Quality Characteristics of Fermented Cassava Flour (Lafun) Produced Using Backslopping Method

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Abstract

This study was conducted to determine the effect of backslopping on the quality attributes of fermented cassava flour (Lafun). Cassava roots were obtained from Ojuwoye market, Mushin, Lagos, Nigeria. The roots were peeled and fermented using traditional method. The controlled sample was made using the traditional fermentation process while backslopping method involving the use of fermenting liquor from previous batch was adopted for the experimental sample. Both samples were coded as IJK and BOD respectively. Proximate composition, physicochemical and pasting properties of the samples were carried out. The results showed that carbohydrate, protein, crude fibre and moisture content were 89.75 ± 0.12 and 89.75 ± 0.23%, 3.32 ± 0.31 and 2.29 ± 0.63%, 0.74 ± 0.03 and 1.37 ± 0.16%, 4.22 ± 0.31 and 3.49 ± 0.07% respectively. Results of bulk density (g/cm³), water absorption capacity (%), residual cyanide and pH were 31.00 ± 1.41 and 35.50 ± 0.71, 6.62 ± 0.87 and 3.27 ± 0.09, 0.24 ± 0.03 and 0.33 ± 0.02, 6.03 ± 0.02 and 5.78 ± 0.07 respectively while peak viscosity, final viscosity, pasting temperature and peak time were 80.17 ± 2.82 and 273.79 ± 2.88RVU, 111.15 ± 0.49 and 257.10 ± 1.60 RVU, 7.55 ± 0.78°C and 5.63 ± 0.13°C, 95.35 ± 1.20 and 79.85 ± 1.06 min respectively. This study showed that most of the analyses carried out on lafun were within the recommended limits and the result on pasting characteristics showed that back slopping method had a very good effect on the product.

Keywords: Quality; Fermented; Cassava; Flour; Backslopping; Pasting

Introduction

Cassava (Manihot esculenta Crantz) is a plant cultivated for its tuberous roots. It is a rich source of carbohydrate as well as essential and beneficial minerals required by the body for healthy living [1]. It is one of the leading food and feed plants in the world and it is the staple crop particularly among the developing countries where several fermented products are obtained from it including fufu, gari, and lafun. It has also been estimated that cassava provides food for over 500 million people in the world [2]. Nutritionally, it is a major source of calorie in the form of starch and can be consumed in various forms. However, the roots of the cassava contain cyanogenic glycosides that can potentially release cyanide ions [3] which is toxic to man as they interfere with the functioning of certain organs and enzymes [4].

Fermented cassava flour (lafun), as it called in Nigeria, is an African fermented product from cassava obtained by soaking peeled cassava chunks in water, at ambient temperature (28 - 32°C) for 2 - 5days [5]. The cassava chunks are later sun-dried and milled. During the fermentation process, different biochemical changes occur such as degradation of cyanogenic compounds; formation of flavour compounds;

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and softening of the roots. The degree of root softening is the most important criterion to determine the end of lafun fermentation. In this respect, the activities of pectinolytic enzymes such as pectin methyl esterase and pectate lyase have been reported to occur. However, like other traditional fermented products, lafun is spontaneously fermented and its microbiological composition is of mixed nature [6].

Backslopping is a fermentation process that can be used to ferment lafun. Backslopping involves the use of a starter culture which makes use of samples of a previous batch of a fermented product as inoculants [7]. The inoculation belt used in traditional fermentations in West Africa serves as a carrier of undefined fermenting micro-organisms, and is one example of an appropriate starter culture.

This study was conducted to determine the quality characteristics of fermented cassava flour (lafun) produced using backslopping method.

Materials and Methodology

Raw material: Cassava was purchased from Mushin market, Lagos, Nigeria.

Preparation of fermented cassava flour: The cassava roots were peeled manually with a knife. The peeled cassava roots were washed and diced. These were divided into three batches. The first batch was steeped for 72 hours (3 days) to ferment. The water used in steeping the first batch of cassava for 3 days was then used to ferment the second batch of cassava and this water stands as a starter culture for fermenting subsequent batches of cassava. The steeped cassava was oven dried and milled to get the fermented cassava flour (lafun).

Proximate analysis

Moisture content: This parameter was determined according to the methods of AOAC [8].

Crude protein determination: The crude proteins in the samples were determined by the routine semi-micro Kjeldahl procedure [8].

Ash content: The method of AOAC (2000) [8] was used.

Crude fibre: The crude fibre was determined using AOAC (2005) [9].

Carbohydrate content: Carbohydrate content was determined by difference [10].

Physio-chemical analysis lafun

Water absorption capacity: Water absorption capacity was carried according to AOAC [8].

