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# Effect of Gutting and Salting on the Organoleptic Qualities and Proximate Composition of Smoked-Gutted and Ungutted, Salted and Unsalted Catfish (*Clarias Gariepinus*)

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**Abstract:**

The effect of gutting and salting on the organoleptic qualities and proximate composition of smoked-gutted and ungutted, salted and unsalted catfish was studied. Live catfish fish of 8kg were procured from Doma Dam for the experiment. The fish sample was divided into four equal parts comprising of 2Kg each giving 4 samples. The experiment was conducted in a 2x2x2 factorial design comprising of 2-gutted and ungutted, 2-salted and unsalted and 2- catfish respectively. The fish samples were prepared separately for smoking as thus; sample 1 (gutted – unsalted), sample 2 (ungutted- salted), sample 3 (gutted-unsalted) and sample 4 (ungutted-unsalted) respectively. At the initial and final stage of the experiment, each fish sample was nutritionally assessed in the laboratory to determine change in nutritional composition using the method of AOAC (2000). Organoleptic parameters which included texture, taste, flavour, odour and appearance were assessed from the initial stage and later fortnightly to eight weeks of storage using a 10-point hedonic scale ranging from A (Excellent) = 10; B (Good) = 8; C (Fair) = 6; D (Unsatisfactory) = 4 and E (Unacceptable) = 2 was adopted for each quality parameter. Ten judges were used for the fortnight organoleptic assessment. Results of organoleptic assessment revealed that catfish gutted-unsalted had highest mean value of 8.92±0.15 in texture, catfish gutted salted had highest mean value of 8.48±0.22 and 8.28±0.25 in odour and flavour respectively. Catfish ungutted-salted had highest mean value of 9.40±1.64 in appearance while catfish ungutted-unsalted had highest mean value of 8.92±0.21 in taste. The proximate composition of smoked cat fish ranged each from (moisture), 3.5 – 14.0% (Ash), 10.0 – 15.0% (crude protein), 36.0 – 45.9% (ether extract) 5.0 – 15.0% (crude fibre) 1.9 – 3.50% and (Nitrogen Free Extract) 8.50 – 30.0% respectively.

**Keywords:** Gutting, Salting, Organoleptic, Proximate composition

## Introduction:

High incidence of fish losses is one of the major impediments to the realization of government goal towards increasing the contribution of the sector to the overall national economy Opara and Al-Jufaili (2006). Waste due to post-harvest losses still accounts for about 40% of the total supply and this widens the gap that exists between the quantity that is produced and that available to consumers (Akande, 1996). This level of post-harvest losses could be very significant especially in the period of fish scarcity and escalating prices and could have negative. Impact on the national food security (Eyo, 2001). This is because post-harvest losses in fish are represented by a net reduction in the amounts of nutrients potentially available to consumers either by direct physical loss or nutritional loss (Daramolaet al., 2007). Fish is highly perishable being a high protein food with typically high levels of free amino acids which microbes metabolize, producing ammonia, biogenic amines (putrescine, histamine and cadeverine), organic acids, ketones and sulphur compounds (Delgardet al., 2006). After harvest, fish is liable to accelerated physiological, chemical and microbial processes that invariably lead to deterioration and loss of wholesomeness. It is then

necessary to institute some measure of processing such as reduction in moisture content, denaturation of endogenous enzymes and microorganisms or packaging in order to curtail perish ability (Vadivel, 2008). Gutting is the removal of visceral organs, the main reason for gutting is to prevent autolytic spoilage rather than bacterial spoilage (Shewan, 1961). Gutting is usually done by cutting, but there are machines that perform gutting by sucking the viscera out and cleaning the belly part through the mouth whereas salting is one of the oldest methods of fish preservation and it is an art as well as a science of salt application to fish, the process of which is influenced by weather, size and species of fish and the quality of salt used as it is often used with drying and smoking (Casper, 2008). Catfish, Clariasgariepinus is easily and widely cultured in Nigeria and of great economic interest. It is generally considered to be one of the most important tropical catfish species for aquaculture. Although, it has a Pan African distribution, it is also commonly reared across Asia and the Middle East (Tao and Linchun, 2008; Osibona et al., 2006). While drying of fish could extend the keeping quality thereby increasing the availability of fish all year round, concerns have been raised about the appearance, texture, flavour and importantly, loss of some essential nutritional compositions (Jurkanet al., 2008; Bala and Mondol, 2008). Therefore, the present study focused on determining the effect of gutting and salting on the organoleptic qualities and proximate composition of catfish.

