



Broodstock diets

an overview

By Judith Kolkovski, Nutrakol Pty Ltd.

The broodstock condition, inclusive of physiological, nutritional and stress aspects, is one of the key issues for the success of marine fish and shrimp hatcheries.

It is well established that high quality larvae and therefore optimal growth and high survival is dependent on the broodstock nutrition and their health. The effect of nutrients on the gonadal development, maturation and fecundity of different aquatic species, including fish and crustaceans, has been the subject of research efforts in past decades. This research includes protein and lipid levels and fractions (i.e. phospholipids), essential fatty acids especially HUFA's such as DHA, EPA and ARA levels and ratios, vitamins such as ascorbic acid (C) and α -tocopherol (E), in addition to many others. Specific nutrients such as carotenoids, yeast extracts and microalgae (*Spirulina*, *Chlorella*, *Dunaliella salina*) have been



found to have a significant effect on fecundity and are currently included as a standard in broodstock diets.

Although there is a significant quantity of scientific literature on broodstock nutrition of marine fish and crustaceans, there are still many factors which are unknown. Due to the large

number of species grown in aquaculture which, in many cases are varied in habitat, behavior, feeding habits, activity etc., there is no one (or even several) optimal formulae that can suit all species. For example, nutritional requirements for flat fish such as *Solea solea* are very different from pelagic

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species such as *Seriola*. As Cobia is a tropical species, it has significantly different requirements from Halibut, which is a cold water species. While in recent years, more species-specific maturation diets have become increasingly available, the nutrition of broodstock is still far from optimal.

The use of fresh and frozen seafood as a partial or complete diet for broodstock is still the standard with many marine species, including established species such as gilthead sea bream and European sea bass in the Mediterranean. While there are commercial broodstock diets that can be used solely, marine organisms such as sardines, mackerels, squid, mussels are considered to be essential for marine fish broodstock. In shrimp aquacul-

ture, significant effort is made to grow polychaetes, which together with squid and *Artemia* is considered being essential for broodstock. Large hatcheries and broodstock centres usually have their own polychaete farms. Although this practice has a potential risk for introducing pathogen vectors which may affect broodstock quality, all shrimp industry worldwide is still reliant on live polychaetes and other fresh and frozen feeds.

Lack of standard feeding protocols

In general, there are no standard feeding protocols for marine fish broodstock and the nutrition and feeding protocols can vary significantly between hatcheries and species. A

mix of seafood such as sardines, mackerels and squid, in addition to commercial boosters, which contain vitamins, minerals, fatty acids and other nutrients are usually the norm. Moist diets (developed during the 80s) which are based on a mix of fishmeal and other marine organism meals (mainly krill and squid), oils and nutritional additives, as well as, fresh ingredients (squid, fish) are commonly used. In many hatcheries, these moist diets are produce in-house.

While the nutritional requirements of fish and shrimp broodstock may not be fully described, especially for 'new'-cultured species such as groupers (*Epinephalus sp.*), *Seriola sp.*, Cobia, and many others, they are partially or fully fulfilled with the supplement-

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tation of fresh feeds and nutritional boosters.

Current commercial broodstock diets and supplements focus on the nutritional requirements of the fish and shrimps. However, additives or supplements that support the hormonal cycle, and thus will lead to better gonadal development and higher fecundity, are scarce. This is especially true for out-of-season broodstock groups of well-established and new species in aquaculture. Moreover, other factors affecting the broodstock fecundity and maturation such as stress and immune system and digestive system are usually not directly addressed.

Promise in herbs

While herbal medicines and herbal therapy for women with reproductive hormonal problems have been recognized for centuries, there is very little adaptation of it in aquaculture. Medicinal plants are known to have hormonal boosting effects. Some herbs are utilized in herbal medicine as natural boosters for the hormonal cycle in both men and women and in hormone replacement therapy for menopausal women. The effect of herbal extracts on the development and performances of fish and shrimp broodstock have not been intensively investigated. However, scientific evidence suggests that aside from the known properties of plant extracts as antibacterial, antiviral and antifungal, these compounds

can significantly improve the broodstock condition and therefore the quality of their eggs and larvae. In black tiger shrimp, *P. monodon*, significant increases in fecundity, gonadal weight and reduced inter-molt period were observed when fed a maturation diet containing extracts of *W. somnifera*, *Mucuna pruita*, *Ferula asafoetida* and *Piper longum*. Similar results (increase in fecundity and gonadal weight and reduced inter-molt period) were found when a mix of *W. somnifera*, *Mucuna rurita*, *Ferula asafoetida* and *Piper longum* was fed to the spawner through bio encapsulated *Artemia*.

Many plant-derived compounds have been found to have non-specific immune-stimulating effects in animals, of which more than a dozen have been evaluated in fish and shrimp (Table 1).

