

EVALUATION OF HETEROCLARIAS QUALITY WITH INCREASED STORAGE TIME USING QUALITY INDEX METHOD (QIM)

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Abstract: The quality of Heteroclaris with increased storage time using Quality Index Method (QIM) was evaluated. 140 live samples of Heteroclaris (average weight 230 ± 7 g) were used for the study. QIM was used to evaluate the key parameters in fish deterioration, twenty semi-trained assessors was used for the sensory evaluation. Data obtained were subjected to appropriate statistical tools using SPSS 16.0 version. Quality Index (QI) of Heteroclaris increases with increased post slaughter time when the fish was left at ambient temperatures ($27 \pm 3^\circ\text{C}$) indicating decrease in fish quality with time. High correlation of ($r=0.993$) with a high coefficient of determination ($R^2=0.986$) was obtained indicating that 98.6% of the variation in post slaughter time was explained by quality attributes; the regression equation was significant $F(9, 130)=1080$ ($p<0.0001$) indicating that it could be used for prediction and estimation of fish quality, the QI used in this study is therefore recommended to be used by relevant agencies for predicting fish quality.

Practical Applications : Fish is highly perishable despite its nutritional value, consumers becoming increasingly interested in the quality of fish they consume and the physical attributes of the fish is very vital for on the spot assessment of fish quality. This study provide quality index that could be used for prediction and estimation of fish quality using sensory evaluation.

Keywords: Heteroclaris; quality; storage time; Quality Index Method (QIM).

I. Introduction

Fish is an important component of human diet due to the high content of long chain polyunsaturated fatty acids (LCPUFAS) which is required for improved health condition and prevention of diseases among the old people [1]. Ayeloja [2], stated that fish is vital in the fight against nutritional and food insecurity prevalent in many developing countries such as Nigeria as it supplies good quality polyunsaturated fatty acids (PUFA's), protein, minerals and vitamins which are essential for good health of the citizens. The protein content of fish is highly required by pregnant women for proper development of the foetus and young children as it enhances the proper mental and immunity development against disease among growing children [3]. Many people also consume fish as a major animal protein in their diets because of its low market price and availability making it the most consumed animal protein source in many developing countries [4]. Ayeloja [5], reported that the increase in the consumption of fish as the major animal protein could be attributed to its low price, and its acceptance by people of different religious believes unlike some other animal products. In spite of all the importance of fish, it is one of the most rapid perishable foods because of its short shelf life; the rate of fish spoilage is also accelerated by poor postharvest handling, weather conditions, fish species and storage temperature [2]. Ayeloja [6,7], stated that the practice of leaving harvested fish at ambient temperatures ($20 \pm 2^\circ\text{C}$) for several hours without processing also lead to rapid quality deterioration of fish and huge economic loss to fish farmers, consumers are also becoming increasingly interested in the quality of fish they consume and the physical attributes of the fish is very vital to immediately access fish quality in the market thus the need for this research.

II. Materials and Methods

140 live samples of Heteroclaris (hybrid catfish) average weight 230 ± 7 g were collected at a commercial fish farm within Ilorin metropolies, Kwara state, North-Central Nigeria and transported to a 1500 litre capacity plastic tank where they were acclimated for 7days. Thereafter, the fish were euthanized as described in [5], by adding 20g table salt/kg fish in plastic container for 10 min, they were then divided into seven groups comprising 20 pieces in each group and stored at ambient temperature ($27 \pm 3^\circ\text{C}$); samples were collected at four hour intervals for 24 hours (i.e. 0, 4, 8, 12, 16, 20 and 24

hours). Sensory evaluation was carried out by a twenty semi-trained panelist from Department of Aquaculture and Fisheries, University of Ilorin Nigeria using the QIM scheme developed by [8]. The appearance of fish colour appearance, skin mucus, fish odour, fish texture, eyes form, gill colour appearance, gill mucus and odour of gills were the qualities evaluated.

1. Data analysis

The data collected were subjected to both descriptive using mainly measure of central tendencies (mean and standard deviation) depicted on a line graph drawn using Microsoft excel and inferential statistics Inferential statistics (correlation and multiple regression analysis) was used to test whether relationship exist between QIM and post slaughter time interval Principal component analysis (PCA) was used to select variable of importance to fish quality using eigenvalue of 1 prior to which the data has been found to favorably comply with Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. All the analysis were conducted using SPSS version 16.

III. Results

1. Quality Index Attributes and Post Slaughter time

This result on Figure 1 indicates that the average score for colour appearance of the fish increased with storage time and there is linear relationship with high correlation ($r^2 = 0.995$) between the colour appearance and post slaughter time.

