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Utilisation of Tuna and Tuna Waste

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Abstract : Several products were prepared with red meat of tuna which is generated as waste during canning of tuna Products like wafer, paste, finger, cutlets, etc. on storage studies indicated lesser shelf life due to rancidity development. Whereas chutney powder, smoked fillets, hydrolysate, surimi, etc. had acceptable organoleptic quality and substantial shelflife. The waste material was converted to tuna meal.

Introduction

Tuna is an important food fish which is abundantly available in the Indian Exclusive Economic Zone. The potential of tuna and allied fishes available in the Indian waters including Lakshadweep and Andaman Islands is about 24,000 tonnes. Commercially important and more available species are Albacore, Big-eye, Northern and Southern Bluefin and Yellowfin tuna. They are called principal market tuna species and priced for canning, Sashimi (raw fish dishes) and other products. Tuna meat is highly nutritious for its protein, fat and essential amino acid content (Chinnamma George, 1975). Unlike other fishes red meat is more in tuna i.e. about 11% of the body weight viz. *Katzuwonus pelamis*. The white and red muscles differ in their chemical constitution as well as in physiological functions. The characteristic colour of tuna muscle is due to the presence of haemoglobin and myoglobin, the concentrations of which are about five times more in red meat than in white meat. Substantial quantities of tuna are canned and a part is processed as massmin and rest is utilised for preparation of products. In canning only the white meat is used. The red meat is discarded. Reports show that in food value, red meat of tuna occupies a higher status with higher amounts of carbohydrate, fat, essential amino acids, iron, sodium, phosphorous and vitamins. Processing of tuna gives 45-50% waste which can be used for preparing products like surimi, chutney powder, cutlets, fingers, etc. Preparation of hydrolysate was first reported by Mc Bride *et al.* (1961). Since then modifications and new methods were developed to make better quality procucts.

Materials and Methods

Fresh tuna collected from landing centres off Cochin were brought to laboratory in iced condition. Each fish was initially examined for its quality. The fish was beheaded, gutted, cleaned properly and white and red meat were separated. Proximate compositions of white and red meat were determined following standard procedures (AOAC, 1990; Bligh & Dyer, 1959; Hawk, 1954). Methods followed for the preparation of products were discussed.

Surimi

Surimi is the semiprocessed intermediate fish mince used in the preparation of a wide range of finished products. The

process involves beheading, gutting, filletting, bone separation, mincing, washing, dewatering, addition of sugar and phosphate and finally freezing. Red and white meat of tuna were used for preparation of surimi. Meat was minced well with potable water (1:2) for 5 min. It was then pressed in filter cloth to remove water. This process was repeated until all the water soluble constituents were removed. Treatment with 0.5% hydrogen peroxide solution for 5 minutes was found to improve the colour of red meat. To the filtered and pressed material sodium polyphosphate (0.5% w/w) and sugar (3% w/w) were added, mixed well and the meat was frozen as blocks at -40°C and stored at - 20°C.

Hydrolysate

The material after separation of white meat was minced in a meat mincer and taken in two beakers. The sample was stirred well and adjusted to required optimum pH and temperature for enzyme reaction. The enzyme alcalase (Novo Nordish, Bagsverd, Denmark) and papain (E. Merck) were used for hydrolysis. The enzymes were added at levels (0.5% w/w) of protein content in the material. The temperature was maintained at 50-55°C, pH 8.0-8.5 for alcalase and temperature50-55°C pH 6.0-7.0 for papain with continuous stirring for 60 minutes. After the reaction enzyme activity was terminated by increasing the temperature to above 85°C for 15 minutes for alcalase and 95°C for 30min. for papain. The slurry was passed through filter cloth and then filtered through Whatman No. 1 filter paper. The filtrate was neutralised, concentrated and vacuum/spray dried, packed in sealed containers and stored at room temperature for further studies.

Tuna meal

The whole filleting waste was cooked and then dried. There are two types of tuna meal. 1) with bones 2) without bones. The powdered meal can be used in cattle and poultry feeds.

