Studies on *Bomone*, a Ghanaian fermented fish product

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SUMMARY

A survey was conducted to ascertain common species of fish used in *Bomone* production and the different processing methods employed in different localities along the coast of Ghana. The chemical and microbiological quality attributes of market samples studied did not show any significant variations. The dominant group of micro organisms isolated from all the samples was Gram positive micrococci. This group accounted for about 72 per cent of the total micro-organisms isolated. Other Gram positive organisms isolated in much smaller numbers were *Staphylococcus aureus* (1.6 per cent), *Bacillus* sp. (4.4 per cent) and *Staphylococcus* sp. (3.2 per cent). The Gram negative rods isolated accounted for 17 per cent of the total number of micro-organisms isolated.

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RÉSUMÉ

NERQUAYE-TETTEH, GLADYS, EYESON, K. K. & TETE-MARMON, J.: *Etudes sur le* Bomone, *un produit ghanéen à base de poisson fermenté.*

Une prospection a été effectuée pour identifier différentes espèces communes de poisson utilisées dans la production de *Bomone* et pour noter les différents procédés de fabrication dans les diverses localités le long de la côte du Ghana. Les qualités chimiques et biologiques des divers échantillons du commerce ont été étudiées, elles n'ont pas mis en évidence de différences notables. Le groupe dominant de micro-organismes isolés de tous les échantillons, a été celui des microcoques gram-positifs. Ce groupe a constitué 72% de l'ensemble des micro organismes isolés. D'autres organismes gram-positifs ont été trouvés en beaucoup plus petit nombre: ce sont: *Staphylococcus aureus* (1,6%), *Bacillus* sp. (4,4%) et *Staphylococcus* sp. (3.2%). Les bacilles gram-négatifs isolés formaient 17% du total des micro-organismes observés.

Introduction

Bomone is a Ghanaian name for salted, fermented and/or sun-dried fish used locally for flavouring soups and stews. The name literally in English, means 'stinkfish' and is derived from the Twi verb 'bon' meaning to 'stink'.

Bomone is different from 'stinkfish' produced in Sierra Leone which Watts (1965) described as fish which has developed strong flavour within 24 h after capture. The latter is often smoked whereas the local product is not.

Although Bomone is very popular and has been in use in Ghana for many centuries, there is very little published information on the various processing methods and on its microbiological and chemical properties.

This study was designed to locate the important centres of Bomone production, to identify the various processing methods and to examine the chemical and microbial quality of Bomone sold in Accra markets.

Materials and methods

Production sites, species of fish commonly used and methods of processing were ascertained through a survey conducted along the Ghana coast from Keta to Busua, near Takoradi.

Processing technology

Methods of procesing differed from site to site, but basically they involved scaling, gutting, washing (in either fresh or sea water), salting (with coarse salt or brine of 30–40° salinometer) and drying (Okraku-Offei, 1968).

During salting, the fish is rubbed with salt and packed in layers of solid salt in various types of containers, commonly wooden barrels. In certain areas, salt is placed inside the abdominal cavity and behind the gills of individual fish before packing. After packing, the containers are covered with old jute-bags or polyethylene sheets. The quantity of salt used ranged from 2 kg to 8 kg per 18 kg of fresh fish. Salting takes 1–7 days. The salted fermented fish may be sun-dried on tarpaulin, or on leaves spread on the ground for 3–8 days, depending upon climatic conditions.

When brine of 30–40° salinometer is used, drying lasts 5–10 days. By this process, a dry, soft and strongly flavoured product is obtained.

Chemical analysis

Samples for analyses were purchased from the following markets in Accra: Makola No. 1 and 2; Salaga; Kaneshie; Osu and Accra Newtown. Samples from different markets were minced seperately in Hobert Mincer (CE-100 Mixer, 10 QT Model) and samples taken for chemical analyses and microbiological axamination.

Moisture content, protein, fat, ash, iron, calcium and salt were determined by A.O.A.C. (1970) methods. Total viable bacteria count by the method of Miles and Misra as outlined by Collins (1967). Identification of cultures (Salmonellae, Staphylococci and Clostridia) was as described by Colindale Central Public Health Laboratory (1965). Faecal coli were confirmed using Brilliant Green Bile Broth at 44±0.5 °C.

