Effect of Ginger and Garlic on the Microbial Load and Shelf-Life of Burukutu

Mbajiuka Chinedu Stanley, Obeagu Emmanuel Ifeanyi, Ochei Kingsley Chinedum and Onyemairo Nnadozie Christopher

Department of Microbiology, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
Diagnostic Laboratory Unit, University Health Services Department, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
Department of H.S.S. and Laboratory, FHI 360 Country Office, Plot 1073-A1 Garki, Abuja, FCT, Nigeria
Department of Microbiology, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria

Abstract: Burukutu was produced using the modified method. After production, the product was analyzed physicochemically and the following values were obtained, using parameters like pH (3.94), total titratable acidity (0.55), specific gravity (0.8273g/mL), alcoholic content (4.10) and temperature (29°C). Diverse microbial genera such as Staphylococcus sp, Bacillus sp, Lactibacillus sp, Saccharomyces sp and Escherichia coli dominated the spoilt burukutu. Isolates of the above mentioned genera were treated with the ethanolic extract of these spices; ginger and garlic in the ratio of 20 grams of spice to 10ml of 90% ethanol (20: 100ml). These spice had an effect on the spoilage organisms but the combination of the spices ginger-garlic in equal proportions (40:1g: 100ml) gave a synergistic effect that was better off. So, of all the treatments, ginger – garlic (40g: 20ml) was the most effective followed by garlic and ginger respectively. Shelf-life of the product can be extended beyond 2 weeks of production, by blending burukutu with a combination of these spices.

Key words: Garlic • Ginger • Microbial Load • Shelf-Life Of Burukutu

INTRODUCTION

Cereals are more widely utilized as food in Africa countries than in the developed world. In fact cereals account for as much as 77 % of total calorie consumption in Africa countries [1, 2]. A majority of traditional cereal- based are important as dietary staples for adult in Africa. Majority cereals growth in Africa includes sorghum, rice, maize and millet [3].

Sorghum is one of the cereals cultivated in the tropical region of Africa and is about the largest cultivated crop in the northern Guinea Savanna areas of Nigeria [4, 5]. Sorghum is large variable genus with many cultivars. Worldwide, sorghum is a food grain for humans. It constitute a major source of energy and it serves as a staple food of many of the world’s poorest and least privileged people [6, 7] in undeveloped countries and even in developed countries like United States, sorghum is used primarily as a feed grain has more protein and fat than corn, but is lower in vitamin A. when compared with core a per pound basis, grain sorghum feeding value ranges from 90% to nearly equal to corn. The grain is highly palatable to livestock and intake seldom limits livestock productivity. However, some sorghum varieties and hybrids which were developed to deter birds are less palatable due to tennins and phenolid compounds in the seed. The grain should be cracked or rolled before deeding to cattle; this improved the portion digested. Pasturing cattle or sheep on sorghum stubble, after the grain has been harvested, is a common practice. Both roughage and dropped heads are utilized. Stubble with secondary growth must be pastured carefully because of the danger of prussic acid (HCN) poisoning.
Grain sorghum may also be used as whole-plant silage; however sorghum, sweet sorghum was developed as a silage crop. Sweet sorghum produced much higher forage yields than grain sorghum, but feed quality will likely be lesser because there is no grain. Some growers mix grain sorghum with soybeans to produce a higher protein silage crop.

Fermented foods are essential parts of diet in all region of the world. Sorghum, otherwise known as guinea corn is among the cereals which provide the bulk of diet for large population in the tropics. Two species of sorghum are common, sorghum bicolor and sorghum vulgar [8, 9]. Starch- containing cereals such as barley, sorghum, maize, millet. Wheat etc. are the starting materials which provide the sugar for beer brewing. Starch is not readily fermentable by yeast to alcohol, but must first be hydrolyzed to simple sugars by the powers of malting. Some indigenous Africa beers made from malting sorghum include. Burukutu, otika, borde, kaffir, bouza, pombe, shukutu shakpato, amgba, dolo, techaplo, kunun-zaki and pito. Because the ingredients and producer for making these beers the beer characteristics such as taste, color and nutritional value also vary.