Determination of residual cyanide: This was determined as described by O’Brien, et al [11].

pH determination: The pH of the flour samples was determined with a pH meter (Hanna Instruments, Model 18521) at 20°C [8].

Bulk density: This was done in accordance with AOAC [8].

Titratable acidity (% lactic Acid): Titratable acidity was determined using AOAC [8].

Determination of residual cyanide: This was determined as described by O’Brien et al [11].

Pasting analysis: Pasting properties were determined using Rapid Visco Analyzer (RVA) (Newport Scientific Instruments) Warriewood, Australia.

Data analysis

Data were used to estimate means of triplicates ± standard deviation. Duncan multiple range tests was used to compare significant differences between the means (p ≤ 0.05). For this analysis IBM SPSS Statistics (version 21.0) was used.

Result and Discussion

Table 1 showed the results of carbohydrate content of the samples. There was no significant difference (p ≤ 0.05) between the values obtained and the values were within the range of the percentage of mass dried cassava roots which were in agreement with the findings of Montagnac., et al [12]. The protein content of the samples were within the range of 1 to 3% of protein content in cassava [13] but high compared to other cassava flour such as cassava starch. The increase in the protein content of cassava flour may be due to some fermenting microorganisms which degrade cassava. The microbial biomass in the form of single cell proteins may be responsible for the increase in the protein content [14]. The values for the crude fibre content of cassava flour were lower than 4% reported by some researchers [15]. The percentage of ash is the indicator of mineral content of the flour. The results obtained for the samples were similar to that of Wheatley., et al [16].

<table>
<thead>
<tr>
<th>Samples</th>
<th>Protein (%)</th>
<th>Carbohydrate (%)</th>
<th>Fat (%)</th>
<th>Ash (%)</th>
<th>Moisture (%)</th>
<th>Crude Fibre (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IJK</td>
<td>3.32 ± 0.37a</td>
<td>89.75 ± 0.12a</td>
<td>0.30 ± 0.08b</td>
<td>1.67 ± 0.11a</td>
<td>4.22 ± 0.31a</td>
<td>0.74 ± 0.03b</td>
</tr>
<tr>
<td>BOD</td>
<td>2.92 ± 0.63b</td>
<td>89.75 ± 0.23a</td>
<td>1.10 ± 0.49a</td>
<td>1.37 ± 0.14b</td>
<td>3.49 ± 0.07a</td>
<td>1.37 ± 0.16a</td>
</tr>
</tbody>
</table>

Table 1: Proximate composition of fermented cassava flour (lafun) using backslopping method and traditional fermentation.

Values represented as mean ± standard deviation. Mean value with different superscript in the same column are significantly different (p < 0.05). IJK = Traditional fermentation; BOD = Backslopping method

Meanwhile, the moisture content of any product determines the shelf stability or the storage life of the product. The results of the moisture content for the samples were with 8 - 10% reported by Dziedzoave., et al [17]. It was also observed that sample BOD will be more shelf stable than IJK while the two samples had very low content of fat due to the fact that cassava has low fat content.

Physico-chemical Analysis

The pH of cassava flour is a good indicator of quality. Table 2 showed the results of the physicochemical properties of the samples. It was observed that there is significant difference in pH of the samples at (p < 0.05). The IJK had higher pH than BOD making BOD more acidic. However, both samples were still within the range of pH of 6-7 for cassava flour. The values were in agreement with the report of Dziedzoave., et al [17]. The cyanide content of IJK and BOD were very low compared to the safe level of 10 mgHCN/kg cassava flour by FAO/WHO (2000). This showed the samples were well processed and good for consumption hence validating the objective of this study.

<table>
<thead>
<tr>
<th>Samples</th>
<th>pH</th>
<th>WAC (%)</th>
<th>Bulk density (g/cm³)</th>
<th>TTA (%)</th>
<th>Residual Cyanide (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IJK</td>
<td>6.03 ± 0.02a</td>
<td>6.62 ± 0.87a</td>
<td>31.00 ± 1.41b</td>
<td>1.41 ± 0.06a</td>
<td>0.24 ± 0.03b</td>
</tr>
<tr>
<td>BOD</td>
<td>5.78 ± 0.07b</td>
<td>3.27 ± 0.09b</td>
<td>35.50 ± 0.71a</td>
<td>1.21 ± 0.03b</td>
<td>0.33 ± 0.02a</td>
</tr>
</tbody>
</table>

Table 2: Physico-chemical properties of the fermented cassava samples.

