Effect Of Fermentation By Pure Cultures Of *Lactobacillus Fermentum* I And *Saccharomyces Cerevisiae* As Starter Cultures In The Production Of 'Burukutu'

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Abstract: Single starter cultures of *Lactobacillus fermentum* 1, *Saccharomyces cerevisiae* and their combination were used during fermentation of red sorghum variety (*Sorghum bicolor* (L) Moench) to produce *burukutu.* The proximate, mineral and anti-nutritional analyses of *burukutu* produced were analyzed. *L. fermentum* 1as starter culture exhibited the highest acid producing ability, decreasing the pH of the malt from 5.26 to 2.90, with a corresponding increase in the titratable acidity (TTA) from 0.06% to 0.35% during the 72 h fermentation period. The effected changes in pH and TTA by other starter cultures ranged respectively from 5.80 to 4.26 and 0.09% to 0.19% when *S. cerevisiae* was used as starter culture and 5.12 to 3.09 and 0.05% to 0.30% using combined starter cultures of *L. fermentum* 1 and *S. cerevisiae* for pH and TTA respectively. The highest alcohol content (2.65±0.07%) was observed in burukutu produced with the combined starter cultures of *L. fermentum* 1 and *S. cerevisiae* while the lowest alcohol content (1.90±0.03%) was seen in burukutu produced with *L. fermentum* 1. The protein content ranged between 1.35% for burukutu samples produced with the combined starter cultures of *L. fermentum* 1 and *S. cerevisiae* to 1.31% for samples produced with *L. fermentum* 1 only. The highest mineral content and lowest antinutritional content was observed in burukutu produced with the combined starter cultures of *L. fermentum* 1 and *S. cerevisiae* compared to burukutu produced using the single starter cultures of *L. fermentum* 1 or *S. cerevisiae*. The combined use of *L. fermentum* 1 and *S. cerevisiae* contributed to the highest characteristic taste, aroma, color and overall acceptability of burukutu produced.
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1. Introduction

Burukutu, a type of Sorghum beer is a traditional alcoholic beverage produced and consumed locally in Nigeria and some African countries. It is produced mainly from starchy grains such as guinea corn, millet and maize. These crops are produced in the tropical regions of Africa and particularly in the Northern Guinea Savanna areas of Nigeria (Ettasoe, 1972; Asiedu, 1989).

The process of burukutu production basically involves malting, mashing, boiling, fermentation and maturation in which variations may occur depending on local practices (Ekundayo, 1969). The basic characteristics of burukutu include a sour taste due to the presence of lactic acid, a pH of 3.3-3.5 and opaque color because of suspended solids and yeasts. It contains vitamins, iron, manganese, magnesium, phosphorous and calcium and also contains about 26.7g of starch and 5.9g of proteins per litre (Kingsley and Victor, 2007).

The production of burukutu, like pito includes: a 12- 36h spontaneous mixed fermentation involving lactic acid bacteria and yeasts (Sefa-Dedeh, 1991; Sefa-Dedeh et al., 1999). Bacteria of the genera *Lactobacillus* spp and *Leuconostoc mesenteriodes* are the major contributors to the acidity of burukutu during the initial souring stage. Most of the acid produced is lactic acid with only traces of acetic and formic acid being present (Sefa-Dedeh, 1991; Kolawole, 2007). In the fermenting medium, the yeast mainly isolated are *Saccharomyces cerevisae* and *Saccharomyces chavalieria* (Achi, 2005).

The diversity of the associated yeast micro flora of traditional alcoholic beverages in sub Saharan Africa was attributed to the spontaneous nature of the fermentation, sources, and types of ingredients used (Sanni, 1993; Sanni and Lonner, 1993). Glover et al. (2005) also reported that *Saccharomyces cerevisiae* predominate the alcoholic fermentation of sorghum wort during production of pito within eight geographical regions of Ghana and dolo at four production sites in Burkina Faso.

