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# A review: *Chlorella vulgaris* as alternative fish feed ingredients

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**Abstract**
Fish growth can never be separated from the consumption of food. *Chlorella vulgaris* is a green alga that contains high protein and various other nutrients. The main component of *Chlorella vulgaris* is protein. The total protein in *Chlorella vulgaris is* around 42-58% of biomass dry weight. Amino acids contained include Arginine (6.9%), histidine (2%), Isoleucine (3.2%), leucine 9.5%), lysine (6.4%), methionine (1.3%), phenylalanine (5.5%), threonine (5.3%), tryptophan (1.5%), and valine (7%). Besides protein, *Chlorella vulgaris* also contains 51.3% if grown on a nitrogen-deficient medium. *Chlorella vulgaris* by 5% was also proven to increase weight gain, specific growth rate, and velocity lenght of *Cyprinus carpio* higher than control. The provision of 25% *Chlorella vulgaris* has been proven to be an alternative feed ingredient for African catfish (*Clarias gariepinus*). A mixture of *Chlorella vulgaris* and *Daphnia* sp can also be used as an alternative to gouramy feed (*Osphronemus gourami)*. Based on the above studies, *Chlorella vulgaris* has the potential to be used as an alternative feed for various types of fish.

**Keywords:** aquaculture, fish feeds, growth rate, *Chlorella vulgaris*, survival rate

## 1. Introduction
The feed is an important factor for the success of fish farming. Fish growth and survival are greatly influenced by the availability of feed. If the quality of the feed given is sufficient quantity, the rate of growth and survival of the fish is also good. However, if the feed quality is low and the amount does not meet the needs of the fish, fish growth will be hampered. The survival rate of fish is also low [1]. This is what causes feed to be a major component in aquaculture. However, feed is a major component that affects production costs because 50-60% of production costs are for feed costs [2].

The demand for fish for food is increasing along with the rapid increase in population. This causes the price of feed ingredients to be higher and has an impact on rising production costs for fish farming. Therefore, we need feed ingredients or alternative feed with high nutrition and low cost [3].

*Chlorella vulgaris* is a green alga that contains high protein and various other nutrients. *Chlorella vulgaris* has also been commercialized as a food supplement for humans and livestock. Several studies have proven that *Chlorella vulgaris* can also increase the rate of growth, the survival of various types, and various other benefits so that it can be used as alternative feed ingredients [4, 5]. Therefore, this article aims to explain the nutritional content and potential of *Chlorella vulgaris* as an alternative feed ingredient for fish.

## 2. Chemical Composition of *Chlorella vulgaris*
*Chlorella vulgaris* is a unicellular green alga with 2-10 µm diameter (safi). It can live in fresh and marine water (5) and grow in alkaline conditions (pH 9 to 10). The best aeration for *Chlorella vulgaris* growth is 200 ml/min (6). *Chlorella vulgaris* can grow optimum when glucose and nitrate contents are 20 and 0.5 g / L respectively and 2920 Lux for light intensity [7].

*Chlorella vulgaris* contains various nutrients namely carbohydrates, proteins, fats, amino acids, vitamins, minerals, pigments, and so on. In 1950-1960, the nutritional content of *Chlorella vulgaris* was identified [5]. *Chlorella vulgaris*. After world war II, *Chlorella vulgaris* was found to be a food source in Japan, the United States, and Germany. Beside that, It can be used as a coloring agent for butter cookies [8], biodiesel (Calcium), anti-aging, depigmentation, moisturizing and thickening agent [9].

The main component of *Chlorella vulgaris* is protein. The total protein in *Chlorella vulgaris is* around 42-58% of biomass dry weight. Amino acids contained include Arginine (6.9%), histidine (2%), Isoleucine (3.2%), leucine 9.5%), lysine (6.4%), methionine (1.3%), phenylalanine (5.5%), threonine (5.3%), tryptophan (1.5%), and valine (7%) [10]. Besides protein, Chlorella vulgaris also contains 51.3% if grown on a nitrogen-deficient medium [11].

