

## Review of the Nutritional Value of Spirulina as a Potential Replacement of Fishmeal in Aquafeed

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**Abstract :** As the intensification of aquaculture production increases on global scale, the growing concern of fish farmers around the world is related to cost of fish production, where cost of feeding takes substantial percentage. Fishmeal (FM) is one of the most expensive ingredients, and its high dependence in aqua-feed production translates to high cost of feeding of stocked fish. However, to reach a sustainable aquaculture, new alternative protein sources including cheaper plant or animal origin proteins are needed to be introduced for stable aqua-feed production. Spirulina is a cyanobacterium that has good nutrient profile that could be useful in aquaculture. This review therefore emphasizes on the nutritional value of Spirulina as a potential replacement of FM in aqua-feed. Spirulina is a planktonic photosynthetic filamentous cyanobacterium that forms massive populations in tropical and subtropical bodies of water with high levels of carbonate and bicarbonate. Spirulina grows naturally in nutrient rich alkaline lake with water salinity ( $> 30$  g/l) and high pH (8.5-11.0). Its artificial production requires luminosity (photo-period 12/12, 4 luxes), temperature (30 °C), inoculum, water stirring device, dissolved solids (10-60 g/litre), pH (8.5- 10.5), good water quality, and macro and micronutrient presence (C, N, P, K, S, Mg, Na, Cl, Ca and Fe, Zn, Cu, Ni, Co, Se). Spirulina has also been reported to grow on agro-industrial waste such as sugar mill waste effluent, poultry industry waste, fertilizer factory waste, and urban waste and organic matter. Chemical composition of Spirulina indicates that it has high nutritional value due to its content of 55-70% protein, 14-19% soluble carbohydrate, high amount of polyunsaturated fatty acids (PUFAs), 1.5-2.0 percent of 5-6 percent total lipid, all the essential minerals are available in spirulina which contributes about 7 percent (average range 2.76-3.00 percent of total weight) under laboratory conditions,  $\beta$ -carotene, B-group vitamin, vitamin E, iron, potassium and chlorophyll are also available in spirulina. Spirulina protein has a balanced composition of amino acids with concentration of methionine, tryptophan and other amino acids almost similar to those of casein, although, this depends upon the culture media used. Positive effects of spirulina on growth, feed utilization and stress and disease resistance of cultured fish have been reported in earlier studies. Spirulina was reported to replace up to 40% of fishmeal protein in tilapia (*Oreochromis mossambicus*) diet and even higher replacement of fishmeal was possible in common carp (*Cyprinus carpio*), partial replacement of fish meal with spirulina in diets for parrot fish (*Oplegnathus fasciatus*) and Tilapia (*Oreochromis niloticus*) has also been conducted. Spirulina have considerable potential for development, especially as a small-scale crop for nutritional enhancement and health improvement of fish. It is important therefore that more research needs to be conducted on its production, inclusion level in aqua-feed and its possible potential use of aquaculture.

**Keywords :** aquaculture, spirulina, fish nutrition, fish feed

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