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Fueling The Future of Science… ISSN: 3048-8397

Bio Vet Innovator Magazine

Volume 2 (Issue 4) APRIL 2025

OPEN ACCESS WORLD VETERINARY DAY – 26 APRIL 2025 POPULAR ARTICLE

Microalgae as Animal Feed Supplement

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DOI: https://doi.org/10.5281/zenodo.15332901

Received: April 03, 2025
Published: April 08, 2025

Abstract:

Microalgae are highly nutritious due to their high content of protein, carbohydrates, lipids, vitamins, minerals, carotenoids, omega-3 fatty acids, and carotenoids and can be considered nutritionally superior compared to conventional animal feed sources. Incorporating microalgae into the diets of livestock and poultry can enhance their overall health, increase immunity and boost their growth and productivity. Presently, the supplementation of microalgae into animal feed is very much encouraging to support and foster the livestock industry.

Keywords: Microalgae, carotenoids, omega 3 fatty acids, antioxidants

Introduction:

The demand and requirements for alternative sources of animal feed led us to have investigations with aquatic plants like macroalgae, microalgae and ferns. They have been utilized in commercial production due to their nutritional benefits. Microalgae grow fast and can convert sunlight and carbon dioxide into biomass through photosynthesis (Adarme-Vega *et al*., 2012). Integrating microalgae in animal diets can supply proteins, vitamins, minerals, amino acids, polysaccharides, omega-3 and omega-6 fatty acids (Drewery *et al*., 2014)

Microalgae:

Microalgae are also known as microphytes or phytoplankton. These are microscopic organisms found in both marine and freshwater ecosystems. These organisms are microscopic in size and lack plant structures such as roots, stems, and leaves but exhibit extraordinary growth and photosynthetic capabilities. They can generate a substantial amount of biomass very rapidly. Hence, they are often referred to as biomass factories. Microalgae are rich in all the essential nutrients, including proteins, polysaccharides, lipids, polyunsaturated fatty acids, vitamins, minerals, biologically active compounds like carotenoids, phycobiliproteins and enzymes. These microalgae have antioxidant, antimicrobial,

antihypertensive, neuroprotective, and immune-stimulating properties (Gürlek *et al*. 2019).

Types of Microalgae:

- Green algae (*Chlorophyceae*)
- Golden Algae (*Chrysophyceae)*
- Blue-green Algae (*Cyanophyceae*)
- Diatoms (*Bacillariophyceae***)**

Important Microalgal species:

- ***Chlorella*:** A single-celled nutrient-rich green alga
- ***Arthrospira (Spirulina)*:** Blue-green microalga, having higher protein levels.
- ***Dunaliella*:** Salt-tolerant green alga and rich source of beta-carotene.

Some Major Uses of Microalgae:

- **Biofuel:** Biofuels can be obtained from some crops, fruits, agricultural residues and algae. These biofuels are renewable and have minimal impact on environmental pollution and global warming, unlike fossil fuels.
- **Human Food:** Currently, microalgae continue to be recognised as a sustainable food source due to their high protein, essential amino acids and various bioactive compounds content. They can be utilized as dietary supplements and used as functional foods with health advantages.
- **Wastewater Treatment:** Microalgae can serve as an effective waste water treatment method due to their efficiency for the removal of nutrients such as phosphorus and nitrogen.
- **Used in Aquaculture:** Microalgae are the major source of food for zooplanktons and various aquatic species.
- **Used in Agriculture:** In agricultural practices, microalgae are used as biofertilizers
- **Cosmetics and Pharmaceuticals:** Microalgae can be utilized in cosmetics and pharmaceuticals, including sunscreens, anti-aging products and moisturizers due to the presence of various bioactive substances.

Storehouse of Bioactive Substances:

- **Carotenoids:** Major carotenoids present in microalgae are phycobiliproteins, phycocyanin, phycoerythrin, β-carotene, and lutein.
- **Sterols:** Sterols are another group of bioactive compounds present in microalgae that have several health benefits, such as reducing cholesterol levels, anticancer effects, and anti-inflammatory properties.
- **Proteins and amino acids:** Microalgae are a rich source of proteins and essential amino acids.
- **Polyunsaturated fatty acids (PUFA):** Polyunsaturated fatty acids like omega-3 fatty acids and omega-6 fatty acids are produced by some species of microalgae.

- **Vitamins:** Microalgae are rich in various vitamins such as vitamin E, vitamin C, vitamin A and vitamin B complex.
- **Toxic metabolites:** Microalgae also produce certain toxic compounds. E.g. cyanotoxins.

Microalgae As Animal Feed Supplement:

Microalgae act as a viable and sustainable alternative feed supplement (Dineshbabu *et al*., 2019). Cultivation of the microalgae on a larger scale can be done by the use of photobioreactors and open ponds, harvested and processed to create functional feed supplements. The microalgae can be incorporated at a rate of 5–10% in ruminant diets. The benefits of incorporating microalgae into animal feed are significant and include the following effects.

- **Overall improvement of Animal Health:**
  Supplementation of microalgae into animal feed can boost immune function, increase disease resistance and improve gut health, thereby contributing to the overall well-being of animals.
- **Effects on growth performance:**
  The cellulose present in the cell walls of microalgae influences weight gain and growth performance in both ruminants and monogastric animals.
- **Microalgae improve egg production and quality:**
  Hens supplemented with microalgae produce eggs with a higher concentration of essential fatty acids. Microalgae serve as an excellent alternative source of omega-3 fatty acids, enhancing the quality of eggs.
- **Microalgae improve meat quality:**
  Incorporation of microalgae into the diets of pigs and broilers increases the omega-3 fatty acid levels in the meat. The inclusion of 1% fresh liquid algae in poultry feed not only improves body weight gain but also strengthens immune function.
- **Microalgae improve milk production and quality:**
  The supplementation of microalgae can elevate the DHA levels in milk (Glover *et al*., 2012). Furthermore, adding microalgae @ 5–10% in livestock feed improves the mineral content of the milk (Christaki *et al*., 2011).
- **Mitigation of Heat Stress:**
  Microalgae can help reduce heat stress by improving growth and performance, increasing immunity, providing protection from oxidative stress and improving gut health.

Challenges and Limitations:

The production of microalgae presents a significant challenge as it may be costly. The harvesting and processing of microalgae biomass often necessitate the use of effective separation and purification methods. Additionally, microalgae cultures are vulnerable to contamination and the uptake of heavy

metals from water. Consumer perceptions and preferences for conventional food sources are also a great challenge.

Conclusion:

From a nutritional perspective, microalgae provide a large number of beneficial compounds, including proteins, lipids, carbohydrates, vitamins, minerals, and antioxidants. These compounds have indispensable roles in livestock production. Hence, incorporating microalgae into animal diets may offer a novel approach to improving the health of both humans and animals. Therefore, further research is needed to determine the optimal selection of desirable microalgae and dosage of supplementation in feeds.

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