Journal of Food Technology 3 (2): 216-219, 2005

Effect of Salting Methods on Quality of Smoked Dry Laked Fish

Tenin Dzudie and [1]Joel Scher
Department of Food Processing Engineering, University of Ngaoundere, Cameroon
[1]Laboratoire de Physico-chimie et Genie alimentaire, Nancy, France

Abstract: Tilapia species (Dreochromis aureus) were used in the present study. They were randomly allocated to three treatment groups of non-salted, brine-salted and dry-salted fishes. Loss in weight was greatest during smoking and least during drying. The pH of the fresh tilapia as well as that of the smoke-dried one increased with the level of salt in the products. Methods of salting the fishes significantly ($P<0.05$) affected the levels of lipid oxidation. Smoking of the fishes exhibited greater antioxidant activity. In respect of the overall acceptability, brine-salted and smoked tilapia was rated higher than the other two samples.

Key words: Fish, Salted, Smoked, Dry

Introduction

Africa is endowed with numerous lakes and rivers. These water bodies constitute a rich source of fresh fish for many people. Compared to red meat, fish is one of the cheapest animal protein sources and it accounts for about 40% of the total animal intake of an average person in the tropics (Sadiku and Aladimeji, 1991). Though many consumers prefer fish in fresh state, a considerable proportion of landed catch is preserved by smoking in order to reduce post harvest losses. In 1980, about 0.91% of the total word fish catch was smoked (FAO, 1983). Smoking imparts a mild flavour and colour. The choice of particular processing methods is greatly influenced by the area's geographical location, social-economic factors and the food habits of the local people.

Among the many preservation methods, drying and smoking were two of the earliest and most effective methods which have been developed in rural areas where refrigeration facilities are not available (Dzudie and Okubanjo, 1992 ; Musongue and Njolai,1994 ; Ockerman and Marriott, 2000 and Dzudie *et al.*, 2003)

The preservation of meat by curing has also been reported to be particularly useful in the tropical developing countries especially in the rural areas (Owen *et al.*, 1986). Generally quality control systems are entirely lacking in the artisanal fish processing industry. However, since smoked and dry fish can be held at ambient temperature several days before consumption, there is sufficient time for the development of lipid oxidation (Cuppett *et al.*, 1989). Large scale production of lake fishes has been suggested for rapidly increaslng meat protein demand in developing countries and widespread distribution to urban areas can be carried out cheaply and more efficiently following the curing and smoking process.

The objective of the present study was to investigate the influence of two different curing methods on the physico-chemical and organoleptical properties of smoked-dry Tiliapa.

Materials and Methods

Materials: Tiliapia (Dreochromis aureus) harvested from lake Bini (Ngaoundere, Cameroon) were received at the Ngaoundere University meat laboratory 48 hrs after harvest. The fish were weighed on reception and those with weights ranging between 500-600 g were selected Commercial style dressing followed, with removal of heads, viscera, back bones and the black lining of the belly flap. Traces of blood were removed with fresh water. Dressed fishes were then randomly allocated to three treatment groups of non-salted, brined-salted and dry-salted fishes.

Experimental Design: The dressed fishes were either brined in a cover pickle containing 80 g sodium chloride per litre solution or dry-salted by rubbing uniformly over the surface of the fish with sodium chloride at the rate of 80 g per kg meat. The total curing time was 24 hrs at 2 °C. The dry-cured fishes were then rinsed of excess salt with fresh water.

The smoking and drying processes were carried out in an Matindex air conditioned smoked house (model 74560, Lamurax Germany) equipped with a Matindex smoked generator (mode 80, Lamurx Germany). The processing time in the kiln was divided into three stages ; (1) a preliminary drying period at 40 °C (HR=90%) for 2 hrs ; (2) a smoking and partial cooking period at 90 °C (HR=80%) for 4 hrs and a final drying period at 95 °C (HR= 60%) for 16 hrs. During processing ventilation was continuous and shelf temperatures were monitored by copper constantan thermocouples with digital recorder (Didalab-model 918, France).