Herbal compounds have the ability to inhibit the generation of oxygen ani-

ons and scavenge free radicals, therefore, reducing stress effects. Herbal anti-oxidant effect was demonstrated when *P. kurroa (picrorhiza)* extract was used as an anti-stress compound for black tiger shrimp. Other herbs such as, *Astragalus membranaceus*, *Portulaca oleracea*, *Flavescent ophora* and *A. paniculata* and many other are known to have specific and non-specific anti-stress effects.

Currently, several hatcheries both for fish and shrimps around the world are using commercially available herbal extract mixes, specifically designed to boost and modulate the hormonal system in aquatic animals. The herbal extracts are used with out-of-season broodstock and/or species with fertilisation and gonadal development problems such as groupers (low sperm motility and volume) and many other species (Table 2).

Using a commercial mix of herbal extract as a standard additive to brood-



Table 1. Examples of herbal extracts used as immune stimulants and growth promoters in aquaculture

Botanical name	Family	Distribution	Useful parts	Biological effect in aquaculture
<i>Hygrophila spinosa</i>	Acanthaceae	India, Sri Lanka	Whole plant	Growth Promoter
<i>Ipomea digitata</i>	Convolvulaceae	India	Root	Growth Promoter, Immunostimulant
<i>Solanum nigrum</i>	Solanaceae	India	Berries	Growth promoter
<i>Terminalia arjuna</i>	Combretaceae	India, Burma, Sri Lanka	Bark	Growth promoter
<i>Boerhaavia diffusa</i>	Nyctagineae	India, Tibet	Leaf and Root	Growth promoter, appetizer
<i>Carica papaya</i>	Caricaceae	India	Fruit	Growth promoter, appetizer
<i>Eclipta erecta</i>	Compositae	India	Whole plant	Hepato tonic, Immunostimulant, Anti-stress
<i>Eclipta alba</i>	Compositae	India	Whole plant	Hepato tonic, Immunostimulant, Antiviral, Anti-stress
<i>Cynodon dactylon</i>	Gramineae	India	Leaf and Root stalk	Immunostimulant, Antibacterial
<i>Emblia officinalis</i>	Euphorbiaceae	India	Whole plant	Immunostimulant, Antibacterial
<i>Urtica dioica</i>	Urticaceae	Europe, Turkey, India	Whole plant	Immunostimulant
<i>Vernonia cinera</i>	Compositae	India	Whole plant	Immunostimulant
<i>Viscum album</i>	Loranthaceae	India, Himalayas, Turkey	Berries and Leaves	Immunostimulant
<i>Zingiber officinale</i>	Scitamineae	India, China, Bengal	Rhizome	Immunostimulant
<i>Picrorrhiza kurrooa</i>	Scrophulariaceae	India	Rhizome	Immunostimulant, Anti-stress
<i>Withania somnifera</i>	Solanaceae	India	Root	Immunostimulant, Growth promoter

stock diet, similar spawning performances are currently achieved with

Seriola lalandi broodstock groups during spawning season and off-season

(Kolkovski and La Camera, 2015).

Table 2: Examples of herbal extracts in broodstock diets

Botanical Name	Family	Distribution	Useful parts
<i>Cinnamomum Zeylanicum</i>	Lauraceae	India, Sri Lanka	Bark
<i>Elettaria cardomomum</i>	Scitamineae	India, Burma, Sri Lanka	Dried ripe seeds
<i>Eugenia caryophyllata</i>	Myrtaceae	India, Sri Lanka	Fruits and dried flower buds
<i>Mesua ferrea</i>	Guttiferae	Andaman, Nicobar Islands	Flowers buds, seeds and bark
<i>Asparagus racemosus</i>	Liliaceae	India	Leaves and Root
<i>Mucuna pruriens</i>	Papilionaceae	Tropics	Seeds, roots and legumes
<i>Witania Somnifera</i>	Solanaceae	India	Root and leaves



Herbal extracts and phytotherapy compounds can contribute significantly to the broodstock condition through direct and indirect effects and more research is needed to introduce these compounds into modern aquaculture.

Conclusion

While a significant quantity of information is available on the marine fish and shrimp broodstock nutritional requirements, optimal nutrition and feeding requirements are still far from optimal. This is especially true for new and 'developed' species.

More attention is needed to reduce the reliance on live, fresh and frozen seafood as major ingredients in

broodstock diet. Herbal extracts and phytotherapy compounds can contribute significantly to the broodstock condition through direct and indirect effects and more research is needed to introduce these compounds into modern aquaculture.

About the author

Judith Kolkovski, ND is a nutritionist and herbalist and the general manager of Nutrakol Pty Ltd. Judith has 15 years of experience in natural therapy in humans. In recent years, Judith focused on the development of natural health solutions for aquatic animals.

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