The effect of ginger and garlic on the microbial load and shelf life of Kunun-zaki

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ABSTRACT

Kunun-zaki was produced using ginger and garlic and stored under ambient conditions for 10 days. The microbiological load and the shelf life of the drink were investigated. Diverse microbial genera: Lactobacillus, Bacillus, Staphylococcus, Aspergillus, Penicillium, Fusarium and Saccharomyces were isolated from samples. The effect of ginger and garlic separately were compared to the combined effect of ginger and garlic in reducing the microbial population. Of all the treatments, garlic (2g in 200mls or 0.01% w/v) was most effective in reducing the microbial populations. In contrast, treatment with 1g of ginger was least effective in reducing the microbial populations. Shelf life based on sensory overall acceptability and microbial quality of the samples varied with treatments but combination treatment with 2g in 200mls(0.01% w/v) ginger and garlic extended the shelf life by approximately four (4) days whereas other treated samples showed marginal enhanced shelf life of 2days. However, untreated control sample exhibited remarkably high microbial load and was virtually unacceptable after 24h of production. The result shows the potential of the combination treatment of ginger and garlic as antimicrobials and in extending the shelf life of Kunun-zaki.

Keywords: Kunun-zaki, ginger, garlic, shelf life, microbial load.

INTRODUCTION

Kunun-zaki, a non alcoholic beverage, very popular, especially in Northern Nigeria is known for its social, religious and therapeutic values. It is taken as a refreshing drink, appetizer, food compliment, thirst quencher, substitute for or to complement soft drinks and wines at social gatherings. (Oramili et al; 2003). The nutritional value of Kunun-zaki as documented by Ayo and Okaka (1998) and Sopade and Kassun (1992) justifies its use. It is found to be rich in carbohydrate, vitamins and minerals and contains protein and fat. Sweet potato, which is used as an additive in its preparation, adds to the vitamin content. Kunun-zaki is produced from fermented millet, sorghum, guinea corn and maize in decreasing order of preference and is normally flavoured with ginger. It is consumed in the active state of fermentation.
The fermentation process is normally dominated by the microbial genera; Lactobacillus, Bacillus, Aspergillus and Saccharomyces. (Efiuvwewere and Akoma, 1997). The method of preparation is simple and cheap and does not require any elaborate equipment. (Agboola, 1987) The short shelf life of Kunun-zaki is a major problem of both the brewers and consumers of this drink. These deleterious changes are due primarily to the objectionable off-flavour (over souring) induced by microorganisms. The use of chemical preservatives for microbial control in beverages is desirable and continues to generate research interest worldwide. However, with most of the published information being on the use of inorganic chemical preservatives to preserve this product, the objective of this study is therefore based on the use of organic chemical preservatives (ginger and garlic) to enhance the shelf-life stability of the product while maintaining the characteristic organoleptic attributes.

MATERIALS AND METHODS

Sample collection
Millet grains (Pennisetum typhoides), sugar, dried pepper, ginger and garlic were obtained from Umuahia main market, Abia State, Nigeria.

Production
Kunun-zaki was produced using the method described by Efiuvwewere and Akoma (1995). Millet grains (1000g) were cleaned and steeped in water (1.5L) for 24h at ambient temperature. After 24h, the water was decanted off and the grains washed with tap water before blending with 10g of dried pepper in two volume tap water. The slurry was sieved and the filtrate allowed to sediment for 3-5h at ambient temperature. The supernatant was discarded while the various treatments were added to the remaining milky and pasty sediment. Each of the different concentrations of the treated samples and the control were divided into two portions. One of these was gelled using two volume boiling water and then allowed to cool to between 45°C -50°C. The gelled portions of each of the different concentrations of the samples and control were mixed (1:1 by volume) with the ungelled portion. Each of the mixture was then diluted with tap water, allowed to ferment for 8h and then sweetened with granulated sugar. The samples were dispensed into sterile screw capped containers.

Storage
The samples were stored at ambient temperature (25-32°C) for 10 days.

