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Nutrient Content of Fermented Tilapia, *Sarotherodon galilaeus*

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ABSTRACT: Eight fresh samples of *Sarotherodon galilaeus* were subjected to two levels of fermentation. The nutritional values of these fermented fish samples were evaluated using *Lactobacillus brevis*, *Klebsiella azaenas* and *Staphylococcus albus*. They were used singly, in combination of twos and the three were combined. The fish sample fermented with *S. albus* had the highest protein content of 41.98% while the spontaneously fermented fish (control) had 14.95%. The sample fermented with *K. ozaenas* had the highest fat content of 20.13 and the highest Free Amino Nitrogen (FAN) of 0.064 while the spontaneously fermented samples had 12.88 fat content and 0.44 FAN. However, the ash content of the fish sample fermented with the combination of *L. brevis* and *S. albus* is the highest (24.31%) of all samples fermented with starter culture while the spontaneously fermented fish sample had 15.3%. The sample with the three starters combined only had highest moisture content of 50.02% and least (19.00%) in *S. albus*. The value of phosphorus was highest in all combinations (2.05 – 8.04%) and least in sodium (1.13 – 2.00%).

Introduction

Food is any edible substance taking into the body of man for the purpose of providing nourishment by the nutrient after which it is digested and absorbed. Nutrients are chemical substances which are necessary for proper functioning of the body (Davies and Dicberson, 1991). Proteins, one of the groups that make up the organic matter in food are required in the body for the growth and repair of tissues. Fish as one of the animal protein contains all the essential amino acids which is of high biological value (Greenstein and Winitz, 1961). Fishes are important for the production of food, raw materials for industry and recreation.

Only a proportion of the fish caught in the rivers and lakes of Nigeria is marketed fresh (Motwaru, 1970). Fish preservation is a crucial aspect of fisheries commerce in Nigeria, especially the usually prevailing high temperature causes rapid deterioration of fish. The artisanal fishermen and the fish mongers process fish to preserve the large quantity purchased or for desired taste, flavour or nutrients (FAO, 1992). The principal methods of fish preservation in Africa are smoking, sun drying, salting, fermentation, grilling and frying. These processes may either be used alone or combined in order to achieve the desired product.

Fermentation as one of the methods of fish curing in which the development of a distinctive flavour in the final product is the principal objective. The product is therefore mainly used as a condiment in preparation of traditional sources (Essuman, 1992). Fermentation is the transformation of organic substances into simpler compounds by enzymes of the fish itself or by microorganisms (F.A.O., 1971).

There are different types of fermentation by bacteria depending on either the nature of the substrate or the nature of the characteristic product. One of these different types is the lactic acid fermentation caused by species of Streptococcus, Leuconostic, Lactobacillus and some other genera. These are processes by which glucose and some other carbohydrates are converted to Lactic acid and sometimes other products.

Fermented fish product is mainly used as a condiment in the preparation of traditional sauces. Fermentation alone as a curing process does not preserve fish because it results in the breakdown of fish muscle. For this reason, fermentation is often combined with salting and/or drying in order to reduce water activity (aw) and retard or eliminate the growth of proteolytic and putrefying bacteria (Essuman, 1992). Fermented fish products exist in different parts of the world. They may either be soft with high moisture content, semi-dry or very dry in Africa. Some are heavily salted and dried while others are dried without any salting. However, no trial on the preparation of fermented fishery products have been reported in Nigeria (Eyo, 1991). In Southeast Asia, fermented fish sauces or pastes remain important condiments and sources of protein (Beddows, 1985). This study was designed to assess the nutritional status of fermented *Sarotherodon galilaeus*.

Materials and Methods

Sample of fresh fish called *Sarotherodon galilaeus* was degutted and washed in clean water. Salt was applied into the mouth, gill and gut regions. The fish was tied in a nylon bag and heavy weight was applied for 12 hours to ferment. Samples were collected and plated on these media – de Mann Rogosa Sharpe (MRS), MacConkey (Mac), Mannitol Salt Agar (MSA) and Malt Extract Aghar (MEA). MRS Plate was incubated anaerobically for 24 hours in an anaerobic jar while other plates were incubated aerobically at 35°C for 24 hours. Isolates were sub-cultured in a pure plate to obtain pure cultures. The different isolates were morphologically studied and biochemically characterized.

Starter cultures were selected from these characterized isolates on their basis of high production of Hydrogen peroxide, lactic acid and diacetyl. The selected starter cultures were inoculated into fresh fish samples singly. In the proportion of 1ml of cells to 10grm of Ash in twos and the three combines. Another fresh fish sample was cleansed and salt was applied to the three different regions (spontaneous). These fish samples were fermented for 12 hours. These fermented fish samples were dried for 5 days.

Nutritional Analysis was carried out on the fermented fish on dry matter basis according to the conventional methods of A.O.A.C. (1984). The shelf life of the fermented and dried fish especially the spontaneously fermented ones was determined. Samples were collected and plated from them after 1 week, 1 month, 3 months and at the 8^{th} months.

