

A review on role of medicinal plants-based remedies in fish pathology

Sachin Panwar¹, Ashish Thapliyal¹ and Madhu Thapliyal²

¹ *Department of Biotechnology, Graphic Era Deemed to be University, Dehradun, India*

² *Department of Zoology, Govt. PG College, Maldevta, Raipur, Dehradun, India*

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ABSTRACT

India has slowly and steadily increased both marine and freshwater fish production. The commercial aquaculture industry has to face problem of fish pathogens as fishes have to face various microorganisms that are present in water environment. These fish pathogens can cause either partial or complete fish loss and these pathogens have become a primary concern for the production of sustainable agriculture, thereby influencing the socioeconomic status of fisheries. Various stress factors like water quality, temperature changes, immune suppression, high density population, feeding habits etc. also cause loss of fish production. Aquaculture industry incurs increased expenditure on use of chemicals that are used to prevent different fish diseases. Conventionally, treatment of fishes is still done using various salts like potassium permanganate and formalin. Alternatives to various drugs are being explored in various fields. Medicinal plants have been used for the treatment of human diseases since ages and Ayurveda has been traced back to 6000BC but information regarding the use of medicinal plants or phyto-components to treat pathogenic conditions in fishes is rather limited. This review focuses on treatment of bacterial, viral and parasitic diseases in fishes using medicinal plants and phyto-components. This knowledge can help in treating different pathological conditions in fishes with local resources and at a faster rate and could prevent losses of aquaculture industry.

Key words: Medicinal plants, Fish disease, Plant extract, Fish farming.

Introduction

In developing countries, aquaculture plays an important role in providing source of income, food security and livelihood (FAO, 2016) but disease occurrence is a crucial factor affecting production of food and cause great economic loss in fishes (Lafferty, 2015). The increase of pathogen in aquaculture led to the usage of various chemicals like insecticides, anti-parasitic etc. (Kaiser, 2011; Reverter, 2014). These chemical residues in water may affect the environment (Carey, 2015; Boyd, 2015), mainly in open water where the chemicals are not controlled easily (Noga, 2010) and also affects the non-target organisms (Pillay, 2004). Alternatively, natural

products are preferred because they are biodegradable in nature (Rahuman, 2011).

For the prevention of these economic losses in fish numerous remedies are used for treatment. These medications are administered through different modes like feed, bath or injections (Rico, 2013). Medicinal plants and phyto-components can be used as alternative which replaces the antibiotics/drugs. The treatment through medicinal plants in human is a traditional approach but our knowledge is rather limited in use of medicinal plants to treat various pathological conditions in fishes (Ahilan, 2010). Medicinal plants are rich source of bioactive compounds and thus serve as crucial raw material for the production of drug and may act as immune-

stimulants, reduce stress, function as anti-parasitic, antibacterial or anti-viral agents (Reverter, 2014). In the present review we focus on various medicinal plants and phyto-components that can be used for effective remedies in fish pathological conditions.

Analysis of plant parts used in aquaculture

According to research the most studied medicinal plant part used is leaves 37% and whole plant used is 22% as an essential oil, powder or extract. The percentage of root used is 18%. All these percentages are depicted in Figure 1.

Analysis of plant bioactivity

The highest percentage of bioactivity shown by

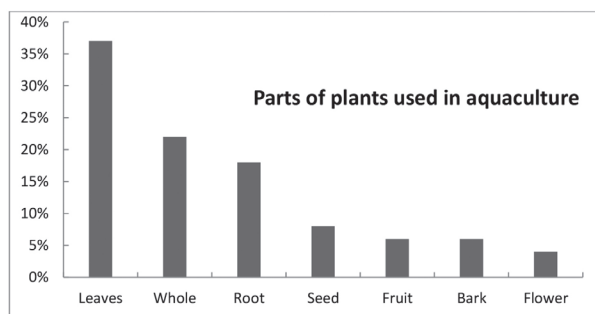


Fig. 1. Figure showing parts of plants used in aquaculture. Source: (Miriam, 2017)

medicinal plant is antibacterial 36%, after that anti-parasitic 17%, then immune-stimulant 16%, antiviral 14%, followed by growth promoter 13% and antifungal 4%. These activities with percentage is clearly shown in Fig. 2.

