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EFFECT OF BRINE AND VINEGAR ON NUTRIENT COMPOSITION AND SHELF-LIFE OF DRIED CATFISH (*Clarias gariepinus*)

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Abstract

This study determined the nutrient composition and shelf life of dried *Clarias gariepinus* pretreated with brine and vinegar. The fish were dried to average moisture content of 5.40 ±1.47% and stored differently at room temperature (26-30^{o}C) for eight months. There were significant differences ($P<0.05$) between the nutrient compositions of the fish with the control having the highest values. Salt and vinegar pre-treatment had no effect on the shelf life of dried *C. gariepinus*. Drying fish to an average moisture content of about 5% and storage in airtight container may increase the shelf life of dried *C. gariepinus.* Mould grew on all the fishes stored in baskets and in the brine treated fish in airtight container and resulted in their having poor texture, odour and taste. The control and vinegar treated groups in airtight containers remained fairly the same. There was no insect infestation of any of the groups.

Keywords – vinegar, brine, proximate analysis, shelf life, *Clarias gariepinus.*

Introduction

Fish are important food resources worldwide due to their nutritional quality. In Nigeria, fish is the major source of animal protein, contributing over 50% of animal protein intake especially among the poor (Agbabiaka *et al*., 2012). As soon as fishes die, they become subject to postmortem changes and damage by microorganisms and insects that quicken the rate of fish spoilage, these together with inadequate preservation, processing and handling leads to the loss of over 40% of the total fish catch in Nigeria (Daramola *et al*., 2007; Ime-Ibang and Fakunle, 2008; Akinwumi, 2011). Spoilage affects the odour, flavour, texture, colour and chemical composition of fish (Agbabiaka *et al*., 2012) and these in turn affect the nutritional quality, consumer acceptability and commercial value of fish (Daramola *et al*., 2007). Fish processing helps to extend the storage life of fish and to give the product a form which is attractive to consumers (Tawari and Abowei, 2011). However, traditionally processed fish are still subject to many form of loss or spoilage such as microbial spoilage, insect infestation and fragmentation (Abolagba and Nuntah, 2011).

Preservation techniques are designed to inhibit the activity of spoilage bacteria and metabolic changes in order to prevent fish spoilage and prolong shelf life. Some of the preservation techniques are effected through the control of temperature (by chilling or freezing), reduction of water activity (drying, salting and smoking) and use of preservatives. Drying, salting and smoking are the most common preservative methods used in Nigeria. These processes ensure year round availability of fish and the distribution of wholesome fish products to all parts of the country. Drying dehydrates the fish and inhibits enzymatic action but during storage, nutritional quality may deteriorate as a result of lipid oxidation and microbial growth (Kumolu-Johnson and Ndimele, 2011). The preservation method and mode of storage of preserved fish determines the rate and degree of fish spoilage or infestation. Therefore, storage methods that prevent lipid oxidation and microbial growth will inevitably increase shelf life of preserved fish.

Salt and vinegar have been employed in the preservation of food commodities for ages. Common salt (NaCl) hinders the activity of bacteria, enzymes and chemicals in fish (Abolagba and Nuntah, 2011). Water is necessary for the microbial and enzymatic reaction involved in spoilage. Salt and vinegar preserve food by reducing the water in them.

This study evaluated the effect of salt and vinegar pretreatment on the nutrient composition and shelf life of dried *C. gariepinus*. According to Daramola *et al*. 2007, the most important environmental factors governing the shelf life of fish are ambient temperature and humidity. Therefore this study also assessed the shelf life of dried *C. gariepinus* stored differently at room temperature of (26-30^{o}C) for eight months.

Materials and Method

Thirty six (36) *C. gariepinus* were purchased from Comb farm located at Nyanya phase 4 F.C.T, Abuja Nigeria. The weights of the fish were measured using standard methods. The fish samples were killed, degutted and washed. They were then divided into three treatment groups of twelve (12) fishes each. The control (group A) was neither immersed in vinegar nor brine. Group B were immersed in 10% brine for one hour, while the third group (C) was immersed in vinegar (consisting of 2.5% acetic acid (CH_3CO_2H), water and sodium chloride) for one hour.

