Evaluation of Biochemical Deterioration of Locust Bean Daddawa and Soybean Daddawa-Two Nigerian Condiments

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Abstract: Some functional properties were used to assess and compare biochemical deterioration in stored locust bean daddawa and soybean daddawa which are two popular fermented Nigerian condiments. The condiments were stored for 14 days at ambient temperature after the normal 72 h of fermentation and at 2 days interval assessed for pH, titratable acidity, free fatty acids (FFA), peroxide values (POV) as well as fat and water absorption capacities. The pH of both samples increased in the alkaline range, so also the titratable acidity. Peroxide values and FFA of the two condiments also increased significantly with storage, with those of soybean daddawa being significantly (p<0.05) higher. Water and fat absorption capacities of the fermented products decreased with storage. Differences recorded in values of fat absorption capacities was also significant (p<0.05). The implications of the recorded values of fatty acids, peroxidation and other functional properties monitored are discussed in relation to the perceived faster deterioration and poor acceptance soybean daddawa.

Keywords: Soybean daddawa, Glycine max, Parkia biglobosa, fermentation, condiments, deterioration

INTRODUCTION

In recent years, the use fermented food condiments and flavouring agents are becoming popular in the diets of many nations. Apart from the fact that condiments improve sensory properties of foods, they add to the nutritional values providing dietary fibre, energy, minerals and vitamins. Also, some of them contain antioxidants and nutraceuticals that provide health benefits. Condiments of plant sources rich in protein are ways of incorporating protein into diets, particularly in African countries where most of the staple foods are starchy. Various types of condiments which are products of fermented seeds that are in use in Africa and some other parts of the world depending on the available raw materials and cultural background include; Kinema in Nepal (Tamang, 2000), Tooru-nao Thailand (Yokotsuka, 1991), Oso in south western Nigeria (Popoola et al., 2006) and Soumbala in Burkina Faso (Onoja et al., 2003).

In Nigeria, two popular condiments which are also commonly used as taste enhancer in soups are fermented locust beans (Parkia biglobosa), popularly known as Iru (or locust bean daddawa) and fermented soybean (Glycine max) popularly known as soybean daddawa. Until recently, the popularity and acceptance of Locust bean daddawa was not in doubt as it is used in soups by communities in several parts of the country. However, the supply of locust bean is dwindling and in recent years it’s been in short supply. This has lead to the search for an alternative raw material for preparing the well-liked condiment (Obatolu et al., 1998). As a result, the popularity of soybean daddawa which is considered as a suitable alternative began to soar. The popularity of soybean...
daddawa is further encouraged by the fact that the preparation of locust bean daddawa is tedious and time consuming. The use of soybean as an alternative to Parkia biglobosa is also seen as a way of incorporating soybean protein into local diets (Achi, 2005). However, the popularity of soybean daddawa is marred by the perception that it is prone to faster deterioration than locust bean daddawa; at the end of the fermentation period (Popoola et al., 2007). Generally speaking, both condiments are products of spontaneous alkaline fermentation and they are organoleptically similar (Omabuwe et al., 2007). The two products are used in the same way as food additives. The fermentation of both products is carried out by Bacillus species. Bacillus subtilis was encountered and used as starter culture for the production of locust bean daddawa (Ikenebomeh et al., 1986; Ogbadu and Okagbue, 1988). This bacterial species was also encountered has been used as starter culture for preparing soybean daddawa (Omabuwe et al., 2002).

There have been reports on methods of improving the shelf life of locust bean daddawa (Ikenebomeh, 1989) as well as that of soybean daddawa (Omabuwe, 2007; Kolapo et al., 2007). However, there is no information on the biochemical deterioration of these popular condiments. This study was therefore carried out to investigate and compare biochemical changes in stored locust bean daddawa and soybean daddawa after 72 h of fermentation. This is with a view to providing scientific information on deterioration of the condiments. It is envisaged that the study will give an insight into possible ways of improving the shelf life of soybean daddawa in particular and encourage its acceptability.

