



FISH BYPRODUCTS



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FISH BYPRODUCTS : AT A GLANCE

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Fish undoubtedly is one of the most nutritious of foods available for human consumption. Fish flesh on an average contains 20 to 50% of protein apart from a very high quantity of body oil. Few species like sharks, cods, etc. are good sources of liver oil. Fish processing and filtering industries turn out large quantities of fish residue, fishery waste. Judicious and economic utilization of fish should have a programme of proper disposition of such fish and fisheries wastes by processing them into different products intended for human consumption, animal nutrition or industrially useful products. The various fishery byproducts of nutritional, biochemical, pharmaceutical and industrial importance are as follows -

Fisheries By-Products

- | | |
|--------------------------------------|-----------------------------|
| 1. Fish meal | 2. Fish protein concentrate |
| 3. Textured fish protein concentrate | 4. Fish oil |
| 5. Gelatin | 6. Fish glue |
| 7. Fish maws (Gum glass) | 8. Pearl essence |
| 9. Smelin | 10. Fish albumin |
| 11. Fishilage | 12. Fish skin leather |
| 13. Shark fin soup | 14. Fish calcium |
| 15. Shark cartilage | 16. Fish fertilizer |
| 17. Vitamin and Vitamin | 18. Glucose amino hydro |
| 19. Squalene (from shark liver oil) | 20. Amblergis - chloride |

①. Fish meal :

Fish meal has high quality protein

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containing healthy amount of lysine, methionine, cysteine. It is a good source of vitamin B12, niacin, pantothenic acid and riboflavin. It is very rich in minerals like calcium, phosphorus, copper, iron. Apart from that there is 'unknown growth factor', contributing to animal growth. Highlights the importance of fish meal in animal nutrition.

Raw Materials

High fat fish like Anchovies, Sardines, Herrings, etc. used as raw material for fish meal. Wastes from fish processing and filtering plants, cannery wastes, carcasses of fish like sharks are also used for this purpose.

Processing

(i) Wet rendering (wet reduction process) and (ii) Dry rendering (dry reduction process) are commonly employed for processing fish meal.

✓ (i) Wet rendering process :

- The fish or offale mass is cooked in live steam. The cooked mass is pressed in a screw, pressed to expel the expressible liquid.
- The pressed cake, containing 50-55% moisture and 3-4% oil, is fluffed up to facilitate easy drawing and is dried suitably in a rotatory drier. It is further ground to the required particle size and packed for store or disposal.
- The pressed liquor is heated and centrifuged to separate the oil and often marketed as fish condensed solution.

Advantages of Wet rendering process :

- continuous process

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- fast production rate
- suitable for processing large quantities of raw materials
- better quality oils
- less expensive to operate

Dry rendering process :

Two types of driers are commonly used to dry the pressed cake -

1) Direct drier (Flame drier)

2) Indirect drier

Direct drier dries the wet meal to 8-10% moisture in 15-20 mins. In direct drying, the fish meal may get contaminated with the product of combustion like oxides of nitrogen, sulphur, etc.

Indirect driers dries the fish meal usually by steam to 170-180°C. It is preferable.

Advantages of Dry rendering

- suitable for batch operation
- easy to manage
- permits flexibility in the operating conditions to suit the raw materials

Pulverization :

The meal coming out of the driers is coarse and differs widely in particle size. So, it is pulverized to yield a homogeneous product by the process of pulverization.

The heating up of fish meal in stacks has led to fire hazards. Oxidation of residual oil leading to polymerisation of the unsaturated fat is yet another problem. It is therefore necessary to convert fish meal to a

stable state before packing and storage, and few antioxidants like butylated hydroxy toluene (BHT) are widely used to prevent heating in store and consequent loss of protein quality. During is the alternate method to antioxidant treatment. Bags containing fish meal are allowed to stand singly for four weeks and then they are stacked and stored at a temperature of approximately 35°C.

Proximate composition :

It varies widely depending on raw material used.

Protein	50-10%
Fat	5-10%
Ash	12-33%
Moisture	6-10%

[FAO resources 2003]

Uses :

- The principal use of fish meal is supplementary ingredients in the livestock feed as -

	Rate in gm/day
Cattle	907 gm / day / 454 kg live wt.
Pig	113-127 gm / day / 45.4 kg live wt.
Poultry	less than 10% of the total ration for hens and not more than 5% for chicks

It is also preferred in aquaculture feeds.

(3). Fish Protein Concentrate (F.P.C.)

