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Full Length Research Paper

Effect of frozen period on the chemical, microbiological and sensory quality of frozen tilapia fish (*Sarotherodun galiaenus*)

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The study was designed to investigate the effect of duration of frozen storage on the chemical, microbiological and sensory profile of tilapia fish (*Sarotherodun galiaenus*). The fish were collected from a research pond of the Agricultural Development Project, Akure, Nigeria and were subjected to sixty days of frozen storage and analyzed at intervals of ten days. Protein content ranges from 43.70 ± 1.17 to 60.65 ± 2.40%. Protein decreases with increasing duration of frozen storage; with the fresh samples (not frozen) having the highest protein content (60.65 ± 2.40%) while the least (43.70 ± 1.17%) was recorded for fish samples that were frozen for sixty days. Similar results were obtained for the fat content where the highest fat content (9.72 ± 0.25%) was recorded for the fresh samples and the least value was recorded for those stored for sixty days. Ash content and moisture content do not show any significant change during storage. Mineral composition (Fe, Ca, Mg, P, Zn and I) of the samples showed a slight change with respect to duration of storage. pH values ranges between 5.20 to 6.90 while the total coliform count range was between 3.0 x10^3 to 7.5 x 10^6 which increases with duration of storage. Sensory evaluation of the fish samples on storage revealed that quality of the fish samples with respect to taste decreases with increasing duration of storage with the best quality (texture, odor and color) when freshly prepared. These, by implication simply mean that fish should be stored, if necessary, for a short period of time to retain the taste, and provide both the protein and fat at optimal level.

Key words: Frozen period, chemical, microbiological, sensory quality, tilapia fish.

INTRODUCTION

Fish is one of the most important sources of animal protein available in the tropics and has been widely accepted as a good source of protein and other elements for the maintenance of healthy body (Andrew, 2001). The less developed countries capture 50% of the world harvest and a large proportion of the catch are consumed internally (FAO, 1985). In many Asian countries over 50% of the animal protein intakes comes from fish while in Africa, the proportion is 17.50% (Williams et al., 1988). In Nigeria, fish constitute 40% of the animal protein intake (Olatunde, 1998).

Fish is a good source of fluorine and iodine, which are needed for the development of strong teeth and the prevention of goiter in man (enlargement of the thyroid gland situated in the neck) (Andrew 2001). However, availability of these vital nutrients depends to a large extent on the methods of storage (Hardy and smith, 1976; Botta et al., 1978; Ryder et al., 1993), such as salting, roasting, drying and freezing. Iced fish of different types are of great demand by the Nigerian consumers as a relatively cheaper source of animal protein. Storage time and temperature are the major factors affecting the rate of loss of quality and shelf life of fish (Whittle, 1997). In spite of some disadvantages associated with frozen storage, freezing is accepted as effective way of preserving fish.

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Table 1. Proximate composition (dry weight basis) of Nile Tilapia (*Sarotherudun galiaenus*) subjected to different Freezing periods (Mean ± SD).

Freezing Periods (Days)	Ash (%)	Fat (%)	Protein (%)	Moisture (%)
0	26.13 ± 2.20	9.72 ± 0.25	60.65 ± 2.40	4.47 ± 0.10
10	26.17 ± 1.30	9.63 ± 0.32	58.60 ± 2.30	4.23 ± 0.23
20	26.24 ± 2.20	9.54 ± 0.31	57.80 ± 2.15	4.15 ± 0.21
30	26.30 ± 1.30	9.30 ± 0.33	57.50 ± 2.00	4.12 ± 0.15
40	26.70 ± 2.31	9.10 ± 0.30	52.30 ± 2.70	4.00 ± 0.32
50	26.75 ± 1.36	8.50 ± 0.27	47.60 ± 1.15	3.95 ± 0.16
60	26.80 ± 1.44	7.20 ± 0.19	43.70 ± 1.17	3.92 ± 0.13

This study therefore is aimed at determining the acceptable storage life of frozen fish, and the freezing effects on the chemical (proximate and mineral composition), microbiological and sensory quality of the fish, commonly consumed in Nigeria.

MATERIALS AND METHODS

Sample collection

Fish (*Sarotherodun galiaenus*) were collected from Agricultural Development Project (ADP) research pond in Akure, Ondo State, Nigeria. Fresh fish samples were washed with tap water several times, rinsed with distilled water and were cut into slices. Some were used fresh while the remaining portions were stored in a plastic container in a refrigerator. A representative and homogenous sample was taken from the front, rear and the middle of the fish from both the fresh and refrigerated samples at intervals of 10, 20, 30, 40, 50 and 60 days, respectively, for analysis (total coliform count, pH, sensory evaluation, proximate and mineral composition). Some of the collected fish samples were oven dried for 24 h at 85-90^{o}C and then ground to a fine powder for analysis (proximate and mineral composition). The chemicals used were of analytical grade, while the water used was glass distilled.

Analyses

The proximate composition (ash, fat and moisture) of the fish samples were evaluated using the standard AOAC procedure (AOAC, 1984). The protein (N x 6.25) content was determined using the micro-Kjedal method. Iodine content was determined using cerric-arsenite procedure (Belling, 1983), while Ca, Zn, Mg, P and Fe contents were determined on aliquots of the solutions of ash, by established flame atomic absorption spectrophotometric procedure (Perkin-Elmer, 1982), using atomic absorption spectrophotometer (Model 372). The total coliform count was determined according to the method of Fawole and Oso (1985) while the sensory evaluation was carried out by a group of taste panelist according to the method of Potter (1968).