MATERIALS AND METHODS

Collection of Seeds and Preparation of Daddawa

Soybean seeds (variety TGX 1440-2E) used for the study were obtained from the Institute of Agricultural Research and Training (IART), Moor Plantation, Ibadan, Nigeria. Locust bean seeds were procured from a local market. The condiments were prepared in the Microbiology laboratory of the University of Agriculture, Abeokuta. Soybean daddawa was prepared using the procedure described by Popoola and Akueshi (1985) while locust bean daddawa was produced using the traditional methods of Edema and Fawole (2006).

Biochemical/Physicochemical Investigations

pH value, titratable acidity (TA), free fatty acid (FFA) and peroxide content of stored products were monitored for 14 days after the normal 72 h of fermenting the seeds into daddawa. Samples were taken for analysis at two days interval. The pH values and titratable acidity were assessed using the methods of Ikenebomeh et al. (1986). The free fatty acid content (as % oleic acid) and peroxide values (meq kg⁻¹) were estimated using alkali titration with 0.1 M sodium thiosulphate solution using starch as indicator (AOAC, 2000). The fat and water absorption capacity of the samples were determined using the centrifugation method previously described by Sosulki et al. (1976). All determinations were carried out in triplicates and mean values were calculated.

Statistical Analysis

Data obtained were expressed as the mean ± standard deviation (SD). The statistical significance of differences (p<0.05) between the treatments was assessed using the student t-test, means within a treatment were separated by Duncan Multiple range test using SPSS 9.0 for Windows.

RESULTS AND DISCUSSION

In both stored locust bean and soybean daddawa, the pH and titratable acidity (TA) increased with days of storage (Table 1). The observed pH changes in both soybean and locust bean daddawa
is similar to the reported trend for the fermentation of the two legumes for production of daddawa (Omobude et al., 2000; Sarka et al., 1993; Ikenebomeh et al., 1986; Oyeyiola, 1988). In these earlier studies, increase in pH during fermentation has been attributed to the proteolytic activities and the release of ammonia by the fermenting *Bacillus* sp. The release of ammonia and other related end products have been reported as a common feature of vegetable protein fermentation (Hesselteina, 1965). The observed result in the present study is an indication that fermentation still continued in post processing period of soybean and locust bean daddawa. This is probably to be expected as the organisms are still present on the products at consumption. Differences observed in pH with storage and with the types of daddawa were significant (p<0.05), with that of soybean daddawa being significantly higher.

The observed increase in the titratable acid of both products with storage implies that some acid producing activities were on going in the products. An earlier report on biochemical deterioration of soybean daddawa has indicated that both acid and alkaline fermentation were superimposed in the stored soybean daddawa (Popoola et al., 2007). However, results from the present study indicates that the rate of acid and alkaline fermentation in stored locust bean daddawa is slower compared to soybean daddawa. This could be a reason why the latter is prone to quick deterioration and therefore has a shorter shelf life.

Peroxidation in stored contents of locust bean and soybean daddawa increased with storage days, however a drastic change was observed between 4th and 6th day of storage (Table 2). Zia-ur-Rehman et al. (2003) reported that an increased in peroxide value is a good predictor of fat deterioration. Thus, the observed increase in peroxide values with the storage period is an indication that peroxidation is associated with daddawa spoilage. The observed peroxide content is significantly higher in soybean daddawa (p<0.05). The implication is that fatty acids in soybean daddawa are more likely to deteriorate faster than those of locust bean daddawa. This may be another reason responsible for its quicker deterioration.