Fish protein concentrate is a stable protein concentrate prepared from whole fish or parts thereof. The F.P.C. is increased by removal of water, oils, bones and other materials. Various processes have been used for extraction of F.P.C. Some of them are as follows.

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- (i) Vichon process - employs ethylene chloride (b.p. 98°C) and water (b.p. 100°C)
- (ii) Canadian process - employs isopropyl alcohol for extraction.
- (iii) Azeotropic extraction method - employs azeotropic mixture of benzene and ethyl alcohol.
- (iv) British process - employs ethyl alcohol.
- (v) Chilean process - employs hexane followed by ethyl alcohol.
- (vi) Moroccan process - employs a solvent mixture of benzene, ethyl acetate and isopropyl alcohol.

Proximate composition :

F.P.C. is a gritty, colourless, odourless and tasteless powder stable upto 3-4 years at room temperature, having following composition:

Moisture	8.1 %
Crude protein	67.7 %
Available lysine	7.9 %
Total lipids	0.4 %
Calcium	5.4 %
Phosphorus	3.9 %
Ash	24.1 %

Peppin digestibility 98% ✓

Uses :

It is incorporated as a protein supplement in human diet. It is therefore 5-10% level F.P.C. in bread and biscuits is considered as the acceptable limit. The recommended level of use of F.P.C. is 35 gm / person / day.

Textured Fish Protein Concentrate

F.P.C. with improved rehydration ability are called as Textured F.P.C. (commonly known as marine beef). In

processing F.P.C. the whole fish after grinding is treated with organic solvents to remove fat and water and then dried and pulverized.

Uses :

✓ It is always used preferably to F.P.C.

(4) Fish oil :

Fish oil are of two types :

- (i) The liver oil and ✓
- (ii) The body oil ✓

Fish liver oil is extensively being used for therapeutical purposes in the treatment of vitamin A and D deficiencies. The body oil of fish is more important as an industrial product besides its limited use in human nutrition. It contains polyunsaturated fatty acid (N3-PUFA) which is used in control of heart ailments in humans.

(i) The liver oil :

Depending on oil and vitamin content, fish liver is classified into 3 categories.

- (a) High oil - Low Vitamin A potency. ✓
- (b) Low oil - High Vitamin A potency. ✓
- (c) High oil - High Vitamin A potency. ✓

Preservation of liver :

The liver may be separated from the freshly killed fish and preserved in - crushed ice in cold room (storage for 2-3 days) - frozen storage maintained at -18°C (or below for several months) - chopping the liver into small pieces mixing with 10% by weight of common salt and stored in free air tight containers.

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- grinding the liver and preserving with 0.25% formalin of its body weight.
- grinding the liver and keeping in aqueous solution of 2% (Na_2CO_3) sodium carbonate with formaldehyde, phenol or benzyl alcohol.

Extraction of oil :

- (a) Direct or Indirect steaming process can be employed for extraction of oil from livers having high oil - low Vitamin A potency.
- The process involves introducing steam directly into the cooker containing liver and raising the temperature to $80^\circ - 86^\circ\text{C}$ till oil floods on the top.
 - Liver is kept in steam jacketed kettle and heated indirectly by steam admitted directly into the jacket with a temperature of $70 - 75^\circ\text{C}$. The oil liberated is skimmed off in a settling tank (centrifuge) and stored.
- (b) The process employed for extraction of oil having low oil - high Vitamin A potency
- Enzyme and alkali digestion ✓
 - Acid digestion ✓
 - Solvent extraction ✓
- (c) Liver having high oil high Vitamin A potency - It may be the liver containing 30-75% oil with Vitamin A potency of 0-3,00,000 μg U.S.P unit per gram and livers containing 40-75% oil with Vitamin A potency of 20,000 - 2,00,000 μg unit per gram.

(ii) The body oil :

The body oil is extracted from whole fish by wet-rendering, dry-rendering or solvent extraction.

Wet rendering is suitable for oil

hardness, shrapnel and pitchforks. A series of four tanks are used in this process where separation of oil and further purification with hot water were achieved in successive stages.

Refining :

Crude fish body oil may contain several undesirable materials in varying amount is suspended matter, free fatty acid, natural occurring oil soluble colouring matter, volatile odouriferous compounds and saturated glycerides. The following methods are employed for refining fish body oils -

Whitening (cold cleaning) :

It involves holding the oil at 5°C to promote crystallization of high melting glycerides which are separated by filtration in a chilled room.

