Effect of Length of Delay after Slaughter (LODAS) on Quality of Raw Catfish (*Clarias gariepinus*)

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Abstract: The effect of delay after slaughter on microbial quality, proximate composition and sensory scores of raw catfish, Clarias *gariepinus* (Burchell, 1822) was evaluated. A total of 52 live catfish weighing 700.0 ± 7.0g were used. Ten freshly slaughtered fish samples each were selected for organoleptic assessment at 0, 4, 8 and 12 hours post-slaughter, while three fish samples each were selected for chemical and microbial analyses. Microbial load on fish samples increased significantly ($P < 0.05$) with increase in length of delay after slaughter, LODAS. Bacteria isolated included *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Bacillus spp* and *Staphylococcus aureus*. Percent protein and ash contents of fish samples increased with increasing LODAS, while moisture content decreased and lipid was not affected. It was observed that raw *C. gariepinus* retained most of its physical attributes up to 4 hours post-slaughter. These quality attributes except colour and odour of gills, deteriorated significantly ($P < 0.05$) at every successive four-hour post-slaughter interval. Significant negative correlation existed between LODAS and sensory quality of raw fish (eyes, $r = -0.966$, $P < 0.05$; gills, $r = -0.980$, $P < 0.05$; skin, $r = -0.998$, $P < 0.01$; and odour, $r = -0.994$, $P < 0.01$). This study established that quality of raw *C. gariepinus* deteriorated with increasing LODAS and that raw *C. gariepinus* was not totally unacceptable when delayed for 12 hours after slaughter at ambient temperatures.

1. Introduction

Population growth is accompanied by increasing demand for food. Direct human consumption of fish reached an estimated 103 million tons in 2003 (World Fish Center, 2009). Fish and fish products constitute more than 60% of the total protein intake in adults especially in the rural areas where they are widely accepted and form a much-cherished delicacy that cut across-economic, age, religious and educational barriers (Adeleye, 2003). Fish is a rich source of essential nutrients required for supplementing both infant and adult diets (Abdullahi *et al.*, 2001), however, poor post-harvest technology (handling, preservation and processing) cause deterioration and spoilage (Kumolu-Johnson *et al.*, 2010). An estimated post-harvest loss of over 40% of total fish landings have been reported in Nigeria (Akande, 1996). Akande and Ola (1992) reported that traditionally in Nigeria, fish are left at tropical ambient temperatures (27 ± 2 °C), for several hours after harvesting and this leads to rapid quality deterioration before reaching the market, thereby calling for more attention to post-harvest handling of fresh water fish species being cultured. *C. gariepinus* was used in this study because it is an economically important freshwater fish, and enjoys wide acceptability. It is extensively cultivated in ponds but

it is sometimes under-priced (Kumolu-Johnson, 2010). The study thus aimed at assessing the effect of Length of delay after slaughter (LODAS) on microbial, chemical and organoleptic characteristics of raw *C. gariepinus* with the specific objective of determining the appropriate LODAS for premium quality raw *C. gariepinus.*

2. Materials and Methods

Collection of samples

52 live *Clarias gariepinus* were collected from the concrete tank of the Nigeria Institute for Oceanography and Marine Research (NIOMR). They were brought to the laboratory immediately for analysis.

Microbiological analysis

The fish were slaughtered using a sharp knife, gutted, washed with clean water and allowed to drip and later spread in the laboratory at ambient temperatures ($27^0C \pm 2$). Thereafter, twelve samples of *C. gariepinus* were filleted to determine their proximate composition and microbial load, Samples were collected at four time intervals including 0 hour (immediately after slaughter), 4, 8 and 12 hours after slaughter respectively. Three replicates each were

collected from each treatment for the determination of proximate composition and microbial load. The microbial count was determined using routine microbiological procedures described by Olutiola *et al.* (1991) and Fawole and Osho (1995). Identification of microbes was carried out using Bergey's Manual of Determinative Bacteriology.

Proximate Analysis

The determination of the crude protein, moisture, ash and fat contents of the raw and smoked fish were carried out in triplicates in accordance with AOAC (1995).