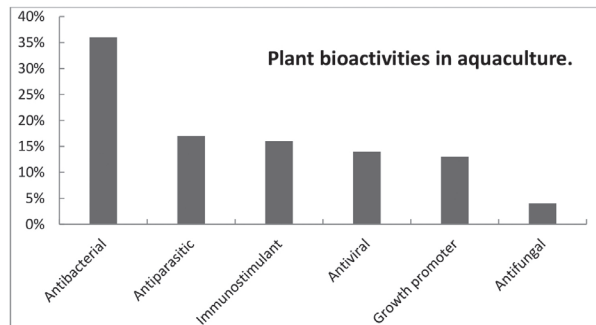


Fig. 2. Figure showing plant bioactivities in aquaculture. Source: (Miriam, 2017)

Source of medicinal plant

Medicinal plants with different parts, like leaves, rhizome, roots, fruit, bark, seed, and bulb used to extract different secondary metabolites and phytochemical compounds, like alkaloids, flavonoids, and tannins (Table 1).

Antibacterial effect of medicinal plants

Table 2 shows antibacterial effect against different

Table 1. Medicinal plant source

S. No	Species of plant	Family	Useful effect	Used part of plant	Active component	Ref.
1	<i>Artemisia argyi</i>	<i>Compositae</i>	Antiparasitic	Leaves	NI	(Huang, 2013)
2	<i>Allium sativum</i>	<i>Amaryllidaceae</i>	Antiparasitic	Bulbs	Allicin	Fridman, 2014; El-Galil, 2012; Madsen, 2000; Martins, 2002; Militz, 2013; Militz, 2014)
3	<i>Caesalpinia sappan</i>	<i>Leguminosae</i>	Antiparasitic	Rhizome	NI	(Huang, 2013)
4	<i>Dioscorea collettii</i>	<i>Dioscoreaceae</i>	Antiparasitic	Rhizome	Saponins	(Hu, 2014)
5	<i>Euphorbia fischeriana</i>	<i>Euphorbiaceae</i>	Antiparasitic	Root	Diterpenoids	(Zhang, 2014)
6	<i>Ficus carica</i>	<i>Moraceae</i>	Antibacterial	NI	Polysaccharides	(Wang, 2016)
7	<i>Galla chinensis</i>	<i>Anacardiaceae</i>	Antiparasitic	NI	Pentagalloyl glucose	(Zhang, 2013)
8	<i>Melia azedarach</i>	<i>Meliaceae</i>	Antiparasitic	Bark	NI	(Zhou, 2017)
9	<i>Ocimum sanctum</i>	<i>Lamiaceae</i>	Antibacterial	Leaves	Ursolic acid, oleanolic acid, and saligenin	(Das, 2015)
10	<i>Urtica dioica</i>	<i>Urticaceae</i>	Antibacterial	NI	NI	(Bilen, 2016) NI-no information

Source: (Deyan, 2018)

medicinal plants. For instance, the medicinal plant *Urtica dioica*, and *Zingiber officinale* through feed administration is effective against *Aeromonas hydrophila*, and *Vibrio harveyi* in aquaculture. *Padina gymnospora* shows antibacterial activity against *Pseudomonas aeruginosa* etc.

Antiparasitic effect of medicinal plants

Table 3 shows antiparasitic effect against different medicinal plants. *Allium sativum* and *Melia azedarach* through bath administration shows antiparasitic effects against *Gyrodactylus* species. *Galla chinensis* shows antiparasitic effect against *Ichthyophthirius multifiliis*. *Euphorbia fischeriana*, *Polygonum multiflorum*, *Dioscorea collettii*, and *Citrus medica*

shows antiparasitic effects against *Dactylogyrus* species etc.

