Current Journal of Applied Science and Technology

40(27): 21-27, 2021; Article no.CJAST.74863
ISSN: 2457-1024
(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)

Bactericidal Potential of Local Medicinal Plants of Kashmir Valley in Fishes: A Review

Inain Jaies[1*], Feroz Ahmad Shah[1], Shabir Ahmad Dar[1], Syed Shariq Nazir Qadiri[1], Asifa Wali[1] and Raj Kumar[2]

[1]Division of Aquatic Animal Health Management, Faculty of Fisheries, SKUAST-K, Rangil-190006, Ganderbal, Jammu and Kashmir, India.
[2]Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammuu, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2021/v40i2731524
Editor(s):
(1) Dr. Chen Chin Chang, Hunan Women's University, China.
Reviewers:
(1) Ricardo F. Tapilatu, University of Papua (UNIPA), Indonesia.
(2) Aditya Irawan, Mulawarman Univesity, Indonesia.
Complete Peer review History: https://www.sdiarticle4.com/review-history/74863

Review Article

Received 01 August 2021
Accepted 06 October 2021
Published 11 October 2021

ABSTRACT

Bacterial diseases in fishes create one of the alarming situations that render significant loss to the fishing industries and aquacultural farm units worldwide. Various drugs have been formulated, standardized, and used in the industry to combat bacterial infections. However, non-judicious drugs can lead to pharmacological problems and induction of toxicity in fishes, leaving them less suitable for human consumption. These drugs can be supplemented with the natural herb plants having antibacterial activities, although they cannot be used solely to curb the menace. Therefore, the review put forth an idea, which plant herbs can be used as antibacterial drugs in fishes.

Keywords: Medicinal plants; bacterial diseases; fishes; anti bacterial activity.

1. INTRODUCTION

The recent goal in aquaculture is to achieve maximum possible fish production from an area, within the shortest possible time period. In order to proceed towards this goal, the emphasis being laid on intensive fish culturing practices, and cage cultures results in overcrowding of

**Corresponding author: E-mail: inainjaies@gmail.com;*

specimens in such culturing units. Thus, chances of disease occurrence increases. In other words, disease outbreak acts as a limiting factor in aquaculture.

The bacterial infections are considered the major cause of mortality in aquaculture [1]. Among the common fish pathogens, *A. hydrophila, Y. ruckeri, S. agalactiae, L. garvieae*, and *E. faecalis* cause infectious diseases. *A. hydrophila* is widespread in freshwater fish culture, causing skin infections, septicemia, and gastroenteritis in human, besides the fish [2]. *Y. ruckeri* causes enteric red mouth disease especially in Salmonids, characterized by reddiningof mouth and throat [3]. *S. agalactiae* is a dangerous pathogen to both freshwater and marine fish, causing brain invasion, nervous signs and septicemia [4]. *S. agalactiae, L. garvieae*, and *E. faecalis* are closely related groups of bacteria that cause streptococcosis, lactococcosis, haemorhagic septicemia, and ulcers in fins [5].

Frequently antibiotics are used to control bacterial diseases but these result in the development of antibiotic-resistant strains [6]. On the contrary, plant extracts can be used as disease inhibitors without causing any negative effect [7,8,9]. Additionally, phytomedicines provide a cheaper source for treatment and have greater accuracy than chemotherapeutic agents in fish [10,11]. Extracts of plants besides treating diseases are also used as stress resistance boosters, infection preventatives, and growth promoters. A wide variety of chemicals, especially secondary metabolites, that have antimicrobial effects *in vitro* are produced by plants [12]. Plant produced antimicrobials belong to two categories:

1) Phytoalexins

Antimicrobials produced in response to microbes, environmental stimuli [8], require activation of specificgenes and enzymes for their synthesis and include simple phenyl propanoid derivates, flavonoids, isoflavonoids, terpenes, and polyketides [13,14].

2) Phytoanticipins

Antimicrobials which are present in plants before the challenge by microorganisms [12]. These includephenolic and iridoid glycosides, glucosinolates, and saponins.

