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Preparation of Quality Upgraded Tuna Mas and Mas-based Diversified Convenience products

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Method of preparation of quality upgraded 'mas', the traditional smoked-dried tuna product of Lakshadweep is reported. Methods are also described for the preparation of diversified convenience products from the quality-upgraded tuna mas, viz., mas fingers, mas granules and mas soup powder and ready-to-serve items like mas chutney powder and mas pickles. Mackerel tuna (*Euthynnus affinis*), abundantly available on the Kerala coast, was used for the studies. Brining, smoking and drying of the fish were carried out at controlled conditions. Exposing the tuna mas to a High-Temperature-Short-Time (HTST) thermal treatment assured stability against insects during storage. All the products showed high sensory quality. Packed in low density polyethylene-polyester laminate pouches the products showed good storage stability at ambient condition.

Key words : Tuna mas, mackerel tuna, diversified products, smoking, thermal treatment, shelf life

A large portion of tuna caught in the Lakshadweep islands is converted to mas, also called masmin. The product is a hard-smoked, hard dried tuna meat which commands demand not only in India but also in overseas market like Singapore, Malaysia, Hong Kong and Sri Lanka (Antony *et al.*, 2002). Sources from the Fisheries Directorate of Lakshadweep reported that 1308 tons of mas was produced in 1997-98 with a unit price ranging from Rs.80 to Rs.140/- per kg (Antony *et al.*, 1999). Production method varies from island to island and the lack of good manufacturing practice reflects in inconsistent quality and storage stability (Antony *et al.*, 2000). At present this product is losing its grip in the overseas market mostly because of the inconsistent quality, inconvenient size and unattractive appearance of the material. In order to save the small scale industry from its present predicament, a production technique based on HACCP system for mas and mas based convenience products such as mas fingers, mas granules, mas soup powder and two ready to serve products such as mas pickles and mas chutney powder was developed. Mas prepared from mackerel tuna (*Euthynnus affinis*) is reported here considering the abundance of the fish on the Kerala coast (Vijayan, 2002) and also its low market price.

Materials and Methods

Preparation of quality-upgraded mas

Fresh mackerel tuna (*E. affinis*) 2 to 3 kg in weight landed in the local fisheries harbour was used for the studies. On collection the fish was immediately iced and brought to the laboratory in chilled condition. The fish was deiced and washed in 10 ppm chlorinated running water, beheaded and gutted and again washed free of any undesirable matter. This was followed by keeping the fish in 5 ppm chlorinated chilled water for 30 min. The fish was taken out, scored longitudinally along back bone on either side. Cooking of the fish was done in 5% (w/v) brine for 60 min. After cooling the cooked fish to room temperature the meat was split into four strips and skin was removed. The skinned strips were moderately dehydrated in an electrically operated dryer (55 - 60°C; 55% RH) for 60 min. This was followed by smoking of the partially

dehydrated strips in a smoke kiln having facilities for temperature control (55 - 60°C), for 60 min. Smoke was produced by igniting locally collected saw dust from non-resinous wood. Smoking was discontinued when the strips acquired the characteristic glossy brown colour and a pleasing smoke flavour. Further drying was continued at the same temperature and RH to lower the moisture content to about 10%.

Preparation of mas fingers and mas granules

Fingers of the size 3x0.75x0.75 cm were cut out from the smoked and dried strips by using an electrically operated band saw. For the preparation of mas granules, the remaining portion of the mas was converted into granules of 2-3 mm size by pulverization in an electrically operated pulverizer and finally sieving to the proper size.

The yield of mas, mas fingers and mas granules were calculated on the weight of whole tuna.

Thermal treatment of the prepared mas fingers and granules was done by employing a high temperature short time (HTST) technique. The products were exposed to a temperature of 100°C for five min, allowed to cool to room temperature and immediately packed.

Preparation of mas soup powder

Smoked tuna strips before final drying were employed for the preparation.