The nutritional content of *Chlorella vulgaris is* also influenced by the culture medium. The lipid content of *Chlorella vulgaris* has been known to be influenced by the medium. Likewise, with the pigment content. Pigments contained in *Chlorella vulgaris* include lutein [12], chlorophyll a, chlorophyll b, β-Carotene [13], Astaxanthin, Canthaxanthin, Pheophytin-a, and Violoxanthin [14]. Table 1 shows the lipid content in different media, while Table 2 shows the chlorophyll content. In table 2 it is known that the highest chlorophyll content is found in the BG-11 medium because in that medium it has N, Mg, Fe which plays a role in the formation of chlorophyll [13].

**Table 1:** Lipid content in *Chlorella vulgaris* at different medium

| No | Medium | Lipid content% | Reference |
|---|---|---|---|
| 1 | Chu Medium | 10.7% | (15) |
| 2 | Beneck Medium | 37% | (13) |
| 3 | Walne Medium | 43% | (13) |
| 4 | BG 11 | 39% | (13) |

**Table 2:** Chlorophyll content in *Chlorella vulgaris* at different medium

| No | Medium | Chlorophyll Content | Reference |
|---|---|---|---|
| 1 | Beneck Medium 1.356 | % | (13) |
| 2 | Walne Medium | 0.8545% | (13) |
| 3 | BG 11 | 1.7% | (13) |

*Chlorella vulgaris* also contains vitamins and minerals. Vitamins contained include thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folic acid, cobalamin, Ascorbic acid, tocopherol, and retinol. While the minerals contained in *Chlorella vulgaris* Na, K, Ca, Mg, Cr, Cu, Zn, Mn, Se, I, fe, P [14].

## 3. *Chlorella vulgaris* as Alternative Fish Feed

Research on *Chlorella vulgaris* as an alternative feed has been widely carried out. *Chlorella vulgaris* has been shown to increase growth in *Cyprinus carpio* [5], *Osphronemus gourami* [16], *Oreochromis niloticus* [17], and *Clarias gariepinus* [18].

The provision of 25% *Chlorella vulgaris* has been proven to be an alternative feed ingredient for African catfish (*Clarias gariepinus*). The specific growth rate of African catfish (*Clarias gariepinus*) given 25% *Chlorella vulgaris* was higher (7.86 ± 0% per day) compared to control (6.77 ± 0.07% day − 1). Also, the *average weight gain of* fish given 25% *Chlorella vulgaris* reached 121.02 ± 0.04 g and this result was higher than the control 62.50 ± 0.01 g [18].

*Chlorella vulgaris* by 5% was also proven to increase weight gain, specific growth rate, and velocity leght offish *Cyprinus carpio* higher than control. weight gain *Cyprinus carpio* was given 5% *Chlorella vulgaris* by 41.9% while the control was 29.7%. The specific growth rate *and velocity length of Cyprinus carpio given 5% Chlorella vulgaris are* 1.47 and 642, respectively, while the Specific growth rate and *velocity length of* fish not given *Chlorella vulgaris* are 1.15 and 583 [5], respectively.

A mixture of *Chlorella vulgaris* and *Daphnia* sp can also be used as an alternative to gouramy feed (*Osphronemus gourami)*. The weight and length of gourami fish (*Osphronemus gourami)* given *Chlorella vulgaris* and *Daphnia* sp were 52 g and 14.57 cm respectively while control 31 g and 12.57 cm [16]. Feeding with *Chlorella vulgaris* was isolated from isolation from Rubber industry liquid waste with tilapia (*Oreochromis niloticus*) for 6 weeks reached 5.2 cm, from an initial length of 0.6 cm [17]. Based on the above studies, Chlorella vulgaris has the potential to be used as an alternative feed for various types of fish.

## 4. Conclusion

In Conclusion, *Chlorella vulgaris* contains a lot of nutrients such as amino acids, proteins, carbohydrates, minerals, and vitamins. The nutrition content in *Chlorella vulgaris* can be influenced by medium composition. *Chlorella vulgaris* can be used as a potential alternative fish feed for *Cyprinus carpio*, *Osphronemus gourami*, *Oreochromis niloticus* (Yulita), and *Clarias gariepinus*.

