GHANA/NETHERLANDS ARTISANAL FISH PROCESSING AND APPLIED RESEARCH PROJECT

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STUDIES ON TRADITIONAL AND IMPROVED METHODS OF STORAGE OF FERMENTED FISH (MOMONE)

FINAL REPORT

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ABSTRACT

Studies into the traditional storage of fermented fish, *momone* were carried out.

Initially, histamine levels in *momone* on sale from five fish species namely; Jack Mackerel (*Caranx hippos*), Scad mackerel (*Caranx rhoneus*), Barracuda (*Sphyraena spp*), Kingfish (*Scomberomorus tritor*) Cassava fish (*Pseudotolithus spp.*) were determined. The effect of three composite solutions of 80% vinegar + 20% garlic extract, 60% vinegar + 40% garlic extract and 60% garlic extract + 40% vinegar, prepared from a 20% garlic stock extract and 3% vinegar stock solution on the quality of vacuum packaged momone from Kingfish (*Scomberomorus tritor*) was evaluated. Solutions of 60% garlic extract + 40% vinegar; 60% vinegar + 40% garlic extract and a control of only salt crystals, in checking the activity of the blowfly's larvae on momone during traditional storage was also investigated.

Histamine levels in the five fish species were of 100 mg to 172 mg/100 g of fish which were above the 100 mg/100 g fish considered to be the critical level for histamine poisoning. The three treatments on the vacuum packaged *momone* from Kingfish (*Scomberomorus tritor*) could account for the lower histamine concentrations of 79.2 - 88.9 mg/100 g of fish obtained in the products as compared to the 100 mg - 172 mg/100 g of fish in the five products. Of the three solutions, the 60% vinegar + 40% garlic extract and the 60% garlic extract + 40% vinegar gave the most satisfactory results in terms of the significant decrease in the microbial population and the total elimination of *Bacillus sp.* and micrococci. The sensory properties of the products were not adversely affected by the treatments. The two vinegar/garlic extract media were also effective in controlling the activity of the larvae of the blowfly and could improve the quality of the products significantly during traditional storage.

INTRODUCTION

One major potential hazard associated with proteinaceous foods like fermented fish is from the growth of food poisoning bacteria, presence of parasitic worms and the production of physiologically active amine.

Despite the fact that there are no reported incidence of diseases associated with the consumption of momone, nevertheless, the production techniques (Abbey *et al* 1994) are suitable for the growth of mesophilic histamine-producing bacteria. Where fish are held overnight at such local ambient temperatures leading to the production of free histidine, these bacteria may convert the histidine to histamine. High levels of histamine may result in scombroid food poisoning in human beings. Scombroid poisoning is synonymously used to mean histamine poisoning and it is associated with symptoms like vomiting, palpation, diarrhea, nausea, headaches, localised inflammation, burning and itching, urticaria, etc. Deaths have been reported in extreme cases (Anon. 1973). A number of histamine poisoning cases resulting from the consumption of jack mackerel have been reported (Mitchell 1994, Taylor 1985).

Though such diseases are rampant in Ghana, there are no official reports linking them to fish consumption. Nerquaye-Tettey et al. (1978), in their studies on momome considered the product a potential source of a health hazard.

Another potential storage problem is the continuous bacterial and enzymatic activity within the fermented product. In a recent study on storage trials with fermented fish (Abbey et

al 1994), it was observed that stored products continued to undergo further fermentation resulting in an unstable finished product. This process could eventually cause unwanted textural changes of the fermented fish and may be regarded as deteriorative. The product appeared brownish and unattractive with a rather stronger than normal offensive odour (Essuman 1992).

The use of garlic to control microbial growth during fermentation and storage of the product has been indicated (Souane 1986).

Momone is generally accompanied by a rather offensive pungent smell. This attracts flies and the product is quite susceptible to larvae infestation (maggots), mould growth and bacterial spoilage especially at low salt levels. These problems pose a major limitation in the presentation, marketing and storage of the product.

Abbey *et al.* (1994) observed that traders resorted to various means of protecting the momone from maggot infestation. Whilst the use of alum was a common feature, some traders employed insecticides and other dangerous chemical to ward off the menace of the insects and the maggots. Flies are typical carriers of diseases, especially the pathogens that cause diarrhoea, dysentery and cholera as well as in the transmission of tape worm eggs (Lawson and Gemmell 1985).

The use of naturally occurring insect repellents/insecticides has been proposed. Work carried out by Asaatyasih and Madden (1986) in preventing blowfly infestation of salted dried fish, showed that white pepper, garlic, star fruit extract and

acetic acid had a repellent effect on *Musca domesticavicina* and *C. megacephala*. In addition the acids could effectively control the microbial as well as the enzymatic activity during the traditional storage of the momone. Borquez and Gonzalez (1994) used acetic acid to preserve Chilean mackerel in a fish meal production studies.