Analyses: Fish samples were weighed at each processing step at a regular interval of 2 hrs to determine respective weight losses. All analyses were carried out on samples ground twice through a 4 mm plate (Moulinex Model 133). Proximate analysis, pH and thiobarbituric acid (TBA) measurements were carried out on fresh and smoke-dried meat, while sensory analysis was determined only on smoke-dried samples. The moisture content was determined by oven drying, protein using the Kjedahl nitrogen estimation, fat content by soxhlet extraction with petroleum ether and ash content by incineration at 525°C as described in AOAC methods (1980). Sodium chloride as chloride was determined by dissolving the ash in boiling water and titrating against nitrate (AOAC, 1980).
For pH measurement, 10g of ground fish sample was homogenised in 100 ml of distilled deionised water. The pH was determined using a Minisi pH meter, Model 8000. Thiobarbituric acid (TBA) reactive substances were measured as described by Witte, Krause and Bailey (1970). The results are expressed as mg malonaldehyde / Kg sample

Consumer Sensory Evaluation: Meat from the smoked-dried fishes from each treatment group was cut into bite samples and were subsequently evaluated by 30 untrained consumers without differentiation of age or sex. Consumers were recruited from students, staff and faculty in the Ngaoundere University. Samples were scored on a 9-point hedonic scale ranging from 1 for dislike (in respect of flavour and overall acceptability), extremely salty (saltiness), abundant (smokiness) to 9 for like extremely for flavour and overall acceptability, extremely tasty and devoid of smokiness. The samples were coded with three-digit random numbers and served at room temperature. Reconstituted whole powdered milk was used to rinse the mouth after each evaluation to avoid carry over flavour.

Statistical Analysis:

CommandBut

The experiments were performed in triplicate and the means of the three values were reported. Data were subjected to one way analysis of variance and ducan's multiple range test (Steel and Torrie, 1980) was used to determine the significant differences among the means.

Results and Discussion

In all the three treatment groups, the weights of the various samples decreased starting from the pre-drying period to the end of the drying step. The percentage weight losses at each processing step are presented in Fig. 1. Extensive dehydration was observed during the smoking. Smoking generally led to substantial weight losses (Dzudie and Okubanjo, 1992). The least loss in weight was observed with the dry-salted fishes during the pre-drying and smoking periods. Loss in weight during pre-drying period was due to evaporative loss of water on the surface of the fishes. During smoking and drying steps loss in weight was due to osmotic withdrawal of water from the interior of the meat, subsequent loss in weight was due to evaporative loss of water from the surface of the fishes. The difference observed in the weight loss of the products in the different treatment groups was certainly due to the positive effect of salt in moisture retention (Shiro *et al.*, 1983).
Means for proximate analysis, sodium chloride, pH and TBA are shown in table 2. In comparison to the non-salted and brine-salted tilapia, the moisture content was lower in the dry-salted fresh one. Some drip was observed during curing process and was attributed to the effect of salt extracted moisture from within the muscle cell to the surface on the fish. On the other hand, the higher moisture content obtained in the same smoked and dried sample was due to positive effect of salt in moisture retention. The protein content of the tilapia was shown to be significantly ($P < 0.05$) affected by the various treatment groups with the dry-salted fresh sample having the highest protein content and after smoking and drying showing the least protein content. The change in the moisture content due to the difference of salt concentration in the fish might explain the differences in protein content among the treatment groups. For fall and spring fish similar data has been presented (Bhuiyan *et al.*, 1986). The high ash content of the dry-salted tilapia over the non-salted and brine-salted ones before and after smoking and drying was expected and attributable to the different concentration of salt in the different samples. Dzudie and Okubanjo (1992) reported that the mean ash content of skinned injected rabbit meat was significantly higher ($P<0.05$) than that of the skinned non injected one.
The salt content increased in both brine-salted and dry-salted tilapia. The salt content of tilapia determined as 0.50g per 100g raw material was comparable to that of 0.45% reported in edible spring fish (Bhuiyan *et al.*, 1986). In respect of salt concentration, a minimum of 3% was enough to inhibit the growth of any food poisoning organism present in food, particularly clostridum botulinum without making the product unpleasantly salty to eat (Bannerman, 1980). The high salt content of tilapia in the present study should not be a great problem. Such fish could be used for stewing or cooking without putting any additional salt or after desalting with water.

