EFFECT OF SALTING, BRINING AND SUNDRYING ON THE SHELF-LIFE OF CLARIAS GARIEPINUS (LACEPEDE)

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ABSTRACT

The effects of salting, brining and sundering on the shelf life of prerserved fish was carried out using a commercially important fresh water fish specie *Clarias gariepinus* stored at ambient temperature for four weeks. Paremeters such as moisture content, crude protein, ash content, fat content, total bacterial count and organoleptic assessment were investigated to assess changes in the quality of unsalted (US), dry salted (DS), 25% and 75% brined samples which were sundried for nine days before storage, Statistical analysis showed that were was significant differences ($P<0.05$) in the taste, colour, ash content and fat content of the fish samples while flavour texture, total crude protein and moistue content were not significant ($P<0.05$). The 75% brined sample has the best quality it terms of proximate composition with its values for moisture, crude protein, ash and fat content being 31.53%, 57.83%, 1.39% and 9.25% respectively after the first week of storage and 20.22%, 68.87%, 1.76% and 9.15% at the end of the fourth week. The unsalted sample had the lowest quality with regards to proximate composition. After the fourth week of storage, the values of 50.52%, 62.06%, 1.02 % and 6.40% were recorded in the unsalted sample. Results on organoleptic assessment indicated that 75% brined samples had the best quality in terms of flavour and texture while 25% brined and dry salted samples followed in the later (texture). The unsalted samples had the best taste over the four weeks storage period while the 50% brined sample had the best colour. The gills and muscle of the 85% brined samples recorded the highest bacterial count in the first week followed in order by 50% brined, unsalted and dry salted samples. However, after four (4) weeks of storage, the bacterial counts in all the unsalted samples approximate zero.

INTRODUCTION

Fish constitute a major and important component of several Nigerian dishes and often supplies nutrients lacking in Cereal-based diets. It is referred to as a very nutritious part of man's food (Murray and Burt, 1969) because its muscle contains about 20% protein; 5% fat; 5% ash and 70% water and these may vary considerably depending on the fish (Borgstrom, 1965; Clucas, 1981; FAO, 1981).

The demand for fish is very high, but the supply is low due to high perishability among other factors (Tobor, 1984). The current fish production level of approximately 550,000 tons per annum is about 5% of the total fish demand in Nigeria. There is therefore a wide gap between fish produced and fish made available to consumers because fish preservation, handling and storage methods in the artisanal sector of the industry are still traditional (Tobor, 1984).

The importance of fish as a source of animal protein therefore makes it compulsory that fish should be efficiently processed and well preserved before deterioration sets in (Eyo, 1983). The purposes of fish processing and preservation are to enhance fish quality, extend the shelf-life and get fish to the ultimate consumer in a good and usable condition (Carruthers, 1986). The commonest preservation methods includes: icing, freezing, cold storage, salting, drying and smoking.

It is difficult to trace which of these methods was first adopted by the primitive man, but we are aware that salting, sun drying and smoking started a long time ago (Doe et al, 1983; Afolabi, 1984). Salting of fish as a traditional processing method is used in combination with drying and smoking (Clucas and Sutcliff, 1981) and common salt (Sodium Chloride) if present in a required strength will slow down or prevent bacterial spoilage of fish (Burgess et al, 1965). FAO (1981) reported that the principle of fish salting is to remove water just as the same principle with smoking and drying as a result of heat production from fuel used for smoking but smoked fish does not last as long as salted fish.

Direct exposure of fish to sunlight is by far the most widely used method of drying fish (Doe et al, 1983). The method varies from one location to another; larger varieties may be split, the fish may be brined or salted directly before being spread out on the ground, rocks or beaches to dry in the sun. Some fish processors use mats or reeds laid on the ground to prevent contamination of flesh by dirts, mud and sand.

Except fish are processed or preserved in some way to retard spoilage, they will become putrid in a few hours of capture especially at the high ambient temperature that prevails in most tropical countries. Fish spoilage proceeds as a series of complex enzymatic, bacterial and chemical changes that begin as soon as the fish dies (Carruthers, 1986). Eventually, the fish becomes soft and the smell more noticeable. This research is therefore aimed at determining the effect of different salt concentration on the shelf-life of *Clarias* sp. by examining the chemical, microbial and organoleptic changes associated with salting, brining and sundrying of *Clarias* sp.