The FFA contents in locust bean and soybean daddawa increased progressively and significantly (p<0.05) with storage time (Table 3). However, the FFA content of stored soybean daddawa was significantly higher (p<0.05). Soybean daddawa is rich in oil (Popoola and Akuashi, 1986). The

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**Table 1:** pH and titratable acidity (mg lactic acid g⁻¹) of locust bean and soybean daddawa

<table>
<thead>
<tr>
<th>Storage time (day)</th>
<th>Locust bean daddawa</th>
<th>Soybean daddawa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pH</td>
<td>Titratable acid</td>
</tr>
<tr>
<td>0</td>
<td>7.41⁹</td>
<td>0.080⁹</td>
</tr>
<tr>
<td>2</td>
<td>7.66¹</td>
<td>0.077¹</td>
</tr>
<tr>
<td>4</td>
<td>7.82¹</td>
<td>0.073¹</td>
</tr>
<tr>
<td>6</td>
<td>7.95¹</td>
<td>0.085¹</td>
</tr>
<tr>
<td>8</td>
<td>7.94¹</td>
<td>0.088¹</td>
</tr>
<tr>
<td>10</td>
<td>8.15¹</td>
<td>0.097¹</td>
</tr>
<tr>
<td>12</td>
<td>8.14¹</td>
<td>0.101¹</td>
</tr>
<tr>
<td>14</td>
<td>8.17¹</td>
<td>0.114¹</td>
</tr>
</tbody>
</table>

Values are means of three replicates. Means with different alphabets along columns are significantly different at p<0.05

**Table 2:** Peroxide values (meq kg⁻¹) of stored locust bean and soybean daddawa

<table>
<thead>
<tr>
<th>Storage time (days)</th>
<th>Locust bean daddawa</th>
<th>Soybean daddawa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.10±0.57⁹</td>
<td>3.56±0.28⁹</td>
</tr>
<tr>
<td>2</td>
<td>2.37±0.28⁸</td>
<td>4.60±0.42⁸</td>
</tr>
<tr>
<td>4</td>
<td>2.53±0.14⁸</td>
<td>6.50±0.14⁸</td>
</tr>
<tr>
<td>6</td>
<td>8.40±0.10⁴</td>
<td>13.59±0.28⁴</td>
</tr>
<tr>
<td>8</td>
<td>9.20±0.13⁴</td>
<td>14.60±0.42⁴</td>
</tr>
<tr>
<td>10</td>
<td>12.12±0.10⁸</td>
<td>18.68±0.98⁸</td>
</tr>
<tr>
<td>12</td>
<td>13.97±0.57⁷</td>
<td>20.28±0.25⁷</td>
</tr>
<tr>
<td>14</td>
<td>17.95±0.84⁶</td>
<td>28.70±0.94⁸</td>
</tr>
</tbody>
</table>

Values are means±standard deviation of three replicates. Means with different alphabets are significantly different at p<0.05.
formation of organic acids and free fatty acids is an initial step in fat deterioration, development of rancidity and off-flavour in fatty foods (Sattar and Demen, 1973). Fatty acid formation was in most cases higher in soybean daddawa than in locust bean daddawa. This is an indication that rancidity and off-flavour will set in earlier and faster in soybean daddawa. This may explain why deterioration becomes more noticeable in soybean daddawa and why poor storage ability of the product is easily noticed. More susceptible to oxidation are the unsaturated lipids because of the presence of double bonds which make the fatty acid molecules particularly reactive with formation of the free radicals and derived oxidized compounds (Tomassi, 1988). The relatively higher content of polyunsaturated fatty acids in soybean (Asiedu, 1989) could be responsible for higher lipid oxidation observed in soybean daddawa. In this regard, the nutritional advantage of polyunsaturated fatty acids in soybean could have a negative influence in stored soybean daddawa as secondary oxidative compounds may have a role to play in deterioration of the product.

