



PROXIMATE AND SENSORY ANALYSIS OF SMOKED *Clarias gariepinus* TREATED WITH SALT AND LIME JUICE

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Abstract

This study evaluated the proximate composition and sensory characteristics of fresh catfish (*Clarias gariepinus*) treated with different concentrations of table salt (Sodium chloride) and lime juice (*Citrus limon*). 30kg of fresh *Clarias gariepinus* table-sized fish were used and randomly assigned to six (6) experimental treatments: T1 (Control)-0g salt with 0ml juice; T2-50g salt; T3-100ml lime juice, T4-50g salt with 50ml lime juice; T5-50g salt with 75ml lime juice and T6-50g salt with 100ml lime juice solutions, respectively. The experimental fish were soaked for 1 hour in each of the already prepared treatment solutions and thereafter degutted, cleaned and set in the smoking kiln consisting of six trays and smoked for 15 hours. Smoked fish were stored in air-free netted sieves and placed on a shelf for 12 hours before they were packed in see-through nylons for thirty (30) days. Results showed that the percentage of crude protein and crude fat of the smoked fish in T4, T5 and T6 increased with an increase in the volume of lime juice and was significantly different from ($p < 0.05$) other treatments. The moisture and ash contents especially in T5 and T6 reduced with an increase in the level of lime juice which was significantly different from others. However, there was no significant difference in the sensory assessment in terms of appearance but the colour and taste of T2 were better ($p < 0.05$) than others, Texture in T3, T5 and T6 were higher than the T1 while the aroma and general acceptability in T5 were significantly higher ($p < 0.05$) than the Control. It can be concluded that using lime juice and salt combination may be useful in improving the nutritive value, shelf life and consumer acceptability of smoked *Clarias gariepinus*.

Keywords: Catfish, Lime juice, Salt, Proximate composition, Sensory characteristics.

Introduction

Catfish, (*Clarias gariepinus*) is a very important freshwater fish in Nigeria as it accounts for about 80% of aquaculture production (FDF, 2003). It has enjoyed wide acceptability in most parts of the country because of its unique taste, flavour and good texture. It is widely distributed, and extensively cultivated in ponds but under-priced (Kumolu-Johnson *et al.*, 2010). However, keeping catfish like any other fish species could result in significant economic loss due to its perishable nature, if adequate preservation/processing techniques are not adopted (Clucas and Ward, 1996). Fish and fisheries products are among the most perishable commodities worldwide mainly due to microbial spoilage. About one-third of the world food production is lost annually as a result of microbial spoilage (Omojowo *et al.*, 2010). This may render it unacceptable and unfit for human consumption. Proper preservation starts from the moment it is harvested until it reaches the consumers' table (Oluborode *et al.*, 2013). Due to the susceptibility of fish to chemical, microbial and physical deterioration, various preservation techniques are put in place to check spoilage (Eyo, 1992). Processing of fish either through smoking or drying is widely used in fish preservation in the process, moisture content present in the fish is extracted through heating, thus inhibiting the action of microorganisms and prolonging shelf life (Clucas and Ward, 1996; Oyeye, 2003; Amoo *et al.*, 2007). Fish smoking is a traditional method of processing globally, it

accounts for about 3% of the world's catch and also increases the shelf-life (Fapohunda and Ogunkoya, 2006; Gupta and Gupta, 2006). The flesh of smoked fish is delicate, succulent, and delicious and can be readily consumed without further processing (Olowoniyi *et al.*, 1998; Eyo, 2001). The objective of this study was to evaluate the effect of different combinations of lime juice and salt on the nutritional qualities and sensory characteristics of smoked African catfish, *Clarias gariepinus*.

Materials and methods

Study Area

The study was conducted in the Aquaculture and Fisheries Unit of the Bioresources Development Centre Ogbomoso, Oyo State, Nigeria, located at latitude 8°11' N and longitude 4°31' E.

Preparation of lime juice

Fresh lime fruits (*Citrus limon*) were purchased from a local market in Ogbomoso after which they were washed, cleaned, cut and squeezed to obtain the lime juice. The fresh juice was sieved and then poured into a clean container until it was ready for use.

Preparation of fish

A total of 30kg of *Clarias gariepinus* were obtained from the earthen production pond of the Aquaculture and

Fisheries Unit of Bioresources Development Centre of the National Biotechnology Development Agency, Ogbomoso, Oyo State.

Experimental set-up

The fish were randomly assigned to six experimental treatments. The treatments were: T1 (Control)-0g salt with 0ml juice; T2-50g salt; T3-100ml lime juice, T4-50g salt with 50ml lime juice; T5-50g salt with 75ml lime juice and T6-50g salt with 100ml lime juice solutions. 5kg of the fish were weighed and soaked into each of the already prepared treatment solutions respectively and left for 1 hour and thereafter set in the smoking kiln consisting of six trays.