The FAO/WHO in 1986 gave the approval for the use of an organophosphate insecticide, pirimiphos-methyl. A number of trials conducted in Indonesia (Esser *et al*. 1988) and Thailand (Rattagool *et al*. 1988) proved that pirimiphos-methyl was effective in controlling blowfly infestation.

Fish and fish products must be prepared in a form that appeals to the consumer. Consumption depends to a great extent on the preparation, uniformity of quality and safety of the product.

The objectives of this study are therefore:

1. To determine the histamine content of the fermented fish.

2. To investigate the effect of varying compositions of vinegar/garlic extract solutions on vacuum packaged and stored momone.

3. To examine the influence of vinegar/garlic extract solutions on the activity of blowfly on on-site storage of momone.

2. MATERIALS AND METHODS

2.1 Materials

Sample lots of momone from the following five fish species; Jack Mackerel (*Caranx hippos*), Scad mackerel *(Caranx rhoneus)*, Barracuda (*Sphyraena spp*), Kingfish (*Scomberomorus tritor*) Cassava fish (*Pseudotolithus spp.*) were randomly purchased from processors and retailers in Accra and Tema. The species were selected on the basis of their popularity and availability within the study period. Histamine levels were determined in the five species.

Quantities of fresh kingfish were purchased from the beach at Tema. These were processed into momone following procedures evolved from previous studies by Abbey *et al*. 1994. The products were held for chemical, microbial and sensory evalutions in the vacuum storage studies. Monitoring of histamine levels was also carried out during the vacuum storage studies.

Fresh quantities of kingfish were processed into momone for field studies at Tema.

2.2 Chemical Analysis

2.2.1 Histamine determination

Histamine was determined by the colorimetric assay method developed by Hardy and Smith (1976).

2.2.2 Water Activity (A_w)

Water Activity (A_w) was determined with a HI 8564 Thermo-Hygrometer. The meter measured both temperature and equilibrium relative humidity. The A_w was determined from the relationship (Troller 1977):

$$A_w = ERH/100$$

Where A_w = Water Activity

and ERH = Equilibrium Relative Humidity (%).

2.2.3 Hydrogen Ion Concentration ($_pH$)

The $_pH$ of the fish tissue was determined by a $_pH$ meter PHM 92 (Radiometer analytical A/S-Denmark. Approximately 5 g of momone tissue was weighed and thoroughly macerated using a stomacher in a 5 ml carbon dioxide-free distilled water. The mixture was left to stand for 2 min before measurement was made with the $_pH$ meter which had been previously calibrated.

2.2.4 Total Volatile Base Nitrogen (TVBN)

Ten grams of momone tissue was macerated and added to 2 g Magnesium oxide with 300 ml tap water in the distilation flask of a macro-Kjeldahl distillation apparatus. The distillate collected in 2% Boric acid solution, was analysed for total volatile base nitrogen (TVBN) by the method outlined by Pearson (1970).

2.2.5 Free Fatty Acids (FFA)

Free Fatty Acids (FFA) was determined by the method described by Pearson (1970).

2.3 Microbiological examination

Microbiological examination of the momone products was carried out using the following standard methods.

2.3.1 Aerobic Bacteria Count (Pour Plate Technique)

Ten grams of momone tissue was macerated with 90 ml of Saline Peptone Solution in a sterilr stomacker bag. Serial dilutions of 10^{-1} - 10^{-6} were prepared, pipetted into Plate Count Agar and the incubated for 72 h at 30°C (Anon. 1986).

2.3.2 Enterobacteriaceae (Coliforms)

One ml of 10^{-1} and 10^{-2} dilutions of the momone tissue suspension were pipetted into sterile petri dishes containing about 5 ml of Tryptone Soya Agar (TSA) following the procedure outlined by Anon. (1992a). For direct plating out, streaks were made onto MacConkey agar plates using the stock tissue suspension. The plates were incubated at 37°C for 48 h.

2.3.3 Mould and Yeast Count

Employing the Pour Plate Technique, 1.0 ml of 10^{-1} dilution of the momone suspension was pipetted into duplicate sterile petri dishes. This was pour plated with Malt Extract Agar, mixed and incubated at 25°C for 5 days.

2.3.4 Salmonella sp.

Salmonella bacteria was identified by the method described by Anon. (1991). Four seperate steps were carried out involving pre-enrichment in buffered peptone water, selective enrichment in Rappaport-Vassiliadis broth, plating out in Xylose-Lysin-desoxycholate (XLD) agar and confirmation by subculturing and biochemical tests.

2.3.5 Staphylococcus aureus

A 5 g momone tissue sample was asceptically weighed and placed in cooked meat medium. A 0.1 ml of the undiluted stock solution was transferred to a Baird- Parker's medium. The inoculum was distributed with a sterile angle bent glass rod and incubated at 37°C for 24 ´48 h (Anon. 1992b).

2.3.6. Culture Identification

Smears of growth from the pltaes were made on clean slides with sterile loop. These were Gram-stained and viewed under the microscope to identify the morphology and Gram reaction.