Antiprotozoal activity showed by medicinal plants in aquaculture

According to recent research medicinal plants shows effective results against protozoal disease in fish farming (Valladao, 2015). The study shows essential oil exposure of *Allium sativum* is effective against Spiro *Spiro nucleus vortens*. extract of *Psoralea corylifolia* and *Toddalia asiatica* shows antiprotozoal activity against *Ichthyophthirius multifiliis* (Table 4). These results shows that the extract of medicinal plants has significant effect in controlling protozoan in aquaculture.

Table 2. Medicinal plants with antibacterial effects

S. No.	Species of Fish	Species of plant	Component used	Mode of application	Antibacterial effect against	Ref.
1	<i>Carassius carassius</i>	<i>Ficus carica</i> , <i>Radix isatidis</i> , <i>Schisandrachinensis</i>	Polysaccharides	Feed additive	<i>Aeromonas hydrophila</i>	(Wang, 2016)
2	<i>Labeo rohita</i>	<i>Ocimum sanctum</i>	Water extract	Feed additive		(Pan, 2013)
3	<i>Lates calcarifer</i>	<i>Zingiber officinale</i>	Powder	Feed additive	<i>Vibrio harveyi</i>	(Thanigaivel, 2015; Talpur, 2013)
4	<i>Oncorhynchus mykiss</i>	<i>Urtica dioica</i>	Methanolic extract	Feed additive	<i>Aeromonas hydrophila</i>	(Bilen, 2016)

Source: (Deyan, 2018)

Table 3. Medicinal plants with antiparasitic effects

S. No	Species of plant	Mode of application	Extract type	Species of Fish	Antiparasitic effect against	Ref.
1	<i>Allium sativum</i>	Bath	Aqueous extract	<i>Poecilia reticulata</i>	<i>Gyrodactylus turnbulli</i>	(Fridman, 2014)
2	<i>Euphorbia fischeriana</i>	Bath	Ethyl acetate extract	<i>Carassius auratus</i>	<i>Dactylogyrus vastator</i>	(Zhang, 2014)
3	<i>Galla chinensis</i>	Bath	Ethyl acetate extract	<i>Ictalurus punctatus</i>	<i>Ichthyophthirius multifiliis</i>	(Zhang, 2013)
4	<i>Melia azedarach</i>	Bath	Methanol extract	<i>Carassius auratus</i>	<i>Gyrodactylus kobayashii</i>	(Zhou, 2017)
5	<i>Polygonum multiflorum</i>	Bath	Water, methanol and ethyl acetate extracts	<i>Carassius auratus</i>	<i>Dactylogyrus intermedius</i>	(Hu, 2014)
6	<i>Citrus medica</i>	Bath	Chloroform and ethyl acetate extracts	<i>Carassius auratus</i>	<i>Dactylogyrus intermedius</i>	(Hu, 2014)
7	<i>Allium sativum</i>	Feed additive	Water extract	<i>Lates calcarifer</i>	<i>Neobenedenia sp.</i>	(Militz, 2013)
8	<i>Caesalpinia sappan</i>	Bath	Chloroform extract	<i>Carassius auratus</i>	<i>Dactylogyrus intermedius</i>	(Huang, 2013)

Source: (Deyan, 2018)

Antianthelmintic activity showed by medicinal plants in aquaculture

The extract type of *Bixa orellana* is effective against *A. spathulatus*. The extract of *Dioscorea zingiberensis*, *Dryopteris crassirhizoma*, *Euphorbia fischeriana*, and *Ginkgo biloba* shows antianthelmintic activity against *Dactylogyrus* species. Various studies on essential oils revealed that oils have outstanding biological activities against many parasites of fish. Antianthelmintic activity of different medicinal

plants are shown in Table 5.

