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EFFECTS OF LENGTH OF DELAY AFTER SLAUGHTER (LODAS) ON RAW CATFISH *Clarias gariepinus* (Burchell, 1822)

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ABSTRACT

The effect of delay after slaughter on microbial quality, proximate composition and sensory scores of raw catfish, Clarias gariepinus was evaluated. A total of 52 live catfish (average weight 700.0 ± 7.0g) were used for the experiment. 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.

Keywords: *Clarias gariepinus*, microbiology, proximate composition, organoleptic assessment.

INTRODUCTION

Population growth is accompanied by increasing demand for food fish, with direct human consumption of fish reaching 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, 1992). 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 ^{o}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 is sometimes under-priced (Kumolu-Johnson, 2010). The study thus aimed at assessing the effect of 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.*

MATERIALS AND METHODS

52 live *Clarias gariepinus* were collected from the concrete tank of the Nigeria Institute for Oceanography and Marine Research (NIOMR). 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 ± 2). Thereafter, twelve samples of *C. gariepinus* were filleted to determine their proximate composition and microbial load, while forty samples (ten at each collection hour) were collected for organoleptic assessment. 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 while ten replicates each were collected from each treatment for organoleptic assessment.

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).

Microbiological analysis

The microbial count was determined using routine microbiological procedures described by Olutiola *et al.* (1991) and Fawole and Osho (1995) and identified using Bergey's Manual of Determinative Bacteriology.

Organoleptic (sensory) 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≤10 = very good, 6≤8 = good, 4≤6 = fair, 2≤4 = bad and ≤2 = worst. Eyes, gills, skill, odour and flesh were examined for raw fish samples.

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.

RESULTS AND DISCUSSION

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 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 coli, Klebsiella pneumoniae*, S*taphylococcus aureus, Pseudomonas aeruginosa* and *Bacillus spp* where isolated from ***C. gariepinus***.

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.

CONCLUSION

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. Infact, Akande and Ola (1992) recommended that raw *C. gariepinus* should not be delayed for 15hours at ambient temperatures before processing.

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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

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 (%) ± SD	Protein (%) ± SD	Lipid (%) ± SD	Ash (%) ± 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.

	Raw Fish Samples				
Hours	Eyes ± SD	Gills ± SD	Skin ± SD	Odour ± SD	Flesh ± 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						