2.4 Sensory Evaluation of Stored Momone

Thirty grammes of each sample product was added to a formulation in preparation of traditional nkontomire stew.
The three stew preparatons were evaluated by 16 untrained panelists but were familiar with nkontomire stew and momone. The stews were presented to the panelists in a random order using 3-degit random number codes and were asked to indicate their preference in a hedonic preference test.

Physical examinations of uncooked pretreated fermented fish samples were also performed. Attributes assessed on the samples were appearance, texture and aroma.

2.5 Vacuum Packed Storage of Momone

Three varying compositions of garlic extract and vinegar mixtures were prepared. A 20% garlic stock extract was initially prepared in a saturated salt solution. This was followed by the preparation of a 3% vinegar stock solution also with a saturated salt solution. The use of the salt solution in the preparation the components was to prevent osmosis of salt solutes from the fermented fish into the solution. This would have reduced the salt concentration in the momone and increased its water activity.

In all, three varying volume to volume ratio compositions of the 20% garlic stock extract and the 3% vinegar stock solution were prepared. These were as follows;

a) 80% vinegar + 20% garlic extract (v/v)

b) 60% vinegar + 40% garlic extract (v/v)

c) 60% garlic extract + 40% vinegar (v/v)

Freshly prepared momone sampls were dipped for two minutes in the three composite garlic and vinegar solutions. These were allowed to drain for a few minutes and then vacuum packaged.

Samples were kept at ambient temperature and pulled on the first day and at subsequent intervals of 28, 56 and 84 days respectively, for chemical, microbial and sensory analyses.

2.6 Field Storage Studies of Momone

The traditional storage of momone was examined and pictorial depictions were made of the structures.

Subsequent to the earlier studies on the vinegar and garlic extract mixtures on momone, a field investigation was conducted to test the efficacy of these mixtures to aid in checking the destructive activity of the blowfly's larvae on the stored products.

Two storage media were prepared from a stock saturated salt solution of 3% vinegar and a 20% stock saturated salt garlic extract. These were as follows:

1) 60% garlic extract + 40% vinegar
2) 60% vinegar + 40% garlic extract

The choice of the above mixtures was made from satisfactory results obtained from the studies carried out under objective two. A third medium made up of salt crystals only as applied in traditional storage was also set up to serve as a control.

Freshly prepared momone samples were introduced into each of the media and covered as done traditionally. The set up was left in the open. In this way, a situation was thus created for flies to attack the fermented fish in storage.

The samples were monitored for the presence of live larvae as an indication of blowfly infestation and also noted, were the physical and aroma characteristics of the samples.

3. RESULTS AND DISCUSSIONS

3.1 Histamine Content of Momone on Sale

The histamine content determined for five different fish species of momone purchased from processors and retailers are presented in Table 3.1.

Table 3.1 Histamine levels of momone from five different fish species

Specie Sample	Sample Lots	Histamine (mg/100 g) Range
Jack Mackerel (*Caranx hippos*)	4	101-160
Barracuda (*Sphyraena spp*)	4	92-130
Scad mackerel *(Caranx rhoneus)*	5	121-172
Kingfish (*Scomberomorus tritor*)	3	119-167
Cassava fish (*Pseudotolithus spp.*	4	101-143

Histamine in the momone samples resulted from the microbial decarboxylation of histidine (Shewan 1955; Shifrine *et al.* 1959). As may be noted these are products from fish species which originally contained large amounts of histidine (Shewan 1955; Shifrine *et al.* 1959; Ferencik 1970) expecially the Jack Mackerel (*Caranx hippos*), Scad mackerel *(Caranx rhoneus)* and the Kingfish (*Scomberomorus tritor*) and had undergone microbial degradation and fermentation. Apparantly these values of 100 mg to 172 mg/100 g of fish (Table 3.1), are well above the 100 mg/100 g food histamine concentration considered to be the critical level for histamine poisoning (Merson *et al.* 1974). However, the limited use of the momone and the small quantities applied in the Ghanaian dish may not be sufficient to cause any major health hazard in the short

term. In general, momone products have a high level of histamine and may pose some problems if consumed in large quantities.

3.2 Vacuum Storage of Momone

3.2.1 Chemical Evaluation of Vacuum Stored Samples

The results of the chemical analysis are presented in Tables 3.2 to 3.4 below.

Table 3.2 Chemical* characteristics of momone treated with 80% vinegar + 20% garlic extract (v/v) during storage.

Day	TVB-N (g/100g)	Aw	pH	Free Fatty (9/100g)	Histamine (mg/100g)
1	247.8	0.59	6.2	12.8	67.5
28	257.7	0.48	5.9	13.5	87.9
56	267.5	0.47	6.1	15.9	88.7
84	269.0	0.43	6.5	18.8	91.8

* Values are means of duplicates.