Enumeration and isolation of microorganisms
This was carried out on Nutrient agar (NA), Sabouraud Dextrose agar (SDA), and Rogosa agar (oxoid) using pour plate method. The samples were serially diluted and 1ml of appropriate dilution was used to inoculate each of the agar plates in triplicates. The nutrient and rogosa agar plates were incubated at 37°C aerobically for 24-36h while the SDA plates were incubated at room temperature for 48-72h. Colonies were counted using a colony counter (Gallenkamp). The mean of duplicate results were then recorded as the colony count. (Lateef et al., 2004).

Identification of isolates
Discrete colonies were picked at random, purified and characterized based on standard microbiological cultural, morphological and biochemical characteristics. (Harrigan and McCance, 1976 and Sneath et al.,1986). The biochemical tests include; catalase, oxidase, Voges-Proskauer, hydrogen sulphide production, nitrate reduction, citrate utilization and sugar fermentation.

For the fungi, the colonies were screened and identified based on the taxonomic schemes and descriptions by Fawole and Oso, (1998) and Mislivec et al., (1992)

Sensory analysis
The sensory attributes were evaluated as described by Larmond (1977).

Physicochemical analysis
pH and titrable acidity were determined. The pH was determined using referenced pH meter (model 291MK2, PYE UNICAM, England) while the titrable acidity was determined using the method described by Speck (1984)

RESULTS AND DISCUSSION

The rapid deterioration in shelf life of traditionally produced Kunun-zaki and other African beverages is widely acknowledged and is of great concern (Odunfa, 1985; Dirar, 1993; Efiuvwewere and Akoma, 1995). The occurrence of diverse microbial genera and the remarkable high microbial load in the untreated control sample (Tables 1,2 and 3) are major cause of accelerated spoilage commonly experienced by brewers and consumers of these products. It is evident from tables 1,2 and 3 that the treated samples have lower microbial load because the added spices (ginger and garlic) have antimicrobial effect and are capable of destroying pathogenic bacteria (Ayo et al., 2003).

In general, ginger and garlic have comparable antimicrobial activities due to the presence of essential oils in them (Nakatani, 2000, Ilondu et al., 2001). But the more appreciable inhibitory effect exhibited by garlic (Tables 1,2, and 3) may be attributed to the differences in their essential oil components. Garlic tends to exert a more pronounced cell membrane interface and disruption than ginger due to the action of Allistatin I and Allistatin II (diallydisulphide oxide) contained in it which are not present in ginger and which affect the growth and respiration of microorganisms (Tynecka and Gos, 1973). Whereas the treatment with ginger and garlic separately resulted in reduction in the microbial load, the combination of the two (ginger and garlic) showed comparable efficacy when compared to that of treatment with ginger alone.

However, the magnitude of effectiveness of ginger and garlic as organic preservative on the microbial load of the sample
differed with the concentration. A decrease in the number of microorganisms was observed with the increase in the concentration of the preservatives. But the effects of ginger and garlic tended to decrease with storage time and this could be due to microbial degradation particularly in the presence of high lactic acid bacteria (De Boer, 1998).

Similar findings had been reported by Efutuwevere and Akoma, (1997) during Kunun-zaki preservation using inorganic preservatives. The drop in pH of all samples over the six days of storage (Table 4.) was in line with what was reported by Agarry et al. (2010). This may be as a result of greater microbial activities since this decrease was more observed in the untreated control samples having high microbial load. The high rate of change in pH of all samples over the six days of storage (Table 4.) was in line with what was reported by Agarry et al. (2010). This may be as a result of greater microbial activities since this decrease was more observed in the untreated control samples having high microbial load. The high rate of change in pH with storage days could be due to the decomposition of fermentable substrates and sugars by microorganisms especially Lactobacillus species which ferment carbohydrates to produce energy and principally lactic acid.

The sensory analysis showed that the treated samples were more acceptable than the untreated control sample. The high rate of acceptability by the 10-member panel for the treated samples is attributed to the extra flavour added by the spices (Adeyemi and Umar, 1994). Combination treatment of ginger and garlic were more acceptable by the panelists with acceptability rate of 100% and 76% respectively. A decrease in the rate of acceptability by the 10-member panel was observed with the increase in the concentration. A decrease in the rate of acceptability by the 10-member panel was observed with the increase in the concentration of the preservatives. This dominance made Efiuvwevere and Akoma (1997) to conclude that Kunun-zaki is a lactic acid bacteria fermented product. The presence of Bacillus species in the samples is not accidental as they occur always on food of low acid content like drinks where they produce organic acids. They may also enter by soil contamination.

