

## Basic pre-requisite information for feed formulation

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**Introduction:** Aquaculture has making it one of the fast-expanding bio industries. The global demand for fish production and the per capita fish consumption is steadily increasing as global population expected to cross 9 billion by 2050. The capture fisheries from both Inland and marine sector shows stagnant trends since last decade due to overfishing, over exploitation and habitat destruction. Therefore, the scope for the growth from capture Fisheries is very limited. The demand for the fish has to meet by aquaculture production. To increase the fish productivity and production per unit area need more intensification. Thus feed/ diet formulation plays a very important role as feed constitute 60% of operational cost and the growth of the fish directly depends on the feed. The feed must be providing all the nutrition to the organisms.

Diet formulation is a process in which the appropriate feed ingredients are selected and blended to produce a diet with the required quantities of essential nutrients. No single ingredient can be expected to meet all the nutrient requirements of a cultured organisms. Thus, by selecting various ingredients in the correct amounts a compounded ration may be formulated which is nutritionally balanced, palatable, easy to store and use. The use of scientifically formulated and optimally processed aqua feed definitely leads to sustainable production of fishes.

The proper aqua feed formulation and management maximizing the growth rate, increase production/unit, increase reproductive efficiency and minimize mortality in aquaculture.

### The basic information required for feed formulation:

- The feeding habits of the species
- Nutrient requirements of the species cultivated
- Ingredients (local availability, cost, nutrient composition and digestibility)
- Ability of the cultured organisms to utilized nutrients from various ingredients as well as the prepared diet. (digestibility and nutrient availability)
- Expected feed consumption
- Feed additives
- Type of processing

### The factors affect feed design:

- Cultured species
- Size and stage of life cycle
- Reproduction stage
- System of culture
- Feeding habits
- Environmental condition
- Stocking density
- Size and shape of feed

**Food constitutes :** For better survival, fish requires balance diet that is containing organic and inorganic ingredients are referred as food constituents. According to their functions in the body, food constitutes are classified as :

- Body builders: Protein, minerals, salt
- Energy producers: Carbohydrates, fats
- Regulators: Vitamins

### Nutrient requirements :

*Macro nutrients :* Protein, fat, carbohydrate, energy

*Micro nutrients :* Essential amino acids, essential fatty acids, vitamins, minerals./

**Protein requirements :** Proteins are composed mostly of amino acids linked with peptide bonds and cross linked between chains with sulphhydryl and hydrogen bonds. Proteins are composed of carbon (50%), nitrogen (16%), oxygen (21.5%), and hydrogen (6.5%), sometimes phosphorous and sulphur. The gross energy of protein is 5.6 kg cal/g. As protein is the most expensive part of fish feed it is important to accurately determine the protein requirements for each species and size of cultured fish. Protein requirements are lower in herbivorous fish (20-30%), omnivorous fish (25-35%) and carnivorous fish (40-50 %). Protein requirements are generally higher for smaller fish and as grow larger their requirements usually decrease. Warm period and tropical climate require lesser protein, carbon and *vis a versa*.

### Factors affecting protein requirement :

- Size and age
- Fertility of the culture system
- Levels of management and intensification
- Seasons
- Geographic location

**Fat (Lipids) :** Lipids represent the second most abundant group of organic compounds in the animal body next to proteins. The calorific value is 8-9.5kcal/g. Lipid covers sterols, waxes, fats, fat soluble vitamins, Phospholipids and sphingomyelins.

**Fatty acids (FA) :** FA are components of lipids. They are of two major types

*Saturated or non-essential fatty acids :* FAs without any double bond are called non-essential fatty acids.eg: Butyric acid, Lauric acid, caproic acid, capric acid.

*Unsaturated or essential fatty acids :* MUFA (Mono Unsaturated fatty acids) eg: Oleic acid, Palmit oleic acid)

PUFA (Poly Unsaturated fatty acids)/ n-6 series eg: Linoleic acid, Arachidonic acid.

HUFA (HighlyPoly Unsaturated fatty acids n-3 series eg:Linolenic, EPA and DHA.

**Function :**

- Serve as biological carriers for the absorption of the fat-soluble Vitamins A,D,E and K.

- Source of essential fatty acids (EFA).

- Play vital role in structure of cell and cellular membrane and serve as a precursor of several hormone.

- Source of essential steroids which play an important role in biological function

- Act as lubricants for the passage of feed through pellet diets which reduce the dustiness of feeds, improve texture.

- Play role in feed palatability as influence in flavor.

**Carbohydrate (CHO):** After the proteins and lipids, the carbohydrate (CHO) represents the third most abundant group of organic compounds in the fish body. CHO are most abundant and relatively least expensive source of energy in aquaculture. Freshwater and warmwater fishes utilize higher levels of dietary CHO than the coldwater and marine species due to higher intestinal amylase activity.

**Function :**

- As a cheapest source of energy.

- Aids in binding.

- Serve as precursors of various metabolic intermediates like non-essential amino acids, nucleic acids and chitin.

- Increases feed palatability.

- Reduce the dust content of finished feeds.

**Vitamins:** Vitamins are diverse group of organic compounds necessary in fish diet in minute quantities for normal growth, reproduction, health and general metabolism. They are often are not synthesized by fish and must be supplied in the diet. There are 11 water soluble and 4 fat soluble vitamins.

**Factors affects vitamin requirements :**

- Size and age of fish

- Growth rate

- Environmental conditions

- Nutrient relationships.

**Minerals :** Minerals are a diverse group of inorganic compounds required in considerable and lesser quantities for essential functions in the body. Micro-minerals (trace minerals) are required in small amounts as components in enzyme and hormone systems. Fish can absorb many minerals directly from the water through their gills and skin allowing them to compensate to some extent for mineral deficiencies in their diet. Minerals are important in many aspects of fish and shrimp metabolism.

**Functions of minerals :**

- Constituents of the exoskeleton (provide strength and rigidity to bones and exoskeleton of crustaceans)

- Balance of osmotic pressure (involved in body fluids mainly with the maintenance of osmotic equilibrium with the aquatic environment and in the nervous and endocrine systems)

- Structural constituents of tissues (components of enzymes, blood pigments and other organic compounds).

- Essentially involved in the metabolic processes concerned with energy transport

- Transmission of nerve impulses

- Muscle contractions

- Served as essential components for enzyme, vitamins, hormones, pigments

- Serve as cofactor in metabolism, catalyst and enzyme activators.

**Conclusion :** Feed is considered as one of the major inputs in aquaculture. A proper and balanced diet ensure good health of animal and production. Hence, before diet formulation some basic information need to know by aqua culturist. The article will help the beginners of aquaculture to know about the nutritional requirement and the importance of fish nutrition in aquaculture. The prerequisite information also helps the reader to understand the basic information and different factors involved in feed design.

**Reference:**

**De Silva, S.S. and Anderson, T.A. (1995).** *Fish nutrition in aquaculture.* 1<sup>st</sup>Ed., Champan and Hall, London, 319pp. ISBN 9402418652, 9789402418651.