Phosphorus was determined by the method of Fogg & Wilkinson (1958), *p*H value by Amu & Disney (1973) method, total volatile bases (TVB) and trimethylamine (TMA) were determined by the methods of Jones, Murray & Burt (1965) and Beatty & Gibbons (1937) respectively.

Microbiological examinations

The microbiological examinations of the fermented fish muscle were carried out as follows:

(i) *Total viable bacteria count.* This was estimated, aerobically and anaerobically, according to the Miles and Misra method outlined by Collins (1967). Cultures were purified and identified using standard methods of staining and biochemical tests (Cruickshank, Duguid & Swain, 1965).

(ii) *Coliforms* were detected using the procedure for the bacteriological examination of foods compiled by Colindale Central Public Health Laboratory (1965). Faecal coli were confirmed using Brilliant Green Bile Broth at 44±0.5 °C.

Results and discussion

Table 1 shows the data on the processing sites and methods of processing in the different localities covered by the survey. The data indicate differences in processing methods as previously reported by Okraku-Offei (1968). The duration of fermentation varied from 6 h to 8 days. Drying period also varied from 3 to 10 days. The method of salting also differed from place to place.

The species of fish covered during these studies were the following: Atlantic Spanish mackerel (*Scomber japonicus*), Burro (*Plectorhynchus macrolepis*), Grouper (*Epinephelus sp.*), Horse mackerel (*Caranx hippos*), Sea bream (*Pagrus* and *Lethrinus* sp.), Surgeon fish (*Acantharus monroviae*), Ten pounder (*Elops senegalensis*), and Threadfin (*Galeoides decadactylus*).

The chemical composition of the minced flesh is presented in Table 2. Using Student t distribution, it may be observed from the relevant statistical tables that q_0 (5, 50) = 4.01 at P = 0.05. Since no calculated value of q_0 is greater than 4.01 we may conclude that there is no significant difference between the chemical compositions of samples obtained from the various markets. The *p*H values recorded were similar to those reported for spoiled temperate marine fish (Reay & Shewan, 1949). Balakrishan Nair, Tharamani & Lahiry (1971) reported that the *p*H values similar to those recorded in this work indicated the accumulation of basic bacterial metabolites such as amines.

The values of amines (TVB and TMA) produced during processing were high and compared well with those reported by Mackie, Hardy & Hobbs (1971) and Amano (1962) for the various fermented fish products from South East Asia. The characteristic flavour and odour of fermented fish products had been attributed to the production of these amines. This might also apply in the case of the local Bomone.

Amines have been reported to be protein breakdown products of low nutritional value

TABLE 1
Processing of Bomone at Various Sites in Ghana

Site	*Preparation of fish*	*Method of salting*	*Duration of fermentation (days)*	*Duration of drying (days)*
1. Keta	Scaled, gutted, washed with sea water and left for 3 days	Salt placed on both inside and outside of fish	3–5	4–7
2. Ada	Scaled, gutted, washed and left for 1–3 days in pots	Fish is salted after 3 days	2–3	3–8
3. Kpone	Scaled, gutted, washed and left for 3 days	Salt placed on both inside and outside of fish	3–4	4–7
4. Ningo New Town	Scaled, gutted, washed with ordinary water and left for 1 day	Salt placed on both inside and outside of fish	3	3–7
5. Accra Chorkor	Scaled, gutted and washed with ordinary water	Granulated salt is placed in both inside and outside of fish	6h–3	4–8
6. Accra James Town	Scaled, gutted and washed with ordinary water	Salting is carried out immediately after washing	3–7	3–4
7. Accra New Mamprobi	Scaled, gutted and washed with ordinary water	Fish is salted in brine of 30–40° salinometer	6h–12h	5–10
8. Teshie	Scaled, gutted and washed with sea water	Fish is salted in brine of 30–40° salinometer	2–3	3–5
9. Senya Bereku	Scaled, gutted and washed with sea water	Fish is salted in brine of 30–40° salinometer	2–5	4–7
10. Fete	Scaled, gutted and washed with sea water	Salt placed on both inside and outside of fish immediately after cleaning	3	5–7
11. Winneba	Scaled, gutted and washed with either sea water or fresh water	Salt placed in both inside and outside of fish immediately after washing	3	3–7
12. Apam	Scaled, gutted and washed with sea water	Salt is placed inside abdominal cavity and behind gills and fish put in sea water	3	3–5
13. Elmina	Small sized fish neither scaled nor gutted. Large sized fish scaled, gutted and washed	Salt is sprinkled on small sized fish and placed inside and outside of large sized fish	3–8	3–5
14. Shama	Scaled, gutted and washed	Salt placed in both inside and outside of fish. Fish landed when already deteriorated is salted without cleaning	1–3	5
15. Busua	Scaled, gutted and washed	Fish is salted using brine of 30° salinometer	1–2	5