Value represented as mean ± standard deviation. Mean value with different superscript in the same column are significantly different (p < 0.05). TTA means titratable acidity, WAC: water absorption capacity; IJK= Traditional fermentation; BOD = Backslopping method
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Water absorption capacity and swelling contributions to aylpectin-amylose phase separation and crystallinity loss which in turn promotes the leaching of amylase to the inter-granular space [18]. The results of water absorption capacity of the samples showed that sample IJK had more water absorption capacity than BOD. The results of titratable acidity for the samples showed that they were both acidic in nature due to the role of the lactic acid bacteria during fermentation of the cassava root [19]. The bulk density indicates the filling weight of samples and this result showed that BOD had more filling weight than IJK.

Pasting analysis

The results of pasting characteristics of samples are presented in Table 3. The samples were significantly different (p < 0.05). When the temperature of heated paste rises above gelatinization temperature, the starch granules begin to swell and viscosity increases on shearing. The temperature at the onset of rise in viscosity is referred to as pasting temperature. It is the minimum temperature required to cook a given sample of food [20-22]. This gives an indication of the quantity of heat required to cook the flour. It has been reported that high amylose content of starch increases the pasting temperature. This is because the presence of high amylose in a starchy food delays starch gelatinization and affects normal cooking properties [23].

<table>
<thead>
<tr>
<th>Samples</th>
<th>Peak (RVU)</th>
<th>Trough (RVU)</th>
<th>Breakdown (RVU)</th>
<th>Final Viscosity (RVU)</th>
<th>Setback (RVU)</th>
<th>Peaktime (mins)</th>
<th>Temp (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IJK</td>
<td>80.17 ± 2.82a</td>
<td>63.60 ± 1.27b</td>
<td>13.76 ± 0.13b</td>
<td>111.15 ± 0.49b</td>
<td>7.55 ± 0.78b</td>
<td>95.35 ± 1.20a</td>
<td></td>
</tr>
<tr>
<td>BOD</td>
<td>73.79 ± 2.88a</td>
<td>186.51 ± 1.07a</td>
<td>85.77 ± 0.33a</td>
<td>257.10 ± 1.60a</td>
<td>69.85 ± 0.46a</td>
<td>79.85 ± 1.06a</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Pasting properties of the fermented cassava samples.

Values represented as mean ± standard deviation. Mean value with different superscript in the same column are significantly different (p < 0.05). IJK = Traditional fermentation; BOD = Backslopping method

The final viscosity is the resistance of the paste to shear force during stirring. It also indicates the ability of a material to form viscous paste or gel after cooking and cooling [22, 24]. The result of final viscosity of IJK was lower than that of BOD. The variation in the final viscosity of the samples might be due to simple kinetic effect of cooling on viscosity and re-association of starch (especially amylose) molecules in the samples.

At pasting temperature, large increase in viscosity is usually experienced. This is referred to as peak viscosity. Peak viscosity is the ability of starch to swell freely before their physical breakdown [25]. The peak for IJK was lower than that of BOD. High peak is an indication of high starch content and is related to the water binding capacity of starch. It is closely associated with the degree of starch damage [23].

The measure of reduction in viscosity that occurred from peak viscosity to trough is referred to as breakdown viscosity. The breakdown viscosity is the measure of the stability of starch or the ease with which the swollen granules of starch can be disintegrated. It is an important parameter in predicting the behavior of food during processing. Higher breakdown viscosity values indicate lower ability of the sample to withstand heating and shear stress during cooking [20, 21] and this shows that IJK will withstand more heating and shear stress than BOD.

Starch paste re-associates upon cooling, a process referred to as setback or retrogradation. It is the difference between final viscosity and hot paste viscosity [22]. The amylose content of starch has been reported to be responsible for retrogradation and low setback value indicates higher resistance to retrogradation. The results obtained from this showed that BOD will retrograde faster than IJK.

During the hold period of a typical pasting test, the sample is subjected to a period of constant heating at 95°C and mechanical stress. This further disrupts starch granules. Amylose molecules generally leach out into the solution and align in the direction of the shear, the period is called trough due to accompanying breakdown in viscosity. The trough, which is the minimum viscosity in the constant tempera-

ture phase of the RVA profile, measures the ability of paste to withstand breakdown during cooling [26]. The trough value for BOD was higher than that of IJK. This implies that BOD will have better keeping quality after cooking than IJK.

The peak time of the samples which is a measure of the cooking time was found to be higher in IJK than BOD. This made BOD cook faster than IJK. The pasting temperature was higher in IJK than BOD [27].

Conclusion

The results had shown that the effect of backslopping on fermented cassava flour cannot be overemphasized. The method helped to reduce fermentation time which was achieved by using the fermented liquor of previous batch. It also reduced the cyanide content to a safe level compared to the recommended value.

Finally, results obtained from proximate and physicochemical properties showed that the samples had almost the same values but pasting analysis established that BOD (fermented cassava flour using backslopping method) was of better quality compared to IJK. All the results were within the values reported from previous studies.

Bibliography


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