YIELD AND PROXIMATE COMPOSITION OF FARM – RAISED AFRICAN FRESHWATER CATFISH (*Clarias gariepinus*) FILLET

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Abstract
The study examined the yield of skinned fillets and the proximate composition of African catfish (Clarias gariepinus) with the view of developing a sustainable turnkey processing method for farmed catfish fillet. Twenty-six (26) freshly prepared live catfish weighing 25kg were harvested and transported to NIOMR. The morphological characterization of the fish was done before processing. The processing of the fish was done manually. The proximate analysis of the skinned fillet was carried out. The proximate composition of catfish fillet indicated high percent moisture, high protein, and low-fat product. The yield of the skinned fillet was 34% of the whole catfish, indicating 66% by-products, of which 61.8% can be converted to fishmeal and 4.2% to mince. The gut and skin made up 10.4% while the slime and drip loss made up 3.2% and 4.2% of the whole catfish respectively. Raw catfish, at the purchase price of ₦8,750.00 (US 58.33 dollars) and only 34% of fillet as the primary product, the cost of the skinless fillet without any fixed or variable costs is ₦25,735.29 (US 171.57 dollars), indicating an increase of 194.12% in the cost price of the whole fish. Development of a business plan and simple financial analysis for catfish fillet processing is encouraged.

Keywords: *Clarias gariepinus,* Fillet, Proximate composition**,** fishmeal, mince, slime

INTRODUCTION

Fish is an important source of human food since time immemorial and contains many high-quality proteins, vitamins, and omega-3 fatty acids, especially found in pelagic fish. Reproduction and brain development can be attributed to fatty acids that are heart-friendly (Mu, G. 2014). World per capita fish consumption almost doubled from an average of 9.9 kg in the 1960s to 18.4 kg in 2009(FAO, 2012)

The contribution of the aquaculture sector of fisheries in Nigeria to domestic consumption of fish as of 2007 is 85,087 tonnes, representing 13.8% of total domestic production (FDF, 2007). The nutritional benefits attributed to fish are particularly obtained from its exceptionally advantageous high protein content (Taiwo *et al*., 2014). As the world's population increases rapidly, and against the constraints of limited land, water, and food resources, it is more important than ever to be able to define accurately, the amount and quality of protein required to meet human nutritional needs and describe appropriately the protein supplied by food ingredients and whole foods (FAO, 2013). Farmed African catfish (*Clarias gariepinus*) production has increased dramatically in recent years and forms over 90 percent of farmed fish. With the potential and promise of further production increases, it is essential to provide information on the development of techniques for fillet production, value-added products from catfish, to further enhance its market expansion. The high demand for convenience foods in Nigeria which are presently coming in as imported products has created a large market for boned fish. Fillets are now getting popular in the country as they are now convenient for a housewife to cook with no further preparation. The most important factor in the profitability of value-added fish production (aside from selling price) is usually the yield of the finished product. However, the processor is left with a lot of waste to get rid-off (carcass) which therefore necessitates charging a higher price for the fillets. The cost of raw material represents the largest percentage of total costs. As consumption grows, consumers have developed higher standards for product quality. Therefore, stronger attention to procedures for maintaining the freshness and quality of the fish is needed by processors. Fresh seafood quality along the value chain depends on the characteristics and condition of the raw material, as well as on factors such as temperature management, relative humidity of the air, hygiene, and handling of fish (Valtysdottir *et al*. 2010).

It is also necessary to understand how processing procedures affect the interrelationship between yield, throughput, and final profitability. The processing yield of various fish species depends almost entirely on the shape of the fish, the size of the head, and the amount of meat that can be extracted from the usable flesh. The knowledge of proximate chemical composition is also very important. Information on protein, oil, ash, and moisture content is needed for effective utilisation while processors and consumers have a direct interest in the composition and safety of the fish product they consume. The present work examined the yield of skinned fillet and the proximate composition of African catfish (*Clariasgariepinus*) with the view to developing a sustainable turnkey processing method for farmed catfish fillet.

MATERIALS AND METHOD

Freshly harvested live catfish were obtained from a commercial farm in Lagos. As at the time of purchase, the selling price was ₦650.00/kg. This price can vary across sizes and is also affected by changes in prices of feed fed to the fishes during rearing. Twenty-six samples, weighing 25kg were collected and transported to Nigeria Institute for Oceanography and Marine Research (NIOMR) Fish Technology processing laboratory. The morphological characterisation of the fish was done before processing. The measurements taken were weight(kg) for all samples using top loading weighing scale (OHAUS® Pioneer™), total body length (cm), standard length and head length for each sample using standard graduated fish measuring board.

