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Enteromorpha tested as shrimp feed ingredient

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Green seaweed cultured in Mexico


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Shrimp after cooking for five minutes. The shrimp were fed diets containing Macrocystis (1), Ascophyllum (2), or Enteromorpha (3).

In previous research, the authors have showed that the substitution of artificial feed binders with seaweed meal increased the water absorption of shrimp pellets and improved their texture while maintaining adequate pellet integrity. Shrimp-feeding results in the lab showed that a 2 to 4 percent inclusion of seaweed was cost-efficient, improved feed consumption, promoted faster growth, and had adequate attractant efficacy.

Green seaweed production

Commercial culture of the green seaweed *Enteromorpha* (recently renamed *Ulva clathrata*) began recently in Mexico. Previously, seaweed production was dominated by brown seaweeds like wild-harvested *Macrocystis* from Mexico, *Ascophyllum*, and *Laminaria*, and red seaweeds like *Eucheuma* produced in other countries. In the past, green seaweeds were confined to small niche markets because of their high costs of production, but using new technology, *Enteromorpha* can now be produced at a price competitive with other seaweeds.

Enteromorpha has several features that make it interesting as a potential ingredient in shrimp feed. It is highly regarded as a food item in Asia, with a reputation as a health food. It contains the sulfated polysaccharide ulvan, which can help in pellet binding and also has potential antiviral activity. *Enteromorpha* has two to three times higher protein content than other seaweeds and various vitamins and minerals. It is also an excellent source of carotenoids, which contribute to shrimp pigmentation.

Ingredient potential

The authors recently conducted research to assess the potential of *Enteromorpha* meal as an ingredient in commercial shrimp feed formulation. They compared the green seaweed *Ulva clathrata* with two kelp seaweeds commonly used in shrimp feed, *Macrocystis* and *Ascophyllum*. Standard pelleted test diets with 3.3 percent *Macrocystis*, *Ascophyllum*, or *Enteromorpha* were compared with respect to pellet stability and texture, shrimp growth performance, and shrimp pigmentation.

Enteromorpha has higher protein and carotenoid levels and approximately 30 percent lower hydrocolloid levels than those in *Macrocystis* and *Ascophyllum*. Instead of the mix of alginates and sulfated fucoidan typical of *Macrocystis* and *Ascophyllum*, *Enteromorpha* has only sulfated ulvan.

Results

Despite its lower hydrocolloid levels, *Enteromorpha* had acceptable binding properties with significantly better retention of dry matter (Fig. 1) and superior water absorption. Increased water absorption results in a softer pellet that shrimp eat more readily than harder pellets.

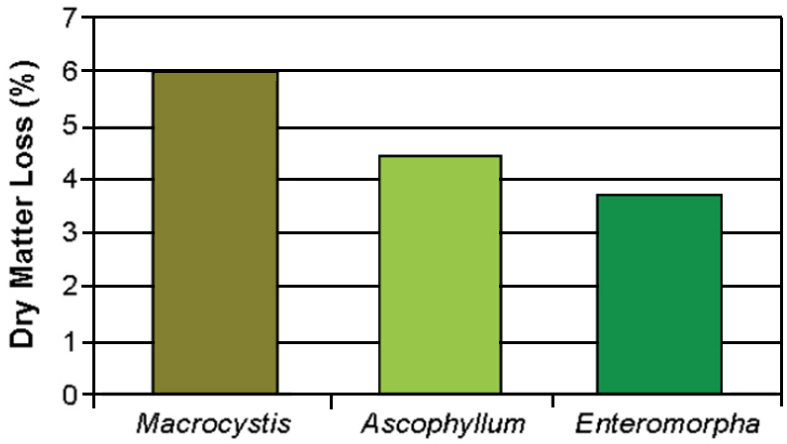

Fig. 1: Loss of dry matter after immersion in water for one hour.

Growth of the (*Litopenaeus vannamei)* was greater in shrimp fed pellets containing *Enteromorpha* than those with *Macrocystis* or *Ascophyllum* (Fig. 2). Similarly, feed with *Enteromorpha* produced the best feed-conversion ratio (1.78 at 28 days) (Fig. 3), and its amino acid contribution was higher than that of *Macrocystis* or *Ascophyllum*.

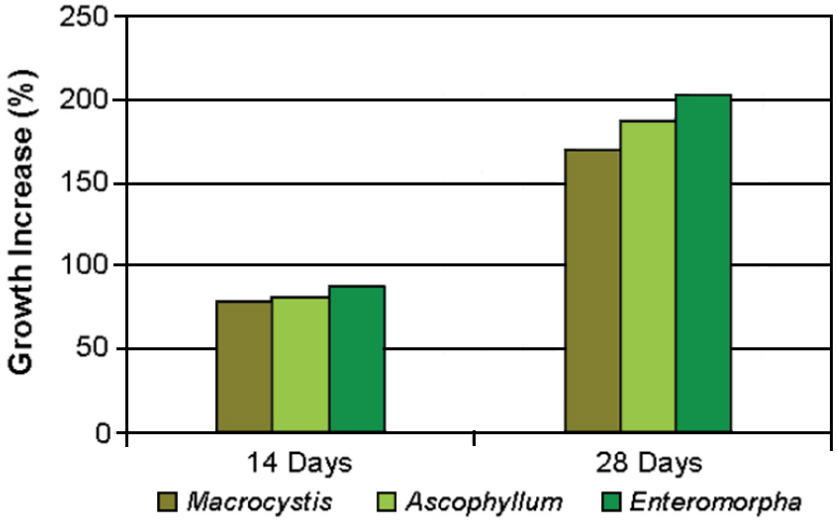

Fig. 2: Final weight less initial weight expressed as a percentage of initial weight.

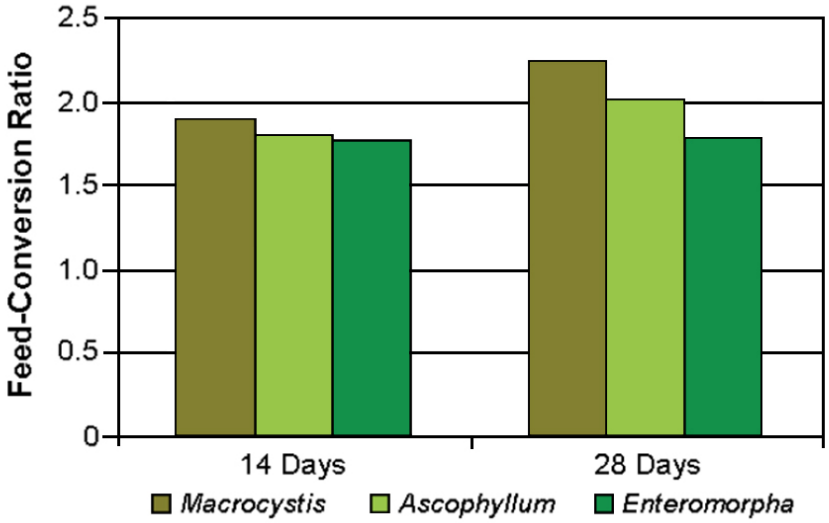

Fig. 3: Feed consumed divided by change in weight.

Red coloration after cooking was markedly darker in animals fed the *Enteromorpha* diet due to the high carotenoid levels typical of *Enteromorpha*. Shrimp with greater pigmentation typically have better consumer appeal.

Of the three seaweeds tested, *Enteromorpha* had the best nutritional and functional properties as an ingredient in shrimp aquafeeds. Its possible antiviral and immunological properties will be the subject of further research.

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