Data were expressed as mean ± SD and were analyzed by one-way ANOVA test using SPSS statistical programme.

RESULTS AND DISCUSSION

Generally, fish has been widely accepted as a good source of protein and other elements necessary for the maintenance of healthy body (FAO, 1985). Inadequate storage techniques would implies a substantial shortfall in fish availability thereby affecting the animal protein intake of the people in the tropics whose protein intake from fish ranges between 17.5-50% (FAO, 1985; Willman et al., 1998). Freezing is a common practice in the meat, fish and other animal protein based industry, because it preserved the quality for an extended time and offers several advantages such as insignificant alterations in the product dimensions, and minimum deterioration in products color, flavor and texture (Obuz and Dikeman, 2003). However, there are some disadvantages associated with frozen storage (Kropf and Bowers, 1992) including freezer burn, product dehydration, rancidity, drip loss and product bleaching which can have an overall effect on the quality of the frozen foods.

The proximate composition of tilapia that was stored in a freezer compartment of the refrigerator for different number of days prior analysis is presented in Table 1. The highest protein content was recorded for fish samples prepared for analysis when freshly sampled (60.65 ± 2.40%) while the least (43.70 ± 1.17%) was recorded for fish samples that were stored for sixty days. This could be connected with denaturation of fish protein that is associated with frozen fish (Reay, 1933). The highest fat content (9.72 ± 0.25%) was observed in the fresh samples that was not subjected to frozen storage while the least (7.20 ± 0.19%) was recorded for fish samples that was stored for sixty days. The changes in fat content during frozen storage could be associated with the oxidation of fat (McGill et al., 1974; Josephson, 1989). The result revealed that the ash and moisture content remain almost the same throughout the sixty days storage.

Table 2. Mineral composition (dry weight basis) of Nile Tilapia (*Sarotherudun galiaenus*) subjected to different freezing Periods (Mean ± SD).

Freezing periods (Days)	Fe (mg/100g)	Ca (mg/100g)	Mg (mg/100g	P (mg/100g)	Zn(mg/100g	I (µg/100g
0	1.25 ± 0.21	61.67±2.32	25.54±3.24	15.32±1.17	2.31 ± 0.21	87.74±4.27
10	1.22 ± 0.32	61.23±3.34	25.52±4.22	15.25±1.60	2.16 ± 0.17	88.20±4.40
20	1.20 ± 0.15	61.43±2.33	26.34±3.12	14.96±2.46	1.97 ± 0.16	87.94±6.20
30	1.18 ± 0.15	61.12±2.45	26.23±3.44	14.98±2.42	1.94 ± 0.14	87.63±3.48
40	1.20 ± 0.18	60.57±3.32	25.97±3.23	15.33±4.40	1.87 ± 0.12	88.31±2.21
50	1.23 ± 0.17	61.14±2.60	25.73±4.26	15.22±3.12	2.44 ± 0.10	88.45±2.28
60	1.57 ± 0.11	61.65±23.40	26.26±4.20	15.15±3.18	2.36 ± 0.11	88.20±3.20

Table 3. pH values and Total coliform count of Nile Tilapia (*Sarotherudun galiaenus*) subjected to different freezing periods.

Freezing period (days)	pH	cfu/g
0	5.20	3.0×10^3
10	5.80	5.6×10^4
20	6.40	6.5×10^4
30	6.60	6.7×10^4
40	6.70	4.0×10^6
50	6.75	4.3×10^6
60	6.90	7.5×10^6

Table 4. Sensory evaluation of Nile Tilapia (*Sarotherudun galiaenus*) subjected to different freezing periods.

Freezing period (days)	Colour	Taste	Aroma	Texture	General Acceptability
0	2.67	4.00	3.00	3.00	3.00
10	2.67	3.33	2.33	2.67	2.67
20	2.67	2.67	2.33	2.33	2.67
30	2.67	2.67	2.33	2.33	2.67
40	2.33	2.67	2.33	2.00	2.38
50	2.33	1.67	2.00	1.67	2.33
60	1.67	1.67	1,.67	1.67	2.00

Table 2 shows the mineral composition of the frozen fish. There is a slight change with respect to frozen period in all the minerals evaluated. This could be attributed to drip loss and dehydration that is associated with frozen storage (Sikorski and Sunpan, 1992). Table 3 shows that the pH and total coliform count increases as the duration of storage increase. The increasing pH values could be associated with the production of basic components induced by the growth of bacteria (Simeonidou et al., 1998). The pH changes are in agreement with the findings of Manthey et al. (1988) and Ryder et al. (1993). The increasing total coliform counts amongst other factors could be attributed to temperature fluctuation resulting from unstable electric power. Temperature fluctuation is known to bring about some physico-chemical changes in frozen foods (Bald, 1990). Table 4 shows the result of sensory evaluation carried out by a group of taste panelist on the fish samples. There were changes in all the sensory parameters during storage with slight changes in color and significant changes in taste.

The result of the investigation shows that the fish is a good source of protein, fat and minerals and that quality of fish is best before frozen storage and that quality of

frozen fish is better achieved in the first ten days of storage. Deterioration increases as the duration of storage increases.

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