



## ANTIMICROBIAL ACTIVITY OF SOME MEDICINAL PLANTS AGAINST FISH PATHOGENS

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Article Received on: 17/02/12 Revised on: 25/03/12 Approved for publication: 10/04/12

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### ABSTRACT

The present article elucidates on the antimicrobial (antibacterial and antifungal) activity of some medicinal plants (herbs) against different microbes (e.g., bacteria and fungi). Aquaculture has been a growing activity for more than 20 years worldwide. The bacterial infections are considered the major cause of mortality in aquaculture. Among the common fish pathogenic bacteria, *Streptococcus agalactiae*, *Lactococcus garvieae*, *Enterococcus faecalis* (all gram-positive), *Aeromonas hydrophila* and *Yersinia ruckeri* (both gram-negative) cause infectious diseases. *A. hydrophila*, the most common bacterial pathogen in freshwater fish, has been recognized to be the aetiological agent of many pathological conditions, including tail rot, motile *Aeromonas* septicemia and epizootic ulcerative syndrome as a primary pathogen. The continuous use of antimicrobial agents in aquaculture has resulted into resistant bacterial strains in the aquatic environment. Treatment of bacterial diseases with different herbs has been safely used in organic agriculture, veterinary and human medicine. Treatment with medicinal plants having antibacterial activity is a potentially beneficial alternative in the aquaculture. These herbs mitigate many of the side effects which are associated with synthetic antimicrobials. Additionally, the plant-derived phytochemicals provide a cheaper source for treatment and greater accuracy than chemotherapeutic agents. Plants have been used as traditional medicine since time immemorial to control bacterial, viral and fungal diseases. In India, 500 medicinal plant species are used against pathogenic bacteria. Recently, research has been initiated to evaluate the feasibility of herbal drugs in fish diseases. Because of the growing bacterial resistance against commercial standard and reserve antibiotics, the search for new active substances with antibacterial activity against pathogenic bacteria is of increasing importance.

**KEYWORDS:** Antimicrobial activity, medicinal plants (herbs), fish, aquaculture, microbes (bacteria and fungi).

### INTRODUCTION

Aquaculture has been a growing activity for the last 20 years worldwide and this impressive development has been attended by some practices potentially damaging to animal health<sup>1</sup>. The bacterial infections are considered the major cause of mortality in aquaculture<sup>2</sup>. Among the common fish pathogens, *A. hydrophila* and *Y. ruckeri* as gram-negative, and *S. agalactiae*, *L. garvieae* and *E. faecalis* as gram-positive bacteria cause infectious diseases<sup>3-4</sup>. *S. agalactiae*, *L. garvieae* and *E. faecalis* are closely related groups of bacteria that can cause diseases like streptococcosis, lactococcosis, haemorrhagic septicemia and ulcers in fins<sup>5</sup>. *Flavobacterium columnare* is pathogenic only to freshwater fish species and shows low environmental fitness, when compared with other aquatic bacteria. Even though, this agent is highly virulent to young fish (fry and fingerling), causing skin lesions and high mortality, generally associated with poor environmental conditions<sup>6</sup>. Fish are susceptible to several bacterial infections, mainly when reared in high density conditions. Disease outbreaks elevated the mortality rate and decrease the productivity efficiency, causing high economic loss of the fish farmers. 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<sup>7-8</sup>. 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)<sup>9</sup>. *S. agalactiae* is a dangerous pathogen to freshwater and marine fish. The infection is characterized by brain invasion, nervous signs and septicemia<sup>10</sup>. These bacteria can infect humans,

causing mainly pneumonia and meningitis in newborns<sup>11</sup>. Enteric red mouth disease mostly restricted to salmonids is caused by *Y. ruckeri* and reddening of mouth and throat is the most common symptom<sup>12</sup>. *A. hydrophila* is responsible for cases of skin infections, septicemia and gastroenteritis in fish and human<sup>13</sup>. *A. hydrophila*, the most common bacterial pathogen in freshwater fish, has been recognized to be the aetiological agent of several distinct pathological conditions including tail/fin rot, motile *Aeromonas* septicemia (MAS) or haemorrhagic septicemia and epizootic ulcerative syndrome (EUS) as a primary pathogen. EUS is a globally distributed disease and has become an epidemic affecting a wide variety of wild and cultured fish species, especially in Southeast Asia including Pakistan and India<sup>3-4</sup>.

