

## Moringa Leaves as A Fish Feed Ingredient

Priyanka Acharya

College of Fisheries (OUAT), Rangailunda, Berhampur -760007, Odisha

Corresponding Author: [priyankaacharya20111993@gmail.com](mailto:priyankaacharya20111993@gmail.com)

The rapid development of aquaculture systems to meet the growing demand of fish has opened up the pathways for intensification of the culture practices. In the commercial aquaculture practices being adopted by the farmers, the single most important recurring expenditure is the feed, which accounts to nearly 60% of the total operational cost (FAO, 2018). The cost of the formulated feed is in turn dependant on the protein source used for the formulation of feed. If, the source of the protein is from animal origin, certainly the cost of the final feed is much higher than that of plant origin.

Besides, the cost of the basic feed ingredients that are being used for formulation of fish feed is increasing day by day, due to increase in the bovine and avian population, so also the increase in different methods of fish culture and diversification of aquaculture practices (Ali et al., 2003). Therefore, in the recent pasts, many research activities were conducted worldwide to formulate fish feed using alternate protein sources instead of fish meal or blood meal with an aim to reduce the cost of the feed.

Also, the rapid expansion of aquacultural practices has given rise to increase the risk of disease incidence which act as a constraint in the aquaculture production system resulting with stress to the cultured animal and mortality which reflects on the production of fish (Priyadarshini *et al.*, 2013). To combat the incidence of disease in the farming system, antibiotics and other synthetic chemicals are being used as therapeutic agents (Lim et al., 2013). However, the continuous application of antibiotics leads to the development of resistant strains that are difficult to be controlled, so finding alternatives for antibiotics is an urgent need (FAO, 2002). As an



alternative to the use of antibiotics, many farmers at present are adopting methods for disease prevention by use of immunostimulants, immune modulators etc., which are mostly of synthetic origin (Bennett et al., 2003 Harikrishnan et al. 2011). The indiscriminate and continuous use of synthetic hormones, antibiotics, vitamins, immune-stimulants, growth promoters and other chemicals have led to the development of disease resistant strains and have several inherited negative impacts on environment as well as human health (FAO, 2002).

As an alternative to the conventional synthetic drugs and chemicals, emphasis is being given these days on the application of natural and more specifically herbal products, to obtain the desired traits in a safe and sustainable manner (Harikrishnan et al. 2011). As an alternative to the conventional synthetic drugs and chemicals,

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Many plant products have been reported to stimulate appetite, promote growth, act as immune-stimulants, and also serve as the source of antibacterial, antiviral and anti-parasitic (protozoans, monogeneans) agents in aquaculture (Jena *et al.*, 2018). These activities are observed due to the presence of many bioactive compounds such as phenols, sulphur, terpenoids, alkaloids, flavonoids, and saponins etc. (Bennett *et al.*, 2003). Drumstick (*Moringa oleifera*) is one such fast-growing tropical and subtropical plant with numerous medicinal properties besides its nutritional values. All most all parts of drumstick tree viz., bark, seed, fruits, leaves and roots have nutritional as well as medicinal values, such as anti-oxidant, anti-diabetic, anti-bacterial, anti-fungal, etc. (El-Gawad *et al.*, 2020), for which the tree is now getting recognised as “the miracle tree” (Ashfaq *et al.*, 2012)

*Moringa oleifera* (Drumstick / Moringa / Miracle tree) of family *Moringaceae*, a highly valued plant of Indian origin is characterized by seasonal fluctuations in the yield (Gopalakrishnan *et al.*, 2016). It is preferred for human consumption in the Indian market throughout the year (Kumar *et al.*, 2004). It can withstand both severe drought and mild frost conditions and hence widely cultivated across the world (Gopalakrishnan *et al.*, 2016). India is the largest producer of moringa with an annual production of 1.1 to 1.3 million tonnes of tender fruits from an area of 38,000 ha (Bharathi *et al.*, 2018).

Besides the health promoting values, moringa leaves acts a source of nutrition owing to the presence of a variety of essential phyto-chemicals namely, carotenoids, glucosinolates, isothiocyanates,

polyphenols, and vitamins (El-Gawad *et al.*, 2020), which makes it virtually an ideal dietary supplement. In fact, moringa leaves is said to provide 7 times more vitamin C than oranges, 10 times more vitamin A than carrots, 17 times more calcium than milk, 9 times more protein than yoghurt, 15 times more potassium than bananas and 25 times more iron than spinach (Udikala *et al.*, 2017; Rockwood *et al.*, 2013).

However, the leaves of moringa possesses the anti-nutritional factors (ANFs) namely alkaloids, flavonoids, polyphenols, phytic acids, tannins, saponins etc. These ANFs hinders the digestion as well as utilization of major nutrients when consumed in higher quantity (Stevens *et al.*, 2016). A number of methods have been tried to reduce the ANFs present in drumstick leaves, such as heat treatment (Tagwireyi *et al.*, 2014); boiling (Sallau *et al.*, 2016); blanching (Indriasari *et al.*, 2016); simmering (Sallau *et al.*, 2016); fermentation using different purified microbial strains, such as *Bacillus subtilis* (Ali *et al.*, 2016); *Aspergillus niger* and *B. subtilis*, (Wang *et al.*, 2018); *A. niger*, *C. utilis* and *B. subtilis* (Shi. *et al.*, 2016) and got encouraging results.

### Conclusion

Moringa (*Moringa oleifera*) is a good source of nutrients. *M. oleifera* leaf meal can be incorporated up to a certain level fish diets for improved growth performance. It could be an alternative source of protein in the fish diet. Further study is required to analyze the effect of medicinal values of Moringa leaves on the health status of the cultured fishes.

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