Ingredients

Tuna strips	-	100 g
Onion	-	75 g
Coriander powder	-	5 g
Starch	-	100 g
Refined vegetable oil	-	75 g
Salt	-	20 g
Milk powder	-	50 g
Sugar	-	10 g
Pepper powder	-	10 g
Carboxy methyl cellulose	-	2 g

The smoked tuna strips were blended with 100 ml water. The onions were fried in vegetable oil to light brown, coriander and pepper powder were added with stirring. Removed from fire, the blended mas was mixed with fried onions and other ingredients except milk powder and again blended till it became a thick fine paste. It was then spread in thin layer in aluminium trays and dried in an electrical dryer (55-60°C and 60% RH). The dried material was powdered and mixed with milk powder to get a homogeneous product. The soup powder was packed in PEST/LDPE pouches.

Preparation of mas chutney powder

Ingredients:

Mas granules	-	100 g
Grated coconut	-	80 g
Chilly powder	-	10 g
Salt	-	5 g
Tamarind	-	5 g
Curry leaf	-	3 g
Refined vegetable oil	-	10 g

Grated coconut was fried in oil to light golden brown colour. The granules were added with stirring and heated in low flame, the other ingredients were added with continued stirring. Removed from the flame and mixed in a grinder to a coarse powder, cooled and packed in PEST/LDPE pouches

Preparation of mas pickle

For the preparation of pickle the smoked (1 h) tuna strips before final drying were employed.

Ingredients

Tuna strips	-	100 g
Gingelly oil	-	200 ml
Green chillies	-	10 g
Garlic	-	20 g
Ginger	-	20 g
Chilly powder	-	10 g
Salt	-	5 g
Vinegar	-	100 ml

The mas strips were cut into small size and were fried in minimum quantity of oil and kept separate. The ingredients except chilly powder were fried in oil and mixed with the fried fingers. Chilly powder was added while hot frying was continued for two min. Removed from the flame and filled in glass jars and finally remaining oil was warmed and added to cover the material.

Packing of the products except mas pickle was done using a packaging material of high barrier properties, namely polyester/ polythene laminate of 150 gauge.

Reconstitution property of the samples was estimated by soaking 10 g in 200 ml water at room temperature for 120 min. The water uptake was expressed as g of water/ 100 g salt free, moisture free material (Antony *et al., 1998).*

Moisture, sodium chloride, total nitrogen, fat and ash were estimated as per AOAC (1990) methods. Total volatile basic nitrogen (TVBN) and trimethyl amine nitrogen (TMAN) contents of the samples were measured by the micro diffusion method (Conway 1947). The method of Foster & Simpson (1961) was employed for the estimation of total phenol. Histamine was estimated by the method of Hardy & Smith (1976). *Invitro* digestibility of protein was determined by the method of AOAC (1990). Water Activity (a_w) of the product was measured using Aqua Lab Water Activity Meter, model Cx3, 1999, Decagon Devices, USA. USFDA(1995) methods were followed for bacteriological examination. Sensory quality of the products based on colour, odour, flavour, texture and general appearance was assessed by a trained panel of 8 members. Hedonic scoring system of Stone & Sidel (1985) having a scale 9 to 1 (9:like extremely, 5: neither like or dislike 1: dislike extremely) was adopted to assess the sensory quality of the products.

Results and discussions

Mackerel tuna contained a high amount of dark meat. The meat was highly unattractive, oily and having slight rancid odour. Figure 1 gives the flow chart for the preparation of quality upgraded masmin. Keeping the dressed fish in chlorinated (5 ppm) chilled water for 30 min was found to improve the colour and appearance by removing the pigments and undesirable odoriferous fractions. In the traditional process, the fish is cooked in sea water for about 4 h. Cooking in sea water for a long period results in solid loss and deterioration of texture (Muraleedharan & Valsan, 1980). The present process of cooking the fish in 5% (w/v) sodium chloride for 1 h was found to be sufficient for muscle firmness and proper