(ii) Gravity settling :

The coarse suspended matter present in the oil after blowing with moist steam at 100°C and cooled settles at the bottom of the tank by gravity and clear oil is drawn off from the top.

(iii) Alkali refining :

Very effective and widely employed method including complete removal of free fatty acids and various colour producing materials. Adding heated oil to a solution of sodium hydroxide, stirred vigorously and allowed to settle. The settling called foots are collected and sold as soap-stocks.

(iv) Bleaching :

Some fish body oils exhibit a natural greenish or reddish colour (due to presence



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carotenoids and xanthophyll pigments) which is eliminated by heating the oil with absorbent and bleaching material to $120^{\circ} - 140^{\circ}\text{C}$ and then their removal by filtration.

Decolorisation :

Hydrogenation is very effective apart from placing heated oil in a vacuum tower and subsequent allowing it to cascade over steam in counter current direction.

Uses :

- Highly unsaturated fish body oil can be used as drying oils in paints and varnishes.
- Many oils are used for human consumption as cooking oil.
- They are used as carriers of fat soluble vitamins A and D.
- They also find use in the manufacture of linoleum.
- Detergents, artificial rubbers, lubricants, printing ink, soaps.
- Body oil of sandsea and similar species having N-3 PUFA used for heart ailments.

Gelatin :

It is a protein lacking tryptophan but having a very high source of lysine and methionine. Deficient in cereal proteins. Gelatin finds extensive use in food in the formulation of some industrial products.

Uses :

It is used in the food industry as a gelling stabilizing, emulsifying, dispersing and thickening agent. It is used in photo engraving and chemical etching of metal parts. It has

(ii) Fish sludge :

Fish sludge is liquid fat protein. Preservation of surplus fish and fish offal as sludge for use in animal feeding is an alternative to processing fish meal. It is quite suitable for operations in remote fishing villages where the infrastructure for any type of processing is limited.

The fish sludge is used as cattle feed either the whole mass or the decanted portion can be used. When solid feed is desired the sludge is mixed with rice bran or other feed ingredients.

(i) Fish skin leather :

Leather is in fact the skin of animals chemically processed to protect against deterioration by microbes. The skin of certain species of fish like shark, salmon, cods which can be converted into good quality leather.

Skinner is carefully removed from shark or any other suitable fish immediately after landing and it is freed from scars, scratches, cuts, wrinkles or excessive variation in thickness. It is then cured with salt by spreading it over by the flesh side. Alternatively, skin is preserved for drying and processing. Fat liquoring, drying, drying and finishing operations follow to give the leather its final shape and texture.

Uses :

It is used in the manufacture of fancy items like wallets, shoppals, hand bags, money purse etc.

Shark fin soup :



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Shark fins are valued for their rays which is an essential ingredient of certain exotic soups. Dorsal, ventral, pectoral and caudal fins are used for extraction of rays.

Fish calcium :

Calcium powder processed from back bone of Tuna is used to combat calcium deficiency in the diet especially children which would otherwise have created spine curvature bone failure in children.

Shark cartilage :

Due to the presence of chondroitin sulphate, shark cartilage has immense importance in reducing cancer related tumours, inflammation and pain associated with arthritis, psoriasis, and enteritis.

Fish Fertilizer :

Fish waste is a slow release fertilizer being a good source of NPK. Fish of low value can be converted to fertilizer by digesting them with sulphuric acid which converts the proteins to ammonium sulphate. It makes the bone phosphate available for absorption by the plants.

Chitin and Chitosan :

Chitin is the second abundant organic compound. It is a white, crystalline nitrogenous polysaccharide widely distributed in the exoskeleton of crabs, shrimp, lobsters, squids etc.

Chitin is deacetylated chitin.

Chitin is a great promoter in animals and birds and is used as an ingredient in their feed. Chitosan has several functions like -

- as a clumping agent of fruit flies
- in purification of drinking water
- as a thickening and stabilizing agent in food
- in the treatment of waste water and sewage effluents

- as a sizing agent in textile and papers
- in cosmetics as moisturizer and as protection against UV rays
- as a base for chromatography
- as a haemostatic agent in surgery and dentistry

Squalene and hydrochloride :

Squalene has great application in pharmaceutical agents and as an additive in feeds.

Squalene :

Squalene is an unsaturated hydrocarbon present in the unsaponifiable fraction of fish oils. It is used in the finishing operations of natural and artificial silk where it gives a brilliant appearance to the product. It is also used in perfumery as a carrier of perfumes. It is also used as lubricants and bactericides.