MATERIALS AND METHODS

A total of 100 African catfish, *Clarias gariepinus* with average body weight and length of 440 I 0.5g and 40.00 ± 0.42cm were purchased from Epe market in Lagos, Nigeria. The fish were transported to the laboratory in coolers containing ice cubes. Fine grain salt was purchased from the open market at Mushin in Lagos, Nigeria.

The fish were gutted and washed thoroughly with clean water and the samples were then treated to various categories of salt concentrations; direct salting, brining at 25%, 50% and 75% salt concentrations. Another set of fisl were not treated with salt and this acted as the control. In all, there were five treatments and each had twenty (20) *Clarias gariepinus*.

PROXIMATE ANALYSIS

The determination of crude protein, moisture, ash and fat content of the fish muscle were done using standard methods (AOAC, 1980 and Chow, 1980).

Crude protein determination was done by the modified micro-kjeldahl method (AOAC, 1980) involving three basic steps; digestion, distillation and titration. Moisture contents of the samples were determined by the AOAC (1980) method in which two (2) grammes of the samples (fish muscles) were oven-dried at 110°C for 24 hours to a constant weight. Lost in weight is equal to the moisture content of the original sample. The ash content was determined by heating the samples to a temperature of 550°C, the residue is equivalent to the ash content.

Total free fatty acid (FFA) was determined by the method of Bligh and Scoth (1966).

MICROBIOLOGICAL ANALYSIS

The microbial analysis was done using the standard serial dilution method as described by Miles and Mizra (1983).

ORGANOLEPTIC ASSESSMENT

The organoleptic assessment was done by two panels. The first consisted of staff of Nigeria Institute for Oceanography and Marine Research (NIOMR), Lagos, Nigeria. The other panel was made up of students Lagos State University. The former panelists are trained fish quality analysis while the latter are untrained. Questionnaires were used by both panels and scoring was done on a weekly basis.

RESULTS

The proximate composition of salted, brined and sundried *Clarias gariepinus* over four (4) weeks storage period were analysed and the results shown in table 1.

Some of the organoleptic properties like taste, colour, flavour and texture were examined on weekly basis and their results are presented in table 2, 3, 4 and 5 respectively. The bacterial load in the muscles and gills of the fish was analysed and table 6 shows the outcome.

TABLE 1: PROXIMATE COMPOSITION OF SALTED BRINED AND SUNDRIED *Clarias gariepinus*

% PROX. COMPOSITION	TREATMENT	WEEK1	WEEK2	WEEK3	WEEK4
MOISTURE CONTENT (%)	US	43.68	40.93	34.25	30.52
	DS	36.74	34.09	25.89	24.06
	25%	41.00	36.20	31.04	27.16
	50%	36.84	33.32	26.29	25.12
	75%	31.53	26.67		

% PROX. COMPOSITION	TREATMENT	WEEK1	WEEK2	WEEK3	WEEK4
ASS. CONTENT (%)	US	0.84	0.91	0.98	1.02
	DS	1.30	1.60	1.71	1.75
	25%	0.94	1.40	1.48	1.73
	50%	1.00	1.40	1.70	1.74
	75%	1.39	1.43	1.72	1.76

% PROX. COMPOSITION	TREATMENT	WEEK1	WEEK2	WEEK3	WEEK4
CRUDE PROTEIN (%)	US	46.49	51.95	58.37	62.06
	DS	55.46	57.93	55.40	67.27
	25%	50.38	54.87	59.98	63.73
	50%	53.33	56.50	63.81	65.00
	75%	57.83	62.67	63.92	68.87

% PROX. COMPOSITION	TREATMENT	WEEK1	WEEK2	WEEK3	WEEK4
FATCONTENT (%)	US	8.99	6.21	6.40	6.40
	DS	6.50	6.38	7.00	6.92
	25%	7.67	7.53	7.50	7.38
	50%	8.83	8.78	8.20	8.14
	75%	9.25	9.23	9.20	9.15

TABLE 2: AVERAGE WEEKLY SCORES FOR TASTE

WEEKS	TREATMENTS US	Ds	25%	50%	75%
1	4.5	1.8	2.2	2.5	1.8
2	4.2	2.0	2.5	2.0	1.9
3	3.4	2.5	2.6	2.6	2.0
4	2.6	3.0	3.0	2.5	2.5

TABLE 3: AVERAGE WEEKLY SCORES FOR COLOUR

WEEKS	TREATMENTS US	Ds	25%	50%	75%
1	3.0	4.0	4.0	3.9	4.1
2	2.5	3.3	3.5	3.7	3.7
3	2.1	3.9	2.7	3.6	2.9
4	1.6	2.6	2.8	2.6	2.8