**Material and Methods:**

**Experimental procedures:**

This study was carried out in the Department of Aquaculture and Fisheries Management of Faculty of Agriculture Shabu-Lafia Campus, Nasarawa State University Keffi.Eight (8kg) live *Clarias gariepinus* were purchased from fish sellers in Doma market and were transported to the experimental location. The fish samples were washed with borehole water to remove dirt, rinsed with distilled water and were shared into four equal parts of 2Kg each. Each sample was allotted separate processing techniques under a completely randomized design as: sample 1 (gutted – unsalted), sample 2 (ungutted- salted), sample 3 (gutted-unsalted) and sample 4 (ungutted – unsalted) respectively. Saline water was prepared according to FAO (2001), (211-300g/litre of water) the lower range was adopted in the present study. 200g of salt was dissolved in 1litre of water to give 20% brine solution concentration. The salted fish samples were immersed in the brine solution for 30 minutes. Smoking was done using red-hot charcoal. After smoking, the smoked fish were allowed to cool and then packaged in plastic containers which were labeled 1, 2, 3, and 4 in the order to which they were treated. The smoked fish were stored in transparent containers for eight weeks of experimental period.

**Proximate analysis:**

At the onset and end of the experiment, the proximate composition of each of the sample were analysed according to the Association of Official Analytical Chemists (AOAC, 2000).

**Sensory (Organoleptic) evaluation:**

Samples from the smoked fish products were fortnightly subjected to sensory evaluation for eight (8) weeks to obtain data for the selection of the best out of the treatments for each species before storage. A 50-member trained taste panel which consisted of staff and students of the University was constituted. Questionnaire was used by the panels and scoring was done fortnightly. The samples were blind coded to reduce bias. Organoleptic parameters to be assessed will include texture, taste, flavour, odour and appearance in accordance with Poste *et al.* (1991). A 10-point hedonic scale ranging from A (Excellent) = 10; B (Good) = 8; C (Fair) = 6; D (Unsatisfactory) = 4 and E (Unacceptable) = 2 was adopted for each quality parameter. Pencils, tissue paper and water were provided to the judges.

**Data analysis:**

The data obtained was subjected to One-way Analysis of Variance (ANOVA) in a completely randomized design using SPSS statistical package 20.0 while significant mean differences was separated at 5% significance level.

**Results:**

The results of mean weekly sensory analysis of the smoked gutted and ungutted, salted and unsalted Catfish and is presented in Tables 1. Catfish gutted unsalted (CGU) hadthe highest mean score 9.00$\pm$0.33 in texture in week 0, followed by catfish ungutted unsalted (CUU) with 8.60$\pm$0.52. Highest texture mean value 9.40$\pm$0.31 was recorded in CGU for week 2. CUU had the highest 9.60$\pm$0.27for week 4, followed by CGS with 9.20$\pm$0.44 and 9.20$\pm$0.33 in week 6 and 8 respectively. Odour mean value in week 0 was highest 8.00$\pm$0.52 in CUU, followed by 9.00$\pm$0.45 and 8.40$\pm$0.50 in catfish gutted salted (CGS) for week 2 and 4. Week 6 odour mean value was

highest 9.00±0.61 in CUU followed by 8.40±0.40 in CGU in week 8. Week 0 and 2 flavours mean values was highest 8.40±0.40 and 8.80±0.50 in CGS, followed by 9.20±0.32 in CGU in week 4. Week 6 odour was highest 8.80±0.44 in CUU, followed by 8.40±0.40 in CGU in week 8. Appearance highest mean values 9.00±0.610 and 8.60±0.60 was obtained in CGU in week 0 and 2 respectively. Week 4 appearance was highest 9.60±0.27 in CGS, followed by 9.20±0.33 for CUU in week 6, while CGU had the highest appearance mean value 8.80±0.33 in week 8. Taste mean value was highest 8.80±0.53 in CUU in week 0, 9.00±0.33 and 9.00±0.45 in CGS in week 2 and 4 respectively. However, taste mean value was higher 9.80±0.20 in CUU in week 6 followed by 8.60±0.67 in CGS in week 8.

