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REVIEW ARTICLE "SPIRULINA FLOUR"

by

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Abstract

Spirulina flour has good prospects in general trade both in Indonesia and in other countries. This review article aims to get information about spirulina flour production. Based on riview literature obtained information that the production of spirulina flour can be done simply, namely cell propagation or cultivation in ponds, harvesting and drying. Spirulina flour can be used for food and fish feed.

Keywords: Production, food, feed, harvesting, drying.

INTRODUCTION

Spirulina is a photo-autotrophic blue green algae that can be found in both fresh and salty waters. These microalgae have long been used as a source of foodstuffs and are one of the most potential natural food sources for both animals and humans. Its high protein content reaches 60-70% (dry base) and the content of the amino acids Spirulina in accordance with the recommendations of the World Food Agency FAO (Firdaus and Ahmad, 2015).

Some feed ingredients that contain color pigments include spirulina flour. The dye is better known as carotenoids. Carotenoids are substances used for skin coloring in fish. The effects of the presence of karatenoids, among others, can cause an increase in the brightness of the red color in fish. With such a complete nutritional content, Spirulina is one of the most promising microalgae developed in Indonesia related to the potential of this microalgae which is large enough to be used as a functional food and source of natural dyes.

As a functional food and its use into human food (food grade level) requires high standards in the manufacturing process. This is very difficult for household businesses to be able to meet these criteria. Product criteria with not high standards (feed grade level) can provide great market opportunities for household businesses. But unfortunately, Spirulina

flour products used at the level of fish farmers are imported products from India and China. Though the product can simply be produced independently by cultivators to meet their own needs, as well as a business on a household scale (Siregar, 2010). This review article aims to get information about spirulina flour production.

Taxonomic Classification of Spirulina

Spirulina sp.is a widely spread microalgae, can be found in various types of environments, both in brackish and unsalted waters (Ciferri, 1983). As for the Classification of *Spirulina* sp. Bold and Wyne (1985) are as follows:

Kingdom : Protista
Division : Cyanophyta
Grade : Cyanophyceae
Order : Nostocales
Family : Oscilatoriaceae
Genus : Spirulina
Species : *Spirulina* sp.

Spirulina includes cyanobacteria, these microorganisms measure 3.5-10 microns and have spiral-shaped filaments with a diameter of 20-100 microns. Spirulina contains 60% protein with essential amino acids, ten vitamins, also efficacious as a drug (therapeutic). In addition, Spirulina has ficosianin pigment which is an antioxidant and anti-inflammatory polysaccharide that has antitumor and antiviral effects, γ-linoleic acid (GLA) from Spirulina can function in cholesterol-lowering (Siregar, 2010).

With such a complete nutritional content, Spirulina is one of the most promising microalgae developed in Indonesia related to the potential of this microalgae which is large enough to be used as a functional food and source of natural dyes. In the field of aquaculture, spirulina is widely used as a supplement added in feed. Vonshak (1997) mentioned that fish fed with an additional 0.5-1% spirulina showed an increase in the growth rate by 17-25% and a decrease in mortality rate by 30-50%. In addition, spirulina also acts as an immunostimulant for fish. Research conducted by Hironobu et al. (2006) on Cyprinus carpio goldfish showed that there has been a reduction in the number of Aeromonas hydrophila bacteria in the liver and heart of fish that are given additional spirulina in their feed. This proves that spirulina is able to stimulate the natural immune system in fish.

Spirulina Flour Production

Spirulina flour production technology simply needs to be further developed in the community, especially at the level of fish farmers so that it can independently provide additional feed needs for them. In addition, with this technology can provide alternative businesses for fish farmers and the community. The ingredients used for the production of spirulina flour include; urea, SP-36, ZA, Edta, FeCL3,Vit. B12 and,Spirulina platensis Seedlings. As for equipment, among others; refractometer, dipping pump, net plankton, sieve of 30 micron meshsize satin cloth, microscope, haemocytometer, digital scales, simple dryer cabinet, and field equipment. Spirulina culture containers can use concrete tubs, fiber tubs, tarpaulin ponds, buckets or gallons of water.

Prepare spirulina culture salinity at salinity 12-15 ppt with the addition of NaCl as much as 0.8 g / l when the culture is done on freshwater media and freshwater addition when culture is done on seawater media. The media water is then sterilized by giving chlorine of 30 ppm. After 24 hours, the media is neutralized with sodium thiosulfate as much as 10–15 ppm. Water media that has been neutral can only be used as a spirulina culture media.

The fertilizer used is a chemical fertilizer to grow cells, namely Urea (80 ppm), SP-36 (40 ppm), ZA (20 ppm), EDTA (5 ppm), FeCL3 (1 ppm) and Vit.B12 (0.001 ppm). Fertilizer is dissolved with water and after dissolving it is put into the culture medium.

Feeding seedlings for Spirulina culture with an initial density of >10,000 sinusoids / ml or 10% - 20% of the volume of the culture medium is carried out after fertilization. The intensity of incoming sunlight ranges from 3,000 lux (12 hours of light: 12 hours of dark). Stirring of the culture is carried out by the provision of aeration. Harvesting is done when Spirulina cells are in the growth phase.