Figure 2 indicates that the average score for skin mucus of the fish increased with storage time and there is linear relationship with high correlation ($r^2 = 0.939$) between the skin mucus appearance and post slaughter time. Figure 3 shows that the average score for fish odour of the fish increased with storage time and there is linear relationship with high correlation ($r^2 = 0.947$) between the fish odour and post slaughter time. Figure 5 indicates that the average score for eye pupils of the fish increased with storage time and there is linear relationship with high correlation ($r^2 = 0.966$) between the eye pupils of the fish and post slaughter time. Figure 6 indicates that the average score for eye form of the fish increased with storage time and there is linear relationship with high correlation ($r^2 = 0.965$) between the eye form and post slaughter time. Figure 7 indicates that the gill colour appearance of the fish increased with storage time and there is linear relationship with high correlation ($r^2 = 0.984$) between the gill colour appearance and post slaughter time. Figure 8 indicate that the average score for gill mucus of the fish increased with storage time and there is linear relationship with high correlation ($r^2 = 0.965$) between the gill mucus and post slaughter time. Figure 9 depicts that the average score for gill odour of the fish increased with storage time and there is linear relationship with high correlation ($r^2 = 0.967$) between the gill odour and post slaughter time. The average scores for the individual quality attributes score increased with increase post slaughter time (Table 1) implying that the quality attributes deteriorate with post slaughter time

2. Principal Component Analysis (PCA)

Prior to a factor analysis, sampling adequacy and sphericity test was conducted to see if our data could be used for factor analysis. The result of this study above (Table 2) showed that KMO value is 0.958, therefore we can proceed with our factor analysis. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of 0.958 shows that our variables are so highly correlated that we cannot distinguish between them (multicollinearity). A general rule of thumb is that a KMO value should be greater than 0.5 for a satisfactory PCA to proceed. The higher the value the better. Bartlett's Test of Sphericity depicting a p value < 0.0001 indicates that the data in this study could be used for factor analysis since $p < 0.05$ is the baseline for compliance of data for PCA.

3. Extraction Method: Principal Component Analysis

Communality (Table 3) shows the proportion of the variability in the variables that can be explained by the components. All the extracted variables can explain more than 80% of the variability in each variable except the gill odour. Table 4 shows that only one component has Eigen value greater than 1 accounting for 88.64% of the variability in the variables. The scree plot is presented in Figure 10.

4. Regression Analysis

The multiple regression equation depicted in Table 5 was significant $F(9, 130)=1080$ ($p<0.0001$). The t-values of all the predictors (quality attributes) were significant except gill mucus and gill odour. The t-values for components of the regression equation were all significant ($p<0.05$). A high correlation of ($r=0.993$) between quality attributes and post slaughter time was observed with a high coefficient of determination ($R^2=0.986$).

IV. Discussion

The increase in the average score allotted by panelists for the parameters used as quality index in this study (Figures 1 -9) with increase post slaughter intervals indicates that the sensory quality of *Heteroclaris* decreased with increase post slaughter time intervals when the fish was left at ambient temperatures because the higher the QI the lower the fish quality. The results (Figures 1-9) further show a high positive correlation between the quality index parameters' values and post slaughter time. This indicates that the longer the post slaughter time, the lower the fish quality because the higher the value of QIM the poorer the quality of fish. Ayeloja [2], observed similar results in their study of 'Effect of Length of Delay after Slaughter (LODAS) on quality of raw catfish (*Clarias gariepinus*)' where it was observed that the sensory quality of *C. gariepinus* deteriorated with increased storage time but the fish retained most of its original freshness up to 4 hour post slaughter as the fish eyes were transparent, clear and protruding, the gills was bright red colour with fresh odour, while the skin was bright with shiny slime and a firm belly; and the flesh was still firm

flexible and elastic with fresh and sea weedy odour. Sveinsdottir [8], also stated good quality index such as odour observed in freshly caught fish could be attributed to its low levels of volatile compounds contents such as 2,6 nonadienal which is characterized to have a cucumber like odour and a low odour threshold of 0.001 ppb. The result of this study (Table 1) further indicates that there exists a negative correlation between the mean quality attributes (whose score increase with increase post slaughter time) and post slaughter time which signify that as the post slaughter time increases, the quality attributes of the fish reduces. Akande and Faturoti [9], reported similar result for Bonga (*Ethmalosa fimbriata*) fish. Sveinsdottir [8], also recorded low scores for quality attributes of Atlantic salmon (*Salmo salar*) with a constant increase in the average scores for the individual quality attributes as the storage time increases. The check of our sampling adequacy specificity (Table 2) using Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) indicated that the result of our study could be used for factor analysis as the variables are variables are highly correlated such that we cannot distinguish between them (multicollinearity), our result indicated that our KMO is 0.958, which indicated that we can proceed with our factor analysis because KMO value being greater than 0.5 is a condition for a satisfactory factor analysis to proceed and the higher the value the better. The result of our Bartlett's Test (Table 2) which also indicated that we can proceed with factor analysis since our Bartlett's test was found to be significant ($p < 0.0001$) as a p value < 0.05 indicates that it is reasonable to proceed with the factor analysis. This study (Table 3) also indicates that more than 84% per cent of its variability is explainable by the listed factors except for gill odour that has 59% variability. Using the criterion of selecting eigenvalues over 1, the result on Table 4 indicated that one component (or factor) of the numbers in the Total Variance Explained table (highlighted in green) have eigenvalues greater than 1. This implies that the only principal component contributing to the QIM is post slaughter time. A high correlation of ($r=0.993$) existed between quality attributes and post slaughter time (Table 5) with a high coefficient of determination ($R^2=0.986$) showing that 98.6% of the variation in post slaughter time was explained by quality attributes. The regression equation was significant $F(9, 130)=1080$ ($p<0.0001$) showing that it could be used for prediction and estimation. The t-value of all the predictors (quality attributes) were significant except gill mucus and gill odour. Ayeloja [6], also observed a negative linear correlation between post slaughter time and sensory quality of *C. gariepinus* as the fish gill, skin colour brightness and fish odour deteriorated with increased storage time at ambient temperatures. Akande and Ola [10], also reported that leaving fish at ambient tropical temperatures for several hours post-harvest leads to rapid quality deterioration. It is therefore important to process or preserve fish as quick as possible to reduce quality deterioration; it is good quality fish as raw material that can give good quality fish products [6].