Burukutu is an indigenous alcohol beverage produced and consumed in the Northern Guinea savannah region of Nigeria, Republic of Benin and Ghana. It is a beverage of vinegar-like flavor, a brown colored suspension produced mainly from the grain of guinea corn of the species sorghum vulgar and sorghum bicolor [10]. It constitutes the major source of energy and protein for people in Asia and Africa and it serves as a staple food for many of the world’s poorest and least privileged people [7]. The aim and objectives of this research work was to produce the alcoholic beverage (Burukutu) and test the effect of the some organic species (Ginger and garlic) on the products microbial load and shelf life.

**MATERIALS AND METHODS**

**Materials:** The materials and equipment used were obtained from the microbiology laboratories of Michael Okpara University of Agriculture Umudike, Abia State.

**Collections of Samples**

**Sorghum and Plant Materials:** The red variety of sorghum (*Sorghum vulgare*), the ginger and garlic used in this work were purchased at Umuahia Main Market in Abia State, Nigeria. The pure strain (*Saccharomyces cerevisiae*) used for this work was obtained from Umuahia main market in the form of baker’s yeast.

The work was carried out in the Microbiology Laboratory Department, all in Michael Okpara University of agriculture Umudike, Abia State.

**Preparation of Burukutu**

**Malting:** 3Kg of sorghum grains were dehulled and cleaned. After which they were steeped in 24 hours. The soaked grain were washed and drained after the steeping process. They were uniformly spread on a wet cloth and covered with banana leaves. The grains were watered every morning and turned at intervals of 24 hours. Germination commenced and continued for four days until the plumules attained a certain length. Germination took place at room temperature (28-30°C) [1]. The malted malt was spread out in the sun for two days.

**Milling:** The dried malt was ground into flour using a community plate disc mill. The flour was stored in a polyethylene bag at an ambient temperature prior to analysis according to Kolwole *et al.* [8].

The mashing of the sorghum malt was carried out by a method of Achi [1] and Egemba and Etuk [4]. 3.0kg of the sorghum malt was weight balance and mixes with an adjunct (A farinaceous fermented cassava product) and warm water (45°C) in the ratio of one part of garri to two parts of malt to six parts of water (1.2:6). The mixture was stirred and allowed to settle for 30 minutes when settled, 2 liters of the clear enzymatic supernatant was decanted and the remaining mash was gradually brought to boil at 100° for 30 minutes. The mash was allowed to cool at 60°C and the clear enzymatic supernatant was added and then kept for 12 hours. The mixture was filtered through a sieve mesh (200 um and) rinsed with 300ml water (50°C) to extract the remaining enzymes from the grist. The pate of the wort was further boiled for 1½ hours and allowed to cool for inoculating with pure culture of yeast.

**Preparation of Yeast for Inoculation:** Two grams of dry *Saccharomyces cerevisiae* weighed with a weighing balance was added to 200 ml of the sorghum wort with six tea spoons of glucose and left for six hours to activate the yeast strain. The activated yeast was inoculated into 800 ml of sorghum wort for fermentation [4].

**Fermentation of Sorghum Wort:** The fermentation was carried out in 4 liters fermentation bucket for 48 hours at room temperature according to Egemba and Etuk [4]. At the end of 48 hours, at the product was pasteurized at 60°C to stop fermentation. This kept the product for two weeks spoilage according to Egemba and Etuk [4].
Physico-Chemical Analysis

Measurement: The PH of the product was measured directly using a pH meter (Jenway model 3310). 20 ml of the sample was put in a 50 ml glass beaker. The electrode of the meter was put into the sample solution and the PH reading from the screen of the meter when the pointer became steady.

Determination of Total Acidity: This was determined by alkaline titrimetric of Onyeagba et al. [11] and Pearson [12]. 20 ml of the sample was dispensed into a conical flask and 3 drop of phenolphthalein indicators was added. This was titrated against diluents standard alkaline solution (0.1ml NaOH solution). Titration was done until a persistent faint pink coloration was obtained.

