Analysis of Malondialdehyde (MDA) Contents in Frozen Fish Sold in Two Fish Markets in Ibadan, Southwest Nigeria

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Abstract— The aim of this study was to analyse the Malondialdehyde (MDA) concentrations in frozen fish sold in Nigerian markets. Thirty-six samples each of Chub Mackerel (*Scomber japonicus*) and Sardine (*Sardinella eba*) were purchased at 8:00, 12:00, and 16:00 hours of the day from twelve fishmongers purposively selected from two fish markets in Ibadan. MDA contents were determined colorimetrically using thiobarbituric acid. MDA contents in both fish types increased with hour of the day. Chub mackerel had higher MDA contents compared to Sardine. It can be inferred that the fish samples analyzed had unacceptable levels of MDA, though; the concentrations of MDA that can cause toxicity have not been established. Thus, there is need for stricter government regulations on the quality of imported fish, sold in Nigerian markets because of MDA toxicity and its implications for public health.

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Abstract— Analysis, Frozen fish, Malondialdehyde,Nigeria

1 INTRODUCTION

Fish constitutes the cheapest and available source of animal protein and nutrients in Africa [1]. Frozen fish of different types are of great demand, and has become regular features of Nigerian diets, even among the affluent [2],[3]. However, consumption of fish may sometimes cause disease [4].

It has been suggested that reactive oxygen species (ROS) and lipid peroxidation products likely contribute to both onset and progression of diseases. Dietary and environmental chemicals such as malondialdehyde (MDA) involved in the etiology of cancer and other related disease conditions are part of the challenges still facing the world today [3]. Malondialdehyde (MDA) is the toxic product of polyunsaturated fatty acid peroxidation [5]. Several deleterious effects of MDA have been reported; exposure to MDA induces intracellular oxidative stress leading to membrane lesions in erythrocytes [6]. MDA is also genotoxic, reacting with DNA to form highly mutagenic adducts in human cells [5]. Results from animal investigations and biochemical studies indicate that ingestion of lipid peroxidation products increases frequencies of tumor and atherosclerosis [7]. One of the methods of food preservation in the food industry is freezing [8]. Paradoxically, freezing appears to have very little inhibitory effect on lipid peroxidation [3]. Indeed, studies have shown that cold. preservation leads to time dependent increases in accumulation of lipid peroxidation products [9]. The high consumption rate of frozen fish among Nigerians and the concern that this deleterious compound may be in high concentrations in these fish because of the way and manner frozen fish is sold, necessitate a study like this. This study aimed at investigating MDA levels as it relates to species of fish, location and time of the day.

2 MATERIALS AND METHOD

2.1 Sample Collection

Seventy-two (72) frozen fish samples comprising two (2) different species: Sardine (*Sardinella eba*) and Chub Mackerel (*Scomber japonicus*) were used for this study. A sample of each species was purchased, in the form it is being sold to the public, from twelve (12) purposively selected fish mongers in two (2) major markets (Bodija and Oja-oba) in Ibadan.

The choice of the two (2) sampling locations was informed by their population densities and high commercial activities while the choice of fish species premised on the most consumed by the populace. The fish sample collection was done at different hours (8:00, 12:00 and 16:00). The samples were collected in sterile polythene bags and transported in ice packs to the laboratory for analysis. .

2.2 Laboratory Analysis Of Samples For MDA

MDA levels were determined colorimetrically using thiobarbituric acid according to the method of [10]. 1 g of fish tissue was finely ground in mortar with acid-washed sand and homogenized with 50 ml of physiological saline for 15 min. The homogenate was centrifuged at 8,000g for 5 min. 1 ml of the supernatant was added to 2.0 ml of trichloroacetic acid-thiobarbituric acid- HCl reagent, and the solution was mixed thoroughly. The mixture was then placed in a boiling water bath for 15 min. On cooling, the protein precipitate was removed by centrifuging at 10,000g for 5 min, and the absorbance of the clear supernatant fraction was read at 535 nm against reagent blank. MDA values were calculated using molar extinction coefficient, and expressed as mm/g of fresh weight. .

2.3 Statistical analysis

The statistical tool/package used was SPSS 15.0 version. The data were presented using descriptive statistics. Malondialdehyde contents (mmole/g fresh weight) were grouped into: low (< 1000), medium (1001 – 2000) and high (2001 – 3000)

3 Results and Discussion

TABLE I
(a) Relationship Between Malondialdehyde (MDA) Content Of Fish Samples And Time Of The Day

Time of the day	MDA content (mmole/g fresh weight) Sardine	
	Bodija	Oja-oba
8:00	620.47 ± 94.37	652.46 ± 115.28
12:00	1096.04 ± 172.88	1137.69 ± 189.76
16:00	1809.51 ± 290.54	1705.12 ± 311.16

TABLE I
(b) Relationship Between Malondialdehyde (MDA) Content Of Fish Samples And Time Of The Day

Time of the day	MDA content (mmole/g fresh weight) Chub mackerel	
	Bodija	Oja-oba
8:00	952.77 ± 146.58	958.00 ± 145.90
12:00	1683.89 ± 100.45	1696.33 ± 110.13
16:00	2258.74 ± 222.43	2276.87 ± 270.10