From the previous reports (Faparusi, 1970; Sanni and Oso, 1988; Faparusi et al., 1973) fermented foods and beverages constitute a major portion of the Nigerian diet. However, most of these foods and beverages are still products of traditional family art and fermentation process is initiated by

chance inoculation. The raw materials are low in proteins, vitamins and minerals (Sanni and Oso, 1988).

Spontaneous fermentation are difficult to control, are predictable in terms of length of fermentation and quality of product; can produce unwanted products or products with short shelf life. To overcome these problems, the most prodorminant microorganisms found in an acceptable product can be isolated, purified and used as starter cultures to initiate the fermentation (Togo et al., 2002).

This present study is aimed at investigating the use of starter cultures for optimizing the production of burukutu.

2. Materials and Methods

Sorghum

The red sorghum variety (*Sorghum bicolor* (L) Moench) used for this research was obtained from Bodija market, Oyo State, Nigeria. The grains were brought into the laboratory in clean polyethylene nylons for immediate use. The seeds were carefully freed from foreign materials as well as broken and shruken seeds.

Laboratory Preparation of Burukutu

Using the method of Ekundayo (1969) the sorghum grains were steeped (150g in 2L of water) for 24 h, drained and germinated at 25^0C for five days. The grains were watered every morning and turned over at intervals of 24 h. Kilning was done at 55^0C for 24 h using a moisture extraction oven (model PF200), followed by milling with an Autotomus laboratory mill. The malt was mixed with water and boiled for four hours. The mixture was left to ferment for 72 h.

Microorganisms

Lactobacillus fermentum 1 and *Saccharomyces cerevisiae* previously isolated from fermented sorghum were used as starter cultures.

Preparation and innoculation of starter cultures

Pure cultures of *Lactobacillus fermentum* I, *Saccharomyces cerevisae* and the combination of *Lactobacillus fermentum* I and *Saccharomyces cerevisae* which were isolated from fermented sorghum were used as starter cultures. Pure culture inocula were made from suspension of *Lactobacillus fermentum* I on De Mann Rogosa Sharpe (MRS) agar slants and *Saccharomyces cerevisae* on Malt extract agar slants as appropriate following the method of Odunfa and Adewuyi (1985). Ten ml of sterilized peptone water was added each to 18-24 h old cultures of *Lactobacillus fermentum* I and *Saccharomyces cerevisae* on slants and shaken to make a suspension. Before inoculation, dilutions of the cultures were made so that 1ml of inoculum would produce a concentration of approximately 10^6-10^7 cfu/ml using a pre-fixed absorbance read at 650nm against sterile peptone water.

Ten ml portions of the respective suspensions of *Lactobacillus fermentum* I, *Saccharomyces cerevisae* and the combination of *Lactobacillus fermentum* I and *Saccharomyces cerevisae* were used as innocula for 250ml each of the prepared burukutu. Traditional production of burukutu (without starter culture) served as control. Fermentation was done at room temperature (25 ± 2^0C).

Assessment of fermentation

The extent of fermentation under the various conditions was assessed (Oyewole and Odunfa, 1988). The fermenting medium was assessed at 0 h and then at 12 h intervals. The parameters used for the assessment include pH; total titratable acidity; proximate analysis; mineral contents; anti-nutritional components and sensory evaluation.

pH

Ten ml of the fermenting medium was aseptically removed into sterile bottles and pH was taken with a Jenway pH meter equipped with a glass electrode.

Total titratable acidity (TTA)

The TTA of the fermenting medium (expressed as percentage lactic acid) was determined potentiometrically according to Nout et al. (1989) by titrating 10ml of the decanted homogenate samples used for pH determination against 0.1N NaOH using a drop of phenolphthalein as indicator.

Proximate analysis

The method of AOAC (1990) was used for the dertermination of ash content, dry matter content, moisture content, reducing sugar content, protein content and alcohol content.

Mineral content determination

The minerals analyzed were sodium, calcium, iron, zinc and phosphorus. They were determined spectrophotometrically as described by AOAC (1990).