A gradual and significant decrease (p<0.05) was observed in Water Absorption Capacity (WAC) of stored locust bean and soybean daddawa. However, there was no significant difference (p>0.05) between the values reported for the two products (Table 4). A similar trend was observed with values recorded for Fat Absorption Capacity (FAC) of the stored products. Except that there was a significant difference (p<0.05) between the two products. WAC is an indication of a product to associate with water in conditions where water is limiting (Giani, 1993) while FAC could be attributed to the physical entrapment of oils which is related to number of non-polar side chains on the proteins that bind hydrocarbon chains of the fatty acids. Fat acts as flavour retainer and increase mouth feel of foods (Kinsella, 1976), consequently a decrease in FAC of stored daddawa may be negatively impacting on its much desired functional attributes. In this respect, the significantly lower values (p<0.05) of FAC in soybean daddawa during storage probably contributes to its poor acceptability compared to locust bean daddawa.

Table 3: Free Fatty Acids (FFA)* of stored locust bean and soybean daddawa

<table>
<thead>
<tr>
<th>Storage time (days)</th>
<th>Locust bean daddawa</th>
<th>Soybean daddawa</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.012±0.001^</td>
<td>0.024±0.001^</td>
</tr>
<tr>
<td>2</td>
<td>0.024±0.001^</td>
<td>0.028±0.001^</td>
</tr>
<tr>
<td>4</td>
<td>0.025±0.003^</td>
<td>0.034±0.002^</td>
</tr>
<tr>
<td>6</td>
<td>0.035±0.000^</td>
<td>0.052±0.005^</td>
</tr>
<tr>
<td>8</td>
<td>0.040±0.002^</td>
<td>0.061±0.001^</td>
</tr>
<tr>
<td>10</td>
<td>0.043±0.001^</td>
<td>0.065±0.002^</td>
</tr>
<tr>
<td>12</td>
<td>0.048±0.001^</td>
<td>0.068±0.001^</td>
</tr>
<tr>
<td>14</td>
<td>0.056±0.001^</td>
<td>0.072±0.001^</td>
</tr>
</tbody>
</table>

Values are means±standard deviation of three replicates. Means with different alphabets are significantly different at p<0.05.

*FFA recorded as % oleic acid in sample

Table 4: Water and fat absorption capacities in stored locust bean and soybean daddawa

<table>
<thead>
<tr>
<th>Storage time (days)</th>
<th>WAC*</th>
<th>FAC*</th>
<th>WAC</th>
<th>FAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>25.0</td>
<td>1.5</td>
<td>21.0</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>25.5</td>
<td>1.6</td>
<td>20.5</td>
<td>0.8</td>
</tr>
<tr>
<td>4</td>
<td>22.0</td>
<td>1.4</td>
<td>18.0</td>
<td>0.7</td>
</tr>
<tr>
<td>6</td>
<td>19.0</td>
<td>1.3</td>
<td>16.0</td>
<td>0.7</td>
</tr>
<tr>
<td>8</td>
<td>16.0</td>
<td>1.4</td>
<td>16.0</td>
<td>0.7</td>
</tr>
<tr>
<td>10</td>
<td>16.0</td>
<td>1.2</td>
<td>15.0</td>
<td>0.6</td>
</tr>
<tr>
<td>12</td>
<td>14.0</td>
<td>1.0</td>
<td>13.0</td>
<td>0.6</td>
</tr>
<tr>
<td>14</td>
<td>14.0</td>
<td>1.0</td>
<td>12.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Values are means of three replicates. Means with different superscript alphabets are significantly different at p<0.05.

*WAC = Water Absorption Capacity (%); *FAC = Fat Absorption Capacity (mL g⁻¹)

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CONCLUSION

The results of this study have shown that the functional properties monitored (particularly free fatty acids and peroxide values) as indices of deterioration was in most cases significantly higher in soybean daddawa than in locust bean daddawa. This may useful in explaining why soybean daddawa deteriorates faster than locust bean daddawa and the subsequent effect on its acceptability. This study will hopefully give an insight into ways of working out a practicable method of preserving soybean daddawa as well as extend its shelf life so as to benefit from its advantages over locust bean daddawa.

REFERENCES

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