

## Extruded Products from Fish Frame Meat

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Extrusion technology is a size enlargement process where in small granular food or powdered particles are reinforced into larger pieces with different shapes, texture, colour etc. Extrusion cooking or thermoplastic extrusion is a common extrusion technology which is considered a HTST (High-Temperature, Short-Time) process for the preparation of snack foods. It permits, with little or no modification of the basic equipments and appropriate process control, the production of a great variety of food products. Extrusion cooking is used for starchy and proteinaceous materials for the preparation of nutritious foods. Generally such products are rich in calories and the protein content is comparatively low. Considerable amounts of frame meat are generated in fish filleting industry which currently impose a cost burden on the processing industry. Frame meat can be effectively utilized in combination with cereal flours to develop extruded products. Alternatively they can be converted to fish protein hydrolysate powder. The incorporation of protein powder derived from the fish frame meat and processing wastes can improve the nutritional value of extruded products.

### **Principle of Extrusion cooking:**

Raw materials (minced frame meat/fish protein hydrolysate powders and cereal flours) are fed into the extruder barrel through a feeder and the screws convey along it. Towards the barrel end, smaller flights restrict the volume and resistance to movement of the food is increased. As a result, it fills the barrel and the spaces between the screw flights become more compressed. As it moves further along the barrel, the screw kneads the material into a semi-solid, plasticized mass. The food is heated above 100°C and the process is known as extrusion cooking (or hot extrusion). Here, frictional heat and the additional heating that is used cause the temperature to rise rapidly. The food is then passed to the section of the barrel having the smallest flights, where pressure and shearing is further increased. Finally, it is forced through dies (restricted openings) at the end of the barrel. As the food emerges under pressure from the die to normal atmospheric pressure and temperature, it expands to the final shape, gets characteristic texture and cools rapidly as moisture is flashed off as steam.

### **Extruders:**

Extruders are the tools used to introduce mechanical shear and thermal energy to food ingredients. Extruders are classified into two according to operation: Hot and cold extruders. Based on type of construction extruders are classified into: Single screw and twin screw extruder. Twin-screw extruders are used for high-moisture extrusion, products that include higher quantities of components such as fibers, fats, etc. and for the production of more sophisticated products. Twin screw extruders are again classified as co-rotating and counter-rotating types based on the direction of rotation of

the screws. In the counter-rotating position the extruder screw rotates in the opposite direction, whereas in the co-rotating position the screw rotates in the same direction.

Extruders are composed of five main parts:

- (i) Pre-conditioning system
- (ii) Feeding system
- (iii) Screw
- (iv) Barrel
- (v) Die and cutting mechanism

Pre-conditioning is not applied to all extrusion processes. It is applied when moisture contents around 20 to 30% and long residence times are required for of the material. Pre-conditioning favours uniform particle hydration, reduces retention times within the extruder and increases throughput and increasing the life of the equipment, due to a reduction in the wearing of barrel and screw components. It also reduces the cost of energy involved in the process.

The feeding system is normally composed of a holding bin where the material is loaded and the discharge of the material can occur through a vertical or horizontal feeding screw. It ensures a constant and non-interrupted feeding of the raw materials into the extruder for an efficient and uniform functioning of the extrusion process.

The screw of the extruder is its most important component. It determines the cooking degree, gelatinization and dextrinization of starch and protein denaturation and also ensures final product quality. Screws can be mono-piece or multi-piece. Screw elements can vary in number and shapes, each segment is designed for a specific purpose. Some elements only convey raw or pre-conditioned material into the extruder barrel, while other segments compress and degas the feed. Others promote kneading, backflow and shear.

Barrels or sleeve surrounds the screw and are often jacketed to permit circulation of steam or superheated oil for heating or water or air for cooling, thus enabling the precise adjustment of the temperature in the various zones of the extruder. Generally barrels are equipped with pressure and temperature sensing and temperature control mechanisms. The barrel is divided into feeding, kneading and high pressure zones.

The die has two main functions: to give shape to the final product and to promote resistance to the material flow within the extruder permitting an increase in internal pressure. The die can be in various designs and number of orifices. Dies are usually designed to be highly restrictive, giving increased barrel fill, residence time and energy input.

The cutting mechanism is necessary for obtaining final products with uniform size. Product size is determined by the rotation speed of the cutting blades. This mechanism can be horizontal or vertical.