Consequently, the isolation of *Staphylococcus aureus* may be attributed to processing and post processing contamination through processors and utensils. Fungi isolated were *Aspergillus, Penicillium, Fusarium* and *Saccharomyces* species. The presence of these fungi is associated with spoilage of beverages. *Saccharomyces* spp are known to convert starch and dextrin to glucose which is then fermented to ethanol and carbon dioxide.

**Table 1:** Effect of ginger and garlic on the total viable count of Kunun-zaki during tropical ambient storage.

<table>
<thead>
<tr>
<th>Storage (day)</th>
<th>K+GG 1g</th>
<th>K+GG 2g</th>
<th>K+GL 1g</th>
<th>K+GL 2g</th>
<th>K+GG+GL 0.5g each</th>
<th>K+GG+GL 1g each</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4.9</td>
<td>4.7</td>
<td>4.3</td>
<td>3.8</td>
<td>4.6</td>
<td>4.2</td>
<td>5.3</td>
</tr>
<tr>
<td>2</td>
<td>6.5</td>
<td>6.2</td>
<td>4.9</td>
<td>5.7</td>
<td>5.7</td>
<td>5.0</td>
<td>7.2</td>
</tr>
<tr>
<td>4</td>
<td>4.4</td>
<td>3.8</td>
<td>4.6</td>
<td>4.6</td>
<td>7</td>
<td>4</td>
<td>ND</td>
</tr>
<tr>
<td>6</td>
<td>2.8</td>
<td>2.3</td>
<td>2.2</td>
<td>2.1</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>8</td>
<td>1.2</td>
<td>0.5</td>
<td>1.1</td>
<td>1.0</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
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<td>21</td>
<td>19</td>
<td>16</td>
<td>20</td>
<td>21</td>
<td>ND</td>
</tr>
</tbody>
</table>

KEY: K = Kunun-zaki, GG = Ginger, GL = Garlic, Control (contains neither ginger nor garlic), ND = Not Determined

**Table 2:** Effect of ginger and garlic on the Total fungal counts of Kunun-zaki.

<table>
<thead>
<tr>
<th>Storage (day)</th>
<th>K+GG 1g</th>
<th>K+GG 2g</th>
<th>K+GL 1g</th>
<th>K+GL 2g</th>
<th>K+GG+GL 0.5g each</th>
<th>K+GG+GL 1g each</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4.0</td>
<td>3.9</td>
<td>3.4</td>
<td>3.0</td>
<td>3.6</td>
<td>3.5</td>
<td>4.3</td>
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<td>2</td>
<td>5.8</td>
<td>5.0</td>
<td>4.2</td>
<td>3.3</td>
<td>5.0</td>
<td>3.9</td>
<td>64</td>
</tr>
<tr>
<td>4</td>
<td>2.2</td>
<td>1.9</td>
<td>1.6</td>
<td>1.5</td>
<td>19</td>
<td>17</td>
<td>26</td>
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<td>10</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

KEY: KZ = Kunun-zaki, GG = Ginger, GL = Garlic, Control (contains neither ginger nor garlic), ND = Not Determined

**Table 3:** Effect of ginger and garlic on the *Lactobacillus* count.

<table>
<thead>
<tr>
<th>Storage (day)</th>
<th>K+GG 1g</th>
<th>K+GG 2g</th>
<th>K+GL 1g</th>
<th>K+GL 2g</th>
<th>K+GG+GL 0.5g each</th>
<th>K+GG+GL 1g each</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4.3</td>
<td>4.1</td>
<td>3.6</td>
<td>3.2</td>
<td>3.9</td>
<td>3.8</td>
<td>4.6</td>
</tr>
<tr>
<td>2</td>
<td>6.0</td>
<td>5.2</td>
<td>4.3</td>
<td>3.5</td>
<td>5.3</td>
<td>4.0</td>
<td>70</td>
</tr>
<tr>
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<td>28</td>
<td>26</td>
<td>25</td>
<td>18</td>
<td>27</td>
<td>22</td>
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<td>17</td>
<td>17</td>
<td>13</td>
<td>19</td>
<td>16</td>
<td>ND</td>
</tr>
</tbody>
</table>

KEY: KZ = Kunun-zaki, GG = Ginger, GL = Garlic, Control (contains neither ginger nor garlic), ND = Not Determined
CONCLUSION

From this study, the combined treatment of garlic and ginger, especially the 0.01 (w/v) extended the shelf life of Kunun zaki up to about 4 days. The shelf life extension means enhanced commercial potential of Kunun zaki. The combined treatment with ginger and garlic especially the 0.01 (w/v) is therefore recommended.

