



ISSN: 2347-5129  
(ICV-Poland) Impact Value: 5.62  
(GIF) Impact Factor: 0.549  
IJFAS 2016; 4(5): 78-81  
© 2016 IJFAS  
www.fisheriesjournal.com  
Received: 11-07-2016  
Accepted: 12-08-2016

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# International Journal of Fisheries and Aquatic Studies

## Formulation of fish feed using ingredients from soyabean, radish, maize and beet

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### Abstract

Currently, limited number of ingredients is used in the formulation of feeds used in intensive aquaculture. The choice of these ingredients should be based on the nutritional value taking into account potential anti-nutritional factors rather than merely on the basis of cost per unit weight alone. Taking into account these considerations, present formulation is undertaken by using plant origin sources of protein such as soyabean, maize, radish and beet root. They are used as base in feed formulation. Other ingredients used are of high nutritive and low economical value. The feeds formulated using soyabean, radish, maize and beet are well accepted and easily consumed by fishes particularly herbivorous fish Grass carp (*Ctenopharangodon idella*).

**Keywords:** Feed formulation, soyabean, maize, radish, beet root

### 1. Introduction

Fish, like other animals, have requirements for the essential nutrients such as proteins, carbohydrates, fatty acids, vitamins and minerals in their diets, in order to grow properly<sup>[1]</sup>. (Lovell, 1989). When fish is exploited for commercial purpose the artificial feed plays a crucial role in growth and development. Conversely the feed may be given as supplementary feed, where part of the nutritional needs is supplied by natural feeds present in the aquatic environment<sup>[2]</sup>. (Balfour and Yoel, 1981). Protein is one of the basic components of animal tissues which constitute 45 to 47% tissue dry matter<sup>[3]</sup>. (Murai, 1985). Therefore, it is an essential nutrient for body maintenance and growth. Fishmeal is important and major source of animal protein in the diets of fish, livestock and poultry. Although it is a major component, its high price, is a major constraint in feed formulation. When used in formulation of feed, it leads to an increase in the cost of feed and a corresponding rise in fish production<sup>[4]</sup>. (Ekelemu *et al.*, 2000). Thus to reduce the cost of feed and thereby cost of fish farming, maggot-meal has been successfully used to replace fishmeal as a source of animal protein in fish and poultry feed<sup>5</sup> (Akpodiete, 1997). Plant protein supplements like deoiled ground nut oil cake, soyabean oil cake, mustard oil cake, cotton seed oil cake, etc are widely used in feeds for aquaculture practices. Global availability and relatively low cost compared to ingredients of animal origin are their positive attributes. Properly processed plant products and by-products generally have high protein digestibility. Present fish feed is formulated to replace more expensive fishmeal and prepared from locally available raw materials.

### 2. Materials and Methods

Feed formulation and preparation is the processes of combining feed ingredients to form mixture that will meet the specific goals of production. It is often a compromise between an ideal formula and practical considerations. While formulating the feed one must take into account some considerations such as price, availability of ingredients used, anti-nutritional factors and palatability of mixtures<sup>[6]</sup>. (Azevedo P.A. 1998). Along with soyabean meal other ingredients such as milk powder, corn flour, eggs, cod liver oil, vitamin mixture containing vitamin B Complex and E, agar powder, garlic paste, pepper powder and cumin powder were used.

#### 2.1 Preparation of feed

Soyabean meal (80gm) was taken in powder form as principal ingredients. Other ingredients like milk powder (60 gm), corn flour (20 gm), and eggs (70 gm) were added and mixed well.

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Agar powder (4 gm) was added as binding agent; turmeric (0.5gm) and garlic (1 gm) as antibiotics. The said mixture was boiled, cooled at room temperature, after cooling cod liver oil (3.5 ml), vitamin mixture of vitamin B complex (1gm) and vitamin E (1 gm) were added. It was kept under refrigeration for 12 hrs. After 12 hrs it was squeezed over polythene sheet and dried at room temperature for 48 hrs. The dried nodules are crushed into small pellets then pellets are sun dried to avoid fungal infection, weighted and stored in the bottle. Following the above procedure all the feeds were formulated in the percentage composition of 25% (soyabean meal 25% +groundnut oil cake 75%), 50% (soyabean meal 50%+groundnut oil cake50%), 75% (soyabean meal 75% +groundnut oil cake 25%), 100% formulated (totally of soyabean meal)and 100%conventional (totally of groundnut oil cake).

## 2.2 Nutritional importance of ingredients used

### 2.2.1 Soyabean meal

Soyabean meal is most frequently studied dietary ingredient as a fish meal replaced in diets for many fish species for its high protein content, relatively well balanced amino acid profiles, reasonable price and steady supply <sup>[7]</sup>. (Storebaken *et al.*2000). Protein and oil content accounts for about 60% of dry soybeans by weight. The other contains include 35% carbohydrate and 5% ash <sup>[8]</sup>. (USDA).

