

An update about beneficial effects of medicinal plants in aquaculture: A review

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Electronic Supplementary Material (ESM)

Table S1. Use of medicinal plants as growth promoters in aquaculture

Table S2. Use of medicinal plants as anti-stress and immunostimulants in aquaculture

Table S3. Use of medicinal plants as anti-virus and anti-bacteria in aquaculture

Table S4. Use of medicinal plants as anti-parasite in aquaculture

List of references

Table S1. Use of medicinal plants as growth promoters in aquaculture

Herbal name	Compound	Dose	Fish species	Function	Reference
Garlic and ginger	Garlic : ginger = 1 : 1	2%	Beluga (<i>Huso huso</i>)	Improve growth and globulin	Gholipour Kanani et al. (2014)
Gokhru (<i>Pedalium murex</i>)	Extract	0.1%	Rohu (<i>Labeo rohita</i>)	Improve weight gain and specific growth ratio	Ojha et al. (2014)
Alder buckthorn (<i>Frangula</i>) bark Emodin	Emodin	30 mg/kg	Rohu (<i>Labeo rohita</i>)	Improve growth performance and immunity	Giri et al. (2016)
Ginger (<i>Zingiber officinale</i>)	Powder	0.8%	Rohu (<i>Labeo rohita</i>)	Improve growth performance	Sukumaran et al. (2016)
Common purslane (<i>Portulaca oleracea</i> L.)	Leaf	powder 1–3%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve growth, antioxidant, and immunological responses	Abdel-Razek et al. (2019)
Mojave yucca (<i>Yucca schidigera</i>)	Liquid extract	0.75 mg/l	European seabass (<i>Dicentrarchus labrax</i>)	Benefit the growth, improve the physiological responses of and decrease the mortality rates	Fayed et al. (2019)
Maidenhair tree (<i>Ginkgo biloba</i>)	Extract	0.1–0.2%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Moderate the growth-suppressing effects, stress, and liver tissue damage induced by diazinon	Hajirezaee et al. (2019)
Ferula (<i>Ferula asafoetida</i>)	Powder	20–25 g/kg	Common carp (<i>Cyprinus carpio</i>)	Improve growth performance	Safari et al. (2019)
Turmeric (<i>Curcuma longa</i>)	Powder	4%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve growth performance	Sanchez et al. (2019)
Chaff flower (<i>Achyranthes aspera</i>)	Powder	0.5%	Rohu (<i>Labeo rohita</i>)	Improve growth performance	Sharma et al. (2019)
Onion (<i>Allium cepa</i>)	Powder	10 g/kg	White carp (<i>Cirrhinus mrigala</i>)	Improve growth performance	Sikotariya (2019)
Dandelion (<i>Taraxacum officinale</i>)	Extract	0.8%	Common carp (<i>Cyprinus carpio</i>)	Improve growth performance	Sirakov et al. (2019)
Fluted pumpkin (<i>Telfairia occidentalis</i>)	Extract	1%	African sharp-tooth catfish (<i>Clarias gariepinus</i>)	Improve growth performance	Ta et al. (2019)
Wolfberry (<i>Lycium barbarum</i>)	Extract	0.5–2%	Hybrid grouper	Improve growth performance	Tan et al. (2019)

Table S1 to be continued

Herbal name	Compound	Dose	Fish species	Function	Reference
Dandelion	Extract	1 g/kg	Silverfish (<i>Trachinotus ovatus</i>)	Improve growth performance	Tan and Sun (2020)
Aloe barbadensis miller (<i>Aloe vera</i>)	Extract	0.4%	Common carp (<i>Cyprinus carpio</i>)	Improved growth performance, blood parameters, antioxidant capacity	Jafarinejad et al. (2020); Lamichhane et al. (2020)
Climbing Senecio (<i>Senecio scandens</i> buch-ham)	Extract	0.05–0.1%	Hybrid grouper	Improve growth performance	Sun et al. (2020)
Salidroside	Powder	100 mg/kg	Common carp (<i>Cyprinus carpio</i>)	Improve growth performance	Yang et al. (2020)
Hardy Rubber Tree (<i>Eucommia ulmoides</i>)	Extract	40 g/kg	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve growth performance	Yao et al. (2020)
Olive extract	Extract	1 g/kg	Common carp (<i>Cyprinus carpio</i>)	Improve growth performance	Zemheri-Navruz et al. (2020)
Curcumin	Curcumin	120 mg/kg	Common carp (<i>Cyprinus carpio</i>)	Improve growth performance	Zhang et al. (2021)
Jamun (<i>Syzygium cumini</i>)	Leaf extract	10 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve growth performance	Kannan et al. (2022)
Sweet wormwood (<i>Artemisia annua</i>)	Extract	0.05%	Largemouth bass (<i>Micropterus salmoides</i>)	Improve growth performance	He et al. (2022)
Fnugreek (<i>Trigonella foenum-graecum</i>)	Methanolic Extract	0.1%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve growth performance	Diab et al. (2023)