Antinutritional component determination

The phytate content of the flours was determined according to the method of Maga (1982). Two (2) mililliter of each finely ground flour sample was soaked in 20ml of 0.2N HCl and filtered. After filtration, 0.5ml of the filtrate was mixed with 1ml ferric ammonium sulphate solution in a test tube, boiled for 30min in a water bath, cooled in ice for 15min and centrifuged at 3000 x g for 15min. One milliliter of the supernatant was mixed with 1.5ml of 2, 2-pyridine solution and the absorbance measured in a spectrophotometer at 519nm. The concentration of phytic acid was obtained by extrapolation from a standard curve using standard phytic acid solution.

For tannin determination, 10ml of 70% aqueous acetone was added to 200mg of finely ground sample in a bottle and properly covered. The bottle was put in a bath shaker for 2 h at 30°C. The solution was then centrifuged and the supernatant stored in ice. From the supernatant, 0.2ml was pipetted into 0.8ml distilled water. Standard tannic acid solution was prepared. Folin reagent (0.5ml) was added to both sample and standard followed by 2.5ml 20% Na_2CO_3 .The solutions were vortexes and incubated for 40min at room temperature after which the absorbance was read at 725nm. The concentration of tannin in the sample was estimated from the standard tannic (Makkar & Goodchild, 1996).

The total polyphenols in the samples was determined using Purssion Blue spectrophotometric method (Price and Butler, 1977). A standard curve which expressed the result as tannic acid equivalent (mg/100g) and gave a colour intensity equivalent to that given by polyphenols after correction for blank was prepared.

Sensory evaluation

The sensory evaluation of burukutu samples was carried out to determine the acceptability of the product. The product (burukutu) was subjected to organoleptic assessment by a 10 member panel. Clean cups were provided for each of the sample; each panellist was requested to taste the sample one after the other and to indicate their degree of likeness or preference for the sample on the questionnaire provided. The samples were evaluated for colour, odour, taste, aroma, and overall acceptability. They were required to score each parameter on the 5 point hedonic scale ranging from 5 indicating like extremely to 1 dislike extremely.

Statistical analysis

The experimental data was analyzed using Analysis of Variance (ANOVA) to determine significant difference between the means and these were expressed as mean ± standard deviation (SD). The level of significance was set at $P \leq 0.05$. The data were analyzed using SPSS version 17.0.

3. Results

The changes in the pH and titratable acidity of burukutu produced with various starter cultures are shown in Table 1. *Lactobacillus fermentum* I effected a decrease in the pH from 5.26±0.00 to 2.89±0.00 after 72 h of fermentation with a corresponding increase in the titratable acidity from 0.06±0.00g/l to 0.35±0.01g/l. Burukutu produced using *Saccharomyces cerevisiae* recorded a decrease in pH from 5.80±0.00 to 4.26±0.00 and also a corresponding increase in the titratable acidity from 0.09±0.01g/l to 0.19±0.00g/l which showed significant difference according to the result of the analysis of variance. In the same vein, burukutu produced using combined starter cultures of *Lactobacillus fermentum* I and *Saccharomyces cerevisiae* affected a decrease in the pH from 5.12±0.00 to 3.05±0.00 and a corresponding increase in the titratable acidity from 0.05±0.00g/l to 0.03±0.01g/l. Similarly, the control recorded a decrease from 6.18±0.00 to 4.31±0.00 and an increased titratable acidity from 0.07±0.01g/l to 0.10±0.00g/l at 72 h.