Table 1: Chemical analysis

	Fresh fish[1]					
	Moisture %	Protein %	Ash %	NaCl %	pH	TBA mg malonaldehyde/kg
NSF	75.80^{b} ±1.23	18.40^{c} ±1.50	1.90^{c} ±0.30	0.60^{c} ±0.02	5.80^{c} ±0.60	0.63^{c}±0.03
BSF	76.60^{a} ±0.76	17.70^{b} ±0.95	3.90^{b} ±0.40	3.50^{b} ±0.25	6.10^{b} ±0.50	0.79^{b}±0.06
DSF	72.75^{c} ±0.92	20.25^{a} ±1.20	5.80^{a} ±0.50	4.80^{a} ±0.30	6.25^{a} ±0.60	0.95^{a} ±0.05
	Smoke-dried fish					
NSF	5.61^{c} ±0.35	75.65^{a} ±1.60	5.80^{c} ±0.60	0.65^{c}± 0.04	5.95^{c}±0.60	0.43^{c}±0.05
BSF	7.85^{b} ±0.45	55.50^{b} ±0.90	18.10^{b} ±2.20	4.80^{b}± 0.30	6.25^{b}±0.70	0.65^{b}±0.06
DSF	13.63^{a} ±0.60	50.96^{c} ±0.85	25.14^{a} ±2.60	11.29^{a} ±1.60	6.40^{a} ±0.50	0.77^{a} ±0.05

[1]Data given are means and standard deviations [abc] Means with different superscripts on each line differ significantly ($P<0.05$)
NSF: non-salted fish BSF: brine-salted fish DSF: dry-salted fish

Table 2: Sensory Analysis

Evaluation [1]	NSF	BSF	DSF
Flavor	5.40±0.90	5.60±0.80	5.00±0.95
Saltiness	6.50±0.85^{a}	3.30±0.70^{b}	1.90±0.56^{c}
Smokiness	3.20±0.75	3.40±0.85	4.10±0.70
Overall acceptability	5.90±0.60^{b}	7.20±0.90^{a}	5.30±1.05^{b}

[1]Data given are means and standard deviations
[abc] Means with different superscripts on each line differ significantly ($P<0.05$)
NSF: non-salted fish
BSF: brine-salted fish
DSF: dry-salted fish

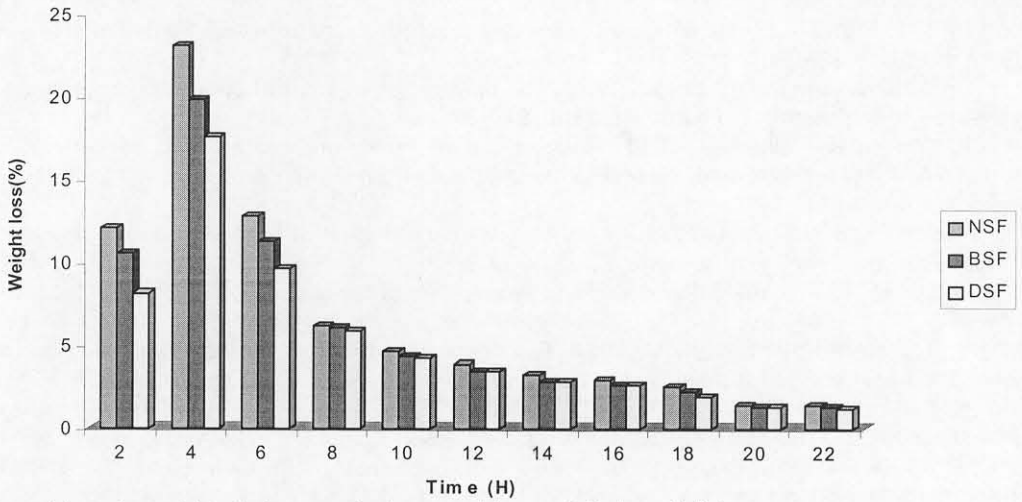

Fig. 1:Percent loss in weight during pre-drying, smoking and drying of fish

The pH of the fresh fish increased as the level of the salt in the muscle tissue increased. The same trend was observed after smoking and drying. The increase in the pH of the fish could be attributed to the effect of salt on muscle proteins. Babji *et al.*(1982) found that pH of salted turkey breast muscle was higher than that of unsalted sample. Dzudie *et al.*(2000) reported that pH of smoked and dried beef meat was higher than that of fresh and salted sample. In contrast, Vishwanath *et al.*(1998) found that pH of smoked mudeel fish was more acidic than that of fresh counterpart. Discrepancy in the results could be due to differences in processing methods.

