

Nutritional requirements of cultivable fish and shellfish (Carbohydrates, vitamins and Minerals)

Carbohydrates

- Like protein and lipids, carbohydrates are also another source of energy.
- Fish do not have specific dietary requirement, but carbohydrates are always included in fish diets as they are inexpensive energy source and act as pellet binder.
- Carbohydrates also serve as precursors for formation of various metabolic intermediates needed for growth.
- Carbohydrates have been shown to have a protein sparing effect in many aquaculture species.

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- Carps, tilapia, milkfish and prawns efficiently utilize carbohydrates as energy.
- In the absence of adequate dietary carbohydrates, fish utilize protein for energy at the cost of growth.
- Several species of carps are considered herbivorous in nature and hence use of cheap sources of digestible energy becomes an important consideration.
- Carps are able to utilize D-glucose, fructose, sucrose, dextrin and starch from potato, rice and tapioca. Some of the cyprinids can utilize cellulose.

- Chitin (0.5%) or its precursor glucosamine (0.8%) when included in diet has been shown to improve growth and feed efficiency in prawns.
- Carbohydrate levels in commercial semi-intensive prawn feeds is in the range of 25-30%. [n feeds for extensive culture, starch level in the range 35-40% is being used.
- In *Penaeus indicus* starch digestibility was maximum upto a dietary level of 20%.
- Different fish species have varying capacity to utilize carbohydrates.

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- For example, rainbow trout efficiently utilizes dextrin and gelatinized starch, while a small inclusion of starch in salmon diet is always beneficial. It is assumed that seabass, *Lates calcarifer* poorly utilizes carbohydrate since its natural food is rich in protein.
- Prawns utilize more efficiently poly-and di-saccharides.
- Carbohydrate is the major constituent of the diet of herbivores and omnivores and it is digestible to the extent of 55-60%.
- The optimum dietary requirements of carbohydrates are 22-26% for carps, 30-40% for common carp, less than 25% for rainbow trout.
- However, carbohydrate levels generally do not exceed 30% in carp diet. The commercial diet of prawns normally contains 35-40% carbohydrates.

Vitamins

- Vitamins are required in traces which are essential for fish growth and health.
- They are also required for metabolism of other nutrients. Many of the water soluble vitamins act as co-enzymes.
- Fishes derive required vitamins from natural food, which become limited in intensive fish culture due to high stocking densities
- Fish require 11 water soluble vitamins, namely thiamine, riboflavin, pyridoxine, niacin, pantothenic acid, inositol, folic acid, choline, biotin, ascorbic acid and B12 along with four fat-soluble vitamins such as A, D, E and K.
- Water soluble vitamins, when taken in excess are excreted. However, excess fat soluble vitamins in the diet results in abnormal growth and liver diseases

Vitamin requirements in diets (per kg feed)

- **Ascorbic acid:** 100-150mg/ kg for carp and channel catfish, 300 mg/kg for salmon and trout
- **Choline:** Trout and salmon 600-800mg/kg diet; carp 500-600mg / kg diet; recommended level in prawn diet 400-2000mg/ kg
- **Inositol:** In fish diets 200-400 mg/ kg; recommended level in prawn diets 300mg/ kg.
- **Thiamine:** Channel catfish require about 1mg/kg, salmon and trout 10-12mg/ kg, carp 2-3 mg / kg and recommended level in prawn diets 50-100 mg/kg.

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- **Riboflavin:** Salmon and trout 10-12mg; carp 4-7mg; channel catfish 10mg; prawns 30-50mg/kg diet
- **Pyridoxine:** In fish diets 10-20mg/ kg, prawn diets 30-50mg/ kg
- **Pantothenic Acid:** Salmon and trout 40-50 mg; carp 30-40mg; channel catfish 25-30mg; prawns 50-100 mg/kg diet
- **Niacin:** Fish in general 50-100 mg/ kg; carp 25-30mg; prawn diets 100-1500mg/kg
- **Biotin:** 0.4 to 1.0mg/ kg diet for fish and 1mg/ kg diet for prawns.

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- **Folic acid:** Range between 5-10mg/ kg for fish and 5-10mg / kg for prawns.
- **Cyanocobalamine (B12):** Fish 0.015 to 0.02 mg/kg dry diet; prawns 0.02 - 0.1 mg/kg diet
- **Vitamin A:** Fish 1000-2000 I.U/ kg; recommended level for prawns 5000-10000 I.U./ kg feed
- **Vitamin D:** Fish requires between 1000 and 1000 I.U., recommended level for prawns 1000-2000 I.U./kg feed
- **Vitamin E:** In fish dietary level recommended range from 30-50mg/kg diet and for prawns 100-200 IU. / kg.
- **Vitamin K:** Dietary level in fish feeds: 10mg/kg; prawn feeds 5-20mg/kg.

Minerals

- Minerals are required for osmotic balance of various metabolic process and for structural functions in fish.
- Some minerals such as calcium are directly obtained by fish through gills and skin or both, while others are made available from natural food and ingested detritus.
- There are more than 20 recognized mineral for performing essential functions in the body.
- The minerals required by fish are calcium, phosphorus, magnesium, sodium, potassium, chlorine, and sulphur along with a number of trace elements such as cobalt, copper, iodine, iron, manganese, selenium, zinc, aluminum, chromium and vanadium.

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- Calcium and phosphorus are closely related in metabolism and constitute major part of skeletal system.
- Calcium plays a major role in blood clotting, muscle function and proper nerve impulse transmission.
- Phosphorus is involved in energy transformation, permeability of cellular membrane and general control of reproduction and growth.

Mineral requirements in diets (per kg feed)

Minerals	Requirements
Calcium (g)	trout and salmon 0.2-0.3 common carp 0.28, red sea bream 3.4; Japanese eel 2.7; Indian and Chinese carps 5-18; prawns 10-18
Phosphorus (g):	trout and salmon 7-8; common carp 6-7; tilapia 9; red sea bream 6.8; Japanese eel 2.9; channel catfish 4-7; Indian and Chinese carps 5-7; sea bass, sea bream 7-8
Magnesium (g):	trout and salmon 0.5-0.7; carp 0.4-0.5; fish(in general) 0.5; prawns 0.8-1.0
Copper (mg)	trout and salmon 3; channel catfish 1.5; fish (in general) 1-4; prawns 25.

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Manganese (mg)	trout and salmon 12-13; carp 4; fish (in general) 20-25, prawns 20
Zinc (mg)	trout and salmon 15-30; fish (in general) 30-100; prawns 50-100
Iron (mg)	carp 150, fish (in general) 50-100, prawns 5-20
Cobalt (mg)	fish (in general) 5-10; prawns 10
Selenium (mg)	trout and salmon 0.1-0.4; prawn 1
Sodium (g)	fish (in general) 1-3; prawns 6
Potassium (g)	fish (in general) 1-3; prawns 9
Sulfur (g)	fish 3-5; prawns 0.2
Chlorine (mg)	fish 1-5