## 5. References


1. Amri, K dan Khairuman. Membuat Pakan Ikan Konsumsi. Jakarta: Agro Media Pustaka, 2002.
2. Yanuar V. Effect of Different Types Of Feed On Growth Rate Of Tilapia Fish (*Oreochiomis niloticus*) and Water Quality In The Aquarium Maintenance. Zira'ah. 2017; 42(2):91-99
3. Singh P, Paul, BN, Giri SS. Potentiality of new feed ingredients for aquaculture: A review Agricultural Reviews. 2018; 39(4):282-2.
4. Akbary P, Raesisi M. Effect of dietary supplementation of *Chlorella vulgaris* on several physiological parameters of grey mullet, *Mugil cephalus*. Iranian Journal of Fisheries Sciences. 2018; 19(3):1130-1139.
5. Khani M, Soltani M, Mehrjan S, Foroudi F, Ghaeni M. The effects of Chlorella vulgaris supplementation on growth performance, blood characteristics, and digestive enzymes in Koi (*Cyprinus carpio*). Iranian Journal of Fisheries Sciences. 2017; 16(2):832-843.
6. Daliry S, Hallajisani A, Roshandeh M, Nouri H, Golzary A. Investigation of optimal condition for Chlorella vulgaris microalgae growth S. Global J Environ. Sci. Manage. 2017; 3(2):217-230.
7. Gong Q, Feng YZ, Kang LG, Luo MY, Yang JH. Effect of Light and pH on Cell Density of *Chlorella vulgaris*. Energy Procedia, 2014; 61:2012-2015.
8. Gouveia J, Empis HMA, Gomes E. Use of Chlorella vulgaris in Rainbow Trout, Oncorhynchus mykiss, Diets to Enhance Muscle Pigmentation. Journal of Applied Aquaculture. 1997; 7(2):61-70.
9. Personal care. Effects of Chlorella extract on skin - Personal Care Magazine 007
10. Shaaban MM. Green Microalgae Water Extract as Foliar Feeding to Wheat Plants.Pakistan Journal of Bioological Series. 2001; 4(6):628-632.
11. Ho Sh, Huang SW, Chen CY, Hasunuma T, Kondo A, Chang JS, *et al*. Characterization and optimization of carbohydrate production from an indigenous microalga Chlorella vulgaris FSP-E vulgaris FSP-E. Bioresour Technol, 2013; 135:157-65.
12. Safafar H, Nørregaard PU, Ljubic A, Per Møller, Holdt SL, Jacobsen C, *et al*. Enhancement of Protein and Pigment Content in Two Chlorella Species Cultivated on Industrial Process Water. Journal of Marine Science and Engineering, 2016; 4:84.
13. Wijoseno T. Uji Pengaruuh Variasi Media Kultur Terhadap Tingkat Pertumbuhan dan kandungan protein, lipid, klorofil, dan karotenoid pada mikroalga *Chlorella vulgaris* buitenzorg. Jakarta: Departemen teknik kimia Fakultas Teknik Universitas Indonesia, 2011.
14. Safi, Carl Zebib, Bachar Merah, Othmane and Pontalier, PierreYves and Vaca-Garcia, Carlos. Morphology, composition, production, processing nd applications of *Chlorella vulgaris*: A review. Renewable and Sustainable Energy Reviews, 2014,

35:265.
15. Chia MA, Lombardii AT, Da Graca, Melao. Growth and biochemical composition of *Chlorella vulgaris* in different growth media. Annals of the Brazilian Academy of Sciences, 85(4).
16. Simajuntak SBI, Indarmawan, Wibowo ES. Pengaruh Pakan Suplementasi Spirulina platensis dan *Chlorella vulgaris* terhadap Pertumbuhan dan Komposisi Tubuh Ikan Gurami (*Osphronemus gouramy*). Majalah Ilmiah Biologi Biosfera. 2019; 36(2):51-56.
17. Eli Yulita. Subtitution *Chlorella vulgaris* from isolation crumb rubber waste water as fish feed to the nila fish (*Oreochromis niloticus*). Jurnal Dinamika Penelitian Industri. 2015; 26(2):131-138.
18. Envidi E. *Chlorella vulgaris* as Protein Source in the Diets of African Catfish *Clarias gariepinus*. Journal of Marine Science and Engineering, 2017.