Harvesting by filtering using a sieve from satin cloth is easier to do because of the shape of Spirulina cells in the form of filaments or threads with twisted cells shaped like spirals with larger cell sizes compared to other types of phytoplankton. The biomass obtained is then rinsed with fresh water 2-3 times to reduce the components of the culture media.

For the drying process, the paste / jel is weighed first and then thinned on a baking sheet coated with mica plastic for the drying process. Spirulina biomass thickness is set at a maximum thickness of 0.5 cm or set at 100 g in each plastic. Spirulina biomass that has been thined is then placed in a simple drying cabinet for the drying process. The simple dryer cabinet used can be made by yourself from a triplek cabinet coated with styrofoam. The simple dryer cabinet has been equipped with a 40 watt bulb light as much as 8 pieces and

exhaust fan for the release of hot air from the closet. The room temperature on the dryer cabinet is set at a temperature of 60 ^{0}C.

Spirulina that has been dried in the form of a slab is then taken and then weighed. The process of sipping from Spirulina that has been dried is done with simple equipment, namely by using a blender machine and then filtering to get finer flour grains. The fine Spirulina flour is then stored using aluminum foil and vacuum sealer so that it can be airtight so that it can be durable and not moldy (Ruliaty et al, 2017).

Utilization of spirulinas flour for fish feed

Spirulina flour protein content is very high, reaching 60-70% (dry base) and the content of Spirulina amino acids in accordance with the recommendations of the World Food Agency FAO (Choi et al. 2003). Spirulina feed helps improve the disease resistance of high-value fish so that there is an improvement in their survival rate from 15 to 30 percent (FAO, 2006). Spirulina flour has been widely used which can increase the brightness of color for ornamental fish and ornamental shrimp. Astaxanthin has been shown to be the dominant carotenoid associated with the red color in windu shrimp (Penaeus monodon). An increase in carotenoids in windu shrimp (Penaeus monodon) occurred when spirulina supplements were given as an additional diet by 3 percent.

Protein from spirulina flour can reach more than 60%, the vitamin content is high, especially vitamin B12, and contains amino acids that are quite complete. It is also rich in gamma-linolenic acid (GLA), and also provides alpha-linolenic acid (ALA), linolenic acid (LA), stearidonic acid (SDA), eicosapentaenoic (EPA), docosahexaenoic acid (DHA), and arachidonic acid (AA). Vitamins contained in it are vitamins B1, B2, B3, B6, B9, B12, Vitamin C, Vitamin D and Vitamin E. In addition to these things algae also contain potassium, calcium, chrome, copper, iron, magnesium, manganese, phosphorus, selenium, sodium, and zinc. A study mentions that S. platensis allows the immune system to help in fighting infection (Susanna et al., 2007). Weil (2000) in Arlyza (2003) also mentioned that Spirulina contains the pigment ficosianin (20% of dry weight) which is useful in cancer treatment, contains high nutritional value, and increases the immune action of certain diseases. Based on its nutritional content, Spirulina can be used as a supplement or complementary ingredient for protein sources in feed.

Utilization of spirulinas flour for food

As a food that has high levels of protein and micronutrients, Spirulina can not only act as a single cell protein, but can also be used as a functional food. Fao noted that Spirulina can be used as a healthy food for humans (Becker, 1994). In general, Spirulina is produced in capsules, juices, or tablets. Spirulina can also serve as a food source for immunity, and Super Oxyde Dismutase (SOD). Some hospitals in modern countries use Spirulina to obtain algae immunoglobulin and higher blgm immunoglobulin. While the ficosianin content in Spirulina has the potential to inhibit the growth of leukemia cells in humans (Liu, et al., 2000). Spirulina contains 62% protein, an amino acid, as the richest source of natural vitamin B12, containing the entire natural spectrum of a mixture of carotene and xantofil (Kozlenko and Henson 2007).

Dried spirulina can be used as a source of mixed pasta, sauces, soups, instant drinks, and supplement foods. Its high protein content reaches 60-70% (dry base) and the content of spirulina amino acids in accordance with the recommendations of the World Food Agency FAO (Choi et al. 2003). Spirulina can be mixed in noodles, bread, biscuits. It is used for the purpose of adding higher nutrition to food. This suggests that Spirulina can be consumed at 10 g/day to maintain a healthy body, not only for children but also for adults (Henrikson, 1989).

On the other hand, Spirulina contains a small dose of toxic ingredient called microcystin. Consumption of this material in high concentrations is harmful to the human body. Microcystin is a type of nonribosomal cyclic peptide contained in all cyanobacteria. Microcystin can cause damage to the liver and cause cancer. Spirulina contains 1 mg/g, therefore it is recommended that spirulina consumption is about 0.5P3 g per serving.

Conclusion

Based on riview literature as mentioned above, information is obtained that spirulina flour production can be done simply, namely cell propagation or cultivation in ponds, harvesting and drying. Spirulina flour can be used for food and fish feed.

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