TABLE 4: AVERAGE WEEKLY SCORES FOR FLAVOUR

WEEKS	TREATMENTS US	Ds	25%	50%	75%
1	3.0	4.0	4.0	3.9	4.1
2	2.5	3.3	3.5	3.7	3.7
3	2.1	3.9	2.7	3.6	2.9
4	1.6	2.6	2.8	2.6	2.8

TABLE 5: AVERAGE WEEKLY SCORES FOR TEXTURE

WEEKS	TREATMENTS US	Ds	25%	50%	75%
1	4.2	4.8	4.5	4.7	4.7
2	4.1	4.8	4.4	4.7	4.7
3	2.6	3.0	3.5	3.4	3.7
4	2.6	2.8	2.6	3.0	3.3

TABLE 6: BACTERIAL COUNT X 10^4 (ORG/g)

TABLE 6: BACTERIAL COUNT OF GILLS AND SUNDRIED *Clarias gariepinus*

	WEEKS			
TREATMENTS	**1**	**2**	**3**	**4**
USG	2.30	2.34	2.44	3.10
USM	2.10	2.24	2.36	3.15
DSG	1.36	0.91	0.25	0.00
DSM	1.34	1.34	0.00	0.00
25%G	2.62	2.00	1.67	0.30
25%M	2.29	1.76	1.50	0.00
50%G	2.71	0.62	0.30	0.00
50%M	2.55	0.31	0.00	0.00
75%G	3.35	2.49	0.00	0.00
75%M	3.32	2.41	0.00	0.00

USG/USM = Gill and Muscle of unsalted and sundried fish.
DSG/DSM = Gill and Muscle of dry unsalted and sundried.
25%G/25%M = Gill and Muscle of 25% brined and sundried.
50%G/50%M = Gill and Muscle of 50% brined and sundried.
75%G/75%M = Gill and Muscle of 75% brined and sundried.

DISCUSSION

The spoilage of fish flesh resulting from the action of enzymes and bacteria can be slowed down by the combination of salt and reduced moisture through sundrying as a means of improving the shelf – life of the fish. Result from this study reveals that a gradual deterioration occurred in the unsalted sundries fish products stored at ambient temperature for four weeks. This view is supported by the studies of Connel (1980) who observed changes in sundried fish preserved at an ambient temperature.

The result of the proximate composition shows that the total crude protein and ash contents of the fish samples increased with decreasing moisture content after four weeks of storage. Doe and Olley (1983) reported that salting and sundrying resulted in the concentration of the nutrients with low residual moisture levels. Though Munro (1965) reported that salt reduces the percentage of other components of the fish, it is evident from this study that the leaching effect of the salt was very minimal since value of the crude protein level is much higher in the salted than in unsalted sundried *Clarias gariepinus*. This is also confirmed by Current et al (1983) that bringing of fish prior to sundrying causes negligible leaching of protein content of the tissue.

The fat content of unsalted (US), salted and brined samples were generally high which may be a disadvantage especially with regards to rancidity development during storage. However, unsalted sample had a tremendous susceptibility to rancidity right from the inception as opposed to the salted and brined samples that had rancidity hindered by salt treatment.

The microbial load in the gills are generally more than the microbial load in the muscles of the fish samples. This may, be due to the moistened and softer nature of the gills, a condition that is more suitable for microbial growth. Also, the gills were more exposed to air-borne micro-organisms than the muscle as the fish rescued in water. Unsalted samples showed an increasing bacterial growth as storage time increase, while there was decreasing trend with sometimes no bacterial growth in the salted and brined samples with storage period. This observation is supported by Procto (1977), Chicas and Sutcliffe (1981) and Carruthers (1986) that salt inhibits bacterial growth. It was observed that the total viable count of unsalted fish samples, though high is far less than the 1.0x105/g standard suggested by Phillips (1977) and the result agrees with the general belief that water activity and not merely moisture content appears to be the most important factor in the suppression of microbial growth, (Scott, 1957).

Finally, the overall acceptability scores obtained using trained and untrained taste panels indicated that the salted and brined samples had better acceptability than the unsalted samples. This agrees with the findings of Carruthers (1986) that salt improves the storage qualities of preserved fish, however, the amount of salt and the salting time should be such that will favour consumer's preference.

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