Quality assessment of processed and packaged garnished *Clarias gariepinus* and *Archachatina marginata* (Swainson) snacks

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**ABSTRACT**

Fish is a recommended intake in the diets of developing countries’ citizens, where malnourishment and food insecurity is still being experienced. Snail is also a rich protein-giving food with numerous health benefiting nutrients. Extending the shelf life as well as preserving the quality of fish and snail meat in developing countries has always been a challenge and source of concern. Quality assessment of cut and cleaned catfishes (*Clarias gariepinus*) and giant African land snails [*Archachatina marginata* (Swainson)]; processed into garnished fish and snail snacks were conducted during four months of preservation in airtight transparent snack plastics sealed with foil paper. Initial and monthly analyses for mould loads, proximate compositions (moisture content, protein content and ash content), mineral compositions (Iodine and Phosphorus), aesthetics (appearance, aroma and taste) as well as entomological observations were carried out. At the end of four months, all the parameters measured were not significantly different (p<0.05). In a developing country where facilities and technology for long term storage is unavailable, this is an effective way of making fishes and snails readily available in a ready-to-eat form that is shelf stable. This will promote healthy diets as well as increase livelihoods and incomes of fish/snail farmers, processors and sellers.

INTRODUCTION

Fishes in diets are of utmost importance and are extremely perishable food items that supply a good balance of protein, vitamins, minerals and 10% calories content (Agbon et al., 2002; Lee et al., 1994; Akande and Tobor, 1992). Fish is generally low in fat, but it is an excellent source of omega 3 fatty acids. They are widely accepted on the menu card and form a much cherished delicacy that cuts across socio-economic age, religious and educational barriers (Adeleye, 1992). Its harvesting, handling, processing and distribution provide livelihood for millions of people as well as providing foreign exchange earning to many countries (Opara and Al-Jufaili, 2006). *Clarias gariepinus* is widely distributed in Africa and parts of Asia (Vitule et al., 2006). It is appreciated by consumers for the quality of its meat (Pruszyński, 2003). In Nigeria, it is mostly smoked and used to prepare a very spicy delicacy called pepper soup, sold at restaurants and relaxation centres.

Snails are both low in calories and fat, but high in protein, mineral nutrients and beneficial fatty acids. Over a quarter of the world’s population faces problems of mineral deficiencies of which iodine is included. Every...
year 60,000 still births, abortions and infant deaths occur within days of delivery as a result of iodine deficiency (Manbir, 2011). Iodine deficiency constitutes the world’s major cause of preventable mental retardation ranging from mild intellectual blunting to overt cretinism. Even fewer people realize that iodine deficiency is a serious health problem currently affecting over 740 million people in 130 countries (WHO, 2004). A practical way to include iodine richly in the body is through the consumption of snails in our diets (Aboua, 1995). According to Ebenso (2002) and Adinya (2006), snail originated from the south of the Sahara in East Africa. Archachatina marginata (Swainson) (Giant African land snail) belong to the phylum mollusc. Its meat is tasty, tender and highly nutritious. Its tenderness and fine texture makes it the most suitable meat for all ages (Okonta, 2012). They are one of the most compact groups of animals which show a wide diversity (Odunaiya, 1995). Imevbore and Ademosun (1988) also reported that snail meat is particularly rich in Calcium and Phosphorus, which are much lower in beef.

Fish and snail are very important sources of animal protein to man. While fishes are highly perishable, snails are expensive during the dry season when its price increases and affordability is beyond the reach of average people. Moreover, most people find the process snail preparation time consuming and tiresome because it is laborious, especially de-shelling and washing to remove the sliminess; thereby discouraging interested consumers. Their consistent consumption as snacks or inclusion in diets will help reduce effects of malnutrition especially in a developing country like Nigeria where a great proportion of its population are malnourished. The production of hygienic garnished fish and snail snacks in packages that will retain their quality for a long period is therefore assessed the quality of garnished fish and snail snacks in terms of moisture content, protein content and ash, mineral compositions (iodine and phosphorus), aesthetics (appearance, colour and taste) as well as insect infestation were carried out for four months. Mould load was determined using the Pour plate method as described by Samson et al. (1995). Moisture, ash and protein, iodine and phosphorus contents were determined using the procedures of AOAC (2000). All chemicals used were of analytical grade. Each analysis was carried out in triplicates.

A questionnaire was designed to evaluate the aesthetics of the fish and snail snacks in terms of appearance, colour and taste using a seven-point descriptive Hedonic Scale (7- Like extremely, 6- Like much, 5- Like moderately, 4- Neither like nor dislike, 3- Dislike moderately, 2- Dislike very much, 1- Dislike extremely). A taste panel of 12 judges, consisting of randomly selected post graduate (PhD) students from various departments in University of Ibadan, casual construction workers and Microbiology Unit staffs of the Nigerian Stored Products Research Institute (NSPRI) Ibadan were used for the assessment.

