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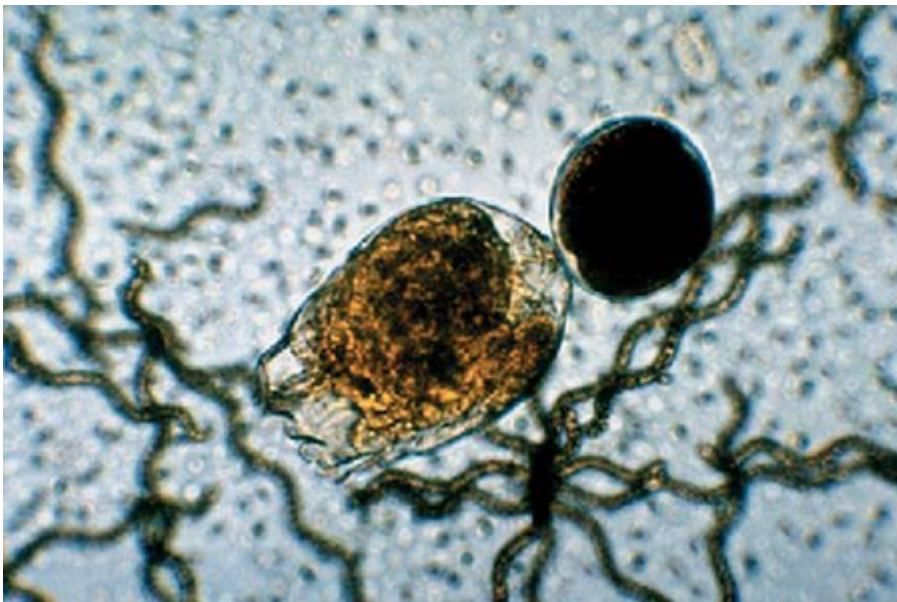
Aquafeeds

Use of spirulina in larviculture

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By Ronald H. Henson

Look for products containing phycocyanin and polysaccharides



Spirulina platensis is an edible planktonic filamentous bluegreen algae used as a human health food around the world. This product is highly nutritious and safe when produced in controlled culture. It is also used as an ingredient in fish feeds and as a supplement when feeding prawn larvae.

Wild *Spirulina* is often found in warm alkaline lakes such as those in the Great Rift Valley of Africa, where it is the main food source for vast flocks of the Lesser Flamingo. Commercial *Spirulina* is a fine, dry powder, easily rehydrated. High quality,

Spirulina (*Arthrospira*) with large rotifer.

commercial *Spirulina* is usually spraydried. When rehydrated, the strands come apart as individual cells. These reconstituted cells are about 5 to

10 microns in size, and are easily eaten by the larvae.

Why use *spirulina*?

Spirulina is a rich source of protein, vitamins, minerals, and pigments (Table 1). It also enhances the non-specific immune system, increasing the state of readiness of natural defenses. The combination of nutrients, pigments and immunostimulants explains reports of dietary *Spirulina* yielding better growth, reduction of stress and better appearance.

Henson, Typical nutritional composition of spray-dried *Spirulina* powders, Table 1

Crude protein	60%
Carbohydrate	20%
Fats	5%
Minerals	9%
Moisture	6%
Carotenoids (red/yellow)	0.3%
Chlorophyll (green)	1.0%
Phycocyanin (blue)	12.5%

Table 1: Typical nutritional composition of spray-dried *Spirulina* powder.

Fish have a fairly sophisticated immune system, similar in many ways to other vertebrates, and respond well to *Spirulina*. Studies at the USDA Fish Disease Laboratory have demonstrated that feeding fish for just one week on a *Spirulina* diet significantly improved the function of the immune system. *Spirulina*-fed fish had enhanced nonspecific cellular immune responses such as chemotaxis and phagocytosis. *Spirulina*-fed fish also produced significantly higher antibody titers to a thymus-dependent antigen. Japanese fish farmers use *Spirulina* because including even small amounts in a fish diet increases survival rates and improves appearance. The fish have a thicker mucous coat, healthier skin, richer color and more consistent growth.

Shrimp have a more primitive immune system than fish, but it is capable of being stimulated by *Spirulina*. Information from China shows feeding with *Spirulina* resulted in a 23 percent increase in survival and 5 percent increase in size, with the size range being much more uniform. Color was improved and it was observed that the larvae were more resistant to stress.

Phycocyanin (a polypeptide) and *Spirulina* polysaccharides are two of the key immunoactive substances *Spirulina* delivers. These substances are being studied for health benefits to humans and high-value animals. When preparing feeds, care should be taken to use a *Spirulina* source with the highest possible amounts of these substances. *Spirulina* can vary in amounts of phycocyanin, and a source with at least 10 percent phycocyanin content should be used.



Penaeus vannamei zoea and rehydrated *Spirulina*.

How to feed spirulina

Fish larvae can be fed *Spirulina* either through gut-loaded rotifers and artemia, or through formulated microparticulate diets. *Spirulina* powder mixes easily with other ingredients for pelletizing. Care should be taken not to overheat the product. Temperatures high enough to denature carbohydrates will destroy the beneficial properties found in *Spirulina*.

What about shrimp? *Spirulina* can be fed directly to the larvae of *Penaeus vannamei* at 20 mg of dry powder per one cubic meter of tank capacity at zoea; 2.0 grams at mysis, and at 0.5 grams for postlarvae. Some shrimp species should be fed more than others: *Penaeus monodon* should be fed about double or more than *P. vannamei*. The basic method may be adapted to other species and local conditions.

Best results are achieved when *Spirulina* is used in combination with fat-rich, live algae like diatoms. *Spirulina* powder is very rich in protein and vitamins, but does not contain enough fat for growing larvae. Fat-rich diatoms, together with dried *Spirulina*, can form an ideal diet that results in very strong postlarvae. Dried *Spirulina* may be used at each feeding, or the hatchery operator may want to



Marine *Spirulina*.

alternate it with a high quality, artificial microparticulate diet, and artemia, depending on local conditions and availability.

High-quality *Spirulina* is produced in aquaculture operations for a consistent, safe and effective product. *Spirulina* is cultured in farms in the U.S., Thailand, China and India using very shallow, raceway-type ponds lined with either plastics or concrete. The highly-alkaline, high-pH pure culture is stirred with paddlewheels and harvested with microscreens, then spray-dried. Harvested effluent is usually returned to the cultivation ponds.

Live *Spirulina*, especially marine species, should not be used for larviculture. Shrimp larvae will become entangled in the coiled strands. Good quality *Spirulina* is dark green, dry, dusty and has a unique smell and a mild seaweed- like taste. *Spirulina* suitable for larviculture is available from aquaculture supply distributors as well as directly from *Spirulina* growers.

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