Catfish Fillet Processing

Figure 1 shows the flow chart for the catfish filleting process. The fish upon receipt were sorted and weighed. Stunning of the fish was done using some quantity of food-grade common salt (NaCl), 5 percent (w/w) which was sprinkled on the fish in a closed plastic container and allowed to stay for 10minutes. The fishes were cleaned and slime removed manually by dipping in water containing 3.5% aluminium sulphate (w/v) and the skin gently robbed to remove the slime and some adhering particles. Cleaned fish were removed and placed on a clean plastic cutting board.

Using stainless steel filleting knife, the fish was headed and gutted (H&G) manually. Filleting and skinning of the fillet were done manually using the knife. The skinned fillet was washed in clean sterile water, allowed to drain, and manually vacuum packed in transparent low-density polyethylene (LDPE) bag using a tabletop vacuum sealer. Storage of the packaged fillet was done and stored in a chest freezer operating at a temperature of -20℃. Plate 1 shows the skinless catfish fillet.

Yield Analysis

The yield at each processing stage was determined by weighing the respective output using a top-loading weighing balance. The frame was further processed by passing it through a Baader® 694 (Lubeck, FRG) belt and drum flesh-bone separator with 5mmdrum perforations to recover the mince from the frame. The minced obtained was weighed and yield determined. The percent yield output at each processing stage was determined by expressing the respective weight as the rate of the weight of raw whole fish before processing multiply by 100. Thus the yield of the skinned fillet was determined according to equation (1).

$$\%Y_{fillet} = \frac{W_{fillet}}{W_{fish}} \times 100$$

The weight of fluid (the blood, slime, and drippings) from the fish was determined by difference according to equation (2)

$W_{fluids} = W_{fish} - (W_{fillet} + W_{head} + W_{frame} + W_{guts} + W_{mince})$

From equations (1) and (2); Yfillet is the yield of the skinned fillet. Wfillet, Wfish, Wfluids, Whead,Wframe, Wguts, Wmince are the weights of the skinned fillet, raw whole fish (as received from the farm), fluids (including blood, slime, and drippings) from the fish, head (and gills), frame (including fins and bones only, no head), guts (and skin) and mince (recovered from the frame and trimmings).

Proximate analysis of the skinned fillet: Catfish fillets, freshly prepared (before freezing) were analysed for moisture, crude fat, crude protein, ash, and carbohydrate.

Determination of crude protein was carried out using Kjeldahl procedure of nitrogen factor 6.25 (Pearson, 1981), total lipid determination method (Bligh and Dyer, 1959), moisture content determination by oven drying at 103±2℃ and ash determination by incinerating in a muffle furnace at 525℃. Carbohydrate was determined by the difference between the total dry sum of ash, protein, crude fat, and fiber subtracted from 100.

NFE = 100 – (% Ash + % Crude Fiber + % Crude lipid + % Crude protein).

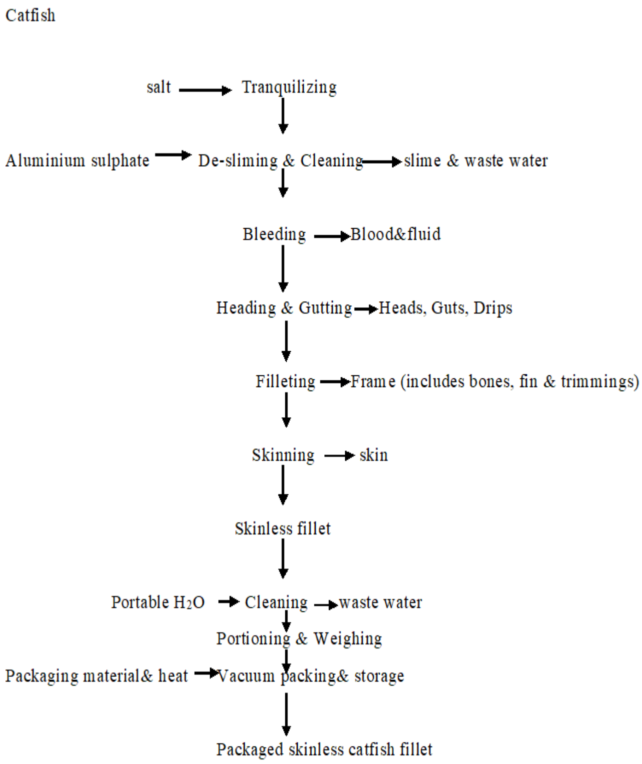

Figure 1: Flow chart for Catfish (*Clarias gariepinus*) filleting process

Plate 1: Skinless catfish (*Clarias gariepinus*) fillets (a) freshly prepared (b) Vacuum packed & frozen

RESULTS AND DISCUSSION

The morphological feature of the catfish used for the production of the fillet is shown in Table 1. The total weight for all samples measured together was 25kg.