The Total Titrable Acidity (TTA) was calculated using the formula below:

\[
\text{% TTA} = \frac{\text{TXN}}{E} \times 100
\]

Where:
- T = Titre value
- N = Normality of titrant
- W = weight of the sample of the used

Determination of Specific Gravity: A measured quantity of the sample (200 ml) was put in clean flask with a condensed alcohol was collated in the receptacle. The sample was distilled at 78° c collected and condensed alcohol was collected in the receptacle. The collected alcohol was allowed to cool to room temperature and its specific gravity was measured.

Determination of Alcohol Content: Alcohol yield of the burukutu sample was determined using the distillation gravimetric method according to Pearson [12].

A measured quality of the sample (200 mls) was put in a clean glass flask fitted with a condenser and a receptacle in situ. The sample was distilled at 78° c and the condensed alcohol was collected in a receptacle.

The collected alcohol was allowed to cool to room temperature and its specific gravity was measured. The weight of the alcohol was obtained as the product of volume and specific gravity (wt=VxS.G) form the obtained weight, the yield was calculated gravimetrically using the relationship below.

\[
\text{% yield of alcohol} = \frac{\text{Weight of ethanol} \times 100}{\text{Weight of sample 1}}
\]

Determination of Temperature: The temperature of the product was determination using a PH meter (Juwey model 3310).

Microbiological Analysis of the Spoilt Burukutu

Sterilization of Materials: The various material used in the work were sterilized as follows, the glass wares eg. Pipettes flasks, test tubes etc. were washed with detergent solution, rinsed, dried and sterilized in an oven at 60°C for a period of 2 hours.

Media Preparation: The various culture media used include Nutrient Agar (NA), McConkey Agar (MCA) and Sabouraud’s Dextrose Agar (SDA), these were in the commercially prepared power hydrated from and prepared according to the manufacture’s specification.

Nutrient Agar: The medium was prepared by suspending 23 g of the medium in 1000ml of distilled water and heated to allow for complete dissolution. The solution was sterilized by autoclaving at 121°C for 15 minutes. It was then allowed to cool to about 48-50°C, before it was poured into sterilized Petri dishes containing sample.

Sabouraud’s Dextrose Agar: This is a selected medium for the isolation of fungi and SDA was prepared by suspending 65 g of the medium in 100 ml of water and heated to dissolve. The solution was sterilized by autoclaving at 121°C for 15 minutes. It was cooled to about 48-50°C, before plate pouring.

Maconky Agar: This medium was prepared by suspending 5.2g of the powder into 100ml of distilled water and heated for complete 121°C for 15 minutes, it was allowed to cool about 48-50°C before plate pouring.

Isolation and Identification of Bacteria in Spoilt Burukutu: 1 ml of the already spoilt burukutu was pipetted out and introduced into three sterilized Petri dish the t were labeled properly and the already prepared media were poured aseptically into respective Petri dishes.

Pour plate techniques was used and after plate pouring, the dished were rotated on the bench surface to ensure an even layer of agar. After gelling, poured plates were incubated at 37°C for 24 hours for bacterial growth.

The various microorganisms observed in the primary culture were then sub cultured using streaking method in order to obtain pure culture were stored in sterile agar
slants and used for identification and characterization of the organisms. The colony characteristics before staining reaction (Microscopic examination) and biochemical properties [3].

Features of each of the bacterial colonies were observed to note the extent of growth, colour, edge, elevation, consistency and presence of pigments.

**Microbiological Examination of Isolation:** The isolation were subjected to microscopic examination which include, motility to show whether to isolates were capable of independent movement, reaction to general and specific dyes.

**Gram Staining:** The gram stain is the most important and most frequently used stain is bacteriology. It helps to differentiate bacteria into two main groups, possibly showing major evolutionary relationships among these organisms. The two groups are designated as Gram-positive (Blue to purple reactions to stain) and Gram negative (Pink and red reactions to stain). Some bacteria are Gram variable since their reaction to stain may vary with age of colony. Present in the outer layer of the protoplasm of Gram-positive bacteria cells, but absent in Gram-negative ones, is a substance which combines with crystal violet and iodine to form a complex that is insoluble in alcohol.

