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Natural Herbs as an Alternative Treatment against Fish Diseases

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Abstract

Disease is one of the major constraints to sustainable fish production which can cause significant economic loss. Antimicrobials and other veterinary drugs are commonly used in aquaculture to prevent or treat disease outbreaks. However, continuous use of aquaculture drugs may lead to cause negative environmental impact from farms to aquatic organisms. As an alternative to conventional methods many plant-derived compounds such as essential oils, plant extracts have been used as an efficient treatment to control parasites in aquaculture systems. The most important herbal species *viz. Allium sativum* (Garlic), *Curcuma longa* (Turmeric), *Zingiber officinale* (Ginger), *Azadirachta indica* (Neem), *Ocimum sanctum* (Tulsi), *Allium cepa* (Onion) are available in India used to treat various diseases in aquaculture industry.

Introduction

The current world population is around seven billion, and by 2050 it is expected to reach nine billion. Hence, animal protein consumption is expected to double by that time. Fish are palatable and proteinous food for human beings. Aquaculture is one of the fastest-growing food-producing sector worldwide, increasing at an average rate of 7.1% per year, and contributes 46% of total food fish supply. This impressive industrial development has been accompanied by the expansion of semi intensive culture to the intensive culture system. Unfortunately, the intensive culture of fish generates a stressful environment leading to the suppression of the immune system and increasing of the susceptibility of fish to infectious diseases. Approximately, a third to a half of farm food fish is lost due to diseases before they could reach marketable size. Thus, disease can cause significant economic loss either through mortality and morbidity, poor growth rate, low quality of flesh, or reduced trade, resulting in reduced profit margins. Due to the use of a wide variety of antibiotics, aquaculture has been implicated as potential environment to the development and selection of resistant bacteria and a source of these pathogens to other animals and humans. Some bacterial fish pathogens are also associated to diseases in humans, making the aquaculture products a potential risk to the customers (*zoonotic* or food borne diseases). It is well understood that harmful microbes, nutritional disorders and poor water quality or environmental disorders cause diseases which in turn have been major obstacles to aquaculture worldwide.

Hazards in Fish Culture

A range of both infectious and non-infectious hazards that can causes direct losses and limit fish culture. Fish diseases are generally the result of the simultaneous action of many, overlapping factors that are difficult to differentiate directly. The current system for the prevention

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and treatment of fish diseases reacts only after the appearance of new pathogens and their confirmed diagnosis, and creating effective legal procedures and the groundwork for their implementation is time consuming.

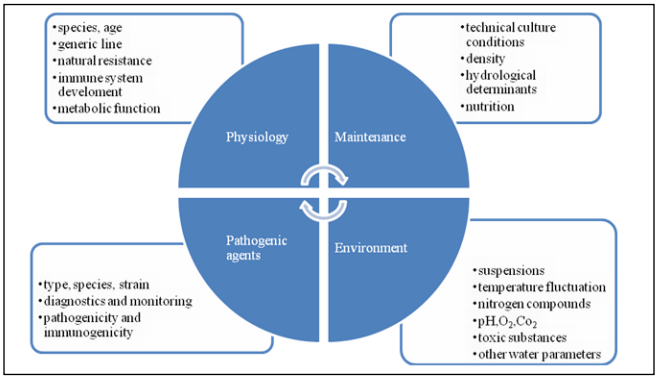

Figure 1: Risk factors for fish diseases in aquatic environments

In order to avoid economic losses related to sanitary shortcomings, several veterinary drugs are commonly used to prevent or treat disease outbreaks. The adoption of these drugs in aquaculture appears to be only profit-driven and unsustainable, as they causes several other constraints such as fish pathogen drug resistance, immune suppression, environmental pollution, and accumulation of chemical residues, which can be potentially hazardous to the public health. Today, the need of replacing antibiotics and other synthetic chemicals with dietary supplements or ingredients that is capable of strengthening fish health, enhance their growth, feed utilization ability, ultimately ensure safety and good quality products from aquaculture are becoming increasingly vital.

Table 1: FDA approved aquaculture drugs

S. No.	Drug	Commercial Name	Usage	Approved Species
1.	Chorionic gonadotropin	Chorulon®	Improving spawning function in brood finfishes	Brood finfish
2.	Formalin	Formaldehyde solution	control of Protozoa and Monogenetic Tremetodes, and on the eggs of Salmon, Trout and Pike (esocids) for control of Fungi of the family Saprolegniacea	Finfish and their eggs, Penaeid shrimp Salmon, Trout, Catfish and Bluegill
3.	Florfenicol	Aquaflor® Type A	control of mortality due to enteric septicemia of catfish. The tolerance for florfenicol amine (the marker residue) in muscle (the target tissue) is 1 ppm.	Channel catfish salmonids
4.	Tricaine methanesulfonate	Tricaine-S MS-222	It may not be used within 21 days of harvesting fish for food. The drug should be limited to hatchery or laboratory use.	Ictaluridae, Salmonidae, Esocidae, Percidae
5.	Oxytetracycline dihydrate	Terramycin® 200	For feed use. in Salmonids,21 days; Catfish, 21 days; Lobster, 30 days. Oxytetracy- cline tolerance in the flesh is 2.0 ppm	Catfish, Salmonids, Lobster
6.	Oxytetracycline hydrochloride	Oxymarine™, Terramycin 343, Phennoxy 343, Tetroxy Aquatic	For feed use. in Salmonids,21 days; Catfish, 21 days; Lobster, 30 days. Tolerance in the flesh is 2.0 ppm	Fry and fingerlings
7.	Sulfadimethoxine/ Ormetoprim	Romet-30®	Withdrawal times are: Salmonids, 42 days; catfish, 3 days	Catfish, salmonids
8.	Sulfamerazine	Sulfamerazine	It may not be used within 21 days of harvest. Note: This product is currently not marketed	Trout(rainbow, brook, brown)
9.	Chloramine-T	Halamid® Aqua	------	salmonids, Freshwater-reared warm water finfish
10.	Hydrogen peroxide	-------	------	Fin fish eggs, Salmonids, Cold freshwater reared finfish