Organoleptic (sensory) Assessment

Forty samples (ten at each collection hour) were collected for organoleptic assessment and ten replicates each were collected from each treatment for organoleptic assessment.. Sensory evaluation was carried out by a ten man-trained panel from NIOMR using a 5-point hedonic scale modified from Eyo (2001) and Tobor (1994). The following grades where allotted depending on the condition of the fish. $8 \leq 10$ = very good, $6 \leq 8$ = good, $4 \leq 6$ = fair, $2 \leq 4$ = bad and ≤ 2 = worst. Eyes, gills, skill, odour and flesh were examined for raw fish samples.

Table 1: Total Microbial Count of raw *Clarias gariepinus*

Hour	TVC (Cfu/g)	Log Cfu/g ± SD
0	3.37×10^5	5.52 ± 0.03[a]
4	3.49×10^5	5.54 ± 0.01[b]
8	5.50×10^5	5.74 ± 0.02[c]
12	7.31×10^5	5.87 ± 0.03[d]

*Values with different superscript in the column indicates significant difference at P < 0.05
** Values represent pooled means vertically of triplicate determination

Statistical analysis

Analysis of variance (ANOVA) was carried out using F-test to determine the treatments level of significance.   Treatments were separated using Duncan Multiple Range Test (DMRT) (Duncan, 1955) at 95% confidence value (P<0.05). Correlation analysis was carried out to determine the relationship between LODAS and sensory qualities of the fish.

3.   Results

Results of the microbiological study (Table1) indicated that total viable count (TVC) of raw fish samples analyzed immediately fish was slaughtered recorded the lowest TVC of 3.37 ×10 (Cfu/g). TVC

value increased significantly (P<0.05) up till 12 hours post slaughter. This is in accordance with the report of Hood *et al.* (1983) that microbial load increases with duration of storage and temperature. This study established that fish left at ambient temperatures up to 8 hours post slaughter still have a TVC that falls within the maximum recommended bacterial count for good quality fish product i.e. 5×10^5 ($5.7 \log_{10}$ Cfu/g) according to the *International Commission on Microbiology Safety for Foods,* ICMSF, (1986). However, this value was exceeded by raw fish samples left at ambient temperature for 12 hours post slaughter with the value of 7.31×10^5 / $5.869 \log_{10}$ (Cfu/g) yet the fish was not totally unacceptable as it had not exceeded the maximum recommended bacterial counts for marginally acceptable products which is 10^7 ($7 \log_{10}$ Cfu/g) (ICMSF, 1986). This is in accordance with the recommendation of Abdul-Raouf *et al.* (1993) that food-borne illness resulting from the consumption of any food is dependent upon a number of factors including contamination with a pathogen and the survival of the pathogen until the time of consumption at levels sufficient to cause illness. *Escherichia* c*oli*, *Klebsiella pneumoniae*, S*taphylococcus aureus*, *Pseudomonas aeruginosa* and *Bacillus spp* where isolated from *C. gariepinus* (Table 2).

Table 3 presents the proximate composition of raw *C. gariepinus*. The highest moisture content (78.32 ± 0.50) was recorded in freshly slaughtered *Clarias gariepinus* (0 hour) and these values decreases significantly (P<0.05) with increase in post slaughter intervals. The percentage protein contents of raw samples increased significantly (P<0.05) with increase in post slaughter interval, this could be due to loss of moisture and an increase in dry matter content per unit of weight following sample dehydration (Omojowo, 2008). The result established that *C. gariepinus* had similar ash content between 0 and 4 hours post slaughter, followed by 8 and 12 hours post slaughter. However, hours of delay after slaughter had no significant (P<0.05) effect on the lipid of raw *C. gariepinus.*

The effects of post-slaughter interval on the sensory quality of raw *C. gariepinus* are presented on Table 4. *C. gariepinus* retained most of its original freshness up to 4 hour post slaughter. The eyes were transparent, clear and protruding with a white cornea and dark pupil. The gills had bright red colour and fresh odour, while the skin was bright with shiny slime and a firm belly; and the flesh was still firm, flexible and elastic; while the odour was fresh and sea weedy. This result agrees with similar findings by Akande and Ola (1992), that African catfish, *Clarias gariepinus* retained most of its original freshness up to 3 hours. There was significant (P<0.05) changes in

the condition of the eyes, gills, skin, flesh and odour of the raw fish delayed for 4 hours post slaughter interval. However, *C. gariepinus* started losing its physical attributes when delayed for 8 and 12 hours post slaughter. Similar findings were reported by Akande and Ola (1992) that deterioration was rapid in *Clarias gariepinus* delayed for 7 and 9 hours at ambient temperatures after slaughter.