24 hour old colonies suspected of *Bacillus, Escherichia, Pseudomonas* and *Staphylococcus* is on nutrient agar slants were used [7]. A drop of sterile water was placed on several clean grease-free slides. Then, an inoculating loop was sterilized by flaming and cooling with the inoculating loopful, of the bacterial colony was taken and a thin smear was made with the dropped on the slide. The smear was allowed to air-dry, after which, the reverse slide of the slide was drawn quickly three times over a flame in other to fix the bacterial. The slide was allowed to cool. On cooling the smear, was flooded with crystal violet for 60 seconds. After which the dye was drained quickly and washed with Lugol’s iodine. The iodine solution was left for 60 seconds. This was drained off and the slide washed gently under a running tap water. The slide was later washed with 95 % ethanol until the slide appears free of violet stain. After which the slide was rinsed under tap water and flooded with safranin for 30 seconds.

The stained cells were examined under the oil immersion lens of the microscope.

**Spore Staining:** Certain bacteria, particularly members of the genera *Bacillus* and *Clostridium* produce endospores. A spore is produced per bacteria cell [7].

Bacteria smear was prepared, heat-fixed by properly passing it several times over a Bunsen flame. The slide was flooded with malachite green stain and heated over a boiling water for 10 minutes and drying was avoided by the occupationally addition of more stain. It was washed well under the tap and later flooded with safranin for 20 seconds. At elapsing of the 20 seconds. The slides were washed under the tap and blot dried. A drop of immersion oil was applied and the slide examined under x 100 lens.

**Motility Test:** Some bacteria possess flagella and can therefore move. Such motility can be demonstrated by the hanging-drop technique. Agar slant culture suspected of *Pseudomonas fluorescens, Staphylococcus aureus* and *Proteus* were used according to Hulse et al.[7].

24 hour old colonies suspected of *Bacillus, Escherichia, Pseudomonas* and *Staphylococcus* were used [7]. A drop of sterile water was placed on several clean grease-free slides. Then, an inoculating loop was sterilized by flaming and cooling with the inoculating loopful, of the bacterial colony was taken and a thin smear was made with the dropped on the slide. The smear was allowed to air-dry, after which, the reverse slide of the slide was drawn quickly three times over a flame in other to fix the bacterial. The slide was allowed to cool. On cooling the smear, was flooded with crystal violet for 60 seconds. After which the dye was drained quickly and washed with Lugol’s iodine. The iodine solution was left for 60 seconds. This was drained off and the slide washed gently under a running tap water. The slide was later washed with 95 % ethanol until the slide appears free of violet stain. After which the slide was rinsed under tap water and flooded with safranin for 30 seconds.

The stained cells were examined under the oil immersion lens of the microscope.

**Biochemical Test**

**Catalase Test:** Most aerobic microorganisms are capable of producing the enzyme catalase although to different extents. Others like the obligate anaerobes are catalase-negative [5]. In carrying out this test, agar culture suspected of *Acrobacter aerogenes, Serratia marcescens* and *E. coli* were used. Two of the organisms, were inoculated into plates, leaving the third uninoculated to serve as control. The cultures were incubated for 24-48 hours. After which several drops of 3 % hydrogen peroxide was added onto the culture. Effervescence, caused by the liberation of oxygen of gas bubbles indicated the production catalase by the test organisms.
Coagulase Test: A drop of normal saline was placed on each end of slide and was mixes a 24-48 hours culture of the test organism using a wire loop. Thick suspensions were made. A drop of plasma was added to one of the suspension and mixes gently while watching the clumping of the organism within 10 seconds. No plasma was added to the second suspension and it was used as the control. Clumping within 10 seconds indicating positive result while no clumping within 10 seconds indicating positive result.

Oxidase: The result depends on the presence of bacteria that can produce oxidase enzymes that will catalyse the transport of electrons between electrons donors in bacteria and redox tetramethyl-p-phenylene-diamine. The dye will reduce to a dark purple color. A few drop of 1% aqueous solution of tetramethy-p-phelyene diamine hydrogen chloride were added to a piece of Whitman’s No.1 filter paper dish. Bacteria isolates were smeared unto the impregnated filter paper with a glass rod. The paper was observed for purple coloration within 5 to 19 seconds as oxidase positive, while absence of purple coloration indicates a negative oxidase reaction.