REFERENCES


Maji, A.A. Omale, J. and Okoli, E.C. Effects of chemical preservatives and pasteurization on the shelf life of Kunun zaki (sorghum and maize gruel) European Journal of Food Research and review. 2011; 1(2): 61-70


Table 1 shows the effect of ginger and garlic on the total viable bacterial counts of pineapple juice during storage. The total viable bacterial counts ranged from $3.8 \times 10^8$ to $4.4 \times 10^8$ cfu/ml. Higher bacterial counts were observed in control samples than the treated pineapple juice during the period of monitoring. Influence of ginger on sensory properties and shelf-life of Ogi, a Nigerian traditional fermented food, African journal of Biotechnology; 9 (12): 1803-1808. Akinosun, F.F. (2010). Production and quality evaluation of juice from blend of water melon and pineapple fruits, Journal of Food Science; 2 (4): 54-58. Microbial Load of Ogi Microbial load of all the samples reduces with the addition of garlic and ginger. The microbial load was lower in 100% garlic and ginger, as the concentration of garlic and ginger was reducing the microbial load was increasing. www.iajps.com. Page 3796. The study shows that garlic and ginger has little effect on the microbial load of ogi i.e. the same bacteria such as Streptococcus sp, Staphylococcus sp, Bacillus sp and Escherichia coli were able to grow in ogi with garlic and ginger and in ogi without garlic and ginger at room temperature and this is contradictory to the report on the use of. However, it was obvious that garlic and ginger alone could not prolong the shelf life of OGI and that garlic and ginger can be used to enhance the flavor of Ogi. Kunun-zaki samples of different concentrations of spices: Cloves (Syzygium aromaticum), Ginger (Zingiber officinale) and Alligator pepper (Aframomum danielli) at 0% (control), 0.5%, 1.0%, 1.5%, 2.0% and 2.5% of each spice were produced. Samples were stored at room (RT) and refrigerated temperature (ReT) respectively. The three spices were able to effectively control the microbial growth for the first three days, while visible growth were observed for the other days in samples stored at RT and less with the samples stored at ReT. Sensory evaluations showed that there were no significant difference in colour, taste and flavour with the samples but the mean values showed that sample treated at 1.5%, 2.0% and 2.5% were generally accepted with 2.0 % concentration mostly acceptable. This study evaluates the effect of Ginger solution concentrations (GSCs) on the quality of Millet-based Kunun-Zaki (MKZ). Six (6) samples of MKZ were prepared using millet, Ginger solution concentrate and sugar syrup and they were coded 200 (KZ preserved with 0% GSC), 201 (KZ preserved with 5% GSC), 202 (KZ preserved with 10% GSC), 222 (KZ preserved with 15% GSC), 232 (KZ preserved with 20% GSC) and 242 (KZ preserved with 25% GSC). Might improve by the addition of ginger solution concentrates in a certain proportion so that shelf life and storage optimization can be improved. Materials and methods. Four natural plant materials (clove, garlic, ginger and lime) and two chemical preservatives (acetic acid and sodium benzoate) were used in this study. Physical method (pasteurization) was also employed. The shelf-life can thus be extended by the use of preservatives or storage at conditions that will not favour bacterial multiplication (Pelczar et al., 2002). Unpreserved samples, however, exhibited the highest bacterial and fungal count as the storage lasted and consequently, had the poorest keeping quality when compared to those with preservatives. The effects of Chem. preservatives and pasteurization on the microbial spoilage and shelf life of Kunun-zaki. J. Food Safety. 17:203-213. Fawole MO, Oshe BA (2002). Laboratory Manual of Microbiol.