Post harvest quality changes in threadfin (*Galeoides decadactylus*) obtained from Liverpool fish market, Lagos, Nigeria

Oramadike Chigozie Eunice[1,*]

Abstract

Fish is exceedingly perishable due to their biological composition and its shelf life. The post harvest quality changes in threadfin (*Galeoides decadactylus*) stored in ice was carried out. Trimethylamine (TMA) and Total Volatile Bases (TVB) of fish flesh were monitored alongside with microbial assessment. TMA and TVN of the fish increased on ice storage from 4.23 and 8.53 mg /100 g on day 0 to 15.1 and 34.3 mg /100 g, respectively on day 18. The microbial assessment showed total viable count (TVC) of 3.43 x 10^4 at harvest and 5.21 x 10^7 Cfu/g on day 18 on ice with range of 0 - 4.0 x 10^5 Cfu/g of hydrogen sulphide (H_2S) producers. TMA and TVN results showed maximum acceptability of samples for 18 days on ice. The microbial and sensory assessment was in support of the chemical assessment. The study revealed shelf life of 18 days for *Galeoides decadactylus* in ice.

Keywords*:* storage life, Total Viable Count (TVC), Trimethylamine (TMA), Total Volatile bases (TVB).

1. Introduction

Nigeria has a diversity of about 199 species from 78 families in the brackish and marine habitats. Moreover, its coastal fish resources include the demersal and pelagic fish resources. The demersal fish can be found up to 400 m depth in the waters and this includes mainly the croakers, threadfins, soles and bigeye (Dublin-Green and Tobor, 1992; Solarin *et al*., 2010).

Galeoides decadactylus commonly called threadfins is among the three fish species of the family polnemidae. It occurs in shallow coastal waters, and also in estuaries (Schneider, 1990; Emmanuel *et al*., 2010). It can be distinguished from the others by its lower portion of the pectoral fin separated to form about nine or ten short free rays. It has an inferior mouth with a fleshy translucent blunt snout (Schneider, 1990). It is a bottom feeder and a carnivorous fish, feeding on fish, crabs and shrimps. It is an important source of protein for man (Kusemiju and Osibona, 1998; Ezekiel *et al*., 2013). The threadfins are of great economic value among trawled fishes in Nigeria coastal waters. Longhurst (1960) reported that the two genera *Galeoides* and *Pentanemus* form 10 and 20%, respectively of the total catch landings from Nigeria coastal waters.

1,* Nigerian Institute for Oceanography and Marine Research Victoria Island Lagos Nigeria

Corresponding author, email: chigooramadike2007@yahoo.com, +2348033551690

Fish is perishable, once dead, series of irreversible changes starts leading to spoilage, thus affecting the shelf - life of the fish. Shelf life of fish is defined as the length of time fish is fit for human consumption (Martinsdottir *et al*., 2001; Akande and Faturoti, 2003). Fish spoilage due to microbial activity is one of the limitations of the shelf life of iced stored fish. Discolouration, off-odours and off-flavours, slime formation, gas production and changes in texture are evidence of spoilage (Akande and Faturoti, 2003). Lack of good transportation facility is a major cause of the delay in getting fish from the hinterland to urban centers where they fetch more money. Many tropical fish species from warm waters have been reported to have storage life of 20–28 days in ice (Lima dos Santos, 1981; Akande and Faturoti, 2003). Shelf life studies of some seafood had been carried out by Abraham-Olukayode and Oramadike (2015), Oramadike *et al*. (2010), Ola and Oladipupo (2004). However, Shewan (1977) observed that certain physical and chemical characteristics like the shape, size and fat content can influence the fish storage life on ice.

The extent of spoilage during storage under chilled conditions is one of the key determinants of fish quality (Whittle *et al*., 1990). The objective of this study was to investigate the post harvest quality changes of *Galeoides decadactylus* obtained from Liverpool fish market, a landing site for trawled fish along the Lagos coastal waters.

2. Materials and methods

Thirty freshly caught threadfin (*Galeoides decadactylus*) fish samples with average weight of 142.26–201.74 g / fish and length of 14.5–20.4 cm were purchased at Liverpool fish market; it is located at Apapa, Lagos State and situated under the Tincan-Apapa Wharf fly-over bridge along Apapa-Mile 2 Express Road. The market is a landing site for fish trawlers and is made up of both wholesalers and retailers of fishes.