Table 1: pH and titratable acidity (TTA) during fermentation of sorghum for the production of burukutu

	Time interval	Starter cultures			
		Lactobacillus fermentum I	*Saccharomyces cerevisiae*	*Lactobacillus fermentum I and Saccharomyces cerevisiae*	Spontaneous fermentation (Control)
pH	**0 h**	5.26±0.00^{c}	5.80±0.00^{b}	5.12±0.00^{d}	6.18±0.00^{a}
	24 h	3.00±0.00^{d}	5.27±0.00^{b}	3.18±0.00^{c}	5.64±0.09^{a}
	48 h	2.90±0.00^{c}	5.21±0.00^{a}	3.09±0.00^{c}	4.72±0.36^{b}
	72 h	2.90±0.00^{d}	4.26±0.00^{b}	3.05±0.00^{c}	4.31±0.00^{a}
TTA (%)	**0 h**	0.06±0.00^{bc}	0.09±0.01^{a}	0.05±0.00^{c}	0.07±0.01^{b}
	24 h	0.26±0.01^{c}	0.16±0.00^{b}	0.18±0.01^{b}	0.08±0.01^{a}
	48 h	0.29±0.00^{b}	0.18±0.01^{c}	0.23±0.01^{a}	0.09±0.01^{d}
	72 h	0.35±0.01^{b}	0.19±0.00^{c}	0.30±0.01^{b}	0.10±0.00^{d}

Mean along the rows with different superscript at each processing variables are significantly different from each other according to Duncan's Multiple range test at $P < 0.05$.

The proximate composition of burukutu produced with the starter cultures is as shown in Table 2. The result of the analysis of variance revealed significant differences in the moisture content, dry matter, total sugars, ash, alcohol, and protein contents in burukutu produced using combined starter cultures of *Lactobacillus fermentum* I and *Saccharomyces cerevisiae* compared to the single starter cultures. The highest alcohol content (2.65±0.07%) was observed in burukutu produced

using combined starter cultures of *Lactobacillus fermentum* I and *Saccharomyces cerevisiae* compared to the single starters of *Lactobacillus fermentum* I (1.90±0.03%) and *Saccharomyces cerevisiae* (2.37±0.07%). Burukutu sample produced with single starter culture of *Lactobacillus fermentum* I recorded the highest total sugar content (0.39±0.01%) while on the other hand burukutu sample produced with the combined starter cultures of *Lactobacillus fermentum* I and *Saccharomyces cerevisiae* had the lowest total sugar content (0.10±0.03%).

The protein content in all the burukutu samples produced with the starter cultures were analysis. Burukutu produced with *Lactobacillus fermentum* I recorded protein content of 1.31±0.01% compare to burukutu produced with *Saccharomyces cerevisiae* (1.29±0.01%) and the use of combined starter culture of *Lactobacillus fermentum* I and *Saccharomyces cerevisiae* had protein content of 1.35±0.01%. The result of the analysis of variance observed in the moisture content of burukutu produced with the starter cultures did not show any significant difference in the use of single starter cultures of *Lactobacillus fermentum* I (98.31±0.01%) and *Saccharomyces cerevisiae* (98.37±0.02%), however burukutu produced using the combined starter culture of *Lactobacillus fermentum* I and *Saccharomyces cerevisiae* revealed significant differences (97.33±0.00%) (Table 2).

Table 2: Proximate composition of burukutu produced with starter cultures

Proximate composition(%)	Starter cultures			
	Lactobacillus fermentum I	*Saccharomyces cerevisiae*	*Lactobacillus fermentum* I and *Saccharomyces cerevisiae*	Spontaneous fermentation (Control)
Moisture	98.31±0.01^{a}	98.37±0.02^{a}	97.33±0.00^{b}	98.07±0.03^{a}
Dry matter	1.69±0.01^{c}	1.61±0.01^{d}	2.07±0.01^{a}	1.90±0.02^{b}
Total Sugar	0.39±0.01^{a}	0.20±0.02^{b}	0.10±0.03^{c}	0.20±0.03^{b}
Ash content	2.75±0.01^{a}	2.50±0.00^{b}	2.35±0.07^{c}	2.40±0.00^{bc}
Alcohol content	1.90±0.03^{a}	2.37±0.07^{b}	2.65±0.07^{b}	2.05±0.07^{c}
Protein content	1.31±0.01^{a}	1.29±0.01^{b}	1.35±0.01^{d}	1.27±0.01^{c}

Mean along the rows with different superscript at each processing variables are significantly different from each other according to Duncan's Multiple range test at P< 0.05.

