of the distillation system, with the tip of the condenser completely immersed in it. The distillation was carried out until all the boric acid solution turned from pink to yellowish green. The solution in the conical flask was titrated against 0.1N HCl solutions and the end point recorded, the distillation processes were done with triplicate samples of the diluted digest, a blank was taken through the same procedure using distilled water in place of the sample. The crude protein was then calculated using a factor of 6.25 (AOAC, 2005).

2.8.4 Determination of Crude Fat Content

About 100g of each yoghurt samples was poured into a previously weighed Petri dish and dried over a water bath till most of the water had evaporated, the samples was then transferred to an oven and further dried at 105^0C till a constant weighed was obtained. The weight of water loss and dried solids obtained were determined by subtraction and later used to calculate the total amount of fat on wet weight basis. Two grams (2g) of the dried sample was weighed into each of two paper thimbles, the thimbles were sealed and placed in the soxhlet extractors. About 150ml of petroleum ether was poured into each of two previously dried and weighed round bottomed flasks attached to the extractors; extraction was carried out for 16 hours. After this, the petroleum ether was recovered from the soxhlet with only small amounts left in the flask. The flasks were then removed and placed in an oven (with the door partially closed) for the ether to completely evaporate. The flasks were cooled in a desssicator, weighed and the fat content was calculated on a wet per weight basis using the water content determined after drying the wet sample (Oladipo and Jadesimi, 2012).

2.8.5 Determination of dry matter

Two grams (2g) of yoghurt was weighed into each of three previously washed, dried and weighed glass crucibles, the crucibles with the samples were then placed in a thermostatically controlled oven at 105^0C for 5 hours till a constant weight of solid material was obtained. The crucibles were then removed and cooled in a desssicator and then weighed, the dry matters of the samples were calculated and expressed as a percentage (AOAC, 2005).

2.8.6 Determination of titratable acidity

0.1N sodium hydroxide was prepared and standardized by first weighing 4g of NaOH pellets into a clean dry beaker and dissolving with distilled water in a 100ml volumetric flask. The solution was titrated against a 0.1ml oxalic acid (universal standard) with phenolphthalein to a pink end point colour; the exact concentration of NaOH was determined by calculation using the mole ratio of the acid and base. Twenty mililitres (20ml) of the different yoghurt samples were measured into each of four 250ml conical flasks and diluted with 20ml of distilled. The diluted yoghurt samples were then titrated with the standardized 0.1N NaOH using phenolphthalein indicator, until a pink end point was observed, the titratable acidity was finally calculated using the acid factor of lactic acid for each yoghurt sample (0.0099) (AOAC,2005).

3.0 RESULTS

The pH of the various yoghurt samples were monitored immediately after production and it was found to decrease as the hour of incubation increased, the result revealed a pH of 6.5, 6.4, 6.3, 6.2 for skimmed milk, full cream milk, cow milk and tiger- nut milk at 0 hour and this gradually reduced to pH of 4.7, 4.4, 4.2 and 3.2 for skimmed milk, full cream milk, cow milk and tiger –nut milk respectively after 8 hours of fermentation (Table 1).

The result of the organoleptic test conducted by a total number of ten panel comprising of both male and female is as shown in Table 2. Yoghurt sample from full cream milk was rated the best in terms of over-all acceptability followed by yoghurt sample from, tiger-nut milk, skimmed milk and cow milk. All samples were served at 10-15^0C using plastic cups. The panel compared the samples on the basis of appearance, sourness, consistency, aroma, cost, and over-all acceptance using the 1-6 hedonic scale, water was also available for the panelist to rinse their mouths after tasting each sample.

The microbial count result indicated that with increase in the number of days, the microbial count of all samples increased as shown in Table 3. Yoghurt from cow milk had the highest microbial count of $27x10^3$ in the first week after production and increased to $182x10^8$ in the sixth week. Yoghurt sample from full-cream milk had the lowest microbial growth count of $14x10^3$ in the first week after production and increased $110x10^8$ in the sixth week.

The shelf life of the various yoghurt samples were observed for six weeks without the addition of preservatives, yoghurt from cow milk and skimmed milk had the lowest shelf of four weeks, while

yoghurt sample from tiger-nut milk had shelf-life of five weeks, and yoghurt from full-cream milk had the shelf life of six weeks (Table 4).

Proximate analysis result revealed that the protein content for the samples were high; it ranged from 4.78 to 5.23% with skimmed milk yoghurt being the highest and full-cream milk yoghurt the lowest. Fresh cow milk yoghurt had the highest fat content (0.73%); while skimmed milk yoghurt had the lowest fat content (0.59%). Tiger-nut milk yoghurt had the highest total ash content (0.83%), while cow milk yoghurt had the lowest total ash (0.69%). Skimmed milk yoghurt had the highest dry matter (17.15%) with full cream milk yoghurt being the lowest (14.61%). The moisture content of full cream milk yoghurt being the highest (85.39%) and skimmed milk yoghurt was the lowest (82.85%), tiger-nut milk yoghurt had the highest titrable acidity (0.187%) but skimmed milk yoghurt (0.159%) was the lowest. The detailed proximate analysis results are shown in Table 5.