(Mackie, Hardy & Hobbs, 1971). The nutritive value of Bomone may, therefore, be affected during processing.

Amano (1962) reported nitrogen loss of about 30 per cent for some South East Asian fermented fish products. Since Bomone is used in small quantities as a condiment and not as a sole protein source, the nutritional loss due to processing might not be very important.

Microbiological examination

Results of microbiological analysis are presented in Table 3 while Tables 4 and 5 show the results of tests in the identification of the isolated organisms.

Values obtained for average total aerobic count per gram were similar to the values obtained in the laboratory for foods which are expected to be cooked before consumption. The numbers for specific organisms as *Staphylococcus* and coliforms were below the values that could cause a possible health hazard.

The dominant group of micro-organisms isolated was Gram-positive micrococci. This

TABLE 2

Chemical Composition of Bomone sold in Accra Markets (per 100g edible portion)

Markets	Moisture (g)		Protein (g)		Fat (g)		Ash (g)		Calcium (mg)		Phosphorus (mg)		Iron (mg)		Salt (g)		pH value		TVB mg N		TMA mg N	
	M	*V*	*M*	*V*	*M*	*V*	*M*	*V*	*M*	*V*	*M*	*V*	*M*	*V*	*M*	*V*	*M*	*V*	*M*	*V*	*M*	*V*
Makola	58.4	8.5	23.2	10.4	3.0	7.2	10.8	4.9	93	2475	39	1063	1.2	2.1	10.4	1.8	7.7	0.05	369	6027	46	67
Osu	62.5	16.9	21.7	1.5	3.0	2.1	9.7	1.9	136	6801	45	317	2.3	4.2	10.6	4.4	7.8	0.07	461	6807	45	129
Salaga	54.7	6.5	23.4	8.6	3.2	8.3	14.5	11.2	68	857	25	570	0.9	1.1	15.4	1.4	7.1	0.03	362	3000	35	46
Accra New Town	55.0	29.5	24.0	9.0	3.9	5.9	13.4	9.1	182	43193	54	2139	0.7	0.8	14.6	5.6	7.3	0.13	366	4282	32	216
Kaneshie	58.0	12.9	23.0	16.6	3.5	9.1	12.1	6.5	85	6972	49	1148	0.8	0.7	12.5	1.2	7.5	0.04	372	3802	35	143
Range	7.8		2.3		0.9		4.8		114		29		1.6		5.0		0.7		99		14	
(S^2)	74.3		46.1		32.6		33.6		10129.5		5177.1		8.9		14.4		0.3		23918.8		601.6	
$\frac{S^2}{n}$	3.9		3.0		2.5		2.9		45		32.2		1.3		1.7		0.8		69.2		11.0	
q_0	2.0		0.78		0.34		1.66		2.53		0.91		1.29		3.0		0.90		1.44		1.26	

M = Mean, V = Variance, n = Sample size; S^2 = Sum of variance; $q_{0.1} = \frac{\text{Range}}{\sqrt{S^2/n}}$

TABLE 3
Microfloral Analysis of Fermented Fish (Bomone)