The purchased fish samples were divided into three batches and transported in ice with a fish/ice ratio of 1:1 (w/w) in a sterile insulated ice box within two hours to the Nigerian Institute for Oceanography and Marine Research Laboratory. Upon arrival, the molten ice was drained from a hole at the base of the insulated box prior to ice storage. The fish/ice ratio was maintained at ratio 1:1 (w/w) in the insulated icebox throughout the storage period of 18 days. Samples were randomly taken every 3 days for chemical, microbiological and sensory assessment.

2.1 Chemical analysis

Total volatile bases and trimethylamine were determined by mincing 50 g of fish flesh into a smooth paste from which 25 g was homogenised in 5% trichloroacetic acid (TCA) and the filtrate analyzed by Conway Micro diffusion Technique (Conway, 1968). The amounts of TVB and TMA were calculated and expressed as mg/100 g.

2.2 Microbiological analysis

Total viable aerobic count (TVC) were estimated by plating serial dilutions of fish samples prepared by homogenising (in Colworth Stomacher), 10 g of fish muscle in 90 ml sterile peptone water (0.1%, w/v). Ten-fold serial dilution of the suspension was made and 0.1 ml of the diluted suspension was dispensed in triplicate using pour plate technique to obtain a total bacterial count. The TVC was estimated with standard plate count agar (SPCA) and hydrogen sulphide (H_2S) producers count were carried out using peptone iron agar (Akande and Faturoti, 2003). Plates were incubated at 35°C for 24 hours.

2.3 Sensory analyses

The quality of fresh *Galeoides decadactylus* stored in ice was judged to assess the degree of freshness based on organoleptic characteristics. Raw samples were washed using potable water and presented whole to the taste panel. Samples were examined physically for general appearance of gills, eyes, body appearance, texture and quality using modified Torry sensory schemes for raw fish following the criteria as shown in Table 1.

To assess cooked fish, about 50 g of the fish fillet wrapped in aluminum foil in a closed dish over boiling water for 35 minutes for eating quality assessment. The closed dish containing the test samples was kept in a water bath at 60°C throughout each panel session and cooked attributes such as odour, texture and flavour using Torry sensory schemes as shown below Table 2a–2c. Samples were evaluated by five trained panelists on changes in quality of cooked fish.

Table 1 Quality table for fresh fish (sensory evaluation)

Class	Gills	Eyes	Body appearance	Texture	Quality
5	Dark red colour; some thin, clear slime; marine smell	Bright, metallic; clear pupils; convex	Natural colours; iridescent; firm scales; little or no slime	Firm before or in rigor	excellent
4	Red colour; some slime, but still thin and clear; no smell	Bright, metallic; slightly cloudy pupils; slightly convex	Natural colours; firm scales; some slime	firm	good
3	Red-brown colour; some thick slime; beery/mousey/warm smell	Dull; pupils cloudy; flat; some blood	Slight red colour; scales loose; more thick slime	firm	Average
2	Brown colour; a lot of slime; slight “off” smell	Dull; pupils cloudy; slightly concave; bloody	Red/yellow colour; scales missing; dry skin; a lot of yellow slime	soft	Poor
1	Brown colour; a lot of slime; very bad smell/ ammonia smell	Dull; pupils cloudy; concave or bulging out; with blood	Red/ yellow colour; few scales; dry skin; a lot of thick yellow slime	Very soft; mark of finger left if pressed	Very poor

Table 2a Quality table for cooked fish odour (sensory evaluation)

Cooked fish odour	Score
Strong fresh ‘seaweedy’ odours	10
Some loss of fresh ‘seaweediness’	9
Lack of odour, or neutral odours	8
Slight strengthening of the odour but no sour or stale odour	7
‘condensed milk’, caramel or toffee-like odours	6
‘milk jug’, ‘boiled potato’ odours	5
Lactic acid, ‘sour milk’ or o-toluidine-like odours	4
Some lower fatty acid (e.g acetic or butyric acids)’grassy’,or ‘soapy’ odours	3
Ammonical (Trimethylamine and lower amines) odours	2
Strong ammonical (Trimethylamine etc) and some sulphide odours	1
Strong putrid and faecal odours (ammonia, indole etc.)	0