**Table 1: Mean weekly organoleptic attributes of smoked catfish**

| | WEEK | | | | |
|---|---|---|---|---|---|
| | **0** | **2** | **4** | **6** | **8** |
| **Sample 1 (CGU)** | | | | | |
| Texture | 9.00±0.33$^{b}$ | 9.40±0.31$^{a}$ | 8.80±0.33$^{c}$ | 9.00±0.33$^{b}$ | 8.40±0.40$^{d}$ |
| Odour | 8.00±0.42$^{a}$ | 7.60±0.72$^{c}$ | 8.00±0.67$^{a}$ | 8.60±0.52$^{a}$ | 8.20±0.76$^{b}$ |
| Flavour | 7.80±0.36$^{d}$ | 7.40±0.73$^{e}$ | 9.20±0.32$^{a}$ | 8.00±0.42$^{c}$ | 8.40±0.40$^{b}$ |
| Appearance | 9.00±0.61$^{a}$ | 8.60±0.60$^{c}$ | 9.00±0.54$^{a}$ | 8.20±0.47$^{d}$ | 8.80±0.33$^{b}$ |
| Taste | 8.40±0.40$^{b}$ | 8.20±0.63$^{c}$ | 8.60±0.31$^{a}$ | 8.60±0.31$^{a}$ | 8.00±0.79$^{d}$ |
| **Sample 2 (CUU)** | | | | | |
| Texture | 8.60±0.52$^{d}$ | 8.00±0.84$^{e}$ | 9.60±0.27$^{a}$ | 9.20±0.33$^{b}$ | 9.00±0.54$^{c}$ |
| Odour | 8.00±0.52$^{c}$ | 6.60±0.52$^{e}$ | 8.20±0.47$^{b}$ | 9.00±0.61$^{a}$ | 7.00±0.80$^{d}$ |
| Flavour | 6.80±0.33$^{d}$ | 7.60±0.40$^{c}$ | 8.20±0.47$^{b}$ | 8.80±0.44$^{a}$ | 7.60±0.78$^{c}$ |
| Appearance | 8.20±0.63$^{c}$ | 8.20±0.81$^{c}$ | 9.20±0.44$^{a}$ | 9.20±0.33$^{b}$ | 7.20±0.70$^{d}$ |
| Taste | 8.80±0.53$^{c}$ | 8.60±0.52$^{d}$ | 9.00±0.33$^{b}$ | 9.80±0.20$^{a}$ | 8.40±0.58$^{e}$ |
| **Sample 3 (CGS)** | | | | | |
| Texture | 8.20±0.47$^{d}$ | 8.40±0.58$^{c}$ | 9.40±0.43$^{a}$ | 9.20±0.44$^{b}$ | 9.20±0.33$^{b}$ |
| Odour | 8.60±0.43$^{c}$ | 9.00±0.45$^{a}$ | 8.40±0.50$^{d}$ | 8.80±0.44$^{b}$ | 7.60±0.58$^{e}$ |
| Flavour | 8.40±0.40$^{c}$ | 8.80±0.61$^{a}$ | 8.60±0.52$^{b}$ | 8.40±0.50$^{c}$ | 7.20±0.70$^{d}$ |
| Appearance | 9.00±0.33$^{b}$ | 8.00±0.89$^{d}$ | 9.60±0.27$^{a}$ | 8.60±0.52$^{c}$ | 6.60±0.95$^{e}$ |
| Taste | 8.80±0.33$^{c}$ | 9.00±0.33$^{b}$ | 9.00±0.45$^{a}$ | 8.40±0.72$^{e}$ | 8.60±0.67$^{d}$ |
| **Sample 4 (CUS)** | | | | | |
| Texture | 7.40±0.43$^{c}$ | 7.80±0.55$^{b}$ | 8.40±0.50$^{a}$ | 7.80±0.81$^{b}$ | 7.80±0.47$^{b}$ |
| Odour | 7.40±0.70$^{c}$ | 7.80±0.75$^{b}$ | 8.20±0.70$^{a}$ | 8.20±0.63$^{a}$ | 7.20±0.85$^{d}$ |
| Flavour | 8.00±0.42$^{c}$ | 8.00±0.73$^{b}$ | 8.60±0.60$^{a}$ | 8.00±0.79$^{b}$ | 6.40±0.93$^{d}$ |
| Appearance | 7.60±0.82$^{c}$ | 8.40±0.40$^{b}$ | 8.80±0.53$^{a}$ | 7.00±1.00$^{e}$ | 7.20±0.85$^{d}$ |
| Taste | 7.40±0.60$^{d}$ | 8.20±0.63$^{b}$ | 8.60±0.67$^{a}$ | 8.20±0.76$^{b}$ | 7.60±0.83$^{c}$ |

