

# Feed Additives for growth promotion in shrimp

S.Ahamad Ali

Central Institute of Brackishwater  
Aquaculture, Madras - 8

Shrimp farming in India is poised for a big leap if the developments that are taking place in coastal regions of maritime states is any indication. This has been made possible mainly because of the development of semi-intensive and intensive farming technologies for penaeid shrimp using high efficiency feeds. It is reported that production rates as high as 15 tonnes per hectare per crop have been achieved in the case of tiger shrimp *Penaeus monodon* under these farming practices.

## Feed: Homogenous Package

Feed plays a major role in shrimp farming constituting as much as 50% of cost of production. In feed formulations, components are added to hasten the growth of shrimp thus shortening the duration of farming. The complex feeding behaviour and feeding preferences of the shrimp are also considered in designing the feed. A successful shrimp feed is a homogenous package of energy, growth promoters, health tonics, attractants and flavours presented in a most convenient and palatable form. The nature, quality and quantity of various additives that are used in prawn feed are discussed below.

## Balanced Feed

A balanced feed formula is made up of basic ingredients and the additives.

**Basic Feed Formula:** The basic formula of a feed consists of feed ingredients, to meet the nutritional requirements of candidate species. Penaeid shrimp require around 3000 - 3500 K cal of digestible energy in their feed for basal metabolism and normal growth. This energy is derived from the major nutrient components, protein, fat and carbohydrate of the diet. Protein is an essential nutrient and its requirement is around 35 to 40% in the diet of shrimp. The protein used should be of good quality having balanced essential amino-acids such as arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, tyrosine and valine. Even though, the quantitative requirement of fat is only in the range of 8-10% in the diet, its quality is very important. Fat should be rich in polyunsaturated fatty acids (PUFA) such as linoleic acid (18:2 W6), linolenic acid (18:3 W3), eicosapentaenoic acid (20:5 W3) and docosahexaenoic acid (22:6 W3) which are

essential for growth and survival. While penaeid shrimps are capable of efficiently utilising polysaccharides such as starch, it is suggested that carbohydrate can be used at 10 to 35% level in the diet.

**Feed Additives:** To make the feed formula complete, various essential additives are incorporated at required levels to the basic formulation. The formulated feed so obtained promotes normal growth of recipient animals. But to stimulate growth faster than the normal, selected growth promoting agents are added. For making the feed more attractive, palatable and digestible attractants, flavours and digestive aids are added in the feed formula. Since shrimp feed has to be presented under water column, it has to be aqua-stable. Binding materials are used to prevent disintegration of feed under water column. In order to facilitate smooth processing, some materials as processing aids may also be added. All these components added to the basic feed formula together constitute feed additives.

## Growth promotion in shrimp through feed additives

The main objective of additives in feed is to achieve healthy and faster growth leading to higher production. The various additives used for this purpose may be classified into (1) essential additives (2) growth promoting but non-essential additives and (3) auxiliary additives (Table 1).

### Essential Additives

Essential additives are supplemented in small quantities to make the formula nutritionally better balanced to promote healthy growth of shrimp. These are called essential because their prolonged absence in feed may cause deficiency disease. Vitamins, minerals, fish oil, fatty acids, phospholipids and steroids are examples of essential additives.

**Vitamins:** Vitamins are important food factors and are involved in many metabolic biochemical reactions of animal body. For ex-

Table 1: List of various additives used in shrimp feeds

Category	Classified name of additives	Broad function
1. Essential additives	1. Vitamins	Physiological and nutritional
	2. Minerals	-do-
	3. Oils and fats	Nutritional
	4. Fatty acids	Nutritional and physiological
	5. Phospholipid	Physiological
	6. Steroids	-do-
2. Growth promoting non-essential additives	1. Plant materials	Nutritional and anabolic
	2. Animal materials	-do-
	3. Single cell proteins	-do-
	4. Antibiotics	Prophylactic
	5. Drugs	-do-
	6. Hormones	Anabolic
	7. Enzymes	Digestive
	8. Chemicals	Physiological
	9. Attractants	Stimulants
3. Auxilliary additives	1. Colours	Physical
	2. Binders	-do-
	3. Molasses	-do-
	4. Animal fat	Nutritional and Physical



ample, deficiency of vitamin 'C' causes black death disease in shrimp. Thus vitamins are essential in diet for promoting healthy growth of shrimp. Improved growth and survival were achieved in different species of penaeid shrimp by adding vitamin mixtures consisting of vitamins A,C,D,E, nicotinic acid, pyridoxine, riboflavin, thiamine, choline chloride, biotin, folic acid and cyanocobalamin.

**Minerals:** Inorganic elements, calcium, phosphorous, sodium, potassium, iron, manganese, magnesium, copper, chloride, iodine, cobalt and zinc are essential minerals in the diet of shrimp. Their insufficiency causes deficiency disease. Dietary minerals are needed for healthy up-keep of shrimp. Trace elements such as copper, zinc, cobalt, iodine and manganese when supplemented in diet improve the growth of shrimp.

