Production of kippers from horse mackerel (*Trachurus trachurus*)

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SUMMARY

Kippers have been successfully made from horse mackerel (*Trachurus trachurus*). Storage trials have shown that the kippers will safely keep for 40 days at 4–5°C and only 5 days at 28–30°C. Consumer tests have shown that the product is acceptable at a salt content of 3–4% and moisture content of 55–60%. This product may prove attractive to the Ghanaian consumer and help raise the present market value of horse mackeral.

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RÉSUMÉ

NERQUAYE-TETTEH, GLADYS & TETE-MARMON, J.: *Production de poisson mariné et fumé (kippers) à partir de saurels ou maquereaux bâtards* (Trachurus trachurus). Les auteurs ont réussi à faire des kippers avec des saurels ou maquereaux bâtards (*Trachurus trachurus*). Des essais de conservation ont montré que ces kippers se gardent en bon état pendant 40 jours à 4-5°C mais seulement 5 jours à 28-30°C. Des essais de dégustation ont montré que ce produit est acceptable avec une teneur de 3-4% de sel et 55-60% d'eau. Ce produit peut se montrer intéressant aux consommateurs ghanéens et aider à améliorer la valeur marchande actuelle des maquereaux bâtards.

Introduction

Kippers are a brined, cold smoked fish product which are normally processed from herring (*Clupea harengus*). Kippered fish are not cooked during the smoking process and, therefore, must be cooked before consumption. They serve well on sandwiches and several other Ghanaian dishes like *kenkey* or *ampesi* with gravy.

Horse mackerel was chosen instead of herring for this work because of two reasons: (a) horse mackerel has a low market value because, in the fresh form, it is unattractive and has a comparatively short life. It is normally hot-smoked without brining and is not very popular with consumers; (b) horse mackerel is available throughout the year.

The objective of this study, therefore, was to produce a kippered horse mackerel with the aim that the product will be attractive to the Ghanaian consumer and help raise the present market value of the fish.

Materials and methods

A 20 kg carton of frozen horse mackerel was bought from the Ghana Cold Stores, Tema. The average weight of each fish was 62·5 g. Three trials were made in this experiment. About a 7 kg weight of fish was thawed at room temperature (28–30°C) and used for the first trial. Approximately 6 kg weight of the thawed fish was used for the other two trials. The fish samples were stored at −20°C and were brined prior to smoking. The samples were dyed lightly with Hexacol Kipper Brown (a product of L. J. Pointing & Sons, Prudhoe, Northumberland, U.K.).

The procedure followed was that recommended by Burgess & Bannermann (1963) with minor modifications.

Cleaning

Approximately 7 kg of thawed horse mackerel was cleaned by splitting down the back of each fish so that the backbone was on the left hand side when looking at the cut surface with the head uppermost. The gills and guts were removed leaving the head on and the belly walls intact. The samples were then washed thoroughly under running tap water to remove blood stains. After

cleaning, washing and draining for 30 min, the total weight of the fish was recorded. Approximately 6 kg samples were similarly treated and thawed in each case for the second and third experiments.

Brining

After a series of brining trials using brine solutions of 30° salinometer, 40° salinometer, 50° salinometer, 70° salinometer and 80° salinometer respectively (as recommended by Cutting, 1965). 40° salinometer brine solution proved to be the most suitable concentration for the size of the fish used. The solution for the first experiment was prepared by dissolving 360 g solar salt in 6·0 dm^3 water. 3·0 g of Brown FK dye readily dissolved in the solution at room temperature (28–30°C). For the second and third experiments, the weight of the salt and dye and the volume of water were calculated in proportion to the weight of the fish. The ratio of fish to brine was 1:1 (w/v). After brining, the fish samples were hung in a row on wooden 'tenter' sticks, arranged on a trolley to fit into the smoking oven, and left hanging for 1 h.

Smoking

The trolley with the fish samples was wheeled into a Torry Mini Kiln (a product of Afos Ltd, Manor Estate, Anlaby, Hull, England). Only one of the three fires of the kiln was lighted. Smoking was done with a mixture of wood chips and sawdusts. The smoking temperature was maintained between 40–45°C for 4·42 h.