Table 3.3 Chemical characteristics of momone treated with 60% vinegar + 40% garlic extract (v/v) during storage.

Day	TVB-N (g/100g)	Aw	pH	Free Fatty (9/100g)	Histamine (mg/100g)
1	227.8	0.61	6.8	12.8	60.1
28	229.4	0.60	6.8	13.2	73.8
56	232.1	0.59	6.6	13.8	78.7
84	236.1	0.55	6.9	14.1	81.9

* Values are means of duplicates.

Table 3.4 Chemical characteristics of momone treated with 40% vinegar + 60% garlic extract (v/v) during storage.

Day	TVB-N (g/100g)	Aw	pH	Free Fatty (9/100g)	Histamine (mg/100g)
1	282.8	0.63	6.8	12.8	69.4
28	292.8	0.61	6.8	13.1	73.3
56	295.8	0.59	6.9	13.5	78.1
84	297.3	0.56	6.9	13.8	79.2

* Values are means of duplicates.

3.2.1.1 Histamine Levels

Histamine concentration increased significantly during the first month of the storage period as recorded on Tables 3.2 (67.5-87.9), 3.3 (60.1-73.1) and 3.4 (62.6-73.6) in all the vacuum packaged samples. However, slight increases were obtained in the subsequent months. As the histamine resulted from the microbial decarboxylation of histidine, a change in the microbial load or activity might have been caused by the vacuum conditions and the pretreatments with the garlic and vinegar on the samples, hence the insignificant increases during the storage period. It may be observed that the histamine concentration in all the samples were lower than the 100 mg/100 g food histamine concentration considered to be the critical level for histamine poisoning (Merson *et al.* 1974). Compared to the histamine levels in the products on sale (Table 3.1) the final concentrations in the treated samples Tables 3.2 (88.9), 3.3 (81.9) and 3.4 (79.2) are quite low. This may mean that the production of histamine could be influenced by vacuum conditions and the pretreatments with the

garlic extract and vinegar solutions.

3.2.1.2 Water Activity (A_w)

Water Activity (A_w) levels within the samples did not vary significantly as shown on Tables 3.2 (0.59-0.43), 3.3 (0.61-0.55) and 3.4 (0.63-0.56). The vacuum conditions within the packaged products could have prevented changes in this parameter and such low A_ws could be considered safe against most bacteria activity (Owens and Mendoza 1985).

3.2.1.3 Hydrogen Ion Concentration ($_pH$)

The $_pH$s of the vacuum packaged samples did not change significantly from the initial stages of the storage period to the end of the third month. The $_pH$ values as determined on Tables 3.2 (6.2-6.5), 3.3 (6.8-6.9) and 3.4 (6.8-6.9) are comparatively lower than the values of 7 and above, obtained by Nerquaye-Teteh *et al.* (1978) and Yankah (1988). The presence of the vinegar which is basically acetic acid, in the samples could have had an effect on the overall $_pH$s of the products. These stable acidic conditions during the three months storage period, may have an effect on the growth of pathogenic bacteria, especially *Clostridium botulinum* (Huss and Rye-Pederson, 1980) and in the control of bacterial degradation (Bórquez and Gonzalez 1994).

3.2.1.4 Total Volatile Base Nitrogen (TVBN)

The total volatile base nitrogen (TVBN) levels was significantly stable with each treated sample as recorded on

Tables 3.2 (257.7-269.0), 3.3 (229.4-236.1) and 3.4 (292.8-297.3), after one month during the storage period. The stable values within each treatment could be attributed to the vacuum conditions within the packages. Biedie *et al* (1982), observed lower TVBN values for vacuum packed fish than obtained from air packaged ones. They noted that vacuum packaging significantly limited the production of volatile nitrogen compounds and ammonia.

3.2.1.5 Free Fatty Acids (FFA)

During the storage period, Free Fatty Acids (FFA) values were fairly stable with slight increases as recorded on Tables 3.2 (12.8-18.8), 3.3 (12.8-14.1) and 3.4 (12.8-13.8). The low variations in Free Fatty Acids (FFA) levels within the treated samples during the storage period may be due to decreased enzymatic activity (Chang *et al*. 1994).

3.2.2 Microbial enumeration and quality of Samples

The microbial characterisation and quality of the treated momone are presented in Tables 3.5 to 3.7.

Table 3.5 Microbiological quality and characteristics of momone treated with 80% vinegar + 20% garlic extract (v/v) during storage.