Mean with different superscript along the row are significantly different ($p<0.05$)
CGU = Catfishgutted unsalted, CUU = Catfish ungutted unsalted, CGS = Catfish ungutted salted, CUS = Catfish ungutted salted.

The total mean scores of sensory attributes of gutted and ungutted, salted and unsalted, catfish is presented in Table 2. Catfish gutted unsalted had a significantly higher score of 8.92 mean texture than other treatments but there was no significant difference between catfish ungutted unsalted (CGS) and catfish gutted salted (CUS). The mean odour was significantly different ($p<0.05$) in the samples. Catfish gutted salted had significantly higher mean score of 8.48 when compared with odour mean values of the other samples, however lowest mean score of 7.76 was obtained in catfish ungutted unsalted and catfish ungutted salted respectively and were not significantly different ($p>0.05$) from each other. The mean flavour was significantly different ($p<0.05$) in the samples. Catfish gutted salted had a significantly higher score of 8.28 while lowest mean score of 7.80 was obtained in catfish ungutted unsalted and catfish ungutted salted respectively whom were not significantly different from each other ($p>0.05$). Mean appearance was significantly higher in

catfish ungutted salted with 9.40, followed by catfish ungutted unsalted with 8.40. The mean taste was significantly different ($p<0.05$) in the samples assessed. Catfish ungutted unsalted had the highest mean score of 8.92 followed by catfish gutted salted with mean value 8.76.

**Table 2: Mean scores of sensory evaluations of smoked- gutted and ungutted, salted and unsalted Catfish**

| | Samples | | | |
|---|---|---|---|---|
| | **1(CGU)** | **2 (CUU)** | **3 (CGS)** | **4 (CUS)** |
| Texture | 8.92± 0.15[a] | 8.88± 0.24[b] | 8.88± 0.21[b] | 7.84± 0.25[c] |
| Odour | 8.08± 0.27[b] | 7.76± 0.28[c] | 8.48± 0.22[a] | 7.76± 0.32[c] |
| Flavour | 8.16± 0.22[b] | 7.80± 0.24[c] | 8.28± 0.25[a] | 7.80± 0.33[c] |
| Appearance | 8.72± 0.23[b] | 8.40± 0.28[c] | 8.36± 0.32[d] | 9.40± 1.64[a] |
| Taste | 8.36± 0.23[c] | 8.92± 0.21[a] | 8.76± 0.23[b] | 8.00± 0.31[d] |

Mean with different superscript along the row are significantly different ($p<0.05$)
CGU = Catfish gutted unsalted; CUU = Catfish ungutted unsalted; CGS = Catfish ungutted salted; CUS = Catfish ungutted salted.