Drying Process

The treated fishes were laid on the different racks of a local-made metal oven. Two pots filled with burning charcoal and emitting constant heat were placed on the last rack of the metal oven. At intervals the fishes were turned to avoid burns and ensure uniform drying. The door of the oven was properly closed to retain heat and prevent contamination from dust and flies. The drying process took about 12 hours.

The dried fishes were stored separately in open and airtight containers. Five (5) fishes from each group were kept in different airtight plastic containers (closed containers), while another five (5) each were kept in plastic basket with the open end covered with transparent polythene to prevent them from dust, insects and other pests but allow air in through the sides. They were stored for the next eight (8) months. The fish samples were carefully examined for insects using a hand lens monthly.

Proximate Analysis

The dried fish stored in airtight containers were analyzed to determine the crude protein, crude fibre, fat, moisture and ash content. Proximate analysis was based on standard methods as described by AOAC (2000). Crude protein was determined using the Kjeldahl techniques. Ash content was determined by incinerating 1g of sample at 600^{o}c overnight.

Statistical Analysis

All determinations were carried out in triplicate and the data subjected to two-way analysis of variance (ANOVA).

Results

Percentage weight loss after drying of fish was 77.59%, 75.29% and 82.32% for the control, brine and vinegar treated *C. gariepinus* respectively. The proximate composition of the control, brine and vinegar treated samples stored in the airtight containers carried out before and after storage for eight months are presented in Table 1.

TABLE 1: Proximate composition of control, brine and vinegar treated dried *C. gariepinus* before and after storage

Parameter	Time	Control (%)	Brine (%)	Vinegar (%)
Fat	Before storage	8.81±0.55	6.80±0.66	8.10±0.13
	After storage	10.97±0.17	6.45±0.42	7.29±0.13
Ash Content	Before storage	5.57±0.12	3.37±0.06	2.69±1,04
	After storage	6.12±0.11	5.20±0.22	6.08±0.06
Moisture Content	Before storage	7.16±0.04	3.77±0.07	5.27±0.06
	After storage	7.86±0.63	8.23±0.09	8.56±0.10
Crude fibre	Before storage	5.11±0.03	1.26±0.06	2.79±0.11
	After storage	5.02±0.01	3.92±0.24	3.13±0.04
Crude Protein	Before storage	67.14±0.97	55.18±2.57	55.49±2.28
	After storage	52.23±0.87	52.17±1.15	55.66±0.68

Mean of triplicate samples followed by the standard deviation.

The proximate analysis revealed that before storage, the crude protein, fibre, fat and ash content of dried *C. gariepinus* not immersed in brine or vinegar were significantly ($P<0.05$) higher than the brine and vinegar treated dried *C. gariepinus.* The proximate compositions of dried *C. gariepinus* after storing for eight (8) months were also significantly different ($P<0.05$) from the proximate compositions of dried *C. gariepinus* before storage. The ash and moisture content of all the groups increased with storage. The increase in moisture content was greatest in the brine treated dried *C. gariepinus* (from 3.77±0.07% to 8.23±0.09%) and least in the control (from 7.16±0.04% to 7.86±0.63%). The crude protein of the control reduced with storage from 67.14±0.97 to 52.23±0.87, that of the brine treated, dried fish reduced from 55.18±2.57 to 52.17±1.15 but the crude protein of the vinegar treated, dried fish did not reduce. However, though the fat content of the brine and vinegar treated, dried fish reduced with storage, the control increased from 8.81±0.55% to 10.97±0.17%.

The physical appearances of dried catfish (colour, texture, odour) were attractive before storage except for the vinegar treated dried catfish. Vinegar spoiled the flesh of catfish during immersion. After drying, the physical appearance of vinegar treated dried catfish shrunk to a very undesirable, unattractive shape and kept breaking into pieces, while the control and brine treated catfish samples looked very appealing and did not fragment. The poor texture of the flesh led to fragmentation of the vinegar treated dried fish which continued with storage.