Results

From the isolates from the fish samples only three were selected as starter cultures. *L. brevis, K. ozaenas* and *S. albus*. Table 1 shows the values got in the proximate analysis for the fermented fish samples both spontaneousand starter cultures. The pH ranged from 5.77 to 6.03 in the fish sample treated with the combination of *K. ozaenas* and *S. albus.*

In the percentage nutritional composition, moisture content is lowest (19.00%) in the *S. albus* sample and highest (50.02%) in the sample with the 3 starters combined. Percentage crude protein is highest in the sample with *S. albus* (41.98%) and lowest with the sample with the starters combined (10.00%). The highest percentage crude fibre (3.32%) was recorded in the sample with the 3 starters combined and the lowest value (2.56%) was recorded in sample inoculated with *K. ozaenas*. The percentage free amino acid (FAN) is highest with *K. ozaena* sample (0.064%) and lowest with *S. albus* sample (0.39%). The percentage ash content is highest for sample *L. brevis* combined with *S. albus* (24.94%) and lowest with sample with *K. ozaenas* (11.81%). *The L. brevis* sample did not produce the lowest or highest values in the nutritional composition but the sample with *S. albus* featured most. The values of the mineral content as seen in the Table are generally very low. None is up to 1% (10mg/g) and the differences as the values of the samples are not very significant.

Table 1: Proximate composition of fermented *Sarotherodon galileaus* (Spontaneous and starter fermented)

	FLB1	FEN4	FCO7	FLB1 & FEN 4	FLB1 &+ FC07	FEN4 + FCO7	FB1 + FEN 4 + FCO7	Spontaneous
pH	5.74	5.91	5.94	5.74	5.83	6.03	6.01	5.74
Nutritional composition (%)				21				
Moisture content	30.43	20.98	19.00	.00	20.90	34.08	50.02	40.10
Crude protein	21.43	33.23	41.98	33.08	34.84	19.98	10.00	14.92
Crude fibre	2.64	2.56	2.96	3.14	3.02	2.87	3.32	2.88
Fats	18.34	20.13	14.31	16.74	17.86	19.01	11.79	12.88
Free Amino Nitrogen (FAN)	0.056	0.064	0.039	0.053	0.052	0.061	0.060	0.044
Ash Content	13.56	11.81	16.19	21.44	24.31	17.06	15.31	15.31
Phosphorus	7.31	6.85	2.06	7.31	8.04	7.31	6.59	4.93
Potassium	2.93	2.93	2.93	3.03	2.93	2.66	2.93	2.93
Calcium	3.00	3.00	2.75	3.00	2.75	2.75	2.75	2.75
Sodium	2.00	1.13	1.76	2.00	1.55	2.00	1.69	2.00
Magnesium	2.81	1.46	2.70	2.70	1.98	2.70	2.48	2.70
Iron	5.83	3.33	5.20	5.84	4.17	5.83	5.00	5.21
Manganese	4.48	2.56	3.84	4.48	3.20	4.48	3.84	4.48
Zinc	4.38	2.66	5.00	4.38	3.75	5.00	4.38	4.44

FLB1, *Lactobacillus brevis*; FEN4, *Klebsiella ozaenas*; FCO7, *Staphylococcus albus*; Spontaneous, fish sample with only salt

Discussion

The percentage crude protein for all the samples of the fish that were subjected to proximate analysis were between 10-41.98% which is still within the range obtained by F.A.O. (1992) to be 20-50. The fish sample inoculated with *Styaphylococcus albus* as one of the starter cultures has the highest value of 41.98. fermentation process seems to increase the soluble nitrogen of the fish, making it more biologically available. This increases the soluble nitrogen of the fish, making it more biologically available. This increases the nutritive value of the fish, an added advantage to the poreservative aspects of the process. Foods containing Staphylococcus are always characterized by high protein content (Hammes et al, 1995). The value of protein of the fish sample inoculated with *S. albus* and the combination of *L. brevis* was next – 34.84.

The % Free Amino Acid (FAN) in this investigation is the lowest in the sample with *S. albus* to be 0.039 and the highest recorded for *K. ozaenas* with 0.064. These values of FAN might be attributed to the rate of hydrolysis of fish muscle by the fish enzymes and microbial activity during fermentation (Ijong and Olita, 1995). The effects of dynamic balance of FAN by analysis and microbial action have been reported by Chang et al (1992) to be associated with the differences in amino acid content. The differences in the balance of FAN produced by autolysis and microbial action respectively (Ijong and Olita, 1995).

fermented fish especially, *Sarotherodon galilaeus* has been found to have high protein content (as one of the characteristics of fermented fish). The spontaneously fermented processes is recommended for the artisanal fishermen, fish mongers as another means of preserving their excess catch and unsold fish and those who would want to do it for pleasure, since the method is simple, sophisticated equipment and trained personnel's are not required.

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