

Principal Nutrients (Carbohydrates, vitamins and Minerals)

Carbohydrates

- After the proteins and lipids, the carbohydrates (CHO) represent the third most abundant group of organic compounds in the fish body.
- CHO are the most abundant and relatively least expensive source of energy in aquaculture
- CHO is stored in the form of glycogen in animals and cellulose in the plant.
- Carbohydrates (starch and sugars) are the most economical and inexpensive sources of energy for fish diets.
- Carbohydrates are included in aquaculture diets to reduce feed costs and for their binding capacity during feed manufacturing.

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- Dietary starches are useful in the extrusion manufacture of floating feeds.
- Cooking starch during the extrusion process makes it more biologically available to fish.
- Up to 20 % of dietary carbohydrates can only be used by fish
- Carbohydrates tend to have on the structural integrity of the feed, caused by the binding quality of starches
- Some carbohydrates are normally regarded as indigestible. These are reported separately in the tables of feed composition as 'fibre' or 'crude fibre'.

CONT....

- Fibre includes substances such as celluloses, lignin, chitin etc.
- Many fish don't have the enzyme cellulase which is necessary for the digestion of cellulose and fibre is usually regarded as unavailable as an energy source.
- At small levels, however, it may aid pelletability.
- Cellulase, however, is produced by the gut bacteria of many fish, as it is chitinase in crustaceans and herbivorous fish are able to digest fibre.

Function of Carbohydrates

- As a cheap source of energy
- Aids in binding
- Serve as precursors of various metabolic intermediates like non essential amino acids, nucleic acids and chitin.
- It increases feed palatability.
- Reduce the dust content of finished feeds

Classification of Carbohydrates (CHO-According to The Chemical Structure)

- Carbohydrates are of two types, namely,
- **Sugars** (those CHO which contain < 10 monosaccharides units) has sweet taste. Sugars are of following types:
 1. **Monosaccharides:** Any class of sugars (e.g. glucose) that cannot be hydrolysed to give a simple sugar.
Example: Glucose, Fructose, Galactose
 2. **Disaccharides:** Any of a class of sugars whose molecule contain two monosaccharide residues.
Example: Sucrose, Maltose, Lactose
 3. **Oligosaccharides:** A carbohydrate whose molecule are composed of a relatively small number of monosaccharide units.
Example: Raffinose

- **Non sugars** (are those CHO which contain > 10 monosaccharides units) and do not possess a sweet taste.
- Non sugars are of 2 types
 - 1.Homo polysaccharides:** Polysaccharides composed of single type of sugar monomer.
Example: starch, dextrin, glycogen, cellulose
 - 2. Hetero polysaccharides:** Contain two or more different monosaccharide units.
Example: Hemicellulose, gums, mucilages, pectin substrates

Vitamins

- Vitamins are a heterogeneous group of organic compounds essential for the growth and maintenance of animal life.
- The majority of vitamins are not synthesized by the animal body or at a rate insufficient to meet the animals needs.
- They are distinct from the major food nutrients (proteins, lipids, and carbohydrates) in that they are not chemically related to one another, are present in very small quantities within animal and plant foodstuffs, and are required by the animal body in trace amounts.
- Approximately 15 vitamins have been isolated from biological materials; their essentiality depending on the species, the growth rate, feed composition, and the bacterial synthesizing capacity of the gastro-intestinal tract of the animal.

Classification

- Vitamins may be classified into two broad groups, depending on their solubility; the water-soluble and fat-soluble vitamins.
- As their name suggests, the fat-soluble vitamins are absorbed from the gastrointestinal tract in the presence of fat and can be stored within the fat reserves of the body.
- Whenever dietary intake exceeds metabolic demands; storage increases with dietary intake causing a toxic condition called hypervitaminosis.
- By contrast, the water-soluble vitamins are not stored in appreciable quantities in the animal body. Body stores being rapidly depleted in the absence of regular dietary water-soluble vitamin sources.

Classification of vitamins

Water soluble

Thiamine (vitamin B1)
Riboflavin(vitamin B2)
Niacin (vitamin B3)
Pantothenic acid(vitamin B5)
Pyridoxine (vitamin B6)
Biotin (vitamin B7)
Folic acid (vitamin B9)
Inositol
Choline
Cyanocobalamine (vitamin B12)
Ascorbic Acid

Fat soluble

Retinol (vitamin A)
Cholecalciferol (vitamin D3)
Tocopherol(vitamin E)
Phylloquinone(vitamin K)

Minerals

- Minerals are a diverse group of inorganic compounds required in considerable and lesser quantities for essential functions in the body.
- The essential mineral elements are usually classified into two main groups according to their concentration in the body as macrominerals and microminerals.
- Macro minerals (major minerals): Required in considerable quantities
- Micro minerals (minor minerals): Required in lesser amounts or trace amounts

Macro-minerals		Trace or micro-minerals	
Principal cations	Principal anions		
Calcium (Ca)	Phosphorus (P)	Iron (Fe)	Fluorine (F)
Magnesium (Mg)	Chlorine (Cl)	Zinc (Zn)	Vanadium (V)
Sodium (Na)	Sulphur (S)	Manganese (Mn)	Chromium (Cr)
Potassium (K)		Copper (Cu)	Molybdenum (Mo)
		Iodine (I)	Selenium (Se)
		Cobalt (Co)	Tin (Sn)
		Nickel (Ni)	Silicon (Si)