Table 2b Quality table for cooked fish texture (sensory evaluation)

Cooked fish Texture	Score
Firm thick white curd; bluish-white in appearance, no discolouration	5
Firm, but woolly; loss of bluish whiteness, some yellowing	3
Softer, cheesy; marked discolouration	2
Sloppy, soapy; very marked browning along the backbone	1

Table 2c Quality table for cooked fish flavour (sensory evaluation)

Cooked fish flavour	Score
Fresh, sweet flavours characteristic of the species	10
Some loss of sweetness	9
Slight sweetness and loss of the flavour characteristic of the species	8
Neutral flavour, definite loss of flavour but no off flavours	7
Absolutely no flavour, as if chewing cotton wool	6
Trace of off-flavours, some sourness but no bitterness	5
Some off-flavours, and some bitterness	4
Strong bitter flavours, some rubber-like and slight sulphide-like flavour	3
Strong bitter flavours, but not nauseating	1
Strong putrid flavour (e.g. sulphides) tasted with difficulty	0

2.4 Statistical analysis

Statistical analysis of results was performed with descriptive statistics using SPSS version 16.0 (SPSS, Inc., Chicago, IL, USA).

3. Results and Discussion

It was possibly noted that as the storage time increases, a continuous increase in TMA and TVB were clearly observed. The highest of TMA and TVB were 18.22 and 38.53 mg/100 g, respectively on the eighteenth day Table 3.

Table 3 Chemical assessment of *Galeoides decadactylus* stored in ice

Days	TMA mg/100 g	TVB mg/100 g
0	4.57	8.53
3	5.40	10.90
6	7.30	15.32
9	11.20	21.20
12	12.35	28.60
15	15.10	34.30
18	18.22	38.53

The total viable bacterial count of *Galeoides decadactylus* stored in ice revealed 3.43 x 10^4 Cfu/g on the first day and 5.21 x 10^7 Cfu/g on the 18^{th} day as shown in (Table 4). The H_2S producer counts revealed no count on the day zero and the third day of storage, the microbial count increased from 4.80 x 10^3 to 4.0 x 10^5 Cfu/g from 6^{th} to 18^{th} day, respectively.

Table 4 Microbiological Assessment of *Galeoides decadactylus* stored in ice

Day	Total viable count (Cfu/g)	Hydrogen sulphide producers (Cfu/g)
0	3.43 x 10^4	ND
3	3.93 x 10^4	ND
6	4.50 X 10^5	4.80 X 10^3
9	5.60 x 10^5	1.50 X 10^4
12	8.10 X 10^6	2.20 X 10^4
15	9.43 X 10^6	3.30 X 10^5
18	5.21 X 10^7	4.0 x 10^5

Note: ND is Not detectable

The organoleptic assessment of *Galeoides decadactylus* stored in ice. The result revealed average score of 5(excellent) for all the quality parameters on day zero and 1 (very poor) on the 18^{th} day as shown in Table 5 below.

Table 5 Organoleptic assessment of *Galeoides decadactylus* stored in ice

Day	Sensory Quality parameters Evaluation scores						Average
	Appearance	Firmness	skin	eyes	gills	Odour	score
0	5	5	5	5	5	5	5
3	5	5	5	5	5	5	5
6	4.5	4.5	4.5	4.5	5	5	4.6
9	4	4	4	3.5	4	4	4.1
12	4	4	4	3	4	3.5	3.75
15	2	2	2	2	3	2	2
18	1	1	1	1	1	1	1

Note: Evaluation score: 5=Excellent, 4=Good, 3=Average, 2=Poor, 1=Very poor

The organoleptic assessment of cooked *Galeoides decadactylus* stored in ice. The result from the observed cooked fish odour revealed an average score of 10 on the day 0 and zero score on the 18th day as shown in the Table 6. The fish texture scored 1 on the 18th day and the fish flavour also had the least score on the 18th day.