The continuous use of antimicrobial agents in aquaculture has resulted in more resistant bacterial strains in the aquatic environment<sup>14</sup>. The large-scale settings of aquatic animal husbandry have resulted in an increased antibiotic resistance in bacteria potentially pathogenic to fish and related environment. Heavy antibiotic used in aquaculture needs to be reduced and replaced with alternative processes for treating fish diseases to avoid the emergence of antibiotic resistance in pathogenic and environmental bacteria<sup>15</sup>. The occurrence of antibiotic resistant strains of bacteria has been described in aquaculture systems<sup>7</sup>. Regarding the problem of microbial resistance, there is an urgent need to establish the rules to the rational use of antibiotics and the discovery of new drugs and alternative therapies to control bacterial diseases<sup>16</sup>.

Treatment of bacterial diseases with different herbs has been safely used in organic agriculture, veterinary and human

medicine<sup>17</sup>, and treatments with medicinal plants having antibacterial activity are a potentially beneficial alternative in aquaculture<sup>18</sup>. Since ancient times, medicinal plants have been used for the treatment of common infectious diseases<sup>19</sup>. Medicinal plants as the alternative agents are effective to treat the infectious diseases and mitigate many of side effects that are associated with synthetic antimicrobials. Additionally, the plant-derived phytomedicines provide a cheaper source for treatment and greater accuracy than chemotherapeutic agents in this field<sup>20</sup>. The use of alcoholic extracts of herbs may be suggested for the natural administration of antibiotics effective in fish disease control. The ability of some herbs and seaweeds to inhibit activity of bacteria having potential interest as fish pathogens has been documented<sup>21</sup>. Some of the local herbs and desert plants were reported to inhibit the pathogenic bacteria in aquaculture and referred to limited number of plant species<sup>4</sup>. Medicinal plants are rich in a wide variety of secondary metabolites such as tannins, alkaloids and flavonoids, which have antimicrobial properties. Many of the spices and herbs used today have been valued for their antimicrobial effects and medicinal powers in addition to their flavour and fragrance qualities. In India, 500 medicinal plant species are used to pathogenic bacteria. Plants have been used as traditional medicine since time immemorial to control bacterial, viral and fungal diseases. In the recent years, herbs and herbal products plays significant role in fish culture. The usage of heavy antibiotic in aquaculture field needs to be reduced and replaced with alternative process for treating fish diseases<sup>22</sup>. The medicinal plants may be used as potential and promising drugs against fish pathogens in the organic aquaculture<sup>3-4</sup>.

Therefore, due to increasing the resistance of microorganisms to antibiotics and the cost of modern allopathic medicines, the scientists are now looking for medicinal plants, because most of them are safe, cost less and effective against a wide range of antibiotic resistant microorganisms. In this view, the present article elucidates about the antimicrobial (antibacterial and antifungal) activity of some medicinal plants (herbs) against different microbes (e.g., bacteria and fungi).