The mineral composition of burukutu produced using the starter cultures was also investigated. According to the results, products produced with combined starter cultures of *Lactobacillus fermentum* I and *Saccharomyces cerevisiae* had the highest mineral contents for Sodium, Magnesium, Calcium, and Iron being 165.15mg/100l, 157.60mg/100l, 27.99mg/l and 2.88mg/100l respectively, compared to burukutu produced with single starter culture of *Lactobacillus fermentum* I or *Saccharomyces cerevisiae* (Table 3).

Table 3: Mineral composition of burukutu produced with starter cultures

Mineral composition (mg/100l)	Starter cultures			
	Lactobacillus fermentum I	*Saccharomyces cerevisiae*	*Lactobacillus fermentum* I and *Saccharomyces cerevisiae*	Spontaneous fermentation (Control)
Sodium (Na)	137.35±0.49^{a}	160.20±42.71^{a}	165.15±0.21^{a}	27.54±0.00^{b}
Magnesium (Mg)	117.65±0.21^{d}	135.60±0.14^{c}	157.60±0.28^{a}	151.25±0.35^{b}
Calcium (Ca)	9.26±0.01^{d}	12.86±0.01^{c}	27.99±0.00^{a}	16.64±0.00^{b}
Iron (Fe)	0.87±0.00^{d}	2.09±0.00^{c}	2.88 ±0.00^{a}	2.22±0.00^{b}
Potassium (K)	0.67±0.00^{d}	1.67±0.00^{a}	1.41±0.00^{c}	1.45±0.00^{b}

Mean along the rows with different superscript at each processing variables are significantly different from each other according to Duncan's Multiple range test at P< 0.05.

Table 4 shows the antinutritional components of burukutu produced with the starter cultures. The use of combined starter cultures of *Lactobacillus fermentum* I and *Saccharomyces cerevisiae* recorded a reduction in the antinutritional components (polyphenols, phytate and tannins) compared to burukutu produced using single starter cultures. Phytate was the most reduced anti nutritional component in burukutu produced with the combined starter culture of *Lactobacillus fermentum* I and *Saccharomyces cerevisiae;* however, the highest phytate value was recorded in burukutu

produced with the single starter culture of *Saccharomyces cerevisiae*.

Table 4: Antinutritional content of burukutu produced with starter cultures

Antinutritional components (mg/100l)	Starter cultures			
	Lactobacillus fermentum I	*Saccharomyces cerevisiae*	*Lactobacillus fermentum* I and *Saccharomyces cerevisiae*	Spontaneous fermentation (Control)
Polyphenols	7.45±0.07^{c}	8.45±0.21^{b}	6.95±0.07^{d}	9.15±0.07^{a}
Phytate	3.40±0.14^{b}	3.85±0.07^{a}	3.25±0.07^{b}	3.80±0.00^{a}
Tannins	4.25±0.07^{c}	5.00±0.00^{b}	4.05±0.07^{c}	6.40±0.14^{a}

Mean along the rows with different superscript at each processing variables are significantly different from each other according to Duncan's Multiple range test at P< 0.05.

The mean sensory scores for taste, aroma, colour, aftertaste and overall acceptability of burukutu produced with the starter cultures is as shown in Table 5. The highest mean value of preference was observed in burukutu produced with the use of the combined starter cultures of *Saccharomyces cerevisiae* and *Lactobacillus fermentum* I compared with burukutu produced with single starter culture of *Saccharomyces cerevisiae* and *Lactobacillus fermentum* I.