Natural Herbs as an Alternative Treatment

The herbs (medicinal plants) use of plants is very old. The writings indicate that therapeutic use of plants is as old as 4000–5000 BC and Chinese used first the natural herbal preparations as medicines. In India, however, earliest references of use of plants as medicine appear in Rig-Veda, which was written between 3500–1600 BC. Later the properties and therapeutic uses of medicinal plants were studied in detail and recorded empirically by the ancient physicians in Ayurveda (an indigenous system of medicine) which is a foundation of ancient medical science in India. Throughout India, the herbs/ medicinal plants (leaves, stem, flower, root, seeds and even whole plant) are widely used by the traditional medical practitioners for curing various diseases in their day-to-day practice.

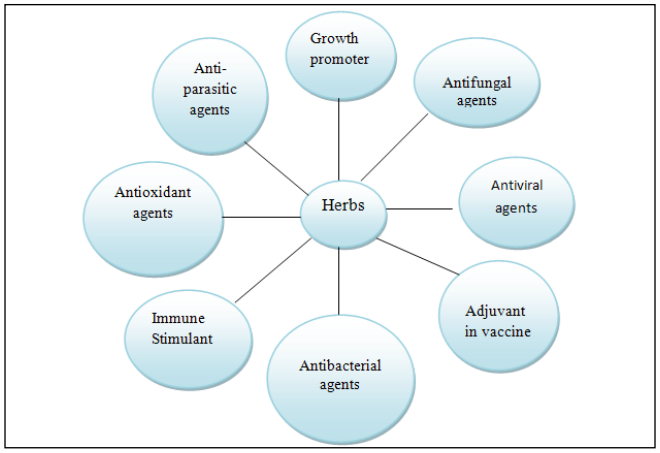

Figure 2: Advantages of natural herbs in aquaculture

Role of Natural Herbs in Aquaculture

As an alternative to conventional methods, many plant-derived compounds such as essential oils (e.g. *Origanum sp*. and *Lippia spp*.) and plant extracts (e.g. *Allium sativum* and *Mentha spp*.) have been used as an efficient treatment to control parasites in various aquaculture systems. The use of the plant-derived compounds has been concentrated in protozoans and especially in monogeneans. Monogeneans (e.g. *Dactylogyrus spp*) salmon fluke *Gyrodactylus salaris*), protozoans (e.g. *Ichthyophthirius multifiliis* and *Trichodina spp*.) are very common ectoparasites living on the gills of fish. Recently these plant-derived compounds have used to control myxozoan species such as *Myxobolus spp*. and *Enteromyxum spp*. For example, essential oil of *Origanum* has been reported to provide varying degrees of protection and therapy in fish infected with myxosporean parasites. Essential oil of *Lippia alba* (bushy matagrass) leaves at concentrations of 100 and 150 mg/L and obtained efficacies of 40.7 and 50.3 % against the *I. multifiliis* protozoan, which is a parasite of *Colossoma macropomum* (tambaqui). *Allium sativum* (garlic) and *Matricaria chamomilla* (chamomile) extracts were also active in the control of *I. multifiliis* in *Poecilia latipinna* (sailfin molly).The exposure of methanol extract of *Magnolia officinalis* (2.45 mg/L) and *Sophora alopecuroides* (pea flowered tree) (3.43 mg/L) caused the highest mortality against *I. multifiliis*, a pathogenic ciliate that infects fresh and marine fish farming.