Table 5 describes the relationship between LODAS and sensory quality of raw *C. gariepinus*. There was significant negative correlation between LODAS and sensory quality of raw fish i. e. eyes (r = -0.966*, P < 0.034), gills (r = -0.980*, P < 0.020), skin (r = -0.998**, P < 0.002), and odour (r = -0.994**, P < 0.006). Significant correlation existed between the sensory quality of eyes and some

physical attributes of raw such as gills (r = 0.971*, P < 0.029), fish skin (r = 0.948*, P < 0.05) and odour (r = 0.975*, P < 0.025). There was also significant positive correlation between colour and odour of raw fish gills and skin (r = 0.966*, P < 0.034), as well as odour (r = 0.996**, P < 0.004). This result established a negative linear correlation between LODAS and the sensory quality of *C. gariepinus*. As sensory quality of the eye deteriorated all other sensory qualities of the fish deteriorated. Also as gills of the raw fish deteriorated by losing its brightness and freshness, the fish skin and odour also deteriorated. This agrees with the opinion of Akande and Ola (1992) that leaving fish at ambient tropical temperatures for several hours post-harvest leads to rapid quality deterioration.

Table 2: Bacterial Isolates From Raw Fish Samples

Samples	*Escherichia coli*	*Klebsiella pneumoniae*	*Staphylococcus aureus*	*Pseudomonas aeruginosa*	*Bacillus spp*
0	+	+	+	+	+
4	+	+	+	+	+
8	+	+	+	+	+
12	+	+	+	+	+

+: Presence

Table 3: Mean proximate composition of raw *C. gariepinus* at different post slaughter intervals

Hours	Moisture (%) $\pm$ SD	Protein (%) $\pm$ SD	Lipid (%) $\pm$ SD	Ash (%) $\pm$ SD
0	78.32 ± 0.50 [a]	18.01 ± 0.34 [d]	1.11 ± 0.35 [a]	1.13 ± 0.04 [b]
4	78.30 ± 0.12 [a]	19.00 ± 0.21 [c]	1.10 ± 0.30 [a]	1.04 ± 0.02 [b]
8	74.91 ± 0.12 [b]	19.70 ± 0.03 [b]	1.44 ± 0.21 [a]	2.88 ± 0.12 [a]
12	72.16 ± 0.16 [c]	21.99 ± 0.35 [a]	1.68 ± 0.39 [a]	2.97 ± 0.12 [a]

* Values with different superscript in the column indicates significant difference at P < 0.05

** Values represent pooled means vertically of triplicate determination

Table 4: Mean sensory score of raw *C. gariepinus* at different post slaughter intervals.

Hours	Raw Fish Samples				
	Eyes $\pm$ SD	Gills $\pm$ SD	Skin $\pm$ SD	Odour $\pm$ SD	Flesh $\pm$ SD
0	8.20 ± 0.43 [a]	9.00 ± 0.45 [a]	8.40 ± 0.67 [a]	8.80 ± 0.91 [a]	8.60 ± 1.03 [a]
4	7.00 ± 0.32 [b]	7.20 ± 1.11 [b]	7.40 ± 0.37 [b]	7.00 ± 0.23 [b]	7.00 ± 0.88 [b]
8	6.80 ± 0.33 [c]	6.40 ± 0.74 [b]	6.00 ± 0.44 [c]	5.80 ± 0.43 [c]	5.60 ± 0.32 [c]
12	6.00 ± 0.65 [d]	3.80 ± 1.27 [c]	5.00 ± 0.32 [d]	3.60 ± 0.85 [d]	5.80 ± 0.25 [d]

* Values with different superscript in the column indicates significant difference at P < 0.05