2. MEDICINAL PLANTS ACTING AGAINST FISH DISEASES

Medicinal plants are known to improve digestibility and feed conversion [15], enhance fish weight [16], enhance immune response (higher levels of erythrocytes, lymphocytes, monocytes and haemoglobin) [17] in fishes. Medicinal plants have been reported to act against wide range of bacterial, viral and fungal pathogens. Medicinal plants prevent mortality rates in aquaculture.

Fish ectoparasites, especially Tricodina infections in *O. niloticus* fingerlings are easily treated by garlic (*Allium sativum*) and Indian almond (*Terminalia catappa*). Indian almond is claimed to act as a wound-healingsubstance for Siamese fighting fish hurt after matches in Thailand. According to Chitmanat et al. [18] neem *(Azadirachta indica)* leaves contain nimbin, azadirachtin, and meliantroil that possess a variety of properties, including insecticidal and antiviral from ancient times. Immunostimulatory effect of aqueous extract (AqE) of Bhangra *(Eclipta alba)* leaf in tilapia fish, *Oreochromis mossambicus* was studied, and it was observed that this extract enhances non-specific immune responses and disease resistance of *O. mossambicus* against *A. hydrophila* infection [19]. Methanolic extract of 46 Brazilian plants were screened against fish pathogenic bacteria; *Streptococcus agalactiae, Flavobacterium columnare*, and *A. hydrophila*, out of which only 31 were found effective [1]. Several studies and reported increase in the phagocytic capability of cells in rainbow trout (fish) when orally administered with ginger (*Z. officinale*) extract [7]. He further observed that the extracts of 4 Chinese herbs (*Rheum officinale, Andrographispaniculata, Isatisindigotica*,and *Lonicera japonica*) increases white'sphagocytic property blood cells of carp. Antibacterial activity of the alcoholic and aqueous extracts of *Nuphar lutea, Nymphaea alba, Stachys annua, Genista lydia, Vinca minor, Fragariavesca, Filipendulaulmaria*, and *Helichrysum plicatum* herbs of Bold (Turkey) against *A. hydrophila*, *Yersinia ruckeri*, *Lactococcus garvieae*, Str. *Agalactae*,and *Enterococcus faecalis* bacteria isolated from fish has been reported [11]. Nya and Austin [20] observed that after feeding rainbow trout, *O. mykiss* (Walbaum) with *A. sativum* @ 0.5 and 1 g/100 g of feed for 14 days, *A. hydrophila*infection can be controlled. The addition of *Phyllanthus niruri*and *Aloe vera* (Aloe) as herbal additives enhances the growth of

goldfish, *Carassius auratus*,and its resistance to*A*. *Hydrophila [*21]. Mixed herbal extracted supplemented diets were reported to enhance the innate immune response of goldfish (*C. auratus*) against *A.hydrophila*infection [22]. Chloroform extract of *Datura metal* plant can be used against several fish pathogens [23]. While studying the effect of dietary doses of *Withania somnifera* (Ashwagandha) root,it was reported that it enhances the immunity and disease resistance of Indian major carp, *L. rohita* fingerlings against *A*. *hydrophila* infection [20]. Aqueous extract of *A. indica* leaf can be used to control the *A. hydrophila* infection in common carp *(Cyprinus carpio)* [24]. They further studied that the antimicrobial effect of aqueous extract of *A. indica* (leaf), *Solanumtorvum*Sundakai (fruit coat), and *C*. *longa* (rhizome) against *A*. *hydrophila*, isolated from infected fresh-water fish, *Channa striatus.* Some herbal extracts such as *Benedeniaseriolae* are highly effective against flukes (gill and skin) [25].The dietary intake of *A. sativum* and *Vitex negundo* extracts has an immunostimulant effect on fingerlings of *L.rohita* fish [26]. Certain parts of *A. indica, Cinnamomum verum*,and *Eupatorium odoratum* have excellent antibacterial activity against bacterial pathogens of fish [23].

The disease-resistant *Catlacatla*fish was produced through immersion treatment of 3 herbs, viz., *A. sativum*, *A. indica*, and *Curcuma longa* (Haldi rhizome, turmeric) in spawn.