After smoking, the kippers were removed from the 'tenter' sticks and spread out on a clean table to cool to room temperature before they were packed in sealed polyethylene bags for the storage experiments.

Storage experiments

For each of the three experiments, 10 packets of the kippers (two fish samples in each packet) were kept at 4–5°C in a refrigerator and another 10 packets kept at room temperature (28–30°C) and about 80% RH. The samples were examined at intervals for total bacterial and mould count, as well as visual examination. The presence of coliforms and pathogens were also tested in all the samples.

Chemical analyses

Proximate composition, as well as salt content of the horse mackerel, were determined before and after brining. The processed kippers were analysed for salt and moisture contents.

Moisture was determined on a 5-g well-mixed sample in a ventilated drying oven at 105±1°C to a constant weight.

Nitrogen was determined on a 2 g minced sample by macro Kjeldahl method and the percentage protein calculated as N×6·25.

Fat was extracted from a 5 g sample by soxhlet extraction method for about 8 h, using petroleum ether.

Ash content was determined with a 5 g minced sample in a silica crucible, heated on a bunsen burner in a fume cupboard to remove excess water. The sample was later ashed in an electric muffle furnace at 550°C.

Salt was determined according to the method by Schonderz (1955).

Microbiological analyses

Total bacterial count was done using the standard plate count method by Collins (1967). The methods used for the isolation of *Salmonella*, *Staphylococci* and *Clostridia* were those by Cruickshank, Duguid & Swain (1965).

Results and discussions

The yield of kippers calculated as a percentage of the fish before cleaning was 55%. Cutting (1965) recommended 65% for kippers from herring.

Taste panel assessment of the kippers showed that salt content of 4% and a moisture content of 55% were acceptable. For tasting, the kippers were fried in hot cooking oil for about 3 min. In all cases, the tail end of the fillets and the thinner side opposite the backbone of the fish were found to be saltier than the thicker portions.

Cooking of the kippers for consumption by grilling or frying increased the concentration of the salt in the flesh, but stewing or boiling in water reduced saltiness. Steeping the kippers in water for 2–4 h reduced the salt content from 4% to 1–2% without impairing texture and flavour.

Results of the proximate composition of the flesh of the fish samples before and after brining are shown in Table 1.

TABLE 1
Proximate Composition and Mineral Content of the Flesh of Horse Mackerel

	Before brining	*After brining*
Moisture %	67·8	68·8
Fat %	11·2	11·1
Protein (N×6·25) %	17·5	15·4
Ash %	3·5	4·7
Salt %	0·4	2·9

Kippers obtained using a brine strength of about 70°–80° salinometer (Cutting, 1965) were too salty to 10 taste panelists at Food Research Institute. This was probably due to:

1. The horse mackerel used in this work had a lower fat content (11%, Table 1) unlike the Europian herring which has a fat content of 15–20%. Cutting (1965) reported that the penetration of salt is retarded by fat in a fish.

2. The small size of the fish used.

Burgess & Bannerman (1963) recommended that smoking of kippers should be done at 30°C for 4–6 h, but this was found to be unsuitable where ambient temperature is in the range of 28–30°C for the greater part of the year. A temperature of 40–45°C was found most suitable.

The results of bacterial count on the samples of kippers stored at room temperature is presented in Fig. 1. Fig. 2 shows the results of bacterial load on the samples kept at 4–5°C.

Tables 2 and 3 show the results of the bacterial count for the three experiments at both room temperature (28–30°C) and 4–5°C respectively. There was a progressive increase of bacterial numbers with time (Fig. 1). (Counts were done both aerobically and anaerobically to assess the keeping quality and detect the presence of *Clostridia*).

There was a sudden fall in bacterial numbers after 8 days storage at 4–5°C, followed by a gradual rise (Fig. 2). This was probably due to the fall in bacterial numbers as a result of the decrease of the activity of mesophilic bacteria on the samples stored at low temperature. The gradual increase in bacteria counts was probably due to the multiplication of the psychrophilic bacteria on the product. Later cultures yielded more chromogenic psychrophiles than mesophiles.