** Values represent pooled means vertically of triplicate determination

Table 5: Correlation between LODAS and sensory qualities of raw *C. gariepinus*

	Time (hr)	Eyes-Raw fish	Gills-raw fish	Skin-Raw fish	Odour-Raw fish	Flesh-Raw fish
Time (hr)		-.966[*]	-.980[*]	-.998[**]	-.994[**]	-.917
		.034	.020	.002	.006	.083
Eyes-Raw fish			.971[*]	.948	.975[*]	.904
			.029	.052	.025	.096
Gills-raw fish				.966[*]	.996[**]	.837
				.034	.004	.163
Skin-Raw fish					.985[*]	.924
					.015	.076
Odour-Raw fish						.879
						.121
Flesh-Raw fish						

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4. Discussions

This study established that spoilage increased with increase in LODAS. It also established that raw *C. gariepinus* was not totally bad when delayed for 12 hours after slaughter at ambient temperatures because bacteria count have not exceeded the maximum acceptable quality. However, it should not be delayed beyond 12 hours after slaughter before processing because fish with LODAS of 12 hours have bacterial counts that had already gone beyond maximum recommended bacterial counts for good quality product. Akande and Ola (1992) recommended that raw *C. gariepinus* should not be delayed for 15hours at ambient temperatures before processing.

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References

1. World Fish Center. The threat to fisheries and aquaculture from climate change. World Fish Center. 2009: 8.
2. Adeleye, O. A. conservation needs of fisheries resources and reorientation for sustainable captive and culture practices. Proceedings of the 10th annual Conference, Fisheries Society of Nigeria, 2003: 230-234.
3. Abdullahi, S. A, Abolude, D. S. and Ega, R. A. Nutrient quality of four oven dried fresh water catfish species in Northern Nigeria. Journal of Tropical Biosciences, 2001: 1(1): 70-76.
4. Kumolu-Johnson, C. A., Aladetohun, N. S. and Ndimele, P. E. The effects of smoking on the nutritional qualities and shelf-life of *Clarias gariepinus* (LACEPEDE). African Journal of Biotechnology, 2010: 9(1): 073 – 076.
5. Akande, G. R. Post-harvest processing in Fisheries. A paper presented at training for officers of UNDP assisted programme on artisanal fisheries development, Ogun State at Federal College of Fisheries and Marine Technology, Lagos, 1996:1- 20.
6. Akande, G. R. and Ola, J. B. Quality changes in iced African catfish (*Clarias gariepinus).* Mysore J. Agric. Sci. 1992: 26:324-328.
7. Olutiola, P. O., Famurewa, O. and Sonntag, H. G. An introduction to General Microbiology: A Practical Approach. Heidelberger Verlagsanslait Druckerei, Heidelberg Germany, 1991:112–175.
8. Fawole, M. O. and Osho, B. A. Laboratory Manual of Microbiology. Shalom prints Ibadan Nigeria, 1995:25 – 30.
9. AOAC, Official Methods of Analysis (16th Ed). Association of Official Analytical Chemist, Arlington, V. A. 1995:1298.
10. Eyo, A. A. Fish processing technology in the tropics. National Institute for Freshwater Fisheries Research (NIFFR), New Bussa Nigeria, 2001: 405.
11. Tobor, T.G. Fish production and Processing on Nigeria. NIOMR Tech.1994:22.
12. Duncan, D. A. Multiple range and multiple F-test. Biometrics, 1955: 11: 1- 42.
13. Hood, M. A., Ness, G. E., Rodrick, G. E. and Blake, N. J. Effects of storage on microbial loads of two commercially important shellfish species. *Crassostrea virginica* and *Mercenaria campechiensis.* Appl. Environ. Microbial, 1983: 45 (4).
14. ICMSF, Microorganisms in Foods 2: Sampling for Microbiological Analysis. Principles and Specific Applications, 2nd Edition. Oxford: Blackwell Science, 1986: 398.
15. Abdul-Raouf, U. M., Beuchat, L. R. and Ammar, M. S. Survival and growth of *Escherichia coli* 0157:H7 on salad vegetables. Applied and Environmental Microbiology, 1993:59:1999–2006.
16. Omojowo, F.S. Impact of antimicrobial agents on the safety and shelf life of smoked fish. Unpublished Master's Dissertation, University of Ilorin, 2008: 88p.

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