The antibacterial properties of medicinal plant extracts are being exploited nowadays. Different concentrations of extracts obtained from various parts of plants are tested against that specific pathogen. Kumar *et al* assessed the ethanol extrat of medicinal plants towards selected bacteria [27]. The Extracts having concentrations between 8 and 250 µg/ml revealed significant antibacterial effect and expressed minimum inhibition concentration (MIC) against both Gram-negative and Gram-positive bacteria. The antibacterial property of *Beta vulgaris* was assessed against various pathogens [28]. Extract obtained exhibited highest activity against *Staphylococcus and Bacillus* species.

Table 1. Locally found medicinal plants in Kashmir

Taxon Name/ Plant	Local Name	Family	Part used	Can be used against	Reference
Datura stramonium	Dhatur	Solanaceae	Leaves	*Streptococcus aureus, Escherichia coli.*	[29]
Punica granatum	Danh	Punicaceae	Leaves, fruit, flower	*Streptococcus aureus, Escherichia coli, Shigella dysenteriae, Salmonella typhi, Vibrio cholera.*	[30]
Celasia argentea	Moval	Amaranthaceae	Leaves, stem, root	*Aspergillus niger*, *Escherichia coli.*	[31]
Trigonella foenum-graecum	Meeth	Fabaceae	Leaf	*Bacillus cereus.*	[32]
Podophyllum hexandrum	Wanwan-gun	Berberidaceae	Rhizome	*Bacillus sp. , Pseudomonas sp.*	[27]
Mentha arvensis	Pudhna	Lamiaceae	Leaves	*Escherichia coli, Streptococcus aureus, Pseudomonas aeruginosa, Pseudomonas mirabilis.*	[33]
Rubus niveus	Chanch	Rosaceae	Leaf	*Streptococcus aureus.*	[34]
Viscum album	Aal	Loranthaceae	Whole plant	*Streptococcus aureus, Bacillus subtilis, Escherichia coli*	[35]
Viola odorata	Banafsha	Violaceae	Aerial parts	*Pseudomonas aeruginosa, Streptococcus aureus, Streptococcus pyogenes*	[36]

Dipsacusinermis	Wopalhak	Caprifoliaceae	Roots	*E. feacali, Escherichia coli, P. vulgaris*	[37]
Coriandrum sativum	Dhaniwal	Apiaceae	Seeds	*Klebsiella pneumoniae, Pseudomonas aeruginosa, Streptococcus aureus, Escherichia coli, Enterococcus faecalis*	[38]
Arnebiabentha mii	KahZaban	Boraginaceae	Rhizome	*Streptococcus aureus and E. coli*	[39]
Artemesiaabse nthium	Tethwan	Asteraceae	Whole plant	*Staphylococcus aureus, Bacillus subtilis, Escherichia coli*	[40]
Berberis lyceum	Kawdach	Beriberidaceae	Roots	*Pseudomonas sp., Escherchia coli, Streptococci sp. and Staphylococcus sp*	[41]
Malva sylvestris	Sotal	Malvaceae	Flower	*Staphylococcus aureus, Streptococcus agalactiae,Entrococcus faecalis,*	[42]
Ficus carica	Anjeer	Moraceae	Leaf, latex	*Staphylococcus aureus, Salmonella typhi*	[43]
Sambaucuswig htiana	Hapatfal	Caprifoliceae	Floral parts	*Staphylococcus aureus, Escherichia coli*	[44]
Gallium aparine	Loothar	Rubiaceae	Leaves	*Pseudomonas aeruginosa, Bacillus subtilis*	[45]
Papaver somniferum	Khush-Khash.	Papaveraceae	Pollens	*Staphylococcus sp. And family Enterobacteriaceae*	[46]
Rumex nepalensis	Aabuj	Polygonaceae	Root	*Staphylococcus aureus, E. coli, Pseudomonas aeruginosa*	[47]
Solanum nigrum	Kambae	Solanaceae	Whole Plant	*Pseudomonas aeruginosa, Staphylococcus aureus, E. coli*	[48]
Beta vulgaris	Beetroot	Amaranthaceae	Root	*Staphylococcus aureus and Bacillus cereus*	[28]
Cichorium intybus	Kazal-Handh	Asteraceae	Seeds	*Bacillus subtilis, Staphylococcus aureus, Micrococcus luteus,Escherichia coli , Salmonella typhi,* Pseudomonas aeruginosa	[49]
Allium sativum	Rohun	Amaryllidaceae	Bulb	*B. subtilis, Escherichia coli and saccharomyces cerevisiae.*	[50]

