

Fish Feed Processing and Production Technology

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INTRODUCTION

In animal production system, nutrition is a key factor to produce an economically healthy, high quality product. Feed is one of the major inputs in aquaculture production and there is also an increasing demand for quality feeds. Adoption of appropriate processing technology is an important factor to determine the final quality of feed. In Feed formulation, ingredients are selected in correct amount to form a single uniform mixture or pellets at possible low cost that will provide all the nutritional requirements of the target fish. The basic steps involved in fish feed manufacturing are

- 1) Selection of ingredients
 - 2) Grinding
 - 3) Feed formulation
 - 4) Mixing
 - 5) Pelleting
 - 6) Drying
 - 7) Packing
 - 8) Storage
- 1) **Selection of ingredients**: The first operation in the feed processing plant involves the selection of raw materials. The quality of feed ingredients both dry and liquid form has an important impact on the quality of final feed. It should be fresh and free from contaminants like sand, stones, and others earthen materials. The ingredients should be examined for quality check and also for nutrient analysis.

- 2) **Grinding**: Grinding or particle size reduction is a major step in feed manufacture. Prior to use, ingredients must be powdered, in order to get uniform particle size. The grinding of ingredients generally improves feed digestibility, acceptability, mixing properties, pelletability, and increases the bulk density of some ingredients. It is accomplished by many types of manual and mechanical operations involving impact, attrition, and cutting. The most commonly used grinding machines are hammer mill, pulverizers, flour mill etc. The powdered ingredients are then passed through a standard mesh sieve to obtain a uniform particle size. Sieving the ingredients helps in preparing feed pellets with uniform and attractive physical appearance.

- 3) **Feed formulation**: In this process appropriate dietary ingredients are selected on the basis of availability, chemical composition, nutritional value and, cost. The ingredients are selected in appropriate amount and blended to produce a compounded feed which is nutritionally balanced, palatable, pelletable, and easy for storage. The important points to be considered for feed formulation are:
 - nutritional requirements of the species to be cultivated
 - feeding habits of the species
 - expected feed consumption
 - type of feed processing required

- 4) **Mixing**: Feed mixing may include all possible combinations of solids and liquids. Sieved ingredients were weighed and mixed in desired proportion according to the formulation. Generally dried ingredients are mixed first followed by liquid materials.

Liquid materials such as fish oil may be added at the end and further homogenized. Water is also added for increasing the moisture level may also be added. For proper mixing of different feed ingredients into a homogenous mass, the mixing may be 20 to 30 minutes. Mixing can be done in batches or in continuous mixers. Batch mixing can be done on an open flat surface with shovels or in any containers. Continuous mixers are such that the material moves through the mixers as it is being mixed. The types of mixers used are horizontal ribbon mixers, vertical mixers, and turbine mixers.

- 5) **Pelleting**: It is the process of compacting of feeds by extruding individual ingredients or mixtures of ingredients. Pelleting converts the homogenous mixture into a quality feed, having physical characteristics that make them suitable for feeding. Pelletization is mainly done using two types of machines namely extruder pelleting and compressed pelleting.

(i) Extruder pelleting technology

Fish feed extrusion process refers to cook the mixture of feed ingredients under high temperature, pressure, and moisture by the means of an extruder within a short time. The basic components in an extruder are, a barrel fitted with a die plate and a screw shaft conveyor connected to a high speed motor. The most important operating parameters are the temperature, pressure, diameter of the die apertures and shear rate.

(ii) Compressed Pelleting technology

The pelletizer works on the principle that the finely ground feed mixture is pelleted by compression process. Compressed pelleting then involves exposing the mixture to steam for 5-20 seconds obtaining 85° C and 16% moisture followed by forcing

the mix through holes in metal die by the action of a roller located inside the die. This process is also known as steam pelleting, due to the use of steam to precondition the mix prior to compression. The combination of heat, moisture, and pressure in which gelatinization of the starch occurs. As the pellets emerge to outside surface of the die, they are cut off by a stationary adjustable knife to the desired length. Pellet quality is influenced by the fat level, moisture, and humidity. The fat level of the mixture should be not less than 2-3% to lubricate the holes in the die and to reduce the dustiness and not higher than 8-10% to avoid excessive lubrication causing insufficient compression of the feed mixture. The moisture level is also critical as the excessive moisture results in soft pellets and insufficient moisture results in crumbly pellets.

- 6) **Drying**: Immediately after pelleting the feed should be dried to reduce the moisture content below 10%. This is essential for good shelf life of the feed. Different type of dryers are used for drying feed pellets, like horizontal conveyer type, vertical hopper type, hot air oven and fluid bed dryers. The ambient temperature used for drying feed is at 65-75°C. Higher temperature is not desirable.
- 7) **Packing**: The dried feed is cooled before packing. Good quality packing covers are used to prevent damage to the feed quality on transportation and storage.
- 8) **Storage**: The feeds are composed of biological material and may degrade upon prolonged storage. Therefore feeds should be stored in clean, cool and dry warehouses/ storage areas away from direct sunlight. The deterioration may be due to

oxidative damages or microbial damages. Provisions should also be made to avoid infestations from insects/ pests/ rodents etc. Storage condition accelerates the process of feed deterioration. Temperature and humidity represents the major environmental factor that determines the storage. Depending on the relative humidity stored feed will reach an equilibrium with the atmospheric moisture content regardless of the original moisture content. High moisture content favours the microbial growth. High temperature cause oxidative damage to feed additives like vitamins thus lowering the nutritional quality of feed and also accelerate deterioration process caused by microbes. Apart from these factors light and oxygen also effect feed decay. The feed should be stored for minimum time.