The initial and final proximate composition smoked gutted and ungutted, salted and unsalted catfishis presented in Table 3. The moisture content of the catfish gutted unsalted, catfish ungutted unsalted, increased from the initial value of 5.00 to 10.00 and 3.50 to 8.00 respectively (Table 3). There was significant difference in the moisture content of the fish from week 0 to the end of the experimental period. The initial and final ash content in catfish ungutted unsalted and catfish ungutted salted remains the same through the experimental period 10.00 and 15.00 respectively while there was a decrease in final ash content of catfish gutted unsalted from 10.00 to 5.00 and an increase in ash content of catfish gutted salted from 12.00 to 15.00 after 8 weeks organoleptic assessment. Catfish ungutted unsalted recorded highest protein content (50.31) in the initial stage and was increased to 53.00 in the final stage of the experiment. Reduction in the value of initial crude protein content was observed in other samples. Ether extract content were highest 15.00 in catfish gutted unsalted and catfish ungutted salted in the initial stage but was decreased to 10.00 respectively in the final stage. There was equilibrium (5.00) in ether extract value of catfish gutted salted in the initial and final stage of the experiment. Initial crude fibre content of sample 1, 2, 3, and 4 was 2.70, 1.90, 2.30 and 2.80, respectively. There was significant increase in crude fibre contents of the samples in the final stage of the experiment to 3.50, 5.00 2.50 and 3.00 respectively. There was significant increase in the nitrogen free extracts of GCU, CGS and CUS from 21.36 to 31.20, 26.95 to 30.30 and 9.89 to 25.20 respectively.

**Table 3: Initial and final proximate composition of smoked gutted and ungutted, salted and unsalted Catfish**

| Sample | Week | MC (%) | ASH (%) | C.P. (%) | E.E. (%) | C.F. (%) | NFE (%) |
|---|---|---|---|---|---|---|---|
| 1 CGU | Initial | 5.00 | 10.00 | 45.94 | 15.00 | 2.70 | 21.36 |
| | Final | 10.0 | 5.00 | 40.30 | 10.00 | 3.50 | 31.20 |
| 2 CUU | Initial | 3.50 | 10.50 | 50.31 | 12.00 | 1.90 | 21.79 |
| | Final | 8.00 | 10.50 | 53.00 | 15.00 | 5.00 | 8.500 |
| 3 CGS | Initial | 10.00 | 12.00 | 43.75 | 5.00 | 2.30 | 26.95 |
| | Final | 10.00 | 15.00 | 37.20 | 5.00 | 2.50 | 30.30 |
| 4 CUS | Initial | 14.00 | 15.00 | 43.31 | 15.00 | 2.80 | 9.89 |
| | Final | 10.50 | 15.00 | 36.30 | 10.00 | 3.00 | 25.20 |

MC = Moisture, C.P. = Crude protein, E.E. = Ether extract, C.F. = Crude fibre, NEF = Nitrogen free extract.
CGU = Catfish gutted unsalted,
CUU = Catfish ungutted unsalted, CGS = Catfish ungutted salted, CUS = Catfish ungutted salted

