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EFFICACY OF PHYTO DRUGS AVAILABLE IN INDIA AS A DISEASE MANAGEMENT TOOL IN AQUACULTURE

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Aquaculture means, “farming in water”. It plays a prime role in Indian economy. India is the second largest aquaculture producer in the world next to China. With the increasing human demand, the use of chemicals in aquaculture increased during the past few decades and is still increasing. A variety of chemicals is used in the name of antibiotics, anaesthetics, vaccines, hormones, pesticides, fungicides, algicides etc. These leads to a great peril to the soil, water, fish, environment and the humans. As the use of chemicals have a variety of problems, it should be alternated with a substance that is nontoxic to the fish and humans. One such alternative is the plant extracts called the Phytochemicals. Phyto drugs, derived from India's rich botanical heritage, have emerged as promising tool for disease management. These can be derived from various plant parts such as root, stem, leaves, bar, fruits, seeds and flowers. The following summary discuss the list of plants and the phytochemicals that are used as a treatment measure in aquaculture.

India is home to a variety of herbal plants. The substance used by the Indian people knowingly or unknowingly have huge medicinal properties. The growing aquaculture sector is affected with bacterial, fungal, viral and parasitic infections. These problems can be treated by herbal plants which has antioxidant, antifungal, antiviral, antibacterial, immune stimulation, growth regulating properties etc.

Rise of Phytochemicals

The vast variety of the herbal plants are found and categorised in the country. There arises a question “why should we not use all these herbal plants in a different way?” Researchers started to make experiments with the herbal plants and found that using medicinal plants have many benefits beyond our knowledge.

Advantages of Usage of Phytochemicals

- It is less toxic to fish and more toxic to harmful microorganisms.
- Improve the immune status of fish.
- Reduce the environmental impact.
- Enhance the growth of fish.
- It is cheap, cost-effective.
- It is easily available.
- Naturally present.
- Phytochemicals are much effective than chemotherapeutics.

Phytochemicals

Phytochemicals are substance that are naturally present in the plants for their protection from predators. Phytochemicals are classified into different classes such as flavonoids, alkaloids, saponins, phenolic acids, tannins, anthraquinones, saccharides, glucosinolates, nitrile glycosides and terpenoids, etc. Some of these major classes are discussed below.

1. Flavonoids:

Flavonoids are class of polyphenolic secondary metabolites present in the plants. Generally, flavonoids have a chemical structure of 15 carbon skeleton, which consists of two phenyl rings and a heterocyclic ring. It possesses a number of medicinal benefits such as antiviral, antibacterial and antioxidant properties.

Table 1 Flavonoids available from plants and their antimicrobial activity

Plants and its active compound	Special antimicrobial property
<i>Anacardium occidentale</i> (catechin)	Retard the growth of methicillin resistant <i>Staphylococcus aureus</i> (MRSA) & methicillin susceptible <i>S.aureus</i> (MSSA).
<i>Ricinus communis</i> (Epicatechin)	Acts against the parasitic activity of <i>Paramphistomum cervi</i> .
<i>Rhizopora apiculata</i> (Genistein)	Have shown antibiotic response against bacterial strains
<i>Punic granatum</i> (Pelargonidin)	Have potent scavenging activity for superoxide radicals.

2. Alkaloids:

Alkaloids are organic nitrogen containing bases that are found in the plants. It is present in the plants to give protection from predators and involved in the growth regulation. It is bitter in taste. According to a report, it was found that more than 40000 alkaloid compounds are present in plants.

Table 2 Alkaloids available from plant and their antimicrobial activity

Plant and its active compound	Special antimicrobial property
<i>Datura stramonium</i> (Pyridazine)	Have antibacterial effects against <i>Escherichia coli</i> , <i>Staphylococcus aureus</i> , <i>Klebsiella pneumonia</i> .

3. Phenolic compounds:

Phenolic compounds are carboxylic acid group which are present in the plants. It plays a major role in induction of resistance to the plants. These compounds have good bioavailability, lipid & water solubility. Phenolic compounds are advantageous over flavonoids because it will be easily absorbed by the stomach.

Table 3 Phenolic compounds available from plant and their antimicrobial activity

Plant and its active compound	Special antimicrobial property
<i>Eucalyptus globulus</i> (Gallic acid)	Have antibacterial activity especially against <i>S.aureus</i> .

4. Terpenoids:

Terpenoids, also known as isoprenoids, are a class of chemical compounds produced from isoprene. Isoprene, a 55-carbon molecule, and terpenes are examples of naturally occurring organic chemicals. Terpenoids present in plants, gives defence against biotic and abiotic stresses.

Table 4 Terpenoids available from plant and their antimicrobial activity

Plant and its active compound	Special antimicrobial property
<i>Rosamarinus officinalis</i> (Diterpenoids)	Carnosic acid and carnosol: exhibited a significant increase in antibacterial activity against <i>Listeria monocytogenes</i> and <i>Staphylococcus aureus</i> strains.

5. Saponins:

Saponins, also selectively referred as triterpene glycosides. Saponins are bitter in taste. These are bioorganic compounds. These produce soap-like foam when agitated in water. These have the potential to provide a platform for the development of drugs based on natural products.

Table 5 Saponins available from plant and their antimicrobial activity

Plant and its active compound	Special antimicrobial property
<i>Chenopodium quinoa</i> (Quinoa saponins)	Have anti bacteriostatic and bactericidal effects on Gram positive bacteria such as <i>Staphylococcus aureus</i> and <i>Bacillus cereus</i> .