Table 1. Mean scores (n=20) for each quality attribute assessed and the correlation to post slaughter time (hour)

Quality Attributes	Post Slaughter Time							Correlation (r)
	0hr	4hrs	8hrs	12hr	16hrs	20hrs	24hrs	
Skin Colour	0.08	0.24	0.39	0.56	0.68	0.80	0.93	0.94
Skin mucus	0.19	0.60	0.94	1.04	1.31	1.48	1.64	0.91
Fish odour	0.15	0.70	1.32	1.89	2.28	2.47	2.61	0.95
Fish texture	0.12	0.44	0.84	1.09	1.20	1.65	1.84	0.96
Eye pupil	0.11	0.22	0.49	0.87	1.25	1.80	1.91	0.97
Eye form	0.08	0.24	0.41	0.68	1.08	1.51	1.86	0.96
Gill colour	0.08	0.22	0.65	1.17	1.40	1.72	1.91	0.95
Gill mucus	0.02	0.26	0.57	0.97	1.38	1.92	1.85	0.96
Gill odour	0.14	0.37	0.95	1.17	1.24	1.95	2.25	0.73

Table 2. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.958
Bartlett's Test of Sphericity	Approx. Chi-Square	2748
	df	45
	Sig.	0.000

Table 3. Communalities

	Initial	Extraction
Post Slaughter Time	1	0.99
Colour appearance	1	0.90
Skin Mucus	1	0.844
Fish Odour	1	0.91
Fish Texture	1	0.94
Eye Pupils	1	0.94
Eye Form	1	0.90
Gill colour appearance	1	0.92
Gill Mucus	1	0.94
Gill Odour	1	0.59

Table 4. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.864	88.635	88.635	8.864	88.635	88.635
2	0.446	4.459	93.095			
3	0.22	2.204	95.299			
4	0.122	1.219	96.518			
5	0.09	0.897	97.415			
6	0.074	0.735	98.15			
7	0.069	0.693	98.843			
8	0.065	0.65	99.494			
9	0.039	0.393	99.886			

10	0.011	0.114	100			
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Table 5. Multiple regression of quality attributes against post slaughter time

Model		B	t	Sig.
1	(Constant)	7.272	136.848	0.000
	Colour appearance	-0.572	-2.957	0.004
	Skin Mucus	-0.398	-4.073	0.000
	Fish Odour	-0.348	-4.694	0.000
	Fish Texture	-0.42	-3.341	0.001
	Eye Pupils	-0.373	-3	0.003
	Eye Form	-0.8	-8.191	0.000
	Gill colour appearance	-0.284	-2.935	0.004
	Gill Mucus	-0.184	-1.677	0.096
	Gill Odour	-0.06	-1.863	0.065
a. Dependent Variable: Post Slaughter Time				

Conclusion

This study established that the average score allotted by panelists for the parameters used as quality index in this study increased with increase post slaughter intervals indicating that the sensory quality of *Heteroclaris* decreased with increase post slaughter time intervals at when the fish was left at ambient temperatures because the higher the QI, the lower the fish quality. Furthermore, high negative correlation existed between the quality index parameters and post slaughter time. Also, a high correlation of ($r=0.993$) existed between quality attributes and post slaughter time with a high coefficient of determination ($R^2=0.986$) showing that 98.6% of the variation in post slaughter time was explained by quality attributes. The regression equation was also significant $F(9, 130)=1080$ ($p<0.0001$) indicating that it could be used for prediction and estimation of fish quality, it is therefore recommended to be used by relevant agencies to be used for prediction of fish quality.

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