Day	Total Viable Count/g at 30°C (Aerobic) PCA	PCA+15% NaCl	Coliforms (in 0.1g)	E.Coli	S.aureus	V. parahaemolyticus (in 25g)	Salmonella (in 25g)	Others
1	8.5×10^3	NC*	Absent	Absent	Absent	Absent	Absent	Micrococci Bacillus sp
28	5.0×10^1	NC*	Absent	Absent	Absent	Absent	Absent	Bacillus sp
56	2.0×10^1	NC*	Absent	Absent	Absent	Absent	Absent	Bacillus sp
84	1.0×10^1	NC*	Absent	Absent	Absent	Absent	Absent	Bacillus sp

* NC - No count

Table 3.6 Microbiological quality and characteristics of momone treated with 60% vinegar + 40% garlic extract (v/v) during storage

Day	Total Viable Count/g at 30°C (Aerobic) PCA	PCA+15% NaCl	Coliforms (in 0.1g)	E.Coli	S.aureus	V. parahaemolyticus (in 25g)	Salmonella (in 25g)	Others
1	6.0×10^2	NC*	Absent	Absent	Absent	Absent	Absent	Micrococci
28	<10	NC*	Absent	Absent	Absent	Absent	Absent	---
56	<10	NC*	Absent	Absent	Absent	Absent	Absent	---
84	<10	NC*	Absent	Absent	Absent	Absent	Absent	---

* NC - No count

Table 3.7 Microbiological quality and characteristics of momone treated with 40% vinegar + 60% garlic extract (v/v) during storage.

Day	Total Viable Count/g at 30°C (Aerobic)		Coliforms (in 0.1g)	E.Coli	S.aureus	V. parahaemolyticus (in 25g)	Salmonella (in 25g)	Others
	PCA	PCA+15% NaCl						
1	8.0×10^3	NC*	Absent	Absent	Absent	Absent	Absent	Micro-cocci
28	<10	NC*	Absent	Absent	Absent	Absent	Absent	---
56	<10	NC*	Absent	Absent	Absent	Absent	Absent	---
84	<10	NC*	Absent	Absent	Absent	Absent	Absent	---

* NC - No count

At the onset of the storage studies, total counts of the three treatments (Tables 3.5- 3.7) had low aerobic bacterial count per gramme of sample, ranging from 6.0×10^2 to 8.5×10^3 when plated on Plate Count Agar at 30°C. However with the addition of 15% NaCl to the Plate Count Agar, incubated at the same temperature conditions, all the three treatments showed no growth of bacterial organisms hence no count was recorded (Tables 3.5 -3.7).

Subsequent microbial loads of the three treated samples were found to have decreased significantly from the previous count of between 6.0×10^2 and 8.5×10^3 cfg to a range of between <10 and 5×10^1 cfu/g, within the next three months of storage (Tables 3.5-3.7). Although the microbial loads obtained at the end of the third month showed a further decrease in the count, these were not considered as significant and ranged between <10 and 1×10^1 cfu/g (Tables 3.5-3.7). However no growth was observed in the Plate Count Agar with 15% NaCl in

any of the samples after the first month of storage. The decreasing bacteria count could be explained by the vacuum conditions and the antimicrobial environment created by the garlic extract and the acetic acid of the vinegar. Souane (1986) used garlic extracts to control microbial growth during fermentation and storage studies. Bórquez and Gonzalez (1994) showed that acetic acid was effective as a preserving agent in the control of bacterial degradation in a study on Chilean mackerel fish meal production. The strong antimicrobial activity of garlic (Kato 1973) could inhibit pathogenic and active microorganisms during the storage period.

However, low levels of *Bacillus sp.* were persistently observed for the 3 month period in the sample pretreated with the 80% vinegar + 20% garlic extract. Significant, was the total absence of *Micrococci* on all the samples during the subsequent study. These were observed in the samples in the initial stages of the storage period.

Coliform organisms or *E. coli* were not detected during the storage period in any of the three treatments (Tables 3.5 - 3.7). No food spoilage or pathogenic organisms like *S. aureus, Vibrio parahaemolyticus* and *Salmonella sp.* were isolated from the products. This is an indication that all the three samples were wholesome and may pose no health hazard to consumers especially with the low microbial load which was within acceptable limits for the fermented fish.

No moulds were also isolated in any of the products. Mould growth may have resulted in the accumulation of harmful mycotoxins (Christensen and Kaufmann 1974) on the products.

It was noted that the samples treated with; (a) 60% vinegar + 40% garlic extract and (b) 60% garlic extract + 40% vinegar gave the most satisfactory results in terms of the significant decrease in the microbial population and the total elimination of the *Bacillus sp.* and the micrococci.

3.2.3 Sensory evaluation of Samples

Sensory evaluation results of the samples added to nkontomire stew are presented in Table 3.8.

Table 3.8 Mean[1] sensory score of treated momone during storage

Day	Product*					
	AA		BB		CC	
	Taste	Odour	Taste	Odour	Taste	Odour
1	7.18±1.4a	6.75±1.2s	7.00±1.5e	7.44±1.1t	7.37±1.4m	6.44±1.9n
28	6.78±1.8a	5.85±1.4c	6.64±1.9e	7.07±1.6t	7.04±1.8m	6.78±1.5n
58	6.10±2.2a	5.64±2.2c	6.80±1.7e	6.79±2.7t	6.98±2.4m	7.10±1.6n
84	5.09±1.0b	4.03±1.1d	6.59±1.3e	6.69±2.5t	6.89±2.3m	7.08±1.6n

1 - Means for sensory scores are for 16 panalists and means in a coloum followed by the same letter are not significantly different (P>0.01)

* AA - Treated with 80% vinegar+ 20% garlic extract
BB - Treated with 60% vinegar+ 40% garlic extract
CC - Treated with 40% vinegar+ 60% garlic extract

Table 3.8 above, showed that the taste and aroma of the fish samples did not change significantly after the first and subsequent months of the studies.