### Nutritional value of soyabean/100 gms

Carbohydrate: 30.16gm; Sugars: 7.33gm; Dietary Fiber: 9.3gm; Fat: 19.94gm; Protein: 36.49gm; Energy: 450Kcal <sup>[8]</sup>. (USDA).

### 2.2.2 Maize

Maize, the American Indian word for corn, literally means "that which sustains life." After wheat and rice, it is the most important cereal grain in the world, providing nutrients for humans and animals. Maize is also used as animal feed and raw material for industrial use. Maize constitutes an important source of carbohydrates, protein, vitamin B, and minerals. As an energy source, it compares favorably with root and tuber crops, and is similar in energy value of dried legumes. Furthermore, it is an excellent source of carbohydrate and is complete in nutrients compared to other cereals.

### Nutritional value of maize/100 gms

Carbohydrates: 11.90gm; Proteins: 2.45 gm; Fats: 14gm; Dietary fibers: 3.0gm; Energy: 47 Kcal.

### 2.2.3 Radish

#### Nutritional value of radish/100 gms

Carbohydrates: 3.40gm; Proteins: 68gm; Fats: 10gm; Dietary fiber: 1.6gm; Energy: 16 (Kcal); and Vitamins B complex. Radish is rich in ascorbic acid, folic acid, and potassium. They are a good source of vitamin B6, riboflavin, magnesium, copper, and calcium.

### Nutritional value of radish/100 gms

Carbohydrates: 9.96gm; Proteins: 1.68 gm; Fats: 18gm; Dietary fibers: 2.0gm; Energy: 43 Kcal; and Vitamins like A, B complex and C. It has practically no fat and cholesterol <sup>[9]</sup>. (USAID).

### 2.2.4 Beetroot

Beetroot is a rich source of carbohydrates, proteins, and has high levels of important vitamins, minerals and micronutrients.

### Nutritional value of beetroot/100 gms

Beetroot contains 66g sodium (Na) and 380g potassium (K)<sup>9</sup> (USAID).

### 2.2.5 Milk powder

In present feed formulation Nestle milk powder was used. It contains 20 standard amino acids. It is rich in soluble vitamins A, D and minerals. Typical average nutrient in the unreconstituted milk are 36% proteins; 52% carbohydrates (particularly lactose); and 1.3% calcium.

### Nutritional value of milk powder / 100 gms

Protein: 20.5 gm; Carbohydrates: 52.7gm; Fats: 19gm; Saturated Fatty Acids: 10.9 gms; Cholesterol: 0.05 gm; Mono Unsaturated Fatty Acid: 4.21gm; and Poly Unsaturated Fatty Acid (PUFA): 0.41gm<sup>9</sup>

### 2.2.6 Egg

Egg albumin contains 15% of proteins dissolved in water. It contains about 40 different types of proteins. The proteins in egg white are, ovalbumin: 64%; ovotransferrin: 12%; ovomucoid: 11%; ovomucin: 1.5%; globulin: 8%; and lysosymes: 3.5% <sup>8</sup>(USDA, 2008).

### 2.2.7 Corn flour

Corn flour was used as filler and binder in present formulation. It contains proteins: 3 gms; carbohydrates: 23gms; and fat: 1gm. The major ingredients are maize and starch. Starch acts as additive in feed processing. It has 110 calories per gm<sup>8</sup>. (USDA, 2008).

### 2.2.8 Cod liver oil

Cod liver oil is derived from the liver of cod fish *Gadus callarias*. It has a mild fishy taste and smell. It contains small amount of fish protein <sup>[10]</sup>. (Aviram M, Brox J. Nordoy A, 1986). It is a good source of the vitamin A and D, as both the vitamins are nutritionally important to body. Cod liver oil along with vitamin E prevents the body from increasing oxidant stress. It helps to reduce generation of free radicals in body. It has been used in form of a gelatin coated capsule named as Seacod. Each single soft gelatin capsule contain 300 mg of cod liver oil.

### 2.2.9 Agar powder

Agar powder used as binding agent. It helps to form a unique mass of the feed. It is a polymer made up of subunits of sugar galactose. It acts as an emulsifying and suspending agent in many feed products.

### 2.2.10 Vitamin mixture

Vitamin B and E were used as vitamin mixture in equal proportions.

### Vitamin B complex

Each capsule of vitamin B complex is composed of Thiamine mononitrite; Vitamin B2, B6, B12; Nicotinamide; Folic acid; Biotin; and Titanium dioxide. It promotes activity of enzymes. It plays an important role in cell growth and metabolism <sup>[11]</sup>. (Vera Reader, 1930). Vitamin B is an essential nutrient for growth, development and other bodily functions <sup>[12]</sup>. (Guyton JR., Boys HF., 2007).