Sugar Fermentation Test: The sugar solutions used were 1% glucose, mannitol, lactose and sucrose. They were sterilized and 0.1% phenol red indicators were used to detect acid production. 10 ml of the medium was dispensed into tubes containing inverted Durham tubes the production of gas by isolates. This was then plugged with cotton wool foiled and sterilized at 120°C for 15 minutes. About 5 ml of the sugar medium was inoculated with the test organism and incubated at 37°C for 24 hours. A change in colour from purple to yellow indicated acid production due to the fermentation of the sugar while retention of the purple colour indicated a negative reaction. Gas production also shows by the presence of bubbles in the inverted Druham tubes.

Fungal Isolation and Identification: The spoilt burukutu sample (1ml) was also inoculated on Sabouraud Dextorose Agar (SDA) for fungal species present to grow, this was incubated at known room temperature of 28 °c-23°C for 2-5 days with daily observation. Each observed fungal specie were sub-cultured to obtain pure and morphological geatures after stanining using lactophenol stain techniques.

Staining Fungal Hyphae: The population stain used in mycological work is cotton blue. This stains the cytoplasm light blue lactophenol is the liquid frequently uses for mounting fungal specimens, i.e. the mountant. Cotton blue and lactophenol are often prepared together and the combination is known as cotton blue-lactphenol. This serves both as a stain and as a mounting[5].

In carrying out this, Agar culture of suspected colonies like Rhizopus, mucor, phycomeyes, Aspergillus, Penicillium,sordaria, cirvularia,pleurtus, scletorium. A drop of lactophenol was put on a clean slide. With the aid of a mounted needle, a small portion of mycelium was removed from one of the above suspected fungal colonies and placed in the drop lactophenol. The mycelium was spread very well on the slide with the aid of two mounted needles. A cover ship was gently lowered on it. Excess liquid was wiped off by putting the slide between two filter papers and a gentle pressure was applied around the cover slip. Examination of the stained cells was made using the x 10 and x 40 objective of the microscope.

Treatment of Isolates with Ginger, Garlic and Ginger- Garlic: Microorganisms isolated and identified from the spoilt burukutu sample were treated with ethanol extract of the species; ginger, garlic and ginger-garlic.

Preparation of Extracts: Ginger and garlic obtained, were washed, epicarpes removed and the mesocarps were sliced into thin slices. These sliced mesocarps were sundried of different trays for 7 days. When the species were seen to have dried, they were grounded into powder using an electric blender. 20 grams of the ground species (ginger and garlic) were soaked in 100 ml of 90 % ethanol in conical flasks respectively and sealed with foil and allowed to stand for 72 hours. A combination of the species gave, 20 grams of each of the species in 200 ml of ethanol. They were filtered to obtain crude ethanolic extracts. All extracts were stored at 4 °C when not in use[12].

Susceptibility Testing: Agar plates were inoculated with a loopful of the test organism. Sterile paper disc (Whitman’s No.1 filter paper) of 5mm diameter were impregnated with different crude extract and a combination of these extract and dried in hot air oven at 60°C for 5 minutes. A single paper disc impregnated with the extract was placed on sugar plates containing the test organism. After which the plate were incubated at 37°C for 24 hours.
RESULTS

The burukutu beverage produced was analyzed before spoilage for physico-chemical characteristics. The readings of this analysis are in Table 1. After two weeks of production, the burukutu product began to spoil.

Table 1: Physicochemical characteristics of the burukutu sample.