3. CONCLUSION

With the continuous usage of antimicrobials in aquaculture, the apprehension of antibiotic resistance has occurred in most water bodies. Medicinal plants can be used as an essential alternate for controlling aquacultural infestations. Besides acting as antibacterial agents, the medicinal plants also diminish the side effects associated with antibiotics, are more economic and have accurate usage. Present study provides an overview of the local medical plants of Kashmir valley that can be used as be used as an alternative to antibiotics, chemicals or drugs in aquaculture.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Meyer FP. Aquaculture disease and health management. Journal of Animal Science. 1991; 69(10):4201–4208.
2. Castro SBR, Leal CAG, Freire FR, Carvalho DA, Oliveira DF, Figueiredo HCP. Antibacterial activity of plant extracts from Brazil against fish pathogenic bacteria. Brazilian Journal of Microbiology.2008;39(4):756-760.
3. https://en.wikivet.net/Enteric_Redmouth_Disease.
4. Madhuri S, Mandloi AK, Govind P, Sahni YP. Antimicrobial activity of some medicinal plants against fish pathogens. International research journal of pharmacy, 2012; 3: 28-30.
5. Buller NB. Bacteria from fish and other aquatic animals: A practical identification manual. CABI Publishing, UK. 2004.
6. Yin G ,Ardo L , Jeney Z, Xu P , Jeney G. Chinese herbs (*Lonicera japonica* and *Ganoderma lucidum*) enhance nonspecific immune response of tilapia, *Oreochromis niloticus* and protection against *Aeromonas hydrophila*. In: Diseases in Asian Aquaculture VI, Fish Health Section (Bondad-Reantaso, M.G., Mohan, C.V., Crumlish, M. and Subasinghe, R. P. eds.). Asian Fisheries Society, Manila, Philippines, 2008; pp269-282.
7. Farag RS, Dawz ZY, Hewedi FM, El-Barotyl GS. Antimicrobial activity of some Egyptian Spice essential oils. J. Food Prot.1989;52:665-667.
8. Citarasu T, Babu MM, Sekar RJR, Marian, PM. Developing *Artemia* enriched Herbal diet for producing quality larvae in *Penaeus monodon*, Fabricius. Asian Fish. Sci.2002;15:21-32.
9. Sagdic O, Ozcan M. Antibacterial activity of Turkish spice hydrosols. J. Food. Cont. 2003;14:141-143.
10. Abdul Kader Mydeen, KP, M. A. Haniffa. Evaluation of antibacterial activity of medicinal plants on fish pathogen, *Aeromonas hydrophila*. J. Res. Biol. 2011; 1: 1- 5.
11. Turker H, Yildirim AB, Karakas FP. Sensitivity of bacteria isolated from fish to some medicinal plants, Turkish Journal of Fisheries and Aquatic Science.2009; 9:181-186.
12. VanEtten HD, Mansfield JW, Bailey JA, Farmer EE. Two classes of plant antibiotics: *Phytoalexins versus* phytoanticipins. Plant Cell. 1994;6:1191-1192.
13. Bailey JA, Mansfield JW. Phytoalexins. Glasgow Blackie (Eds) 1982 pp: 334.
14. Dixon RA. The phytoalexin response: elicitation, signaling and control of host gene expression. Biology Reviews. 1986; 61:239-291.
15. Putra AAS, Santoso U, Lee MC, Nan FH. Effects of dietary katuk leaf extract ongrowth performance, feeding behavior and water quality of grouper Epinephelus coioides. AcehInternational Journal of Science and Technology, 2013;2.
16. Takaoka O, Ji SC, Ishimaru K, et al. Effect of rotifer enrichment with herbal extracts on growth and resistance of red sea bream, Pagrus major (Temminck & Schlegel) larvae againstVibrio anguillarum. Aquaculture Research, 2011;42:1824–1829.
17. Yuan C, Li D, Chen W, et al. Administration of a herbal immunoregulation mixtureenhances some immune parameters in carp (Cyprinus carpio). Fish Physiology and Biochemistry, 2007;33:93–101.
18. Chitmanat C, Tongdonmuan K, Nunsong W. The use of crude extracts from traditional medicinal plants to eliminate Trichodina sp. in tilapia (*Oreochromisniloticus*) fingerlings. Songklanakarin. Journal of Science and Technology.2005;27(1):359-364.
19. ChristybapitaD ,Divyagnaneswari M, Michael RD. Oral administration of *Eclipta alba*leaf aqueous extract enhances the non-specific immune responses anddisease resistance of *Oreochromis mossambicus*. Fish Shellfish Immunology. 2007; 23(4):840-852.
20. Nya EJ, Austin B. Use of garlic, *Allium sativum*,to control *Aeromonas hydrophila*infection in rainbow trout, *Oncorhynchus mykiss*(Walbaum). Journal of FishDiseases. 2009; 32(11): 963-970.
21. Ahilan B,Nithiyapriyatharshini A, Ravaneshwaran, K. Influence of certain herbal additives on the growth, survival and disease resistance of goldfish, *Carassiusauratus*(Linnaeus). Tamilnadu J. Vet. Ani. Sci. 2010;6(1): 5-11.
22. Harikrishnan R, Balasundaram C, Heo MS. Herbal supplementation diets on haematology and innate immunity in goldfish against *Aeromonas hydrophila*.