Effect on environment

In aquaculture system usage of antibiotics, pesticides and insecticides causing another problem of drug resistance in pathogen (Reverter, 2014; Caipang, 2015). Additionally, bioaccumulation is also a problem which ultimately affects human health. The use of these chemicals directly or indirectly affects the non-target organisms. Therefore,

Table 4. Antiprotozoal activity showed by medicinal plants in aquaculture

S. No	Species of Fish	Species of Plant	Mode of application	Extract type	Compound isolated	Species of Protozoan	Ref.
1	<i>Carassius auratus</i>	<i>Psoralea corylifolia</i>	Bath	Methanol	Isopsoralen, psoralidin	<i>Ichthyophthirius multifiliis</i>	(Song, 2015)
2	<i>Carassius auratus</i>	<i>Toddalia asiatica</i>		Methanolic (leaves)	Chelerythrine and chloroxyllonine	<i>Ichthyophthirius multifiliis</i>	(Xiao-feng, 2014)
3	<i>Pterophyllum scalare</i>	<i>Allium sativum</i>	Oral/Bath	Essential oil	<i>E. Z. Ajoene</i>	<i>Spiroucleus vortens</i>	(Williams, 2016)

Source: (Alison,2017)

Table 5. Antianthelmintic activity showed by medicinal plants in aquaculture

S. No	Species of Fish	Species of Plant	Mode of application	Extract type	Active component	Anthelmintic activity	Ref.
1	<i>Arapaima gigas</i>	<i>Mentha piperita</i>	Bath	Essential oil (Leaves and inflorescences)		<i>Dawestrema</i> spp.	(Malheiros, 2016)
2	<i>Carassius auratus</i>	<i>Dioscorea zingiberensis</i>				<i>Dactylogyrus</i> sp.	(Jiang, 2014)
3	<i>Carassius auratus</i>	<i>Dryopteris crassirhizoma</i>	Bath	PE, EA, ME (roots)	Protocatechuic acid, sutchuenoside A, and kaempferitrin	<i>D. intermedius</i>	(Jiang, 2014)
4	<i>Carassius auratus</i>	<i>Ginkgo biloba</i>				<i>Dactylogyrus</i>	(Jiang, 2014)
5	<i>Carassius auratus</i>	<i>Santalum album</i>	Bath	CHL, EA, ME, water		<i>Dactylogyrus</i> sp., <i>Gyrodactylus</i> spp.	(Tu, 2013)
6	<i>Colossoma macropomum</i>	<i>Bixa orellana</i>	Bath	Acetone (seeds)	Bixin and geraniol	<i>A. spathulatus</i>	(Andrade, 2016)
7	<i>Colossoma macropomum</i>	<i>Ocimum gratissimum</i>	Bath	Essential oil (leaves)		Monogenean	(Boijink, 2016)
8	<i>Oreochromis niloticus</i>	<i>Lippia sidoides</i>	Bath	Essential oil (leaves)		<i>C. tilapiae</i> ; <i>C. thurstonae</i> ; <i>C. halli</i> ; <i>S. longicornis</i>	(Hashimoto, 2016)
9	<i>Poecilia reticulata</i>	<i>Allium sativum</i>	Oral/Bath	Water		<i>G. turnbulli</i> , <i>Dactylogyrus</i> sp.	(Fridman, 2014)

Petroleum ether (PE); Chloroform, (CHL); Ethyl acetate, (EA); Methanol, (ME).

Source: (Alison, 2017)

the compounds that are derived from medicinal plants is an alternative approach against these pathogens. They have no negative impact on environment as they are biodegradable.

Conclusion and Recommendations

By examining the problem of antibiotic resistance against pathogen against pathogen medicinal plants is an excellent approach in treating parasitic, bacterial and viral infections in fishes. The major area of research is to estimate mode of preparation, dosage application, duration of treatment and also effect on other fish species.

From this study we conclude that:

- However various medicinal have the potential as growth promoter and immune-stimulant but only few shows the effect on fish health like histological parameters. Thus need to be studied further.
- As medicinal plants can be used as an alternative to antibiotics, chemicals or drugs. Need to be investigate further related to health condition of fish.
- The dosage optimization is an important factor.

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