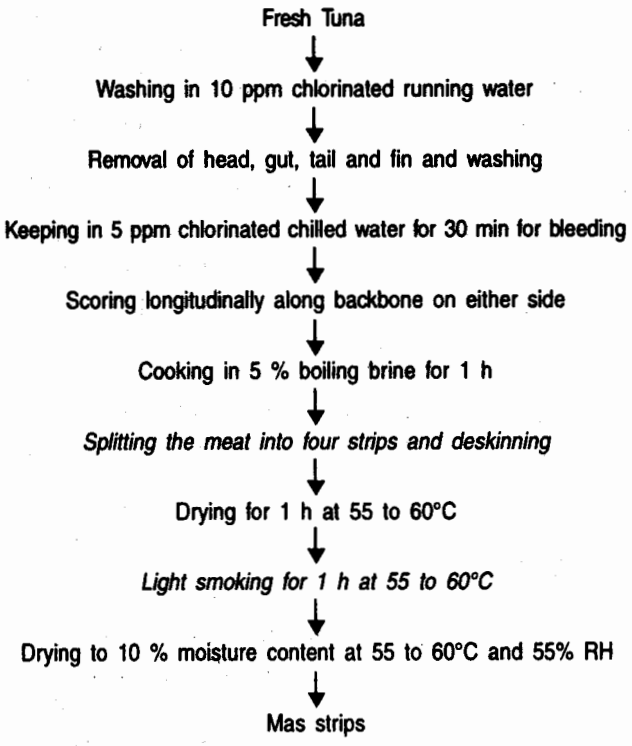

Fig. 1. Flow chart for the preparation of quality – upgraded tuna mas

Table 1. Yield of mas, mas fingers and mas granules

Processing stage	Yield %
Removal of head, guts, tail and fin	72
Cooking	58.5
Splitting the cooked meat into four strips and deskinning	50.25
Mas strips	21.65
Mas fingers	20.15
Mas granules	19.80

salt uptake as proved by sensory evaluation. The yield of masmin by this method was slightly higher (21.65%- Table 1) as against the traditional method and modified method(Nair *et al.*, 1994), which were only 17.33 and 21.36% respectively. The higher yield of masmin may be is due to lower cooking time. Yield loss in the case of mas fingers and mas granules is to be expected as a result of solid loss during saw cutting, grinding and sieving (Fig. 2). Drying of the tuna strips at 55-60°C for 1 h lowered the moisture content to about 50% which was found to induce uniform smoke absorption (Muraleedharan & Valsan, 1980). Controlling the temperature inside the smoke kiln also contributed to proper development of smoked colour and flavour (Muraleedharan & Valsan, 1980). Further dehydration at controlled conditions of temperature and humidity prevented case hardening of the product (Muraleedharan *et al.*, 1987). It took only 60 to 70 h for reduction of moisture to about 10%. These optimum conditions of processing also resulted in less loss of nutritional quality as seen from the high percentage of pepsin digestibility of 92.32% (Table 2). In addition there was not much accumulation of TVN and TMAN and also total phenol