### Vitamin E

Each soft gelatin capsule contains Tocopherol acetate of 400 mg. It acts as an antioxidant, protects body against free

radicals, which are potentially damaging by products of energy metabolism. DL-X Tocopherol acetate is the form used while formulating feed.

### 2.2.11 Turmeric powder (*Curcuma longa*)

It was added for its antibacterial, anti-inflammatory and hepatoprotective properties. It functions as an antioxidant and adjuvants in feed preparation. Turmeric used to protect the feed from sunlight<sup>[13]</sup>. (Shrinivasan M. and Satya Narayan, 1987). It adds warm, mild aroma and distinctive yellow color to the feed. It is also hypolipidemic<sup>[14]</sup>. (Khanna K. M., Sarine J. P and Singh S, 1904).

#### Nutritional value of turmeric /100 gms.

Protein: 8.6%; Carbohydrates: 63.0%; Fat: 8.9%; Fiber: 6.9%; Total ash: 6.9%; Moisture: 5.8%; Calcium: 6.2%; and, Iron: 0.05%. The caloric value is 390 calories per 100 gm (USAID, 2004). It also contains 5% essential oil, and 3% Carcumin which is a polyphenol<sup>[15]</sup>. (Sharma S; Agarwal S; and Kulkarni SK, 2006).

### 2.2.12 Garlic paste: (*Allium sativum*)

It is used for its antibiotic and antibacterial properties<sup>[16]</sup>. (American Chemical society, 2002).

#### Nutritional value of garlic / 100 gms

Moisture: 62.8%; Protein: 6.3%; Carbohydrates: 29%; Fiber: 0.8; Total fat: 0.1%; Total ash: 1.0%; Calcium: 0.03%; Phosphorus: 0.31%; Iron: 0.001%; Vitamin C: 13 mg; and Nicotinic acid: 0.4 mg. The caloric value is 142<sup>9</sup> (USAID, 2004).

### 2.2.13 Pepper powder: (*Pepper nigrum*)

It is used as a stimulant for appetite. In India it is used in number of health related problems<sup>[17]</sup>. (H. J. D. Dorman and S. G. Deans 2000). Pepper has two main components- volatile oil and pungent component commonly known as piperine. Black pipers contain 0.6 to 2.6% essential oil. Nutritionally pepper contains Vitamins A, B and C.

### 2.2.14 Cumin powder (*Cuminum cyminum*)

Research in animals indicates that it stimulate the secretion of pancreatic enzymes, important factors in nutrient digestion and assimilation.

#### Nutritional value of cumin / 100 gms.

Carbohydrates 44.24 gm; proteins 17.81 gm; fats 1.53; dietary fibers 10.5 gm; iron 66.36mg; sodium 168 mg; zinc 4.8 mg; calcium 931 mg; vitamins such as A 64 mg; thiamine B1 0.628 mg; riboflavin B2 0.327 mg; niacin B3 4.579 mg; foliate B9 10 mg; vitamin C 7.7 mg; and E 3.38 mg<sup>9</sup> (USDA,2008).

## 3. Results and Discussions

Aquaculture feed ingredients are mostly by-products of processing or milling industries. In formulation of feeds, these ingredients are included and substitutions made within mixtures in accordance with market price, local availability and composition. Basically, the concept is to use available ingredients in most economical way to provide essential nutrient content and balance of the final diet. Different proportions of less expensive ingredients can often be combined to achieve the nutrient balance of more expensive ones. However, it is necessary to consider factors such as the quality, palatability and functional properties of ingredients

and possible content of anti-nutritional components that are known to affect the growth and health of fish.

Among ingredients of plant origin, relatively high crude protein contents and well-balanced amino acid profile of soybean protein have made soybean meals important ingredients in fish feeds. The steady supply of soybean and composition of various products with respect to nutrient composition and physical characteristics in feed processing are positive factors that contribute to their widespread use in feed formulation. There is great scope to enhance production of fish by supplementary feed<sup>18</sup> (Pantha 1993). Soybean meal is an excellent source of dietary protein for fish. Whole Soybean contains about 40% of protein and 18% of Fat. The fat can be used by a feed formulator to add appreciable amounts of essential fatty acids to diet, and can be used as source of protein sparing energy<sup>[19]</sup>. (Jauncy and Ross1982). In fish feeds, protein is the most expensive portion and is usually the first nutrient that is computed in feed formulation. The energy level of the feed is then adjusted to the desired level by addition of high energy supplements which are less expensive than protein supplements. Feed should supply all essential nutrients and energy in tune with the fish's needs for the maintenance of vital physiological functions such as growth, reproduction and health which was observed in all experimental fishes grass carp *Ctenopharengedon idella* fed on formulated feed with respect to FCR, FCE,SGR, PER, and GCE.

## 4. Acknowledgement

Authors are thankful to Head, Department of Zoology, Shivaji University, Kolhapur for providing laboratory and other infrastructure facilities towards completion of said work.

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