Table I (a & b) shows MDA profiles of the fish samples and time of the day. The MDA contents of fish samples purchased at both markets increased with time, as shown in Table I (a & b) above. The fish samples at Bodija and Oja-oba had MDA contents which are relatively comparable. The mean values for Sardine purchased at Bodija and Oja-oba progressed from 620.47 ± 94.37 (8:00) to 1809.51 ± 290.54 (16:00) and 652.46 ± 115.28 (8:00) to 1705.12 ± 311.16 (16:00) respectively while values for Chub mackerel purchased at Bodija and Oja-oba varied from 952.77 ± 146.58 (8:00) to 2258.74 ± 222.43 (16:00) and 958.00 ± 145.90 (8:00) to 2276.87 ± 270.10 (16:00) respectively.

TABLE II
Relationship Between Malondialdehyde (Mda) Grouping And Time Of The Day

Time of the day	MDA content (mmole/g fresh weight) groupings Low < 1000	Medium 1001 – 2000	High >2000	Total
8:00	18 (75.0%)	6 (25.0%)	0	24 (100.0%)
12:00	4 (16.7%)	20 (83.3%)	0	24 (100.0%)
16:00	0	10 (41.7%)	14 (58.3%)	24 (100.0%)
	22 (30.6%)	36 (50.0%)	14 (19.4%)	72 (100.0%)

Table II shows the relationship between Malondialdehyde groupings of the fish samples and time of the day. The Malondialdehyde (MDA) content in the fish samples were grouped into low, medium and high as shown in Table II. The Table shows that 18 (75.0%) samples out of the 24 (100.0%) samples purchased at 8:00 hour and 14 (58.3%) samples out of the 24 (100.0%) samples purchased at 16:00 hour had less than 1000 mmoles/g fresh weight and between 2001-3000 mmoles/g fresh weights respectively.

Table III
Relationship Between Malondialdehyde (MDA) Grouping And The Fish Types

Type of fish	MDA content (mmole/g fresh weight) groupings Low < 1000	Medium 1001 – 2000	High >2000	Total
C. mackerel	6 (16.7%)	20 (55.6%)	10 (27.8%)	36 (100.0%)
Sardine	16 (44.4%)	16 (44.4%)	4 (11.1%)	36 (100.0%)
Total	22 (30.6%)	36 (50.0%)	14 (19.4%)	72 (100.0%)

Table III shows the relationship between Malondialdehyde (MDA) content grouping and the fish types in the two markets. It shows that Chub mackerel had higher content of MDA compared to Sardine since 6 (16.7%) samples out of the 36 (100.0%) samples of Chub mackerel had less than 1000 mmoles/g fresh weight while 16 (44.4%) samples out of the 36 (100.0%) samples of Sardine had less than 1000 mmoles/g fresh weight

The presence of MDA in these fish as demonstrated in this study is consistent with earlier reports of [11], on the occurrence of MDA in frozen fish. The different concentrations of MDA in these samples suggest the different degrees of their deterioration (rancidity), because MDA is normally used to assay the extent of damage incurred by lipid peroxidation [12]. The higher levels of MDA in Chub mackerel may be attributed to its fat content (which is consistent with the findings of [3]) as well as the rate of exposure of the fish to atmospheric air by

the fishmongers during sales. Also, the high MDA contents of the fish samples at the early hour of the day as seen in the analyses may be a consequence of prolonged refrigeration since imported frozen fish may take several months to reach the Nigerian consumers due to time used in importation, clearing, distribution and retailing.

All things being equal, it is better to purchase and process frozen fish in the early hour of the day since this has an effect on the MDA content of the fish. Consequently, it can be inferred that the frozen fish samples analyzed have very unacceptable levels of MDA, although, according to [3], the concentrations of MDA that can cause toxicity have not been established. The health implications of these findings cannot be over emphasized because [3] reported that increased levels of lipid peroxidation products have been associated with a variety of chronic diseases in both humans and animal model systems. One important pathological condition caused by MDA during pregnancy is pre-eclampsia. This is a leading cause of premature delivery and foetal growth retardation [13]. Also, ingestion of foods containing lipid peroxidation products increases risks of cancer and cardiovascular diseases [7].

The least concentration of MDA obtained in this study was 432.95 mmoles/g fresh weights of fish. This is equivalent to 432,950 μmolar MDA/g. Thus, if a child consumes 50 g of frozen fish in a meal, this would amount to an oral exposure of 21,647,500 μmolar of MDA, which is indeed, very high. [11] opined that children are more susceptible to the toxic effects of this chemical carcinogen as they have low body weight and immature enzymatic system. Consequently, consumption of frozen fish may have serious implications for public health in Nigeria. Therefore, in view of the toxic effects of MDA and its public health implications, there is need for stricter government regulations and implementation on the quality of imported fish, sold in Nigerian markets in order to reduce to the lowest feasible levels, the exposure of Nigerians to this compound. Also, the International community should set an allowable limit of this compound in foods for human consumption because of its public health importance.

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