<table>
<thead>
<tr>
<th></th>
<th>Temperature °C</th>
<th>P value</th>
<th>Specific Gravity (g/ cm³)</th>
<th>Alcohol content %</th>
<th>Total titratable acidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>29</td>
<td>3.94</td>
<td>0.8273</td>
<td>4.10</td>
<td>0.53</td>
</tr>
<tr>
<td>2nd</td>
<td>29</td>
<td>3.94</td>
<td>0.8273</td>
<td>4.10</td>
<td>0.56</td>
</tr>
<tr>
<td>Mean value</td>
<td>29</td>
<td>3.94</td>
<td>0.8273</td>
<td>4.10</td>
<td>0.55</td>
</tr>
</tbody>
</table>

Four bacteria and two fungi genera were isolated and are shown in Tables 2 and 3 respectively. Table 4 shows the serial number of pure extract and a combination these extracts. Table 5 shows the inhibitory effect of ginger, garlic and ginger-garlic the microbial isolates from the spoilt burukutu.

Table 2: Morphological and biochemical characteristics of bacteria isolated from the spoilt burukutu

<table>
<thead>
<tr>
<th>Isolate</th>
<th>Colony Description</th>
<th>Gram Reaction</th>
<th>Spore Staining</th>
<th>Motility</th>
<th>Catalase</th>
<th>Coagulas</th>
<th>Oxidise</th>
<th>Glucose</th>
<th>Lactose</th>
<th>Manimtol</th>
<th>Sucrose</th>
<th>Porbable Isolate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shiny surface, small yellow colonies</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Staphylococcus spp.</td>
</tr>
<tr>
<td>2</td>
<td>Convex Coloured Coloni</td>
<td>Rods cluster some</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>Bacillus SPP</td>
</tr>
<tr>
<td>3</td>
<td>Circular, smooth translucent colonies on nutrient agar</td>
<td>Tiny or short rods in cluster (+).</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Escherichia coli</td>
</tr>
<tr>
<td>4</td>
<td>Non- sporing smooth colonies</td>
<td>Rods in chains (+)</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>Lactobacillus SPP</td>
</tr>
</tbody>
</table>

Table 3: Morphological identification of the fungal isolates

<table>
<thead>
<tr>
<th>Isolate</th>
<th>Macroscopic characteristics</th>
<th>Texture</th>
<th>Microscopic characteristic</th>
<th>Probable isolate identify</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>White colonies later turned black Reverse slide is yellow</td>
<td>Velvety</td>
<td>Separate hyphae, unbranched variable lengths, covers the vesicle and forms a radiate head.</td>
<td>Aspergillus SP.</td>
</tr>
<tr>
<td>2</td>
<td>Pseudomycelium of large ellipsoidal cells buildingcells (ascopore) are smooth walled.1</td>
<td>Fluffy</td>
<td>Large ellipsoidal cells multilateral budden. Conjugation blastophore and ascus contain ascopores</td>
<td>Sacchromycess (wide strain)</td>
</tr>
</tbody>
</table>

Table 4: Crude extracts of species and their combinations.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Extracts</th>
<th>Combination ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ginger (ethanol extracts)</td>
<td>20g of spice to 10 ethanol</td>
</tr>
<tr>
<td>2</td>
<td>Garlic (ethanol extracts)</td>
<td>20g of spice to 100ml ethanol</td>
</tr>
<tr>
<td>3</td>
<td>Ginger and garlic (ethanolic extract)</td>
<td>40g of species to 200ml ethanol</td>
</tr>
</tbody>
</table>

Table 5: Inhibitory effect (in millitres) of ginger, garlic and ginger-garlic on microbail

<table>
<thead>
<tr>
<th>Microbial species</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial species.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staphylococcus SPP</td>
<td>-</td>
<td>-</td>
<td>11</td>
</tr>
<tr>
<td>Bacillus SPP</td>
<td>-</td>
<td>-</td>
<td>13</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lactobacillus Sp</td>
<td>-</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Fungal species</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspergillus Spp</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sacchromycess (wide strain)</td>
<td>-</td>
<td>11</td>
<td>17</td>
</tr>
</tbody>
</table>

CONCLUSION

Conclusively, it is evident from this research that a combination of ginger-garlic had a remarkable effect on the spoilage organisms of burukutu and these species when blended alongside with the burukutu can robustly increase the shelf-life of the product and save brewers from their usual economic losses experienced.

REFERENCES