TABLE 2
Results of the Average Bacteria Count on Horse Mackeral Stored at 4–5°C

Days	*Lab. No.*	*Viable bacterial count/g*	
		Aerobic	*Anaerobic*
3	K_1	$72=10_3$	$70\times10_1$
8	K_2	$85\times10_1$	$76\times10_1$
24	K_3	$72\times10_3$	$88\times10_2$
28	K_4	$46\times10_2$	$36\times10_2$
33	K_5	$11\times10_2$	$13\times10_2$

TABLE 3
Results of the Average Bacteria Count of the Horse Mackeral Samples Stored at28–30°C

Days	*Lab. No.*	*Viable bacteria count/g*	
		Aerobic	*Anaerobic*
3	K_1	$68\times10_3$	$81\times10_1$
8	K_2	$68\times10_3$	$50\times10_1$
18	K_3	35×10^4	$25\times10_2$
24	K_4	64×10^4	$88\times10_2$
28	K_5	64×10^4	$88\times10_2$

Moulds may also play an important role in the spoilage of the kippers. Samples kept at room temperature were found to carry more moulds than bacteria. Most common moulds found on the samples were *Asperigillus* sp. and *Penicillium* sp.

No food poisoning organisms i.e. *Salmonella*, *Staphylococci* and *Clostridia* were isolated in any of the samples analysed.

Samples of the kippers kept at 4–5°C stored for 40 days without any visible signs of deterioration whilst those kept at 28–30°C stored for not more than 5 days.

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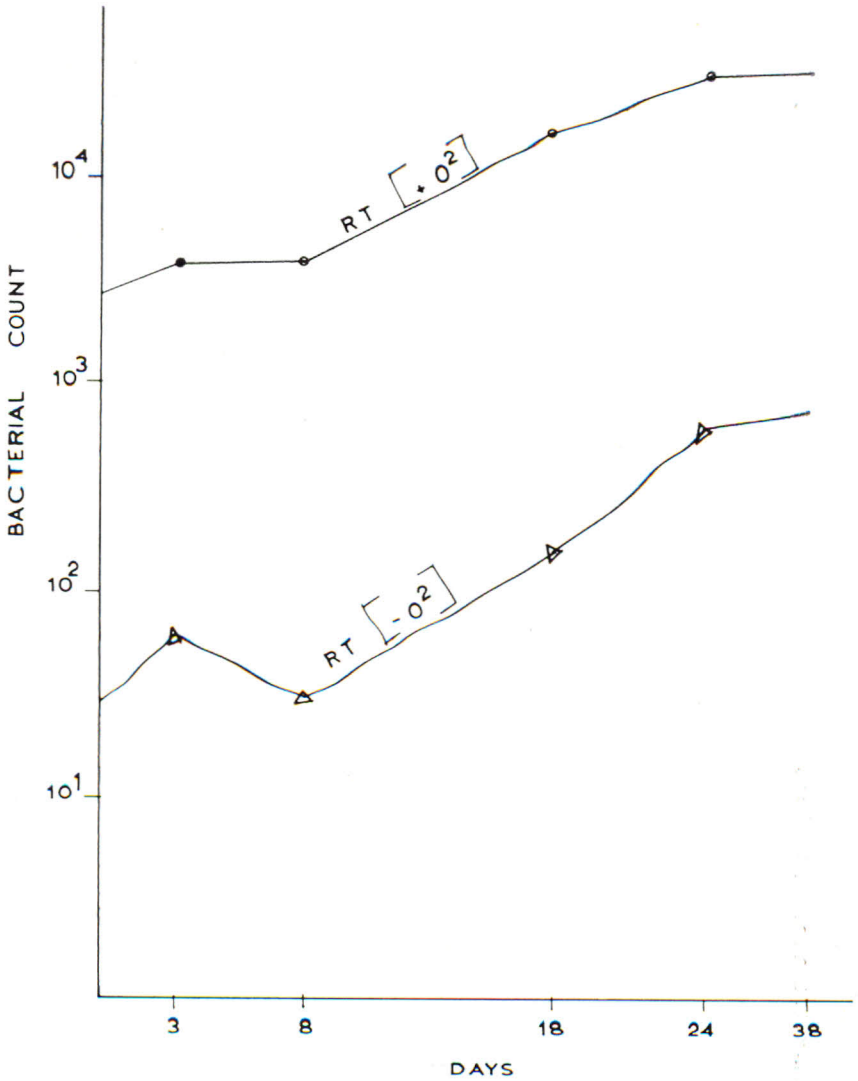

Fig. 1. Bacterial count on samples stored at ambient temperature (28-30°C).