Table 6 Organoleptic assessment of cooked *Galeoides decadactylus* stored in ice

	Sensory quality parameters evaluation scores			
Day	Odour	texture	Flavour	Average score
0	10	5	10	8.3
3	10	4	10	8
6	8	4	7	6.3
9	6	3	6	5
12	3	3	3	3
15	2	2	2	2
18	0	1	0	0.3

A good number marine fish have a substance called trimethylamine oxide (TMAO). Some bacteria occur naturally on the skin and in the guts of fish which can break down TMAO to trimethylamine. Ammonia and trimethylamine can also be formed during spoilage of fish, together with traces of others. These bases, other than ammonia, are known chemically as *amines.* The combined total amount of ammonia, dimethylamine and trimethylamine is called the total volatile base content of the fish and is a commonly used estimate of spoilage.

The amount of TMA produced is a measure of the activity of spoilage bacteria in the flesh and so is an indicator of the degree of spoilage. TMA and TVB are reported to increase linearly as spoilage in seafood progresses so they are compounds associated with seafood spoilage (Abraham-Olukayode and Oramadike, 2015). TMA value range between 10-15 mg/100 g and TVB value range of 30-35 mg/100 g is recommended for fresh fish acceptability (Connell, 1995; Gokodlu *et al*., 1998). In this study, increase in the TMA and TVB values of fresh *Galeoides decadactylus* stored in ice exceeded this limit at 18 days of iced storage, which indicated seafood spoilage and this result is in agreement with Fernandez *et al.* (2009) who also reported that TVB is often used as an index to assess the keeping quality and shelf life of seafood products. This result is also in agreement with (Abraham-Olukayode and Oramadike 2015), (Akande and Faturoti 2003), who observed that TMA is associated with the odor of the spoiled fish and can be used as an indicator of bacterial activity causing the deterioration of seafoods.

According to the International Commission of Microbiological standards for foods (ICMSF) (1986)), which states that microbial level rise should not exceed 10^7 Cfu/g for fresh fish. In this present study, the microbial assessment of *Galeoides decadactylus* stored in ice got to the limit on the eighteenth day of storage in support of the chemical assessment result as reported in this present study. The H_2S producer counts revealed no count on the day zero and the third day of storage. The gradual increase of the H_2S producers in this study may have played a prominent role in the spoilage of *Galeoides decadactylus* stored in ice. This result is in agreement with Abraham-Olukayode and Oramadike, (2015) and Oramadike *et al.* (2010) where the hydrogen sulphide producers present in seafood contributed to seafood spoilage. In addition, microbial growth may lead to the production of slime and changes in texture of fishes (Gram *et al*., 2002).

The acceptability of freshness and quality of food or seafood is always based on sensory changes together with their chemical changes (Oramadike *et al*., 2010). The physical properties of seafood change along with decreasing freshness. Furthermore, the change can be attributed to the water environment, anthropogenic activities around where the seafood was got from and the original condition of the muscle of the seafood (Ocano-Higuera *et al*., 2006). This present study shows that the undesired sensory parameters that occurred during spoilage could be as a result of byproducts of bacterial growth and metabolism. This work is in agreement with Abraham-Olukayode and Oramadike, (2015); Oramadike et al. (2010) also reported undesired off-odours and flavours in ice stored fish which they attributed to bacterial growth.

4. Conclusion

In conclusion, this study revealed that the average shelf life of fresh tropical *Galeoides decadactylus* in ice is 18 days.

References

Abraham-Olukayode A. O., Oramadike C. E. (2015). Shelf Life Studies of Wild Tilapia guineensis Stored in Ice and at Ambient Temperature. American Journal of Agricultural Science. 2(1): 8–12.

Akande, G.R., Faturoti, E. O. (2003). Postharvest quality changes in Bonga (Ethmalosa fimbriata) under delayed icing conditions. Bioscience Research Communications 15 (6):20–24

Connell, J.J. (1995). Quality deterioration and extrinsic quality defects in raw material, 1995. In: Control of Fish Quality, Fishing News Books Ltd. Surrey, England. 31–35.

Conway E. J., (1968). Microdiffusion analysis and volumetric error. London, Crosby, Lockwood and Son Ltd., 465.