Ambergris :

It is a fatty pitch like substance grey or black in colour produced in the intestine of sperm whale.



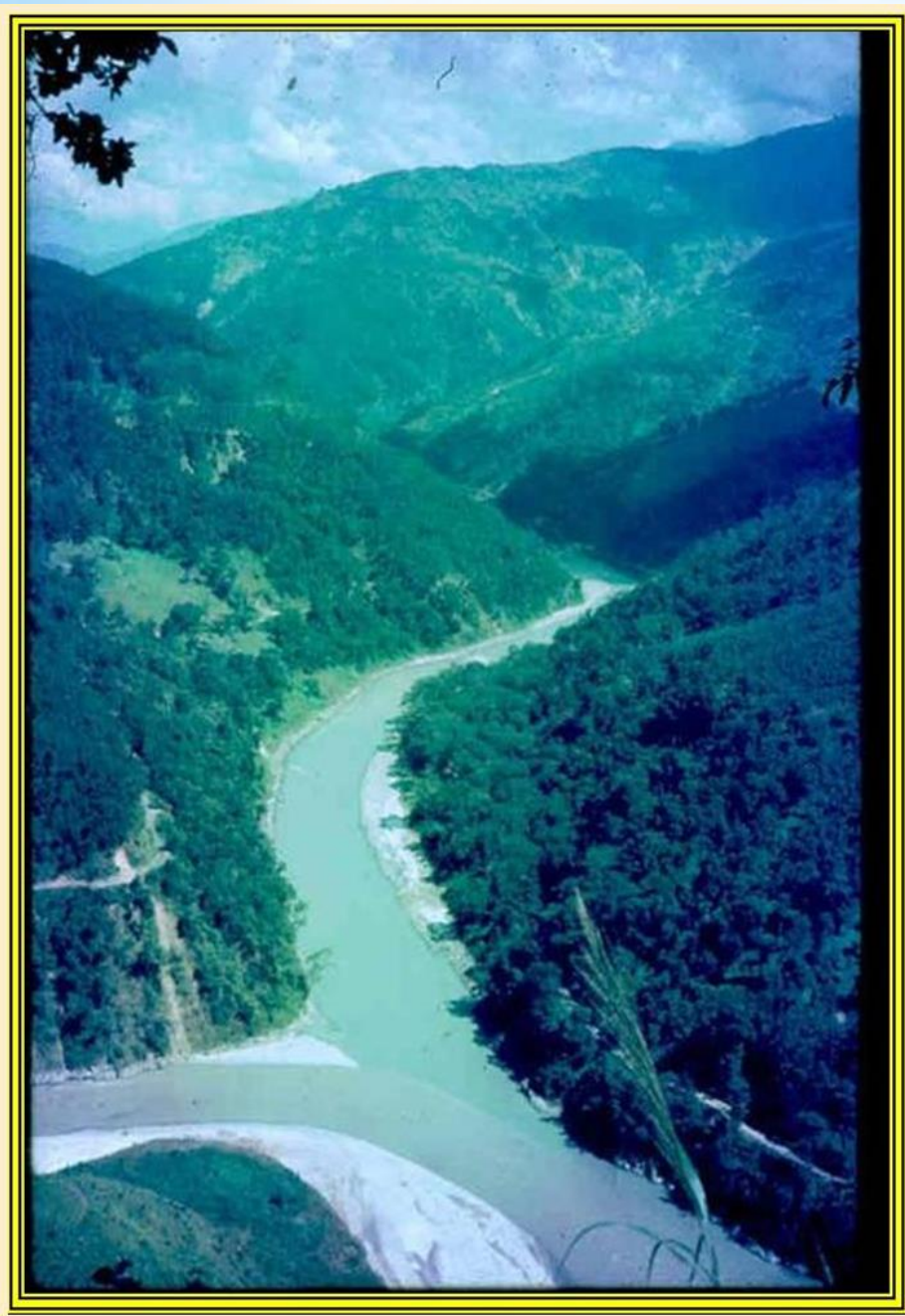
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Uses :

It is widely used in yeast as aphrodisiac. Its main use in perfumery as fixative as it prevents the volatile oil from evaporating too quickly.

Conclusion :

Hence, it can safely be concluded that since last a decade the fishery has taken the place of industrial fisheries. Apart from fish flesh a large number of fish by-products obtained through different groups of fishes find their applications in day to day human consumption, pharmaceuticals and for other purposes. Probably, this is the main reason as to why fishes has been given the designation of "Gourmet par excellence".



THANK YOU