#### **SOME PROVEN ANTIMICROBIAL HERBS AGAINST FISH PATHOGENS**

The antimicrobial activity of 5 Chinese herb extracts against 13 bacterial and 2 viral fish pathogens has been reported long back<sup>23</sup>. The aqueous extract of *Azadirachta indica* (Neem) leaf has been tested against *A. hydrophila* infection in common carp, *Cyprinus carpio* and the results showed that this plant could effectively control *A. hydrophila* infection<sup>24</sup>. In a study of 46 methanolic extracts of Brazilian plants, 31 extracts were found to exhibit the antibacterial activity against fish pathogenic bacteria, viz., *S. agalactiae*, *F. columnare* and *A. hydrophila*. *F. columnare* was the microorganism most susceptible to many tested extracts. In contrast to its high virulence to young fish, this bacterium is sensible to the main disinfectants used in fish farms, such as potassium permanganate, hydrogen peroxide, chloramines and salt. Despite of their common use, these compounds may be dangerous to fry and aquatic environment. The plant extracts can be applied as an alternative to prevent and control outbreaks of columnaris, mainly in hatchery. Since these substances are natural, their hazardous potential is lower when compared with other products. The results show that the analyzed plants presented a high potential as alternative therapy of bacterial fish diseases<sup>16</sup>.

The alcoholic and aqueous extracts from 22 species of herbs from Bolu (Turkey) were screened for antibacterial activity against *A. hydrophila*, *Y. ruckeri*, *L. garvieae*, *S. agalactiae* and *E. faecalis*. Extracts with various solvent of *Nuphar lutea*, *Nymphaea alba*, *Stachys annua*, *Genista lydia*, *Vinca minor*, *Fragaria vesca*, *Filipendula ulmaria*, *Helichrysum plicatum* showed the highest inhibitory activity. The alcoholic extract of *V. minor*, and the alcoholic and aqueous extract of *N. lutea* displayed a broad antibacterial spectrum against the target organisms<sup>4</sup>. *Enterobacter* species and *Escherichia coli* isolated from marine fish, *Amphiprion sebae* caused 15 mm zone of inhibition against *A. indica* (Neem) extract<sup>25</sup>. In vitro antibacterial and antifungal activity of the chloroform extracts of the 17 different coastal medicinal plants were screened against ornamental fish pathogens, e.g., different gram positive and gram negative bacteria, and fungi. Of the selected plants, *Datura metel* Linn (Thorn-apple) showed wide range of antimicrobial activity against many of the fish pathogens. *D. metel* showed maximum sensitivity (19 mm diameter) against *Penicillium restrictum* fungal species and *Lantana camara* showed maximum sensitivity (13 mm diameter) against *Vibrio* bacteria species. The strong antimicrobial activity of *D. metel* might be due to the presence of various phytoconstituents, such as alkaloids, flavonoids, phenols, tannins, saponins and sterols. It has been concluded from this study that the *D. metel*, which collected from the Kanyakumari coast can be used as a putative antimicrobial drug in the aquaculture maintenance<sup>22</sup>.

The antimicrobial potency of aqueous extract of 3 medicinal plants, viz., *A. indica* (leaf), *Solanum torvum* (Sundakai fruit coat) and *Curcuma longa* (Haladi, turmeric) against the in vitro growth of pathogenic bacterium, *A. hydrophila* isolated from infected fresh-water fish, *Channa striatus* was assessed. The strongest antibacterial activities among all plants were obtained by the aqueous extract of *A. indica* with inhibition zone of 18 mm against *A. hydrophila*. The *S. torvum* demonstrated moderate (11 mm) and *C. longa* marked weak (8 mm) inhibiting activity against *A. hydrophila*. From this study, it is proved that among the 3 herbs, extract of *A. indica* is very effective against *A. hydrophila*<sup>3</sup>. Fifteen coastal medicinal plants/parts were investigated to evaluate the antibacterial activity against bacterial fish pathogens. Among the plants, *A. indica*, *Cinnamomum verum* and *Eupatorium odoratum* exhibited excellent antibacterial activity against 10 bacterial pathogens from diseased ornamental fishes under captivity. *E. odoratum* inhibited the growth of *Vibrio* species (14 mm). It is concluded from the present study that the coastal medicinal plants from the Kanyakumari coast has the potential antimicrobial compounds to cure the ornamental fish bacterial diseases<sup>26</sup>.

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