Wafer

The cooked meat (500 g) was homogenised with water in a food grinder to obtain a fine paste. Tapioca starch (500 g), corn starch (250 g), Salt (20 g) and sufficient water were added and grinding was continued. Viscosity of about 600-700 c.p. was ideal to obtain very fine finished product.

Small portions of the homogenised mass was poured into flat aluminium trays previously smeared with groundnut oil and spread to a film of 2-3 mm thickness. The materials was cooked in steam chamber for 3-5 min. to gelatinise the starch. The film formed could be cut into desired size. The trays were dried in sun or artificial hot air drier at 50-60°C for 1-2 hours to get a moisture content of about 6%. The wafer thus prepared was packed in polythene bags stored at ambient temperature.

Paste

Tuna red meat was washed with water, salt solution (1% w/w) and different concentrations of hydrogen peroxide in order to improve the colour. Hydrogen peroxide (0.5% w/w) was found to be effective for decolourising the meat, although mild textural and flavour changes were noticed. Water and sodium chloride had very little effect in improving the colour of red meat.

Starch (2 g) was boiled in minimum quantity of water. The other ingredients namely sodium polyphosphate (0.5 g), hydrogenated vegetable oil (8 g) and milk powder (5, 7.5 or 10 g) were mixed

with tuna red meat (100 g) in a blender for about 2 minutes. Almost 5 drops of rose essence was added and packed in polyethene bags and stored at 0-10°C.

Finger

Tuna red meat was mixed with (1% w/w) salt and the meat was frozen in the form of slabs. It was cut into fingers of uniform size (5/8"x5/8"x3") and coated with batter (beated egg white) and bread crumbs. The product was packed in cartons lined inside with polyethene and stored at -20°C.

Cutlet

Cooked tuna red meat (500 g) was mixed with cooked and smashed potato (250 g), fried onion (125 g), ginger (25 g), green chillies (20 g), pepper, clove, cinnamon powder (total 10 g) and salt (10 g) in a frying pan under low flame in order to reduce the moisture content. Cutlets were formed (about 30-40 g) then battered (beaten egg white) and breaded , packed and stored at -20°C.

Chutney powder

Minced red meat was dried in hot air oven at 50-60°C or in sun to a moisture level of below 10% and then powdered. The ingredients, coconut grated (500 g), chilli powder (40 g), coriander (30 g), garlic (25 g), onion (100 g), pepper (12 g), curry leaves (10 g) and asafoetida (5 g) were fried in low heat until the colour was changed to brown. This was minced in a dry grinder with tuna powder, tamarind and salt, mixed properly to get a fine powder. Packed in polythylene bags and stored at ambient temperature.

The products were evaluated for its quality by a taste panel of 6 members. The parameters evaluated were shelflife, taste, rancidity, colour, texture and overall acceptability.

Results and Discussion

The red and white meat of tuna showed slight difference in their proximate composition as seen in Table 1. Though much difference was not observed in their protein content, the lipid content was higher in red meat correlating the earlier observations (Chinnamma George, 1975).

In the case of surimi, results (Table 1) indicated less variation between samples prepared from red and white meat. The quality of surimi was determined by its rheological properties and gel forming ability. The addition of sugar protected the material from denaturation. Surimi prepared from white meat was good in appearance than that from red meat. Hydrogen peroxide treatment was good for improving the

Table 1. **Proximate Composition**

	Tuna meat		Surimi		Dried hydrolysate		Meal	
	Red meat	White meat	Red meat	White	Alcalase hydrolysis	Papain hydrolysis	With bone	Without bone
Moisture %	72.10	75.54	78.36	80.54	6.40	3.40	4.03	5.84
Protein %	23.70	22.93	20.71	18.18	67.35	65.54	72.76	80.72
Fat %	3.20	1.27	0.27	0.38	Nil	Nil	20.68	11.56
Ash %	3.93	1.34	0.26	0.29	8.92	8.99	4.49	3.57