All the three products were rated high in taste and odour (Table 3.8), which could be an indication of the fact that the

products were not adversely affected by the treatments.

After one month of storage all three samples developed a slight brown colour. However, after 2 months of storage, the samples treated with 80% vinegar+ 20% garlic extract developed an intense dark brown colour, rendering the products less attractive and undesirable. It was noted that the other samples from the different treatments maintained their light brown colour. The texture of all the three products remained quite firm. It was also observed that the strong pungent aroma associated with freshly perpared momone was slightly decreased and was quite significant in the samples treated with 80% vinegar+ 20% garlic extract.

3.2.4 Traditional momone storage

In traditional processing, products which for one reason or the other, needed to be kept, were ususlly left in the fermenting vats with salt crystals on them.

The storage structures consisted of concrete vats whose dimensions may vary from one another. Typical vats dimensions noted, ranged with upper diameters of between 90 to 110 cm, and base diameters of between 60 and 90 cm. Heights observed could range between 60 and 100 cm.

A circular wooden board was used to cover the entire circumference of the vat. Usually a thick brown paper apparently obtained from empty cement bags was placed as the first protective cover against insect attack on the products. This was followed by a piece of saisal hemp sack which probably may help in insulating the products from heat

radiating from the wooden board at the top.

In certain cases, medium sized plastic barrels were also used as fermentation tanks as well as for storage. Processors indicated their preference for the concrete vats for various reasons. These included the durability of the vats and their ability to insulate the momone from the high ambient temperatures, as these structures were permanently located in the open sun.

A pictorial depiction of the storage structure and components are shown in Figs 1 - 5

