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Moringa leaf meal: a low-cost alternate protein source for fish feed

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ABSTRACT

The ever-increasing aquaculture industry and the need to fulfil the demand for increased fish feed consumption led to finding a low-cost alternative protein source for feed in place of fishmeal. Due to the availability, sustainability, environmental friendliness, safety, and relative affordability as compared to fishmeal protein, plant-based protein sources have become more important to aquaculture producers and nutritionists. *Moringa oleifera* has been utilized extensively based on these sources. For its exceptional nutritional value and distinct makeup of *Moringa oleifera* leaf meal phytochemicals such as phenolic acids, flavonoids, carotenoids, alkaloids, tannins, lectins, and terpenoids, it possesses a wide range of qualities, including immune-stimulating, hepato-protective, antioxidant, and antibacterial effects.

Keywords: Fishmeal, leaf meal, protein, health benefits, feed formation.

INTRODUCTION

The availability of inexpensive protein sources to produce aqua feed is critical to the aquaculture industry's success. Due to its many advantages, such as its perfectly balanced amino acid composition, excellent digestibility, and palatability, combined with its significance, fish meal (FM) is one of the primary sources of protein to improve the uptake, digestion, and absorption of additional elements in fish diets. But because of the growing demand for aqua-feed fish diets, fishmeal will become more expensive when it comes to diets. Additionally, inconsistent quality of

fishmeal in the past ten years, it is crucial to discover a substitute protein source for aqua feed. The plant derivatives/meals are excellent and emerging sources in recent times. Also, the overuse of chemicals in the food and fish industry has caused rising issues regarding human and animal health. The slender wood tree moringa is a member of the family Moringaceae. It can be found in many countries of tropical & sub-tropical regions like India, Madagascar, Sri Lanka and certain African countries. It can be grown in drought or low-moisture soil, making it easy to grow and survive in any region and soil. However, protein, vitamins, mineral contents etc. are affected by the maturity stages of the leaf, different altitudes and seasons. Moringa is also called “Tree of Life” or “The Miracle Tree” due to its unique medicinal properties such as anti-inflammatory, antioxidant, antimicrobial, anti-cancerous, hepato-protective etc. Known by many as the "Drumstick Tree" because of the shape of its pod, which is a common dish in many households worldwide. Each part of the Moringa tree like bark, roots, seeds, flowers and leaves is edible by humans and animals with minimum to no harmful effects on overdose.

NUTRITIONAL COMPOSITION OF MORINGA LEAF

Moringa has a lot of nutrients, but its leaf meal is low in fat and rich in protein, vitamins, and carbohydrates. The protein content can vary from 23-34% on dry matter (DM) basis with respect to dry leaves, containing seventeen distinct kinds of amino acids. The carbohydrate content is estimated to be 6%, and lipid and fatty acids account for almost 7%. Moringa leaf meal is rich in vitamin content especially, retinol, vitamin B complex, ascorbic acid & tocopherol. Minerals found in moringa leaf meal include five trace elements (zinc, copper, iron, manganese and selenium) and six macronutrients (calcium, magnesium, phosphorus, potassium, sodium, and sulphur). Moringa leaf meal also contains bioactive compounds like polysaccharides, polyphenols, alkaloids and fatty acids.

HEALTH BENEFITS OF MORINGA LEAF MEAL

Moringa has medicinal properties and various health benefits like regulation of glucose & lipid metabolism in the body of both animals and humans. This can be given to diabetic patients, lowering their blood glucose levels. It can increase the estrogen hormone in pregnant women leading to better development of the fetus and conditions formed during neural disorders like Alzheimer’s disease or Parkinson’s disease. A variety of anti-cancerous chemicals like alkaloids,

phenols, glucosinolates, and isothiocyanate can be used as natural anti-cancer substitutes in food to inhibit the growth and proliferation of cancer cells. Other health benefits are properties like anti-inflammatory, anti-bacterial, anti-viral, it improves gut health, protects liver, helps wound healing, reproductive health etc. However, increased anti-nutritional factors (ANF) (group of basic substances or metabolites produced by plants) not only affect their nutritional value and palatability but also destroy or hinder the digestion and utilization of nutrients in the organisms, in turn, affecting fish health and growth. *Moringa oleifera* contains several anti-nutritional factors like lectins, phenols, saponins, phytate, tannins, cyanogenic glucoside and glucosinolate. By blanching leaves in hot water, many anti-nutritional substances like oxalic acid, tannins, and saponins that are present in leaves can be reduced.

Blanching is the process of heating the leaves in boiling water for seven minutes and then immediately dipped in ice water to stop the cooking process and then left overnight to remove excess water. Next day, the blanched leaves are put in the drier at 40 °C temperature until complete drying and then grounded in fine powder to make/ mix in leaf meal or other food materials. Several studies have shown the above-mentioned beneficial effects on fishes like tilapia, catfish, freshwater shrimp, trout and guppy. They have shown increased growth, enhanced disease resistance, improved haematology; mitigating stress etc. leading to an increase in fish production. As moringa is easily available, it has a low cost and can be used as a protein source for the fishes.

Studies on Rohu (Mehdi *et al.*, 2016; Imran *et al.*, 2018; Hussain *et al.*, 2018; Masood *et al.*, 2020) by substituting 10% fish meal with moringa-based diet showed a significant improvement in food conversion ratio (FGR), weight gain (WG), and specific growth rate (SGR). Similarly, a four-week experiment (Mansour *et al.*, 2018) on gilthead seabream fish, fed with 10% substituted moringa leaf meal diet enhanced the growth rate and better utilization of feed. Another study on haematological parameters (Ayoola *et al.*, 2013, and Ezekiel *et al.*, 2016) on African catfish showed an increased packed cell volume, haemoglobin, white blood cells, and red blood cells, as compared to the control group, with increased immune response.



Fig 1. The general beneficial uses of dietary *Moringa oleifera* for aquatic animal health (Abdel-Latif *et al.*, 2022)

OTHER APPLICATIONS OF MORINGA LEAF

It can be used in a wide variety of food materials like beverage foods (tea, wine etc.), fermented foods (curd, candies, fermented beverages etc.), pastry foods (cake, cookies, noodles etc.) and cosmetics (body lotion, cleansing cream, makeup remover etc.). The antioxidant and preservative properties can increase the shelf-life of food products and even of meats, thus making them last longer and fresh for up to few days. It can be used in the agricultural sector, increasing animal appetite, increasing carcass yield, enhancing digestive enzyme secretion, stimulating immune response, and promoting antibacterial and antioxidant properties. Other uses in agriculture are pesticides, insecticides, or biodiesel.



Fig 2. Multi-functional application of *Moringa oleifera* in various industries (Srivastava *et al.*, 2023)

CONCLUSION

As fishmeal supplies are running low and expenses are going up, moringa leaf meal offers aquaculture a sustainable alternative source of protein. It is a desirable choice for complementing fish diets due to its high nutritional content and many health advantages. Its adaptability to a range of applications from food items to agricultural purposes also emphasizes its potential to have a favorable impact on aquaculture and other industries. Adopting moringa can result in more sustainable aquaculture methods and better fish health.

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