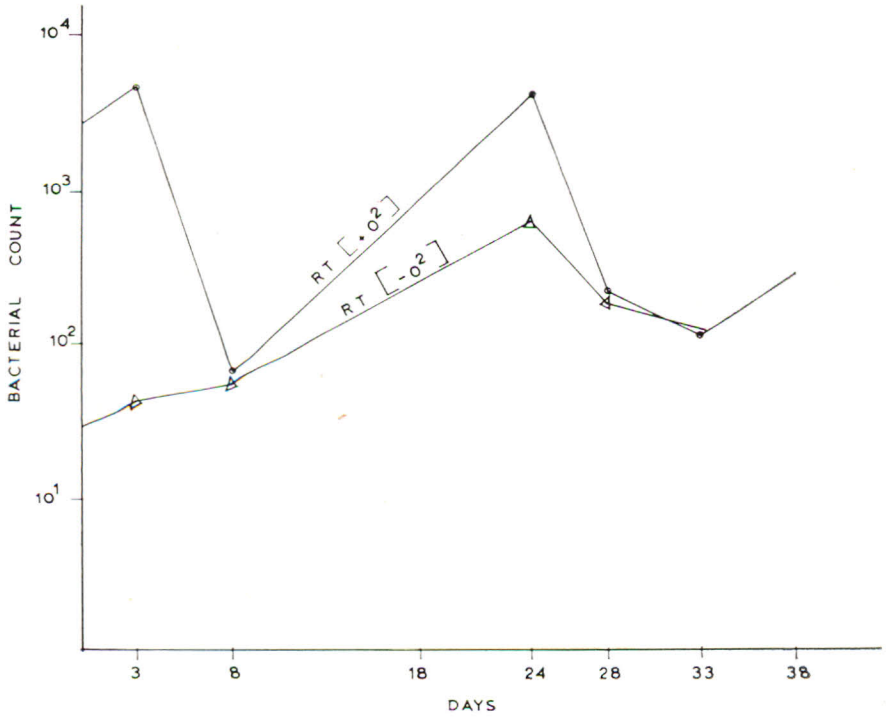

Fig. 2. Bacterial count on samples stored at 4-5°C.

REFERENCES

A. O. A. C. (1970) *Official methods of analysis*, 11th ed., pp. 294–310. Washington, D.C. Association of Official Analytical Chemists.

Burgess, G. H. C., Bannerman, A. McK (1963) Some smoked products; Fish smoking. A Torry Kiln Operator's Handbook, pp. 34–35. Edinburgh: Her Majesty's Stationary Office.

Collins, G. H. (1967) *Microbiological methods. Fresh, frozen and dried foods*, pp. 332–334. London. Butterworths.

Cutting, C. L. (1965) Description of the chief types of smoke-cured fish in Western Europe. In fish was food (ed. Georg Borgstrom), vol. 3, pp. 82–85. New York: Academic Press.

Cruickshank, R., Duguid, J. P. & Swain, R. H. A. (1965). *Pathogenic and commensal bacteria*, 11th ed., pp. 135–148. Edinburgh: The English Language Book Soc. and E & S. Livingstone Ltd.

Fogg, D. N. & Wilkinson, N. T. (1958). The colorimetric determination of phosphorus. *Analyst, Lond.* **83,** 406–414.

Food Research Institute (1968). *Food Analysis Sheet* No 3. Accra: The Institute (Mimeo.)

Shewan, J. M. (1970) Bacteriological standards for fish and fishery products. *Chemy. Ind.* **6,** 193–199.

Silliker, J. H. (1963) *Total counts as indexes of food quality; Microbiologica quality of foods*, (ed. L. W. Slanetz, C. O. Chichester, A. R. Gaudin, and Z. J. Ordal,) pp. 102–111. New York: Academic Press.

Zygmunt Schonderz (1955). Determination of salt based on titration with mercuric nitrate; *Fd Mf.* **30,** 460.