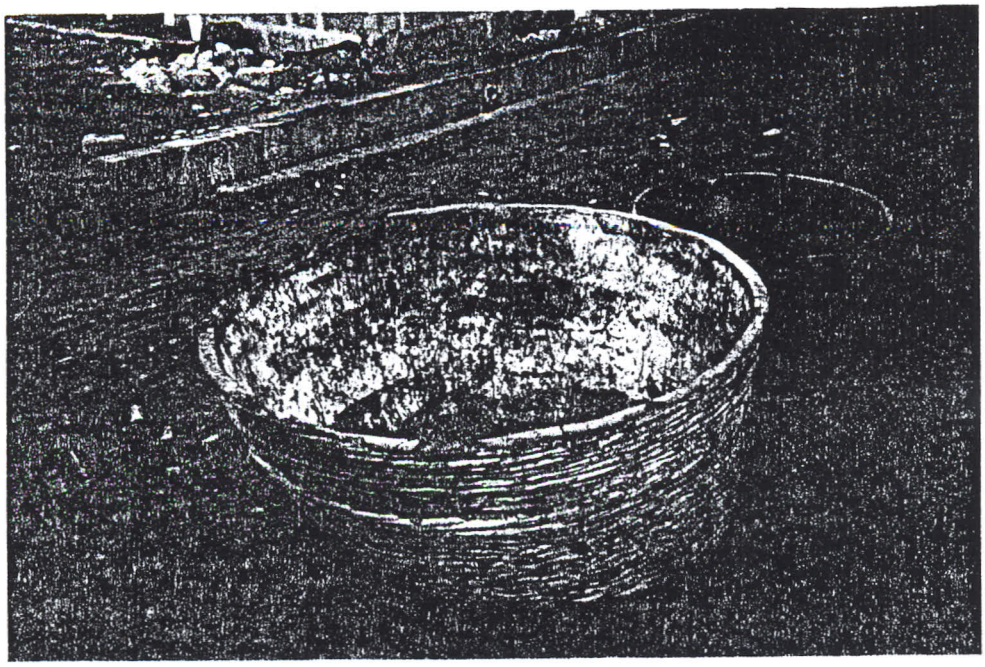

Fig. 1 Concrete vat usually used as storage and fermentation vessel

Fig 2. Momone packed for storage in Vat

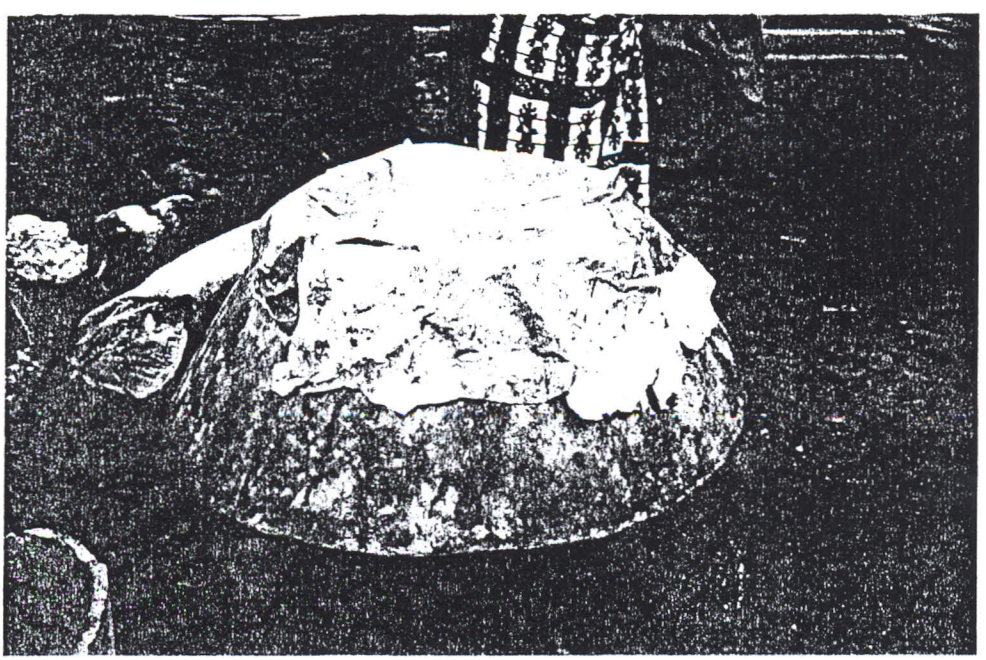

Fig 3. First protective sheet of paper on Vat

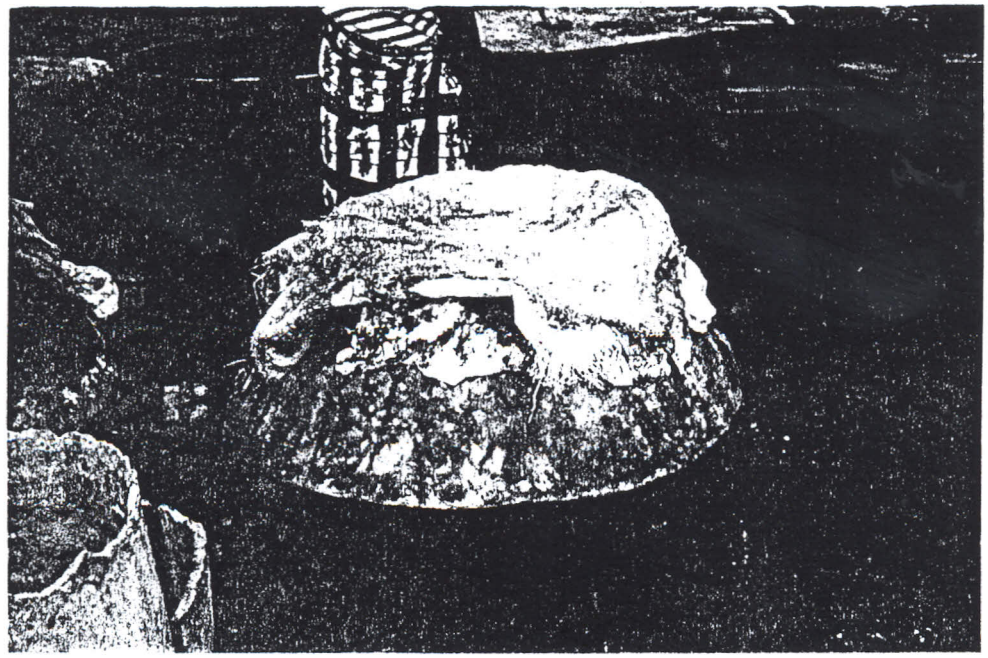

Fig 4. Sack placed on Vat as second protective cover

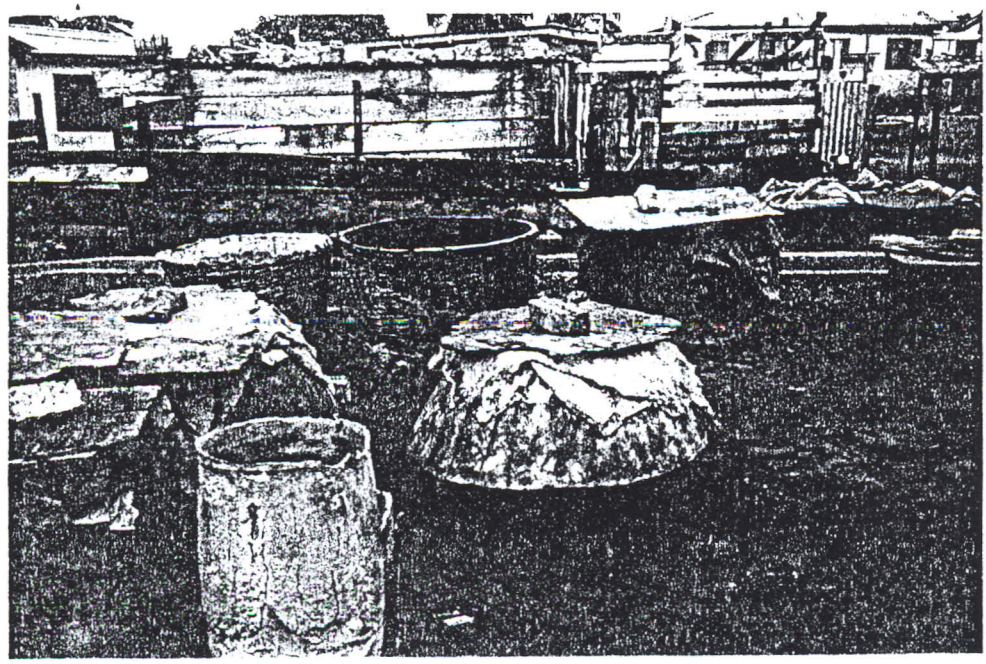

Fig 5. Typical storage structure of momone at a traditional processing site

Larvae infestation was monitored and the results obtained for the 28 days are shown on Table 3.9 below. It must be noted that during the preparation of the samples for storage, blowfly activity over the samples was so intense and for the purposes of the studies, this was desirable. Thus it became possible for oviposition by the flies before the samples were introduced into the media.

Table 3.9 Effects of vinegar/garlic extract on larvae infestation of momone during storage

Treatment	No. of days				
	1	7	14	21	28
60% vinegar/ 40% garlic extract	-	++	+	-	-
40% vinegar/60% garlic extract	-	++	-	-	-
Control	-	++++	++++	+++	+

- No larvae or dead larvae
+ Not less than 10 live larvae

During the first 7 days, larvae were found in all the media but the control was heavily infested. The intensity of the larvae population increased in the control whilst that of the vinegar/garlic extracts reduced significantly. It was observed that the decreased number of live larvae in the vinegar/garlic extract media could account for the presence of dead larvae which floated on the surfaces of the media. Work carried out by Asaatyasih and Madden (1986) in preventing blowfly infestation of salted dried fish, showed that white pepper, garlic, star fruit extract and acetic acid had a repellent effect on *Musca domesticavicina* and *C. megacephala*.

4. CONCLUSIONS AND RECOMMENDATIONS

Histamine levels determined in momone prepared from the following five fish species: Jack Mackerel (*Caranx hippos*), Scad mackerel *(Caranx rhoneus)*, Barracuda (*Sphyraena spp*), Kingfish (*Scomberomorus tritor*) Cassava fish (*Pseudotolithus spp.*) showed values of 100 mg to 172 mg/100 g of fish. These are well above the 100 mg/100 g food of histamine concentration considered to be the critical level for histamine poisoning. In general, momone products appear to have high levels of histamine and may pose some problems if consumed in large quantities.