**Statistical analyses**

Statistical analysis was carried out using SAS 9. 1 version (2003) statistical software and means were separated using Duncan Multiple Range Test (DMRT).
Table 1. Mean mould load of packaged fish and snail snacks.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Day</th>
<th>Mould load (cfu/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fish</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0.33×10^3</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>0.33×10^3</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>0.67×10^3</td>
</tr>
<tr>
<td>4</td>
<td>90</td>
<td>0.67×10^3</td>
</tr>
<tr>
<td>5</td>
<td>120</td>
<td>0.67×10^3</td>
</tr>
</tbody>
</table>

Table 2. Mean moisture content of packaged fish and snail snacks.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Day</th>
<th>Moisture content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fish</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>44.70</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>44.70</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>44.71</td>
</tr>
<tr>
<td>4</td>
<td>90</td>
<td>44.73</td>
</tr>
<tr>
<td>5</td>
<td>120</td>
<td>44.75</td>
</tr>
</tbody>
</table>

Table 3. Mean mineral compositions of packaged snail snacks.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Day</th>
<th>Iodine (mg/100 g)</th>
<th>Phosphorus (mg/100 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0.08</td>
<td>875.00</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>0.08</td>
<td>874.83</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>0.06</td>
<td>874.75</td>
</tr>
<tr>
<td>4</td>
<td>90</td>
<td>0.05</td>
<td>874.72</td>
</tr>
<tr>
<td>5</td>
<td>120</td>
<td>0.03</td>
<td>874.66</td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION

Mould load was not significantly different (P<0.05) throughout the four months storage period with mean values ranging between 0.33-0.67×10^3 cfu/g for both snacks (Table 1). These values fall within the microbiological guideline for RTE food (2007). This is an indication that packaging and storing of dried products in airtight transparent snack plastics sealed with foil paper may serve as an effective way of preserving its microbial quality as evidenced in the garnished dried fish and snail snacks. This is further buttressed by the work of Engmann et al. (2012) where well-dried snails (Solar tent, kiln and smoke-dried snails) packaged in rigid plastic containers and stored at 24±1°C had high increases in microbial populations. It was recorded that as the moisture content of the samples increased during storage, there was corresponding increases in microbial population for all the differently dried samples. This may be attributed to the absence of the foil paper seal which may have provided the additional air-tightness to plastic snack containers used for packaging and storing the fish and snail snacks in this work.

Table 2 shows the moisture content of the sample during the experimental period. No significant increase in moisture contents were recorded in both snacks throughout the four months storage. The moisture content of the snail snacks were however significantly different from that of the fish (P<0.05).

Entomologically, there was no visible insect infestation observed throughout the four months storage period which further confirms the effectiveness of the storage container. It is evidenced from Table 3 that the levels of Iodine and Phosphorus in the snail snacks were relatively high. This may be attributed largely to increase in concentration as a result of drying. Drying foods reduces the moisture content and so increases the concentration of other nutrients (King and Burgess, 1993). No significant differences were recorded in the iodine and phosphorus content of the snail during the four months.
storage period. In this research, Phosphorus content ranged between 874.7–875.0 mg/100 g which is very high compared to 269.2 mg/100 g, 22.9 mg/100 g and 405–435 mg/100 g as reported by Engmann et al. (2013), Babalola and Akinsoyinu (2009) and Watson (1971), respectively. This high phosphorus and iodine levels may be contributed by the spices and condiments used in garnishing the snail snacks.

The result from Table 4 shows snail’s protein values, ranging from 89.70-90.15%. This falls close to the range of protein contents recorded in the works of Imevbore and Ademosun (1988) and Engmann et al. (2013). However, it is in contrast to the work of Malik et al. (2011) who recorded 20.5% as the highest protein content of A. marginata (Swainson) processed using three different cooking methods (that is, boiling, frying and barbecuing) and equal amount of spices. The low protein value obtained in their work might be attributed to the fact that the boiled, fried and barbecued snacks were not dehydrated hence protein contents were not concentrated in the snails. Over the four month storage period, no significant increases were recorded in the protein contents of both snacks.

Ash contents for both fish and snail snacks were both high and this can be attributed to their concentration as a result of drying. The ash contents of the snail snacks in this work were high when compared to 6.49 and 3.22% obtained by Malik et al. (2011) and Engmann et al. (2013) in their work. Similarly, ash and protein contents in the fish snacks were also higher in value when compared with the work of Ogbonnaya and Ibrahim (2009). However, this was different from the work of Akinwumi et al. (2011). In their work, proximate composition of electric oven dried catfish at 110°C for 50 min and sunlight radiation (sunshine) dried catfish for 27 days at average of 6 h per day were determined. Protein contents recorded in this work is higher than what was obtained in their work (69.770±0.550 for electric dried and 37.277±0.513 for sun dried). However, the ash content of the electric oven dried catfish was higher (9.672±0.182) while that of the sunshine dried catfish was similar to what was recorded in this work 6.830±0.217. The reason for higher ash content recorded in the electric dried fish compared to the dried garnished fish snack is not yet ascertained at the moment. There were high significant differences between the protein and ash contents of the fish snacks and that of the snail snack (P<0.05).

General acceptability for the snail snacks by all the panellists were higher when compared to the fish snacks (Table 5); and this was significant (P<0.05). This result agrees with the findings of Ukpong (2009) when he fed snail and snail pie as well as beef and beef pie to school-age children and young mothers. He found that the snail pie was preferred to beef pie in terms of appearance, texture, taste and flavour. Hence, he recommended snail pie as a cheap source of protein and iron for school-age children and young mothers. However, in this work, appearance of fish snack was preferred as it was more colourful and inviting (Figures 1, 2, 3 and 4). Overall preference for snail snacks may be due to taste, aroma and knowledge of its high nutritive values.

**Conclusion**

In line with Nigeria’s Ministry of Agriculture and Rural
Figure 1. Showing garnished snail snacks.

Figure 2. Showing garnished fish snacks.
Development, Agricultural Transformation Agenda (ATA), hygienically producing garnished fish and snail snacks packaged in airtight containers will be a powerful tool for ameliorating malnutrition by promoting healthy diets for Nigerians, creating jobs as well as increasing incomes specifically of women who are the main processors and sellers of snails and fishes.

ACKNOWLEDGEMENT

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