While calcium and phosphorous are found in exoskeleton (shell) of shrimp, sodium, potassium, magnesium and chloride are associated with osmoregulation. Copper is found as part of haemocyanin of colourless blood in shrimp. Magnesium, Manganese and zinc are found as co-factors of metabolic enzymes. Even though the function of cobalt and iodine in shrimp nutrition is yet to be understood, these are included in mineral mixtures of shrimp feeds.

**Fish Oil:** Fish oils such as cod liver oil, shark liver oil, sardine oil, squid oil and clam oil are rich in PUFA. These oils are added at 2 to 3% level in shrimp feeds to improve growth and food conversion ratio, as these oils provide dietary energy as well as the fatty acids essential for shrimp.

**Fatty acids:** Highly unsaturated fatty acids (HUFA) such as eicosapentaenoic acid (20:5 W3) and docosahexaenoic acid (22:6 W3) may be added at 1% level to promote better growth of shrimp, as these fatty acids are the most essential for shrimp. These are also present in fish oil described above.

**Phospholipid:** Phospholipids such as phosphatidylcholine is essential in the diet of shrimp for growth and survival. Addition of 1 to 2% of soyabean lecithin in the diet promotes faster growth and improves food conversion ratio. Phospholipids are physiologically important in transportation of lipids in the body of shrimp.

**Cholesterol:** Among the steroids, cholesterol is nutritionally and, physiologically essential in the diet of shrimp. Addition of 0.1 to 0.5% of cholesterol to shrimp feed enhances growth and survival of shrimps. Cholesterol is present in shrimp head waste meal.

**Growth Promoting Non-essential Additives**

Materials derived from plants and animals, single cell proteins and some synthetic substances are used as additives in shrimp feeds for achieving faster growth and higher production. These additives are not essential in the sense that their non-inclusion in the feed does not cause any deficiency disease. On the other hand they are beneficial when added to feed. These are growth promoters and attractants.

**Growth Promoters:** The following are some of the selected growth promoters used in shrimp feeds (Table 2).

tein source show negligible response when antibiotics are added, as fish meal itself possesses growth promoting factors.

The exact mode of action of antibiotics as growth promoters is not very clear. However, antibiotics (1) reduce or eliminate the activity of pathogens causing sub-clinical infection, (2) eliminate bacteria which produce toxins that reduce growth, (3) stimulate growth of micro-organisms which synthesise known or unknown nutrients (4) reduce micro-organisms which compete with host for nutrients and finally (5) increase the absorptive capacity of intestine. Antibiotics also reduce the requirement of vitamin B12 and increase conversion of feed nitrogen into body nitrogen.

In shrimps, addition of 100 to 1000 mg of

**Table 2: Growth Promoters**

Name of material	Category	Quantity used in feed %
1. Alfalfa	Plant, forage legume	2.0
2. Bromelain	<i>Medicago spp.</i> Protein digesting enzyme extracted from pineapple	0.1-0.2
3. Chitin	Derived from prawn shell, a polymer of N-acetylglucosamine	0.8-1.5
4. Glucosamine	synthetic chemical or derived from hydrolysis of chitin	0.8
5. Papain	Protein digesting enzyme extracted from papaya fruit latex	0.1-0.2
6. <i>Spirulina</i>	Single cell protein, fresh -water alga	0.5-8.0
7. Squid protein	Marine animal Squid, <i>Loligo spp</i>	5.0-10.0
8. Yeast	Single cell protein, <i>Fungi, Saframcyces spp.</i>	1.0-3.0

These materials have different factors which contribute to growth promotion in shrimps. Antibiotics, drugs and steroid hormones are reported to be used in shrimp feeds for improving growth and FCR. The background of their use in animal feeds is discussed below.

**Antibiotics:** Antibiotics are added in cattle and poultry feeds apparently to improve growth. Bacitracin, chlortetracycline, streptomycin, tyrothricin, gramicidin, erythromycin, virginianycin and flavomycin are some of the antibiotics used for this purpose. The dose and response vary from animal to animal. It is reported that antibiotics improve the growth by 15% and feed efficiency by 5%. Antibiotics are generally found to stimulate growth of young animals rather than adults. But they are added in feeds of adult animals because their abrupt withdrawal may cause a setback and nullify the initial advantage. Further, antibiotics show positive response in feeds formulated with vegetable proteins. However, feeds containing fish meal as pro-

oxytetracycline per kg of feed had improved growth in early juveniles of *Penaeus aztecus* (150mg size). However, it had shown adverse effect when fed to large size shrimps (450 mg) in the United States of America (Corliss *et al* 1977). Similarly no growth stimulating response was noticed when oxytetracycline was fed to *P. indicus* (50 mg) at 100 mg/kg in the diet in India (Vaitheswaram and Ahmad Ali, 1986).

Use of antibiotics freely in feeds is not permitted because administration of antibiotics to farm animals could pose a hazard to human health due to potential development of resistant strains of enteric bacteria. Because of these reasons antibiotics are classified as 'feed' or 'therapeutic'. Only feed antibiotics are permitted to be used in feeds and are regulated such that the antibiotic used will not have any application in therapeutic use either in human beings or in animals. Further, the antibiotic used will not impair the efficacy of prescribed therapeutic antibiotic through development of resistant strains of organisms.