Using the crude extract from raw and squeezed garlic (A. *sativum*) at 200 mg/L had potential to treat *trichodiniasis* in eel fish. The crude ethanol extract from the leaves of Indian almond was found to be active against *Staphylococcus aureus* bacterium with a minimum inhibitory concentration of 512 g/ml. In addition the crude extracts of *T. catappa* had in vitro antifungal properties against *Pythium ultimum, Rhizoctonia solani, Sclerotium rolfsii* and *Aspergillus fumigates*. The crude extracts of either garlic or Indian almond at 800 mg/L significantly one of the new challenging methods for *trichodiniasis* treatment. Rainbow trout fish fed with diets containing aqueous extracts of mistletoe (*Viscum album*), nettle (*Urtica dioica*), and ginger (*Zingiber officinale*) exhibited significant non-specific immune responses. *Psidium guajava* was also able to eliminate *Vibrio* infection in Black tiger shrimp (*P. monodon*). Impressively, it was higher efficacy than the antibiotic oxytetracycline extract derived from olive tree leaf (*Olea europaea*) and its major compound, oleuropein (Ole) was very successful in controlling *Salmonid rhabdovirus*, and *Viral Haemorrhagic Septicaemia virus* (VHSV). The use of petroleum ether, benzene, diethyl ether, chloroform, ethyl acetate, methanol and ethanol extracts of 20 species of Indian traditional medicinal plants such as *Aegle marmelos, C. dactylon, Lantana camara, Momordica charantia and Phyllanthus amarus* have antiviral activity against White Spot Syndrome virus (WSSV).

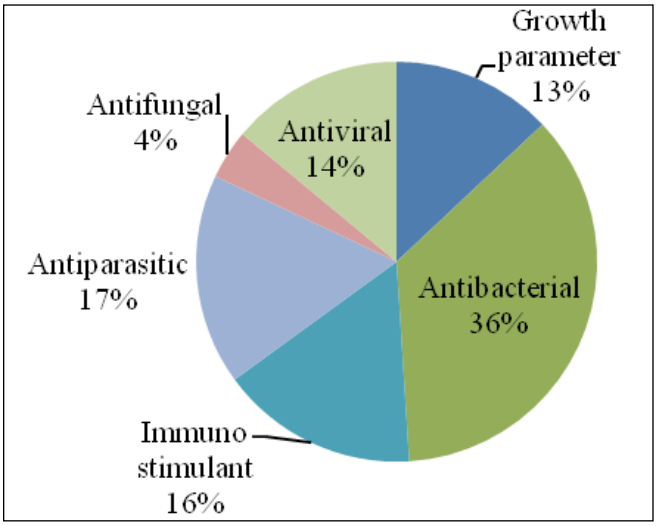

Figure 3: Contribution of natural herbs in aquaculture health management practices

Herb Based Aquaculture Practices in India

India enfolds rich diversity of herbs and forms a good platform for herb based aquaculture practices. A diverse of medicinal plants those are indigenous or cultivated in India are being used extensively in aquaculture worldwide. India has two located in Eastern Himalaya and Western Ghats regions containing approximately 3500 and 1600 medicinal plants respectively. Herbal medicines derived from Ashwagandha, Punarnava, Brahmi, Isabgol, Tulsi, Turmeric, Neem, Safed Musli, Amla, Shatavari, Garlic, Senna, Tamala, Nutmeg, Shankhapushpi have revolutionalized modern herbal therapy in India. India has often been referred to as the "Medicinal Garden of the world'' owing to its rich biodiversity. India represents about 75% of medicinal needs of the third world countries. Neem leaves, garlic, and turmeric powder induced disease resistance in fry of Indian major carp (*Catla catla*).

Table 2: Important herbal species available in India and its uses in Aquaculture

Name of the herb	Scientific name	Reports
Garlic	*Allium sativum*	promote protein synthesis , enhances the uptake of free amino acids in *Clarias lazera*, provide antibacterial effect and enhance blood parameters in *Oreochromis niloticus*, to control *Aeromonas hydrophila* infection in *Oncorhynchus mykiss*.
Turmeric	*Curcuma longa*	Carotenoid source on pigmentation, growth of Poecilia reticulate, natural curcumin and its analogue inhibits lipid peroxidation in *Anabas testudineus*.
Ginger	*Zingiber officinale*	Increase extracellular activity of phagocytic cells in blood in *O. mykiss*; to increase the phagocytic capability of cells in rainbow trout, nutrition and feed indices in *Penaeus monodon* fed with Z.O. enriched Artemia.
Neem	*Azadirachta indica*	Enhanced primary and secondary antibody response in *O. mossambicus*, possess anti- bacterial effect in *Channa striatus*; exhibit anti- bacterial activity in ornamental fishes; exhibit antiviral properties in cultured shrimp; produce disease resistant fry of *Catla catla.*
Tulsi	*Ocimum sanctum*	Increase energy utilization, weight gain and survival rate against the control group in *Macrobrachium rosenbergii*, anti-stress, immune stimulation, and anti-bacterial properties in Penaeus larviculture
Onion	*Allium cepa*	prevent bacterial infection in *P. monodon*; to exhibit anti- microbial activity in *C gariepinus*; to increase growth rate in *Clarias gariepinus*; to promote glycogenesis, lipogenesis in *Clarias lazera*

Conclusion

Using of chemicals to control diseases in aquaculture usually brings temporary relief and also causes stress to the fish and chances to increases of future infections. Herbs are the most accessible medicine which can be used in aquaculture industry to reduce chemical material. Plant-derived compounds offer viable alternatives to deal with the outbreaks of infectious diseases in fish farming. Therefore, plant-derived compounds seem to represent a promising alternative to control fish diseases in aquaculture.

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