Table 5: Sensory evaluation of burukutu produced with starter cultures

Sensory parameters	Starter cultures			
	Lactobacillus fermentum I	*Saccharomyces cerevisiae*	*Lactobacillus fermentum* I and *Saccharomyces cerevisiae*	Spontaneous fermentation (Control)
Taste	3.75±0.07^{a}	3.50±0.00^{b}	3.95±0.07^{a}	3.20±0.14^{c}
Aroma	3.10±0.14^{b}	3.00±0.28^{b}	3.90±0.14^{a}	3.10±0.14^{c}
Color	3.05±0.07^{a}	3.00±0.28^{a}	3.25±0.35^{a}	3.00±0.14^{a}
After taste	3.15±0.07^{a}	3.15±0.07^{a}	3.25 ±0.07^{a}	3.05±0.07^{a}
Overall acceptability	3.25±0.07^{ab}	3.30±0.14^{ab}	3.40±0.14a^{a}	3.05±0.07^{a}

Mean along the rows with different superscript at each processing variables are significantly different from each other according to Duncan's Multiple range test at P< 0.05.

4. Discussion

The use of starter culture in this work is in line with research of Sanni (1993) and Kimaryo *et al.* (2000) who stated the use of starter culture as an appropriate approach for the control and optimization of fermentation problems of variation in organoleptic quality and microbiological stability observed in African indigenous fermented food.

The fermentation of malted sorghum for the production of burukutu was characterized by a fall in pH and corresponding rise in TTA (lactic acid production) which was observed throughout the period of fermentation and is similar to the spontaneous fermentation of maize (Halm et al., 1993, Olsen et al., 1995), millet (Lei and Jakobsen 2004; Agarry et al., 2010) and sorghum (Odunfa and Adeyele 1985; Achi 1990; Kunene et al., 2000; Muyania et al., 2003). Decrease in pH was as a result of increasing hydrogen ion content, probably due to the microbial activity on the carbohydrate and other food nutrients to produce organic acids. This agrees with the report of Adeyemi and Umar (1994).

The major role of *L. fermentum* 1 in acidification has been reported in the production of dolo and pito wort (Sawadogo- Lingani et al., 2007). A lactic acid fermentation already seen during the production of burukutu with the involvement of *L. fermentum* 1 is likely to further strengthen the acidification of the medium for subsequent yeast fermentation (Halm et al., 1993; Annan et al., 2003). The lower pH noted for the fermentation with the use of *L. fermentum* I and *S. cerevisiae* could be attributed to the combined action of the yeast and LAB which brought about a more significant decrease in pH and a simultaneous increase in acidity during fermentation than the use of single culture of *S. cerevisiae* (Kheterpual and chaunan, 1990).

Higher alcohol content and lower total reducing sugar in the burukutu produced with the combine starter cultures of *L. fermentum* I and *S. cerevisiae* was observed in this study. The result of the high alcohol content in the monoculture fermentation with *S. cerevisiae* showed that yeast is solely responsible for the alcohol yield. This agrees with the report of Fleet (2003). The observable alcohol yield observed in the monoculture fermentation with *L. fermentum* I has been reported by Coulibaly et al. (2008) that yeast may produce

alcohol however, *Lactobacillus* species also produce ethanol. Higher protein values were observed in burukutu produced using combine starter cultures of *L. fermentum* I and *S. cerevisiae* while a lower protein value was observed in burukutu produced with the Spontaneous fermentation (Control). The differences in the protein values in the diferent products could be as a result of the co-metabolism between the LAB and yeast. According to Gobbetti et al. (1994), growth of *S. cerevisiae* 141 during wheat sourdough fermentation was due to the ability of the yeast to sequentially utilize free amino acids produced by lactic acid bacteria. They further maintained that this stable co-metabolism between the LAB and yeasts is common to many African indigenous fermented foods, enabling the utilization of substances that are otherwise non-fermentable (e.g. starch) and thus increasing the adaptability of these microbes to complex food systems.

The presence of mineral elements was recorded in all the burukutu samples prepared with the different starter cultures. Mineral elements are important because they are essential for regulating and building the living cells and fighting depression. Calcium is essential for building the living cells that make up the human body balanced, it promotes a healthier cardiovascular system that help in maintaining the volume of water necessary for life processes maintaining (Harold et al., 1970). Magnesium helps in keeping the muscles relaxed and the formation of strong bones and teeth. It helps to control the blood pressure and nerve transmitter. Iron is an important element that is necessary in the heamoglobin of the red blood cell and myoglobin in the muscle (Thomas, 2002). The finding from this study reveals that burukutu produced with combine starter cultures of *L. fermentum* I and *S. cerevisiae* had a higher mineral element composition compared to the single starters.