Extraction Methods of Phytochemicals from Plants

Phytochemicals, also referred to as phytobiotics or phytochemicals. These are extracted from the plants and incorporated into the animal feed (fish feed). Phytochemicals can be extracted by two ways. One is the traditional or conventional extraction method (Soxhlet method, maceration, percolation and decoction). Even the traditional method is a slow and time-consuming process, it is used widely. Another way is the advanced extraction method (Microwave -assisted extraction, ultrasound-assisted extraction, enzyme-assisted extraction and superficial fluid extraction). The name itself implies that they are advanced technique discovered recently and used everywhere nowadays due to the reason of fast extraction process.

Plants Available In India and Their Use in Aquaculture

Quillaja saponin, a plant that is added to the feed of fishes has increased protein efficiency ratio, apparent energy utilization, apparent lipid utilization, specific growth rate and reduced the feed conversion ratio (Francis et al.2001; Francis et al.2002a and Francis et al. 2002b). Ahmad and Tawwab (2011), found that the tilapia (*Oreochromis niloticus*) fed with feeds having cumin have increased specific growth ratio, protein efficiency ratio, apparent energy utilization, apparent lipid utilization. Medicinal plants such as *Curcuma longa*, *Azadirachta indica*, *Ocimum sanctum* have the ability to act against *Aeromonas hydrophila* as an antimicrobial agent in goldfish (Harikrishnan and Balasundaram 2008). In the study conducted by Chitmant et al.(2005a), it was found that the *Terminalia catappa* have antiparasitic, antibacterial and antifungal effects in tilapia (*Oreochromis niloticus*). In

another study conducted with plants such as garlic (*Allivum sativum*) and sea almond (*Terminalia catappa*) in tilapia the antiparasitic effect of the plants were found. Suzuki et al. (2006) observed that the raw extract of green tea (*Camellia sinensis*) had a strong potential to control *Ichthyobodo necator* in salmon & chum salmon. Herbal extracts have shown a total protein, albumin and globulin increase in fish (Goda 2008 and Xie et al. 2008). Some substances present in plants are functionally similar to that of animal testosterone and are collectively known as Phyto androgens (Turan & Akyurt 2005a).

Diosgenin, a steroid sapogenin constituent of fenugreek seeds: daidzein, an isoflavone present in soy. These compounds have potential to act as phytoandrogens (Raju et al.2004; Chen & Chang 2007; Ong & Tan 2007). Phyto androgens have been found to have a sex-reversal properties in fish (Godwin et al.2003). *Origanum heracleoticum* contains phenolic compounds of thymol and carvacrol, act against bacteria in channel catfish, *Ictalurus punctatus* (Zheng et al.2009). Balasubramanian et al. 2007) found that the plants such as *Aegle marmelos*, *Cyanodon dactylon*, *Lantana camara*, *Momortica charantia* and *Phyllanthus amarus* have antiviral effect against WSSV. Amaryllidaceae family plants are distributed in the Uttarkhand Himalayan region of India. These family plants have an active compound called lycorine and it was reported that it has antibacterial effect against *Flavobacterium columnare*. A well-known plant that is *Eichornia crassiceps* -“terror of Bengal” is an exotic species which forms a thick mat like structure by growing monstrously. It is a remarkable aquatic weed in aquaculture which retard penetration of sunlight and its overgrowth leads to clogging. But this monstrous plant shows antibacterial activity against *Vibrio harveyi* and it increased bacterial resistance of *V.harveyi* in *Channa punctatus* culture. Papaya leaf meal have an active compound called papain which increases the growth performance in fish. Leaves of the *Ocimum sanctum* (Thulasi) contains eugenol, caryophyllene which acts as an immunostimulant. These compounds give resistance against *A.hydrophila* and also gives specific and nonspecific immunity to the fish. Amla fruit pulp have high vitamin C and found to act as an immunostimulant. In addition to this *Phyllanthus emblica* (Amla) has antioxidant, antimicrobial, antifungal activity. *Cassia auriculata* (Avaram) have phytochemicals such as terpenoids, tannin, steroids and saponin. Fish meal containing *C. auriculata* leaf have proven to show increased growth in milkfish. *Cinnamomum cassia* has resistance against myxozoan species in goldfish farming. *Piper guineense* (pepper) act against *Dactylogyrus extensus*. *Glycyrrhiza glabra* (liquorice), which is mainly cultivated in Himachal Pradesh. It has a growth promoting effect in *Cirrhinus*

mrigala. *Moringa oleifera*, *Allium sativum* and *Zingiber officinale* have potential to improve growth performance in aquaculture species. Oregano, a hardy plant found in temperate Himalayas from Kashmir to Sikkim has antimicrobial properties and used in aquaculture.

Conclusion

The plains, valleys and mountain ranges of the Indian region is found with diverse vegetation. Most of the plants that are found in India are medicinal plants with idiosyncratic characteristics. The medicinal plants are generous and diversified. But these herbaceous plants are underutilised. Many researches have done to investigate the medicinal properties of plants and their usage in aquaculture. Yet usage of these compounds in the aquaculture is not popular among the farmers. Most of the money spent on the aquaculture goes to the chemicals such as antibiotic, vaccines etc., in the name of prophylactic measures. Use of antibiotics in aquaculture is banned in many countries as it leads to the development of antibiotic resistant bacterial strains and consequently results in disease outbreak in humans. Use of Nitrofurans is strictly prohibited in aquaculture. Instead of antibiotics, plants with active compounds can be used. The usage of plants in the place of antibiotics have long lasting effect & also leads to better economic management. The usage of these compounds in aquaculture can improve productivity, disease resistivity and maintain environmental sustainability with less toxic effects. It is estimated that the global antimicrobial consumption in 2017 at 10259 tons in aquaculture is expected to increase 33 percent between 2017 and 2030. Before this threat happens, use of antibiotics ought to be diminished by the use of phytochemicals. It is the only way to the betterment of both aquaculture and the humans.

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