### **Coating:**

The flavouring of extruded products follows a similar pattern to colouring. A product with fish incorporated has characteristic fishy flavour and it may develop further flavours by thermal reactions between flavour precursors in the mix or be flavoured by adding synthetic or natural flavorings. The addition of flavouring is usually carried out

on the dry extrudate by spraying or dusting, because of the changes caused by the losses of volatiles during extrusion. This can be performed with simple rotating drums with electric heaters installed or with a gas operated hot air installation.

#### **Packaging:**

One of the major properties of snacks is the crispness, which is achieved during the manufacture of the product. Retention of desirable texture (crispness) is directly related to the moisture level in the product. The moisture content of snack is very low, and any increase due to the hygroscopic nature of the product may lead to loss of crispness of the product. Moisture also accelerates other biochemical changes such as oxidative rancidity. Oxygen inside the package may be replaced by an inert gas like Nitrogen. Low water vapour and gas permeability of the package is, therefore, a very critical requirement. Also the packaging material must be physically strong enough to withstand the processes of vacuumising/gas flushing. Metalized Polyester-Polyethylene laminated pouches with Nitrogen flushing are used for the packaging of extruded products.

#### **Storage:**

Extruded product can be stored at ambient temperature. Nitrogen flushed pouches can be bulk packed in carton box and stacked inside the store.

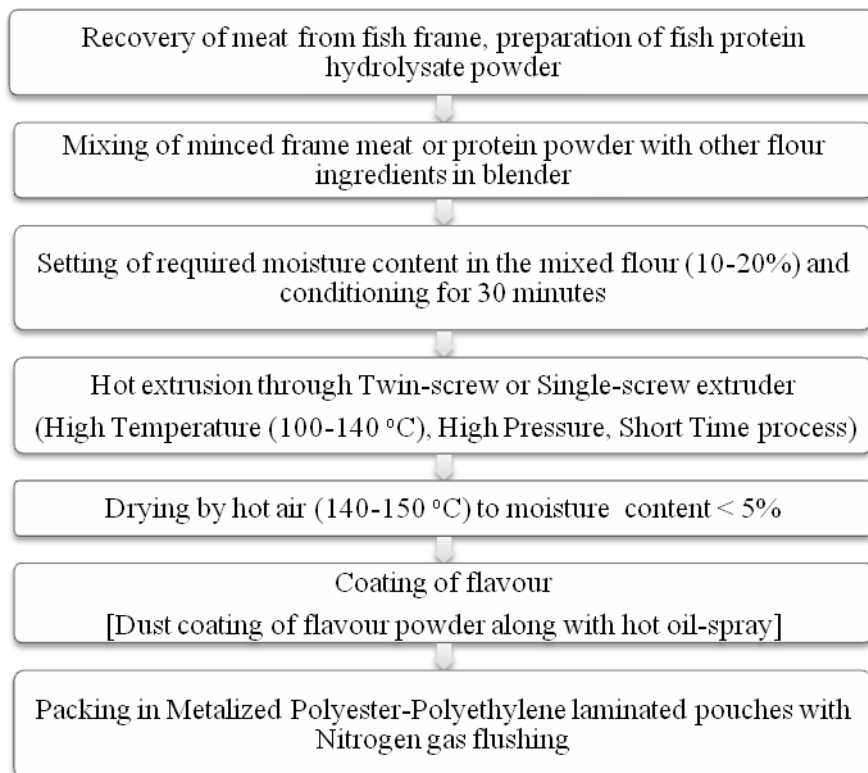
#### **Advantages of thermoplastic extrusion:**

Versatility, low costs, high production yields, good quality nutrient enriched products and no effluents.

#### **Rice-based extruded product incorporated with protein hydrolysate powder derived from the frame meat of Milk fish (*Chanoschanos*)**

A work was conducted on preparation of extruded product incorporated with fish hydrolysate powder (FPH) derived from the frame meat of Milk fish (*Chanos chanos*). 5% level of fortification with FPH was found to have similar physical properties as control sample like higher expansion ratio, low bulk density. The protein and lipid content (15% and 9% respectively) in the product increased significantly with the incorporation of FPH at 5% level in comparison with the control (7% and 4.5% respectively). The product hardness remained similar while in colour, the lightness (L\*) values showed a slight decrease with the incorporation of hydrolysate powder.

**Preparation of extruded snacks enriched with protein from fish frame meat– flow chart:**



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