Total phenols, tannins and phytic acid which have been known as antinutrients that precipitate nutrients (Bate-Smith and Swain, 1962; Muller and McAllan, 1992) have been observed to reduce during germination (Troare et al., 2004). Germination (sprouting of the seeds) induces hydrolytic enzymes which may have indirectly resulted in contributing to the reduction in the anti nutritional components. From this study, lower values of antinutrients were observed in burukutu produced with the use of combined starter cultures of *L. fermentum* I and *S. cerevisiae* compared to burukutu produced with single starter cultures of *L. fermentum* I or *S. cerevisiae*. Even though some minimal amounts of antinutritional components have been recorded in this study, recent and ungoing researches have shown that these antinutritional factors (polyphenols, phytate, tannins) can act as antioxidants (Miglio et al., 2008) which help to prevent cancer by enhancing the immune system as well as increase the activity of natural killer cells which attack and destroy cancer and tumor cells (phytate) (McGee, 2004). Tannins have been shown to improve mouthfeel when taking wine and well as possess potential antiviral (Lu et al., 2004), antibacterial (Akiyama et al., 2001) and antiparasitic effects (Kolodziej and Kiderlen, 2005).

The sensory ratings revealed that the burukutu smaples had varying taste and aroma. The development of alcohol, organic acids, esters and carbonyl compounds contribute particularly to taste and aroma during fermentation (Hammond, 1993). The combined use of *L. fermentum* I and *S. cerevisiae* in producing burukutu recorded a higher sensory rating compared to the single starter cultures used which also had a moderate sensory rating. The ability of the combination of *L. fermentum* I with *S. cerevisiae* to produce good burukutu in all attributes evaluated is not surprising as suggested by Sefa-Dedeh et al. (1999), the yeast strains were involved in the assimilation of nutrients for cell growth to the detriment of fermentation activities to enhance flavour and general acceptability of the final product. Teniola and Odunfa (2001) reported the use of mixed cultures of *S. cerevisiae* and *Lactobacillus brevis* for fermentation of Nigerian ogi, resulting in a product much more improved in terms of acceptability and increased concentrations of lysine and methionine. Double-strain starter culture combinations of lactic acid bacteria and yeasts have been reported in several studies on sourdough to produce more aroma compounds and in many cases to improve flavour than when used individually (Martinez-Anaya et al., 1990; Hansen & Hansen, 1994; Meignen et al., 2001).

According to Annan et al. (2003), one of the major aims of isolating starter cultures for use in the production of fermented foods has is to ensure consistency and to preserve the unique flavour, aroma and texture attributes of these products. The fact that isolates of *S. cerevisiae* from African fermented products have properties different from those of well recognized starter cultures (Hayford & Jespersen, 1999; Van Der Aa Kühle et al., 2001; Glover et al., 2005) demonstrates that starter cultures for indigenous fermented foods and beverages should be isolated from the products they are supposed to be used for, and selected according to the technological properties required for the actual type of product (Jespersen, 2003). This study, which involved the use of strains of lactic acid bacteria and yeast isolated from burukutu from Nigeria, is yet another example of isolating strains of microorganisms from African

fermented foods and beverages and thereafter successfully using them as starter cultures.

5. Conclusions

The present study has generated information on the isolation of dominant microorganisms (lactic acid bacteria and yeast) from fermented sorghum and using them as starter cultures to get products of organoleptic quality quite similar to that of the commercial product. Single and combined starter cultures have been used successfully to produce burukutu of different quality indices. The use of single starters of *L. fermentum* I and *S. cerevisiae* produced burukutu that had good organoleptic quality however; the combined use of the starter cultures of *L. fermentum* I and *S. cerevisiae* gave better organoleptic properties.

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