A total number of thirteen micro-organisms were isolated from the various yoghurt samples, out of which seven were non-lactic acid bacteria (NLAB) while six were lactic acid bacteria. The isolates were subjected to microscopic, macroscopic, macroscopic, physiological and biochemical test. The bacteria were identified using Bergey's manual of Systemic Classification and were identified as *Lactobacillus xylosus* (1), *Lactobacillus brevis* (2), *Lactobacillus plantarum* (1), *Lactobacillus casei* (2), *Pediococcus acidiclactici* (1), *Flavobacterium rigense* (2), *Flavobacterium aquatile* (1), *Pseudomonas putida* (1), *Enterobacter aerogenes* (2). The distribution of the bacteria in various yoghurt is shown in Table 6.

Table 1: pH values of the yoghurt samples

Samples	0 hour	2 hours	4 hours	6 hours	8 hours
CMY	6.3	6.0	5.6	5.0	4.2
TMY	6.2	5.8	5.3	4.7	3.2
SMY	6.5	6.2	6.0	5.6	4.7
FMY	6.4	6.1	5.8	5.3	4.4

CMY: Cow milk yoghurt, TMY: Tiger nut milk yoghurt, SMY: Skimmed milk yoghurt, FMY: Full cream milk yoghurt

Table 2: Organoleptic properties of yoghurt samples

Isolate	CMY	TMY	SMY	FMY
Appearance	1.75±0.463	1.75±0.886	2.625±0.196	3.00±0535
Sourness	1.875±1.246	2.50±1.20	2.25±1.165	3.75±0.707
Consistency	1.50±0.535	1.75±707	1.75±0.707	2.75±0.886
Aroma	1.50±0.535	3.375±0.744	1.625±0.916	2.75±0.707
Taste	1.875±0.835	2.25±1.035	1.875±0.641	3.625±0.518
General acceptance	1.125±0.991	3.00±1.069	1.750±0.886	3.25±0.886

CMY: Cow milk yoghurt, TMY: Tiger nut milk yoghurt, SMY: Skimmed milk yoghurt, FMY: Full cream milk yoghurt

Table 3: Microbial load of the yoghurt samples

Samples	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
CMY	$27x10^3$	$36x10^4$	$69x10^5$	$124x10^6$	$153x10^7$	$>182x10^8$
TMY	$15x\ 10^3$	$24x10^4$	$51x10^5$	$98.0x10^6$	$106x10^7$	$116x10^8$
SMY	$20x10^3$	$32x10^4$	$63x10^5$	$104x10^6$	$123x10^7$	$>142x10^8$
FMY	$14x10^3$	$29x10^4$	$52x10^5$	$98.0x10^6$	$102x10^7$	$110x10^8$

CMY: Cow milk yoghurt, TMY: Tiger nut milk yoghurt, SMY: Skimmed milk yoghurt, FMY: Full cream milk yogh

Table 4: Shelf life of the yoghurt samples

Samples	Shelf life
CMY	Four weeks
TMY	Five weeks
SMY	Four weeks
FMY	Six weeks

CMY: Cow milk yoghurt, TMY: Tiger nut milk yoghurt, SMY: Skimmed milk yoghurt, FMY: Full cream milk yoghurt

Table 5:proximate analysis of the yoghurt samples

Samples	% CP	% Crude fat	% Total ash	%Dry matter	% Moisture	% TTA	% Fibre
CMY	4.83	0.73	0.69	15.27	84.73	0.174	-
TMY	4.97	0.65	0.83	16.13	83.87	0.187	-
SMY	5.23	0.59	0.75	17.15	82.85	0.159	-
FMY	4.78	0.71	0.72	14.61	85.39	0.165	-

CP: Crude protein, TTA: titrable acidity, CMY: Cow milk yoghurt, TMY: Tiger nut milk yoghurt, SMY: Skimmed milk yoghurt, FMY: Full cream milk yoghurt

Table 6: Distribution of bacteria isolates in the yoghurt samples

Isolates	CMY	TMY	SMY	FMY
L. xylosus	-	+	-	-
L. brevis	-	-	+	+
L. plantarum	-	+	-	-
L. casei	-	+	+	-
P. acidilactici	+	-	-	-
F. rigense	-	+	+	-
F. aquatile	-	-	-	+
P. putida	+	-	-	-
E. aerogenes	-	+	+	-

CMY: Cow milk yoghurt, TMY: Tiger nut milk yoghurt, SMY: Skimmed milk yoghurt, FMY: Full cream milk yoghurt

DISCUSSION AND CONCLUSION

The pH of the yoghurt samples were between 6.5 and 3.2 after production and this gradually decreased as the hours of fermentation increased; this is an indication of the ability of lactic acid bacteria to convert milk sugar into lactic acid when incubated at their optimum temperature (40-45^0 C). This is supported by Zourari *et al*. (1992) who reported that the lactic acid that is produced from the fermentation of lactose contributes to the sour taste of yoghurts by decreasing the pH and allows for the characteristic texture by acting on the milk protein.