Mould growth was observed on the catfish samples stored in baskets seven weeks after drying. The growths were first observed on brine treated fish and in comparison the control and the vinegar treated group had less mould growth. After three (3) weeks, the moulds began to die off till they disappeared leaving patches of white on the fish. Two (2) weeks after the first mould growth, mould growth was observed on the brine treated fish in airtight containers, the mould covered the entire fish. The control and vinegar treated *C. gariepinus* preserved in an airtight container were fresh and edible till the end of the study. There were no signs of insects on any of the catfish. The catfish samples with mould growth had poor texture, odour and taste; the taste was unpleasant. The control and vinegar treated, dried *C. gariepinus*

stored in airtight containers had very good odour and taste. These samples of control and vinegar treated, dried *C. gariepinus* still retained these qualities even after eight (8) months of preservation.

Discussion

The reduced weight of the smoked fish was due to the heat which caused the reduction of moisture content of the dried catfish. This observation is in agreement with the findings of Kumolu-Johnson *et al*. (2010) and Agbabiaka *et al.* (2012). The higher protein and fat content of the control may be attributed to the fact that they were not subjected to any treatment. Bligh *et al*. (1988) reported that salting exerts an osmotic effect on fish flesh and as such oil and other constituents may be lost from fatty fish. Some form of protein and fat may have diffused out of the fish during immersion in brine and vinegar accounting for the lower protein and fat content of the brine and vinegar treated fish. The protein contents were however higher than the value of 53.10% recorded by Ogbonna and Ibrahim (2009) and slightly lower than 68.17% reported by Agbabiaka *et al.* (2012). The significant differences of proximate composition observed after storage may be as a result of loss during storage. The reduction of the crude protein of the stored fish could be due to degradation of the initial crude protein and leaching. The increased ash and moisture content of all the groups with storage is in agreement with the findings of Daramola *et al*. (2007). The increase in moisture content of dried fish has been attributed to the absorption of moisture from its environment. The higher increase of moisture content in the brine and vinegar treated samples may also be attributed to the hygroscopic property of salt. The proximate analysis of fish stored in baskets was not carried out as they were unfit for consumption as a result of the growth of mould. It is not advisable to eat such fish as they may be affected with mycotoxin and may have some health implications (Hanson and Barlow, 2001; Daramola *et al*., 2007).

The attractive appearances of the control and brine treated dried catfish demonstrates one of the benefits of processing. The vinegar used had a very low amount of acetic acid (2.5%) but apparently this accounted for the disfigured appearance of the vinegar treated fish. The non infestation of insects on the fish samples emphasized that preservation method and mode of storage of preserved fish are important in hindering the rate and degree of fish spoilage or infestation. The proper sealing of the baskets and containers protected the fish samples from insects. The result showed that storage of properly dried fish in airtight containers delays or prevents altogether the infection of fish by mould and insects.

Mould infection were worse in brine treated fish in baskets and only affected brine treated fish in airtight containers, this may mean that salt also influences the infection of mould. These results are in variance with other reports that salting of fish increases the shelf life of fish (Hanson and Barlow, 2001). Bligh *et al*. (1988) reported that dried-salted fish products are susceptible to oxidative changes. Furthermore, they stated that at lower concentrations, salt is a pro-oxidant in fatty species and may inhibit lipid oxidation only at high concentrations.

Conclusion

The results obtained showed that salt and vinegar pre-treatment may affect the nutrient composition of *C. gariepinus* and do not necessarily contribute to extending the shelf life of *C. gariepinus.* Higher level of salt may be required in the preservation of fatty fish like *C. gariepinus* but consumption of high levels of salt also have some health implications. Vinegar gives dried fish an unappealing, unattractive appearance which may reduce its acceptability to consumers hence its commercial value. Storage time had no unfavourable effect on the physical qualities and resulted in only a little reduction of crude protein content of untreated, dried *C. gariepinus.* Therefore, drying *C. gariepinus* to an average moisture content of about 5% and storing in airtight containers is recommended. In times of abundant harvest, to ensure year round availability of this important source of animal protein in Nigeria, a longer storage period of dried *C. gariepinus* could be realized by drying to average moisture content of 5% and storing in airtight containers without the use of salt or vinegar.

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