The smoking process

After soaking the fish in the respective treatment solutions T1, T2, T3, T4, T5 and T6 for 1 hour, the fish were gutted and washed thoroughly with clean water and the samples were arranged on galvanized trays/racks and put in the smoking kiln. Smoking of the fish lasted for 15 hours. The temperature in the smoking chamber was manually regulated using a thermometer to make sure it does not exceed 70 °C. The smoke was produced by the burning of charcoal. After smoking, the products were allowed to cool in netted plastic sieves for 12 hours after which the fish were packed in transparent polyethylene bags, sealed to reduce microbial infestation and left for 30 days before they were taken for analysis.

Determination of the proximate composition of the smoked fish

Samples were analyzed chemically according to the official methods of analysis described by the Association of Official Analytical Chemists (A.O.A.C., 18th Edition, 2005). The crude protein in the sample was determined by the routine semi-micro Kjeldahl, procedure/technique. This consists of three techniques of analysis namely Digestion, Distillation and Titration. The value of nitrogen obtained was then multiplied by 6.25 to get the crude protein value. The moisture content of the samples was determined by the method in which 2 g of the fish samples were oven-dried at $110 \pm 1^\circ\text{C}$ for 24 h to a constant weight. Loss in weight is equal to the moisture content of the original sample. The ash content was determined by heating the samples to a temperature of 550°C , the residue is equivalent to the ash content. The fat content was determined by extraction with petroleum ether by the Soxhlet method.

Analysis of the sensory characteristics of the smoked fish

Sensory evaluation was carried out on the fish samples by a 30-member panel drawn from the staff of the Bioresources Development Centre, Ogbomoso. They were instructed on the parameters such as appearance, colour, taste, texture, aroma and acceptability using a nine-point

hedonistic scale. The scales of preference were ranked 1 - 9 which translates to 1- Like Extremely, 2-Like Very Much, 3-Like Moderately, 4-Like Slightly, 5-Neither Like Nor Dislike, 6-Dislike Slightly, 7-Dislike Moderately, 8-Dislike Very Much, 9-Dislike Extremely. The results were recorded inside the questionnaire given to them. Data generated from the respondents were therefore subjected to statistical analysis.

Statistical analysis

Completely Randomized Design (CRD) was adopted in carrying out the experiment. Data for proximate composition were presented as mean $\pm$ standard error. The data collected for sensory characteristics were subjected to one-way ANOVA (Analysis of variance) to determine the significant differences between the samples using Statistical Package for Social Science SPSS 17.0 for windows.

Results and Discussion

Table 1 presents the percentage proximate composition of the treated smoked *Clarias gariepinus* fish in salt and lime juice. The highest crude protein was recorded in T5 and T6 (72.69 ± 0.94 , 72.93 ± 0.94) while the lowest was obtained in T2 (67.08 ± 0.94), the moisture content for T5 and T6 (6.84 ± 0.29 ; 6.78 ± 0.29) were the lowest which was in agreement with the work of Oluborode *et al.* (2013) that the higher protein content of samples T5 and T6 respectively was as a result of a decrease in moisture contents of the products. Besides, the moisture content of the dried catfish which is of great importance in storage is still at safe level of 7.3% which is within the recommended safe moisture content of dried fish (6 to 8%) (Olayemi *et al.*, 2011). This also agrees with the work of Haruna *et al.* (2021) in which a moisture content of $6.93 \pm 1.66\%$ was recorded in fish products treated with 1.5% Cinnamon solution. Also, Ayeloja and Bhandary (2013) reported $6.10 \pm 0.14\%$ moisture content in smoked fish spiced with garlic. Haruna *et al.* (2021) also observed that the differences in the moisture contents could be due to variations in the moisture-absorbing properties of the various concentration of solutions applied prior to smoking, which in effect can bring about a reduction in the moisture content of the smoked fish product that will reduce the rate of spoilage and elongate the shelf life of the smoked products.

Daramola *et al.* (2007) averred that water activity determines storage life of fish, a position that was corroborated by Modibbo *et al.* (2014) that a reduction in moisture content resulted in an increase in crude protein. This work shows that the crude protein in the mean proximate composition formed the major part of the dry matter in fish products in agreement with the works of Haruna *et al.* (2021) and Ajani *et al.* (2013) that crude protein formed the largest quantity of the dry matter in all fish. The results for the fat content followed a similar pattern as

Table 1: Effect of salt and lime juice on the proximate composition of smoked *Clarias gariepinus* catfish.