Fish Shellfish Immunology.2010;28(2):354-361.
23. Ravikumar S, Selvan GP, Gracelin NAA. Antimicrobial activity of medicinal plants along Kanyakumari coast, Tamil Nadu, India. Afr. J. Basic Appl.Sci.2010;2(5-6):153-157.
24. Sharma A, Deo AD, Riteshkumar ST, Chanu TI, Das . Effect of *Withaniasomnifera*(L. Dunal) root as a feed additive on immunological parameters and disease resistance to *Aeromonas hydrophila*in *Labeorohita* (Hamilton) fingerlings. Fish Shellfish Immunol. 2010;29(3):508-512.
25. Kolkovski S,Kolkovski J. Herbal medicine in aquaculture. International Aquafeed. 2011;14(2):28-31.
26. Nargis A,Khatun M,Talukder D. Use of medicinal plants in the remedy of fish diseases. Bangladesh Res.Publ. J. 2011;5(3):192-195.
27. Kumar R,Badere R, Singh SB. Antibacterial and antioxidant activities of ethanol extracts from trans Himalayan medicinal plants. Pharmacognosy journal. 2010;*2*(17):66-69.
28. Velićanski AS, Cvetković DD, Markov SL, Vulić JJ, Đilas SM. Antibacterial activity of *Beta vulgaris* L. pomace extract. Acta periodicatechnologica. 2011;(42):263-269.
29. ElNour ME, Mahmood FZAAR,Yagoub SO. Callus induction and antimicrobial activities of callus and intact plant extracts of *Datura stramonium* L. Int J Sci Res.2014;3(8):1105-1109.
30. Pradeep BV, Manojbabu MK, Palaniswamy M. Antibacterial activity of *Punica granatum* L. against gastro intestinal tract infection causing organisms Ethnobotanical leaflets. 2008;1: 143.
31. Okpako E, Ajibesin K. Antimicrobial activity of *Celosia argentea* L. Amaranthaceae American Journal of Research Communication. 2015;*3*(5):123-133.
32. 32)Hwa CY, Perveen N, Paliwal N, Khan NH. Phytochemical screening, antimicrobial and antioxidant activity determination of *Trigonella foenum-graecum* seeds. Pharm Pharmacol Int J. 2019;7(4):175-186.
33. Nascimento EMM, Rodrigues FFG, Campos AR,da Costa JGM. Phytochemical prospection, toxicity and antimicrobial activity of *Mentha arvensis* (Labiatae) from northeast of Brazil. Journal of Young Pharmacists. 2009;1(3):210.
34. Shibu Prasanth SCR, Chandran P. Phytochemical and antimicrobial analysis of leaf samples of different *Rubus* species. Intl J Chem Tech Res. 2019;*10*(4):359-368.
35. Hussain MA, Khan MQ, Hussain N. Antimicrobial screening of viscum album L. extracts. In 2nd Int Conf Environ Sci Technol IPCBEE. 2011;6: 203-208.
36. Gautam SS, Kumar S. The antibacterial and phytochemical aspects of *Viola odorata* Linn. extracts against respiratory tract pathogens. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences. 2012;*82*(4):567-572.
37. Wani I, Manzoor N, Singh KP, Pal A. Evaluation of antioxidant property of hydro-alcohol root extract from thymus *Linearis benth.* and*Dipsacusinermis* wall. in Kashmir valley. Global Journal of Research on Medicinal Plants & Indigenous Medicine. 2017;6(11):121-126.
38. Wei JN, Liu ZH, Zhao YP, Zhao LL, Xue TK, Lan QK. Phytochemical and bioactive profile of *Coriandrum sativum* L. Food chemistry, 2019;286:260-267.
39. Mehta J, Shahista S. Studies on the screening of phytochemical, antioxidant and antibacterial activities of certain medicinal plants of Kashmir. International Journal of Biological Research and Development. 2021;9(2):1-14.
40. Patwa N, Das AK. Bio-efficacy of *artemisia vulgarisl*. against microorganisms. TTPP. 2020;149
41. Irshad AH, Pervaiz AH, Abrar YB, Fahelboum I, Awen BZ. Antibacterial activity of *Berberis lycium* root extract. Trakia Journal of Sciences. 2013;11(1):89.
42. Razavi SM, Zarrini G, Molavi G, Ghasemi G. Bioactivity of *Malva sylvestris* L., a medicinal plant from Iran. Iranian journal of basic medical sciences.2011;14(6):574.
43. Al-Snafi AE. Nutritional and pharmacological importance of *Ficus carica*-A review. IOSR Journal of Pharmacy. 2017;*7*(3):33-48.
44. Chashoo IA, Kumar D, Bhat ZA, Khan NA, Kumar V, Nowshehri JA. Antimicrobial studies of *Sambucus wightiana* Wall. ex. Wight &Arn. Journal of Pharmacy Research. 2012;5(5):2467-2468.
45. Vasilevna IT, Volodymyrivna GO, Leonidivna TE *et al*. Antimicrobial Activity