During the three month storage of vacuum packaged momone prepared from Kingfish (*Scomberomorus tritor*) and treated with varied composition of garlic extract and vinegar solution, the final histamine concentrations of 79.2 - 88.9 mg/100 g of fish which were obtained were lower than the values of 100 mg - 172 mg/100 g of fish in the products on sale. This may mean that the production of histamine could have been influenced by the vacuum conditions and the mixed solutions of the garlic extract and vinegars. However, the samples treated with, (a) 60% vinegar + 40% garlic extract and (b) 60% garlic extract + 40% vinegar gave the most satisfactory results in terms of the significant decrease in the microbial population and the total elimination of the *Bacillus sp.* and the micrococci. The sensory properties of the products were not adversely affected by the treatments.

The traditional storage structures which also served as fermentation tanks consisted of concrete vats whose dimensions may vary from one another. As covers, wooden boards were used

together with thick brown papers.

Vinegar/garlic extract media was also effective in checking the destructive activity of the larvae of the blowfly and may have a repellent effect on the fly.

Traditional storage of momone with the application of adequate amounts of vinegar and garlic extract could yield stable products of good quality as observed from the decrease in microbial activity of the products, low levels of histamine and the effect on blowfly activity.

In practice these ingredients which are spices and food acids are readily available and affordable. The adoption of the application of biological agents such as spices and food acids would offer a safe approach to deal with some of the problems associated with the traditional processsing and storage of momone especially the menace of the blowfly.

It is recommended that processors should have the storage sites and vats enclosed or screened with mosquito nettings against flies at all times. Further to this, products should always be submerged in the storage medium so as to avoid surface oxidation on any exposed part.

More analytical work is needed to screen momone products in the market place for histamine levels. The results would aid in assessing the severity of the histamine problem and any appropriate measures to be taken.

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