Parameters	T ₁ (Control)	T ₂	T ₃	T ₄	T ₅	T ₆
%Crude Protein	68.39±0.94 ^c	67.08±0.94 ^c	70.18±0.94 ^{bc}	70.38±0.94 ^b	72.69±0.94 ^a	72.93±0.94 ^a
%Crude Fat	11.54±0.12 ^b	11.76±0.12 ^b	11.93±0.12 ^{ab}	12.25±0.12 ^a	12.23±0.12 ^a	12.12±0.12 ^a
%Ash	10.86±0.53 ^{ab}	11.21±0.53 ^a	9.94±0.53 ^b	9.84±0.53 ^{ab}	8.22±0.53 ^c	8.11±0.53 ^c
%Moisture content	8.36±0.29 ^a	8.44±0.29 ^a	7.54±0.29 ^{bc}	7.32±0.29 ^b	6.84±0.29 ^c	6.78±0.29 ^c
%Carbohydrate	0.83±0.23 ^{bc}	1.52±0.23 ^a	0.42±0.23 ^b	0.23±0.23 ^c	0.03±0.23 ^c	0.07±0.23 ^c

*Values are presented as mean ± standard error of the mean; the different superscripts along the same row are significantly different ($p < 0.05$)

were the values obtained for the crude protein in which T4 (12.25±0.12), T5(12.23±0.12) and T6 (12.12±0.12) present higher values that were significantly different ($p < 0.05$) from the other treatment samples similar to the work of Daramola *et al.* (2007), Ogbonnaya and Shaba, (2009) and Bouriga *et al.* (2012) in which there was an increase in fat content, a variation they agreed could be the result of evaporation of moisture contents of the fish. However, the ash content in T2 (11.21±0.53) was higher than in other treatments and significantly different from T5 (8.22±0.53) and T6 (8.11±0.53) with less salt in agreement with Salan *et al.* (2006) that an increase in the ash content in smoked *C. gariepinus* may be due to the loss of humidity and the significant reduction of moisture content during smoking and drying. Ndakuta *et al.* (2011) recognized ash content as an index for the presence of minerals in fish which contributes essentially to the metabolic process. Meanwhile, the percentage of carbohydrates recorded in T4 (0.23±0.23), T5 (0.03±0.23) and T6 (0.07±0.23) indicate lower values significantly different ($p < 0.05$) from the other treatment samples.

Table 2 shows the result of the mean scores for the sensory

Table 2: Effect of salt and lime juice on sensory characteristics of smoked *Clarias gariepinus* catfish

Parameters	T ₁ (Control)	T ₂	T ₃	T ₄	T ₅	T ₆
Appearance	2.17±0.26 ^a	2.55±0.29 ^a	2.63±0.28 ^a	2.25±0.23 ^a	2.29±0.24 ^a	2.61±0.25 ^a
Colour	1.96±0.15 ^c	2.46±0.19 ^a	2.42±0.23 ^{ab}	1.76±0.18 ^c	2.14±0.25 ^{abc}	2.05±0.21 ^{abc}
Taste	2.00±0.24 ^b	2.61±0.25 ^a	2.42±0.20 ^{ab}	2.61±0.31 ^a	2.50±0.31 ^{ab}	2.52±0.39 ^{ab}
Texture	2.00±0.25 ^b	2.38±0.21 ^{ab}	2.72±0.37 ^a	2.32±0.24 ^{ab}	2.52±0.20 ^a	2.67±0.28 ^a
Aroma	2.24±0.38 ^b	2.55±0.24 ^{ab}	2.45±0.24 ^b	2.40±0.28 ^b	3.00±0.28 ^a	2.90±0.34 ^{ab}
Acceptability	2.29±0.31 ^d	2.55±0.25 ^{bcd}	2.45±0.23 ^{cd}	2.90±0.24 ^{abc}	3.32±0.33 ^a	3.15±0.41 ^{ab}

*Values are presented as mean ± standard error of the mean; the different superscripts along the same row are significantly different ($p < 0.05$)

characteristics such as appearance, colour, taste, texture, aroma and general acceptability of the treatment samples. It also depicts the mean scores of the sensory evaluation from 30 test panelists which reveals that smoked *Clarias gariepinus* can retain very good scores after 30 days of storage and the overall acceptability mean score in fish treated with T5 (50g salt, 75ml lime juice solution) indicate the product is very well accepted. There were no significant differences in the appearance score. However, the scores for colour were best in T2 (2.46±0.19) and significantly different ($p < 0.05$) from others when compared with the lowest values obtained in T1 (1.96±0.15) and T4 (1.76±0.18) making it more attractive. The mean score for taste in T2 (2.61±0.25) and T4 (2.61±0.31) were higher while T1 (2.00±0.24) had the lowest. Texture mean scores were best in T3, T5, and T6 and the least in T1. The best aroma and appearance scores were obtained in T5 and were significantly different compared to the other treatment samples. Abolagba and Osifo (2004) opined that improved shelf life of up to 30 days may be a result of activities of the salt/juice combination, smoke and heat which reduces water activity and impaired the action of spoilage microbes which, according to Omojowo and Raji (2010) were very crucial values in marketing strategy to have value addition that can have better product appeal and attract the consumer's attention.

Conclusion

This study demonstrated the effect of smoking, salt and lime juice treatment on the proximate composition and sensory characteristics of smoked *C. gariepinus*. The combination of salt and lime in the proportions as used in treatment samples T4, T5 and T6 can present quality products in terms of the increase in crude protein thereby improving the nutritive value of the product and at the same time increasing the shelf life of the products as well as consumer acceptability.

Recommendation

This work can be further extended to include microbiological evaluation of the products in order to determine their bacterial load.

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Declaration of interests

Authors have declared that no conflicting interests exist.

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