Dublin-Green, C.O. and Tobor, J.G. (1992). Marine resources and activities in Nigeria. NIOMR Tech. Pap. No. 8425.

Emmanuel B.E., Gbesan, K., Osibona, A. O. (2010). Morphology, Fecundity and diet of *Galeoides decadactylus* (Pisces: Polynemidae) (Bloch, 1795) off Nigerian coast. Nature and Science 8 (3):15–23

Ezekiel M.O., Olusola A.O., Edah B., Udoezika U.C. (2013). Fecundity, food and feeding habits and growth pattern of galeoides decadactylus in nigeria coastal waters. International Journal of Natural Sciences Research, 1(1): 1–13.

Fernandez, K., Aspe, E., and Roeckel, M. (2009). Shelf-life extension on fillets of Atlantic Salmon *Salmo salar* using natural additives, super chilling and modified atmosphere packaging. Journal of Food control, 20(1):1036–1042.

Gokodlu, N., ozden, O. and Erkan, N. (1998). Physical, chemical and sensory analyses of freshly harvested sardines (*Sardina pilchardus*) stored at 4°C. Journal of Aquatic Food Product Technology, 7(2): 5–15.

Gram, L., Ravn, L., Rasch, M., Bruhn, J.B.,Christensen, A.B., Givskov, M. (2002). Food spoilage — interactions between food spoilage bacteria. International Journal of Food Microbiology 78(1): 79–97.

ICMSF (International Commission on Microbiological Specifications for Foods), (1986). Micro organisms in Foods 2,Sampling for Microbiological Analysis. Principles and Specific Applications, 2nd edn. Oxford: Blackwell Science.

Kusemiju, K. and Osibona, A. (1998). "Growth and fecundity of threadfin *Pentanemus quinquarius* (L) off Aiyetoro coast, Nigeria," Journal of Science Research and Development, 3(1):33–62.

Lima dos Santos, C.A.M. (1981). The storage of tropical fish in ice: Tropical Science. 97–127.

Longhurst, A.R. (1960). A summary survey of food of West Africa demersal fish. Bulletin Institute For African Noitre. A 22(1): 276–282.

Martinsdottir, E. Sveinsdottir, K., Luten, J., Schelvis-Smit, R. and Hyldig, G. (2001). Sensory Evaluation of Fish Freshness. Reference Manual for the fish sector. QIM Eurofish.

Ocano-Higuera, V. M., Maeda-Martinez, A. N., Lugo-Sanchez, M. E., & Pacheco- Aguilar, R. (2006). Postmortem biochemical and textural changes in the adductor muscle of catarina scallop stored at 0°C. Journal of Food Biochemistry, 30(4), 373–389.

Ola, J. B and Oladipupo, A. E. (2004). Storage life of Croaker (*Pseudotholithus senegalensis*) in ice and Ambient Temperature. African Journal of Biomedical Reasearch, 7(1): 13–17.

Oramadike C.E., Ibrahim, O.A. Adejonwo, O.A. Akande, G.R., Kolade, O. (2010). Post harvest quality changes in wild Tilapia melanotheron and Chryischtys nigrodigitatus obtained from Ogudu/Agboyi lagoon south-west Nigeria. World Journal of Fish and Marine Sciences, 2(3): 216–220.

Schneider, W. (1990). Field guide to commercial marine resources of the Gulf of Guinea, Food and Agricultural organization of the United Nations. Rome. 268.

Shewan, (1977). The bacteriology of fresh and spoiling fish and the biochemical changes induced by bacterial action. Proceedings of the Conference on Handling, Processing and Marketing Fish. Tropical Products Institutes. London. 51–66.

Solarin, B.B., Williams, A.B., Hamzat, M.B., Rabiu, A., Oguntade, O.R., Bolaji, D.A. and Oramadike M. (2010). Report on survey of fish and other living resources of Nigerian coastal waters conducted between 14th April and 6th June 2009. NIOMR, Lagos. 57.

Whittle, K. J., Hardy, R. and Hobbs, G. (1990). Chilled fish and fishery products. In Gormley, T.R. (Ed.) Chilled Foods. *The state of the art*. London and New York: Elsevier Applied Science.