of the Genus Galium L. Pharmacogn. Commn. 2016;6:42-47.

46. Ismaili A, Sohrabi SM, Azadpour M, Heydari R, Rashidipour M. Evaluation of the antimicrobial activity of alkaloid extracts of four *Papaver* species. Herbal Medicines Journal. 2017;2(4):146-152.
47. Yadav S, Kumar S, Jain P, Pundir R, Jadon S, Sharma A, *et al*. Antimicrobial activity of different extracts of roots of *Rumex nepalensis*Spreng. 2011;2(1):65-69.
48. Shahiladevi S, Jegadeesan M. Antimicrobial activity of black fruit variant of *Solanum nigrum* L. Int. J. Curr. Microbiol. App. Sci. 2017;6(6):2706-2713.
49. Khan K, Haq A, Khan H, Khan H, Fazal H, Nisar Ahmad. "*Cichorium intybus*: An Excellent Medicinal Herb and Potential Growth Inhibitor of Pathogenic Microorganisms Causing Various Diseases in Humans," Sumerianz Journal of Agriculture and Veterinary,Sumerianz Publication. 2018;(1):14-20.
50. Viswanathan V, Phadatare AG, Mukne A. Antimycobacterial and antibacterial activity of *Allium sativum* bulbs. Indian journal of pharmaceutical sciences. 2014;76(3):256.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/74863