**Discussion:**

Sensory assessment as judged by the panelist is presented in table 2. It was observed that the smoked catfish had mean score above average. The result shows that the highest mean scores were 8.92, 8.48, 8.28, 9.40 and 8.76 for texture, odour, flavour, appearance and taste respectively. This result is in line with the results of Abolagba *et al.* (2015) who reported mean values of 8.95, 8.11, 8.21, 8.95 and 8.0 for taste, flavour, colour, appearance and texture of smoked cultured *Clarias gariepinus* in Delta and Edo State. The result shows that the judges liked the smoked fish because of its flavour, juiciness and tenderness as reported by Safari *et al.* (2001). The smoked catfishscored above average, which indicates that they might still be acceptable 8 weeks after smoking. This agreed with findings of Bilgin*et al*. (2008) and Kumolu-Johnson *et al*. (2010), who reported that in terms of flavour, texture, appearance, odour and taste, the smoked catfish scored above average which indicated that they might still be acceptable 28 days after smoking. From the result of this study, gutted-smoked fish had better organoleptic attributes in comparison with ungutted-smoked fish. Fish guts are known to be a reservoir of digestive enzymes and bacteria. The digestive enzymes cause autolysis at post mortem which gives rise to strong off-flavors and off-odours especially in the belly area and at times causes belly burst (Tejada and Huidobro, 2002). The gutting process therefore destroys the reservoir of these digestive enzymes and bacteria there by reducing the process of autolysis in fish. Gutting has been reported to have an effect in extending the shelf life of fish species during chill storage (Rodriguez *et al.*, 1999). The process of gutting has also been reported to delay the ripening process in anchovies under chilled storage conditions (Mendes *et al*., 1999). George (2009) also obtained higher organoleptic values for gutted control Lake Victoria Nile perch (*Lates niloticus*) stored for 28 days of sampling. The measurement of some proximate profiles such as protein contents, carbohydrates, lipids, moisture contents and ash percentage is often necessary to ensure that they meet the requirements of food regulations and commercial specifications (Watermann, 2000). The initial proximate value obtained for the smoked catfish in this study was between 3.50-14.0, 10.0-15.0, 36.0-45.9, 5.0-15.0, 1.90-3.50 and 8.50-30.0 for moisture, ash, crude protein, ether extract, crude fibre and Nitrogen Free Extract respectively. The result of moisture content in this study is in range with 10.86 as reported by Kumolu-Johnson (2010) for smoked catfish from LASU fish pond. The ash value obtained in this study is in line with the findings of Fapohunda and Ogunkoya (2006) who reported 15.32 as ash value for smoked *Clarias gariepinus* from Akure and Ondo State, Nigeria. Ether Extract content of this study is in range with 17.0 as reported by Abolagba *et al.* (2015) in smoked *Clarias gariepinus* in Delta and Edo State. Crude protein content observed in this study was lower as compared to 68.61 by Fapohunda and Ogunkoya (2006), 66.5 by Abolagba *et al.* (2015) and 68.17 by Agbabiaka *et al.* (2012). However, the crude protein content in catfish observed was higher than 28.3% as reported for smoked catfish by Ande *et al.* (2012) in their study on proximate analysis of smoked and unsmoked catfish and tilapia in Ombi River, Lafia Nasarawa State Nigeria.The increase in the crude protein content could be as a result of the presence of food nutrients present in the gut as at the time of the assessment. Salted fish recorded the lowest crude protein level 34.56 – 51.63. This may be due appreciably to the level of loss in protein which occurs as a result of salting as it was reported by Pace *et al.* (1989) in a study on processed tilapia and trigger fish. They reported that salting or procedures which involved salting were usually accompanied by protein losses. Reduction in the percentage crude protein of the species during the period of storage could be due to gradual degradation of the initial crude protein to more volatile products such as Total Volatile Bases (TVB), Hydrogen sulphide and Ammonia. Changes observed in protein content during storage may also have been due to leaching out of some extractable soluble protein fraction (Daramola *et al*., 2007). The highly susceptible of fish to oxidative rancidity resulted from the high degree of unsaturation in the form of multiple double bonds in **fatty acids** Obemeata *et al.* (2011). By comparing pre-storage and post-storage crude fat content, a significant difference ($p<0.05$) was recorded in both of sundried and smoked chela fish. There was a reduction in crude fat (Ether Extract) content in gutted unsalted and ungutted salted fish from the initial stage to the final stage. Reduction in ether extract content could have been due to oxidation and crude fat break down into other components. That is, oxidation of poly-unsaturated fatty acids (PUFA) contained in the fish tissue to products such as peroxides, aldehydes, ketones and the free fatty acids as reported by Daramola *et al.* (2007). Fish oil has been found to be more liable to spoilage than other oils due to their greater number of unsaturated fatty acids as shown by the lower specification number and higher iodine value. The

greater the degree of instauration, the greater would be the tendency for fat oxidation (rancidity). There might be high risks of rancidity during prolonged storage conditions due to the fatty nature of fish (Daramola *et al*., 2007). The increase in the crude fibre content of salted and unsalted fish during the period of assessment in this study could be accounted for by the fact that in these samples, there had been an oxidation of their poly-unsaturated fatty acids (PUFA) components, contained in their tissues to products such as peroxides, aldehydes, ketones and free fatty acids (Daramola *et al*., 2007).

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