The Organoleptic test indicated that yoghurt produced from skimmed milk and full cream milk had a firm texture and this supported by the findings of Domagla (2009), who reported that powdered milk yoghurt has a firm texture. The result of the sensory evaluation indicated highest preference for full cream milk yoghurt followed by tiger-nut milk, skimmed milk and cow milk. The higher value for full cream milk yoghurt may due to long time familiarity with products from full cream and because fat improves the taste, appearance, structure, texture and flavor of yoghurt. Also most consumers of diary product are conscious of the positive impact of yoghurt from skimmed milk but sacrifice their health to taste, texture and flavour (Sahan *et al*., 2008). Skimmed milk yoghurt was not highly accepted to the panel and this may be due to the fact that it had low fat content which is known to promote good mouth feel. Full cream yoghurt was also preferred over the three samples for appearance (creamy), the same pattern was also observed in the texture score (smoothness and consistency). Yoghurt from tiger-nut milk was rated the best in terms of aroma and this may be due to the fact that yoghurt from tiger –nut milk

produced a wider scope of biomolecules of acetaldehyde and volatile aromatic compound resulting from the anaerobic breakdown of carbohydrates by the relevant microbes than yoghurt from other milk samples. In this study it was noted that the taste score for skimmed milk was lower than that of yoghurt from other milk samples due to the low fat content, this supported the findings of (Onweluzo and Nwakalor, 2009), who reported that fat is known to promote good mouth feel. It was noted from this study that yoghurt from cow milk had the lowest aroma which still remained unclear.

The results of the proximate analysis of the various yoghurt samples showed that, fiber was not detected in all the yoghurt samples and this correlates with the findings of Food Standard Agency (2002) who reported no fiber for all the various type of yoghurt produced from different sources. The protein content was highest for yoghurt produced from skimmed milk followed by cow milk. The higher value for high crude protein of skimmed milk yoghurt may be due to the fact that skimmed milk is a much concentrated products which is fractionated using ultra filtration to make it concentrated, thereby making it to be lactose reduced, this process of skimmed milk production, separate milk component according to their molecular size, the milk passes through a membrane that allows some of the lactose, minerals and water to cross through, the casein and protein will not pass through due to their large molecular size, the protein and the little lactose and minerals that do not pass through are then spray dried, after the final processing the skimmed will still maintain its high nutritional value (AL Meyer *et al*., 2006). High crude protein of tiger-nut milk could probably be due to high crude protein of tiger –nut as reported by Eka and Ohaba (1997) who also found similar protein increase in tiger-nut. Yoghurt from tiger –nut milk also had high dry matter and titratable acidity, this confirmed the report that increase in the rate of dry matter causes an increase in the rate of acidification or pH reduction during yoghurt production since this improved the growth of *Lactobacillus* species (Tamime *et al.,* 1989; Ozer and Robinson, 1999; Yeganhzad *et al.*, 2007).

Occurrence of microorganism's which are non- lactic may be due to the fact that no environment is completely sterile, poor collection, poor milking process and contamination during preparation of the various yoghurt samples. While, the lactic isolates present are indigenous to raw milk which is the pre-dominant microflora found in milk and milk products (Neviani *et al*., 1982). All the yoghurt samples showed an increase in the total bacteria count as the weeks of storage increased and this correlates with the findings of El-Gazzar and Hafez (1992), who reported that the microbial hydrolysis of yoghurt component during storage was found to be the key deteriorating factor to taste, colour, flavour and texture which hence affects overall preference of the products.

Conclusively, the production of a quality and generally acceptable yoghurt with good physiological, microbiological and nutritional characteristics is achievable. Although, the characteristics depends on several factors such as good sanitary and processing conditions, starter culture, fermentation process e.g. hour and temperature (optimum) of incubation of the starter culture and post- fermentation treatment. If all these factors listed above are strictly adhered to by yoghurt manufacturers and encouraged by Food Standard Agency, the production of a good, quality and generally acceptable product is guaranteed.

It is a known fact that most fruits, nuts, tubers and vegetable are important source of nourishment and a vital ingredient in healthy and balanced diets, but harbor varied loads of microbial flora while passing from farm to table due to use of contaminated irrigation water, use of inadequate composted manure, cross contamination, however effective antimicrobial treatment at any step from planting to processing of the nut into milk and surface sterilization, sanitization of the tiger-nut could ensure the stability and safety of the yoghurts with respect to microbial growth. Tiger-nut milk with its inherent nutritional and therapeutic advantage could serve as a good alternative to milk from animal source in the production of yoghurt. In addition, the inclusion of tiger-nut milk in the production of yoghurt could reduce the price of yoghurt and make it more affordable to many people. More so, proper handling of equipment and sanitization of the environment during and after milk collection should be advocated. Moreover, the udder of cow should be properly washed before milk collection, pasteurized before it is consumed and the production environment should be well sanitized in order to reduce microbial contamination thereby ensuring safe consumption of the products.

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