The lipid stability in fresh and smoke-dried tilapia was evaluated by TBA procedure. Overall, the results indicated that the TBA values increased with increase in the salt content in the samples. These results confirmed those of Wheeler *et al.*(1990) who found that TBA values in restructured beef steaks were significantly higher ($P<0.05$) in salted samples than in unsalted ones. In the present study, the antioxidant effect of the smoke was evident. The TBA values of the smoke-dried fish was significantly lower ($P<0.05$) than those of the smoke-dried counterparts. Chen and Issenberg (1972) noted that the preservative effect of wood smoke in foods was the result of partial

surface dehydration and deposition of antioxidant compounds from the smoke on the surface of the products. No literature value could be obtained for a comparison with the taste panel results presented in table 2. No significant difference ($P>0.05$) was found in the products as far as flavour and smokiness were concerned. The panellist could have been certainly influenced by the degree of saltiness in the products resulting in the general acceptability rating of the brine-salting fish. Bhuiyan *et al.* (1986) stated that in respect to salt concentration in smoked mackerel, a concentration of 4.23% was acceptable.

References

AOAC , 1980. "Official Methods of Analysis", 13th ed., Association of Official Analytical Chemists Washington, D.C.

Babji, A. S., B. W. Froning and D. A. Nogka, 1982. The effect of short term tumbling and salting on the quality of turkey breast muscle. Poultry. Sci., 61: 300-303

Banerman, Meka, 1980. Hot smoking of fish Torry Advisory Note. Torry Research station, Ministry of Agriculture, Fisheries and Food, Aberdeen, Scotland.

Bhuiyan, A. K. N., W. M. N. Ratnayaka and R. G. Ackman, 1986. Effect of Smoking on the proximate composition of atlantic mackerel (Scomber scombrus L). J. Food Sci., 51: 327-329

Chen, L. B. and P. Issenberg, 1972. Interaction of some wood smoke component with amino-groups in proteins. Agric. Food Chem., 20: 1113-1117

Cuppett, S. L., J. I. Gray, A. M. Booren, J. F. Price and M. A. Stachiw, 1989. Effect of processing variables on lipid stability in smoked great lakes whitefish. J. Food Sci., 54 : 52-54

Dzudie, T. and A. Okubanjo, 1992. Effects of two skinning and curing methods on the quality of rabbit meat. J. Food Sci. Technol., 29: 162-166

Dzudie T., Magara Bouba and C. M. F. Mbofung, 2003. Effect of salt dose on the quality of dry smoked beef. Ital. J. Food Sci., 15: 433-440

FAO, 1983. Food and Agri. Organisation. Production year Book, 37, Rome

Musongue, P. and N. Eric, E. N. Njolai, 1994. Drying and infusion during the traditional processing of Kilishi. J. Food Engin., 23: 159-168.

Ockerman, H. W., C. T. LI and N. G. Marriott, 2000. Sensory and microbial attributes of a dehydrated pork product (shredded pork). J. Muscle Foods, 11: 143-155

Owen, J. E., F. J. Cutierrez and E. P. Carbajal, 1986. The preparation of smoked cooked chicken by conventional and accelerated curing methods. Poultry Sci., 65: 314-320

Sadiku, S. O. E. and A. A. Oladimeji, 1991. Relationship of proximate composition of Lates niloticus (L), Synodontis synodontis, Schall and Sarotherodon qalilaeus from Zaria dam, Nigeria. Bioscience Rsource Communication, 3:29-40

Schiro, A., N. Hiroyasa and J. Toshio, 1983. Effect of salt concentration of brine and curing time on quality of cooked cured loin. Bull. Nat. Inst. Anim. Ind., 37: 40-43

Steel, R. G. D. and J. N. Torrie 1980. «Principles and Procedures of Statistics», 2nd Edition. McGraw-Hill, New York.

VISHWANATHW., LILABATI H. and BIJEN M. 1998. Biochemical, nutritional and microbiological quality of fresh and smoked mud eel fish. Food Chem., 61: 153-158

Wheeler, T. L., S. C. Seideman, G. W. Davis and T. L. Rolan, 1990. Effect of chloride salts and antioxidants on sensory and storage traits of restructured beef steaks. J. Food Sci., 55 : 1274-1277

Witte, V. C., G. F. Kause and M. E. Bailey, 1970. A new extraction method for determining 2-thiobarbituric acid value of pork and beef during storage. J. Food Sci., 325 : 582-585