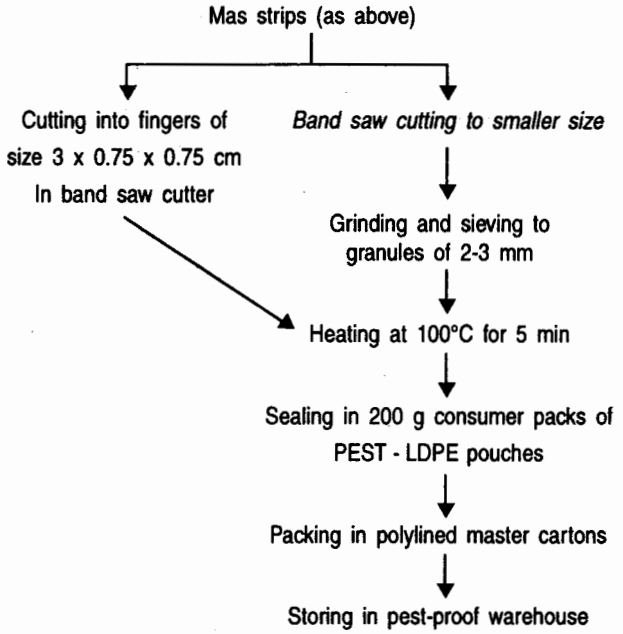

Fig. 2. Flow chart for the preparation of mas fingers and mas granules

Table 2. Biochemical and microbiological characteristics of quality upgraded tuna mas

Moisture %	11.37
a_w	0.55
Fat (wwb) %	4.32
Protein (wwb) %	73.45
NaCl (wwb) %	4.52
Acid insoluble ash%	Nil
TVBN mg%	28.18
TMAN mg%	4.36
Phenol mg%	1.9
Histamine mg%	18.5
Pepsin digestibility %	92.32
TPC/g	4.86×10^2
Escherichia coli	Nil
Coagulase positive staphylococci	Nil
Faecal streptococci	Nil
Salmonella	Nil
Fungus	No visible fungus

content (Table 2). Total bacterial count was only 4.86×10^2. Indicator organisms and salmonella were absent indicating the hygienic conditions of processing. Visible fungus was not observed all through out storage. Histamine content was only 18.5 mg/100g as a result of adopting GMP in handling of raw material on landing and processing. The histamine limit is restricted by USFDA in processed tuna to 50mg/100g (USFDA, 1982).

Recipe for the chutney powder, pickles and soup powder were formulated taking into consideration consumer palate. These are not arbitrary but can be varied conveniently according to regional fancies. For the preparation of pickle and soup powder the tuna strips immediately after the smoking stage were drawn and directly used without further dehydration for better homogenity with the added ingredients. However, the final product may also be used, after soaking sufficiently in water.

The shelf life of the products is given in Table 4. Storage at ambient conditions was found to give appreciable shelf life because of the upgraded process. The shelf life was

increased to a higher period by keeping the products at refrigerated conditions as seen from the table.

Table 3. Reconstitution property

Mas	-	20.3g water/100g
Mas fingers	-	49.9g water/100g
Mas granules	-	94.80g water/100g

The reconstitution property of the products (Table 3) is higher compared to the conventional product which requires overnight soaking in water before preparation into products (Table 3). The insects commonly found on mas have been identified to be belonging to Necrobia rufipes and Dermestes sp. (Valsan, 1968). To prevent the hazard from insects the products were subjected to a high temperature short time (HTST) treatment in an electrically operated chamber. The HTST treated (100°C, for 5 min) samples were allowed to cool to room temperature under no risk of contamination before they were packed. This HTST was found to impart good storage stability against insects, at the same time it reduced the chance of case hardening of the products (Muraleedhran *et al.*, 1987).

High phenol content may bring into the product the hazard of benzopyrene, a suspected carcinogen. In order to reduce the risk, non resinous, hard wood saw dust was used with proper control over smoke production and smoking temperature.The phenol content of the product was limited to 1.9 mg/100 g. which was far below total phenols reported in mechanical kiln prepared masmin and traditional masmin which were 23.56 and 10.50 mg/100g respectively (Kingston *et al.*, 1990). In the traditional method the temperature of smoking and drying might be going beyond 70°C and no control was possible since the process was conducted in open air.

Table 4. Shelf life of products prepared from quality-upgraded tuna mas

Product	Shelf life in months	
	In ambient condition	Chilled storage at 5°C
Mas fingers	12	-
Mas granules	10	-
Mas chutney powder	6	10
Mas pickles	6	10
Mas soup powder	4	8

Upgradation of quality of the product has been designed without deviating much from the traditional processing system. Preparation of diversified products takes into account convenience of the consumers. These factors are sure to attract better consumer acceptability in domestic and overseas markets.

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