The data for the weight and yield of the catfish filleting process is presented in Table 2. The yield of the skinned fillet, the primary product is 34% of the whole catfish. This shows that 66% are processing bye products or waste from the catfish filleting process of which heads and frames contribute 31.2% and 17% respectively. The guts and skin, 10.4% while slime and drip loss constitute 3.2% and mince, 4.2%. The yield of the fillet is less than 40% which could be attributed to the large head structure. Yield is also a function of the quality of the fish. Studies on the technological properties of Bonga fish have shown that those with large heads relative to the muscle produce smaller yields and vice versa (Akande and Faturoti, 2005). The low yield could also be attributed to manual filleting efficiency which is a function of the dexterity of the processor.

The flesh-bone separation process produced 1.05kg of mince representing 19.81% of frame and trimmings. A more in-depth study on this fish species will help give more information which will lead to more research.

Considering the effect of yield on the catfish filleting process; at the purchase price of the raw catfish of ₦8,750.00 (US 58.33 dollars) and only 34% of fillet as the primary product, the cost of the skinless fillet without any fixed or variable costs is ₦25,735.29 (US 171.57 dollars). This amounts to an increase of 194.12% of the buying price of the whole fish. However, conversion of the waste to fishmeal at a ratio of 5:1 will give a yield of 3.1kg. The protein of fish meal from fish waste, for example, canned tuna waste has been reported to be 54percent crude protein (CP). The selling price of imported 72percent crude protein fish meal is ₦500.00 (US3.33 dollars) per kg. Assuming catfish waste fishmeal (54% CP) sells for ₦375.00 (US 2.5dollars) per kg, this amount to ₦116.50 (US7.75 dollars) for the recoverable waste from catfish meal. Additional ₦525.00 (US3.5 dollars) would be realised from minced, selling for ₦500.00 (US 3.33dollars) per kg. Hence, total recoverable waste from catfish amounts to ₦1687.50 (US11.25 dollars) representing 19.3 percent of buying price of whole fish. One of the major contributory factors to fish flesh development is the kind of feed given to fish. Feed composition is directly proportional to flesh production. The more adequate the content of the feed, the better and more the flesh.

The proximate composition of the fillet is shown in Table 3. This shows that the fillet is low in lipid and high in protein. The average values of constituents obtained are in agreement with the published data for catfish (Igbabul, *et al.*, 2009); however, with very little variation of numerical values. This variation might be due to the type of species used, climatic and environmental conditions to which the fish sample was subjected before processing.

CONCLUSION

The yield of fillet was 34% of the whole fish while 66% accounted for the yield of by-products, of which 61.8% can be converted to fishmeal and 4.2% to mince. The effect of yield on the filleting process showed an increase of 194.12% on the cost of buying raw whole fish excluding any fixed or variable costs.

Future Plan

Development of business plan and simple financial analysis for catfish fillet, processing plant, and other value-added products from catfish fillet (smoked fillet), high lighting the effect of yield at various stages of production on the profitability.

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Table 1: Morphological feature of the farm-raised African freshwater Catfish (*Clarias gariepinus*).

Parameters	Mean[a]	Range	Std.D
Total Bodyweight (kg)	0.96	0.9 - 1.2	0.09
Total length (cm)	51	48 - 55.5	1.66
Standard length (cm)	41.7	38.4 - 45.3	1.6
Head length (cm)	11.8	10.5 - 13.5	0.75
Total weight for all fish samples (kg)[b]	25		

[a]Values are mean of 26 measurements
[b]value is the weight of the 26 fish samples measured together

Table 2: Weight and yield of catfish filleting process

Yield indices	Weight (kg) Yield[a] %	Yield[a]%
Whole fish	25	100
Skinless fillet	8.5	34
Heads	7.8	31.2
Frame	4.25	17
Guts, skin	2.6	10.4
Slime and drip loss	0.8	3.2
Mince from frame	1.05	4.2

[a]Expressed as a percentage of the weight of whole fish

Table 3: Proximate composition of farm-raised African freshwater Catfish fillet

Constituent	(g/100g fillet)[a]
Water	77.2 ± 0.69
Protein	17.12 ±0.12
Lipid	3.39 ± 0.78
Ash	1.53 ± 0.12
Carbohydrate	0.75 ± 0.00

[a] Mean of three replicates and standard deviation. The proximate composition of catfish fillet indicated high percent moisture, high protein, low-fat product.