Moisture : Tuna and Surimi wet basis; hydrolysate and meal : dry basis

Table 2. **Storage characteristics of Surimi**

	Red meat			White meat		
	One month	3 months	6 months	One month	3 months	6 months
Colour	Good	Good	Good	Good	Good	Good
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
Taste	Good	Slightly rancid	More rancid	Good	Good	Slightly rancid

colour of red meat. Water holding capacity of surimi was better than that of the raw material and fat content was reduced considerably. Surimi prepared from white meat of tuna had more shelflife stored at -20°C (3 months) than that of red meat (Table 2). Colour was not changed much in both cases during the entire storage period of 6 months whereas rancid flavour developed after one month in red meat product. The ash content of hydrolysate prepared using alcalase and papain was almost same. Sensory properties were better in the case of alcalse hydrolysed product (Table 3). This observation was in confirmity with that of Quaglia & Orban, (1987). The yield of hydrolysate using alcalase was 11.49% while that from papain was 8.48%.

Organoleptic qualities of the product stored at ambient conditions (Table 4) indicated change in colour, odour and flavour in both samples. But the product prepared with alcalase behaved better than that of papain i.e. bitterness was less in alcalase product and colour was slight brown by 6 months, whereas in the other product colour was changed to dark brown with fishy odour and bitter taste.

In the case of tuna meal, protein content was more in sample without bone, whereas fat content was more 29.68% in meal with bones (Table 1). Much difference was not observed in colour and odour of meal without bones even after 3 months storage at ambient temperature. The products can be kept in good condition for more than three months.

Sensory evaluation of the wafer flash fried in edible oil indicated that in colour and flavour tuna red meat wafer was much inferior to fish/prawn/crab meat wafers.

Paste was made with three different concentrations of milk powder i.e 5,

Table 3. **Storage characteristics of Hydrolysate**

	Alcalase			Papain		
	One month	3 months	6 months	One month	3 months	6 months
Colour	Yellowish	Slight brown	Slight brown	Yellowish	Slight dark brown	Dark brown
Odour	Odourless	Odourless	Odourless fishy odour	Odourless fishy odour	Slightly	Slight odour
Taste	Slight bitter	Slight bitter	Bitter	Bitter	Bitter	More bitter

Table 4. **Storage characteristics of Tuna meal**

	Without bones			with bones		
	One month	3 months	6 months	One month	3 months	6 months
Colour	Good	Good	Slightly dark	Good	Good	Slightly brown
Odour	Good	Good	Slightly rancid	Good	Slightly rancid	Rancid odour
Taste	Good	Good	Rancid	Good	Slightly rancid	Rancid

7.5 and 10%. Sample with 5% milk powder had tuna meat taste and dull colour, other two samples were better with agreeable characteristics. On storage at - 4°C rancid smell developed in all the samples within a week but flavour was not affected much in second and third samples.

Battered and breaded fingers of red meat preserved at -20°C remained in acceptable condition for 6 weeks only; upon further storage rancid odour and bitter/dry fish flavour developed. This was in agreement with the earlier observation of a shelflife of about 10 weeks for frozen stored tuna red meat fillets (Chinnamma, 1975).

Sensory qualities of cutlets prepared with white meat and red meat (washed with 0.5% H_2O_2, then with water twice) had different scoring. White meat cutlet was graded as good, that from red meat was of fair grade, having liver taste and dull colour. Within a month's storage the product with red meat reached unacceptable stage while that with white meat were in acceptable condition. Hydrogen peroxide used for decolourisation favours fat oxidation.

Chutney powder prepared with red meat had very good flavour and this can be stored for more than 4 months if packed in moisture proof packing materials and stored at ambient temperature.

Processing wastes from tuna canning factories can be completely used in the preparation of different products suitable for human consumption. Products like surimi, hydrolysate, chutney powder and meal can be prepared for human and animal nutrition.

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