Name of fish	*Average total aerobic count/g (muscle) (Range)*	*Gram negative rods (per cent)*	*Gram positive (per cent)*					*Total Gram positive*
			Micro-cocci	*Staphy-lococci*	Bacillus *spp.*	Staphy-lococcus aureus	*Others*	
Atlantic Spanish mackerel (*Scomber japonicus*) (12)	225×10^3 ($25 \times 10^2 - 120 \times 10^4$)	17.8	72.2	3.0	5.2	1.8	0	82.2
Burro (*Pleotorhynchus macrolepsis*) (2)	300×10^7 ($38 \times 10^3 - 30 \times 10^8$)	18.2	72.3	3.1	5.3	1.1	0	81.8
Grouper (*Epinephelus* sp.) (1)	10×10^5	16.2	72.0	4.0	4.2	2.9	0	83.1
Horse mackerel (*Caranx hippos*) (2)	92×10^3 ($41 \times 10^2 - 180 \times 10^3$)	17.1	72.4	3.5	4.5	2.5	0	82.9
Sea bream (*Pagrus Lethrinus* sp.) (4)	170×10^4 ($420 \times 10^2 - 63 \times 10^5$)	17.0	71.8	4.4	5.6	1.2	0	83.0
Surgeon fish (*Acanthurus monroviae*) (2)	146×10^3 ($85 \times 10^3 - 21 \times 10^4$)	17.6	71.5	4.2	5.4	1.3	0	82.4
Ten pounder (*Elops senegalensis*) (6)	48×10^4 ($109 \times 10^2 - 21 \times 10^4$)	17.3	72.1	3.3	5.3	2.0	0	82.7
Thread fish (*Galeiodes decadactylus*) (1)	56×10^5							

The number of samples of each species analysed is given in parenthesis after the scientific name.

group accounted for about 72 per cent of the total micro organisms. Other Gram-positive organisms isolated in much smaller numbers were *Staphylococcus aureus* (1.6 per cent), *Bacillus* sp. (4.4 per cent), *Staphylococcus* sp. (3.2 per cent). The Gram negative rods accounted for 17 per cent of the total number of micro organisms.

No Salmonellae or *Shigella* spp. were isolated although faecal coli were detected. Although anaerobic cultures were made for the isolation of the clostridia species, no isolates were detected.

Fermented fish products may be considered as potential vehicles for transmission of food-borne diseases, since their methods of preparation would not necessarily kill all disease causing organisms. Amano (1962), in his review of products produced from South East Asian countries, noted that except for reported sporadic outbreaks of botulism type E from Japan, no serious causes of food poisoning due to the consumption of fermented fish had been reported. In the present work no serious food poisoning organisms were found.

It appears Bomone prepared under our traditional processing methods does not constitute a serious health hazard. However, the present methods need to be standardized and hygienically controlled.

TABLE 4
Isolates from Fermented Fish
Biochemical Tests for the Identification of Gram-positive Organisms

Organisms isolated	*Catalse test*	*Hugh & Leifson Oxidative/Fermentative*	*Coagulase test*	*Type of organisms*
Gram + ve rods (+)	+	Fermentative	?	Spore forming bacillus
Gram + ve cocci (+)	+	Oxidative	?	Micrococci
Gram + ve cocci (+)	+	Fermentative	–	Staphylococci
Gram + ve cocci (+)	+	Fermentative	+	*Staphylococcus aureus*

?—Tests not performed on the organisms

TABLE 5
Biochemical Tests for the Identification of Gram–negative Organisms Isolated

Organisms isolated	*Indole*	*Lactose*	*Gas at 44 °C*	*MR*	*VP*	*Citrate*	*Type of organisms*
Gram–ve rod	+	+	+	+	–	–	*Eschericia coli*
Gram–ve rod	–	+	–	–	+	+	*Aerobactor aerogenes*

To understand the mechanisms involved in Bomone processing, further studies need to be carried out. Identification of specific microbial flora involved, biochemical changes taking place as correlated with flavour development in the final product could, for instance, form part of such studies.

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