4 Table S2. Use of medicinal plants as anti-stress and immunostimulants in aquaculture

Herbal name	Compound	Dose	Species	Function	References
Antraquinone	Extract	1–2%	Common carp (<i>Cyprinus carpio</i>)	Mitigate negative effects of crowding stress	Xie et al. (2008)
Antraquinone	Extract	0.1–0.2%	Giant river prawn (<i>Macrobrachium rosenbergii</i>)	Prevent high-temperature stress	Liu et al. (2010)
Garlic (<i>Allium sativum</i>) and Ginger (<i>Zingiber officinale</i>)	Garlic : ginger = 1 : 1	2%	Beluga (<i>Huso huso</i>)	Improve growth, globulin	Gholipour Kanani et al. (2014)
Curcumin	Curcumin	60 mg/kg	Wuchang bream (<i>Megalobrama amblycephala</i>)	Improve non-specific immunity (IL-1 β , TNF- α)	Xia et al. (2015)
Peppermint (<i>Mentha piperita</i>)	Menthone, menthol	3%	Caspian white fish (<i>Rutilus frisii kutum</i>)	Improve immunity (both mucosal and systemic)	Adel et al. (2015)
Blue Spade Flower (<i>Hybanthus enneaspermus</i>)	Extract	3 g/kg	Rohu (<i>Labeo rohita</i>)	Enhance haematological, biochemical, and immune responses and the intestinal enzymatic activities	Giri et al. (2017)
Basil (<i>Ocimum gratissimum</i>)	Leaf extract	12 g/kg	African sharp-tooth catfish (<i>Clarias gariepinus</i>)	Elevate antioxidant and immuno-activity (activities of AST, ALT, ALP, urea, creatinine levels)	Abdel-Tawwab et al. (2018)
Garlic (<i>Allium sativum</i>)	Extract	1–2%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Induce changes in the intestinal microbio- ta, conferring beneficial effects on the host	Buyukdeveci et al. (2018)
Mongolian wild onion (<i>Allium mongolicum</i> Regel)	Flavonoids	40 mg/kg	Northern snakehead (<i>Channa argus</i>)	Improve innate immunity (SOD, IgM, HSP70, HSP90, IkB- α , GR)	Li et al. (2018)
Clove (<i>Eugenia caryophyllata</i>), buds	Extract	15 g/kg	African sharptooth catfish (<i>Clarias gariepinus</i>)	Improve immunity (increase red blood cells, haemoglobin, haematocrit, white blood cells, platelets, lymphocytes, and heterocysts, while monocytes, eosinophil)	Adeshina et al. (2019)
Fishwort (<i>Houttuynia cordata</i>)	Powder	1.5–3%	Sea cucumber (<i>Apostichopus japonicus</i>)	Improve immunity (increase alkaline phosphatase, acid phosphatase, superoxide dismutase, lysozyme activity of intestine)	Dang et al. (2019)
Rosemary (<i>Salvia Rosmarinus</i>)	Leaf powder	2–3%	Common carp (<i>Cyprinus carpio</i>)	Mitigate the negative effects of crowding stress	Yousefi et al. (2019)

Table S2 to be continued

Herbal name	Compound	Dose	Species	Function	References
Female ginseng (<i>Angelica sinensis</i>)	Extract	1–6 g/kg	Common carp (<i>Cyprinus carpio</i> var. Jian)	It could be used as an inhibitor of trichlorfon stress in fish	Li et al. (2019a)
Female ginseng (<i>Angelica sinensis</i>)	Extract	1–6 g/kg	Common carp (<i>Cyprinus carpio</i> var. Jian)	Could be used as a natural antioxidant	Li et al. (2019b)
Bupleurum (<i>Radix Bupleuri</i>)	Saikosaponins and flavonoids	1–3 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Protect against H ₂ O ₂ -induced oxidative damage	Jia et al. (2019)
Moringa (<i>Moringa oleifera</i>)	Seeds and leaves extract	7, 10%	Nile tilapia (<i>Oreochromis niloticus</i>)	Resist oxidative stress	Ibrahim et al. (2019)
Moringa (<i>Moringa oleifera</i>)	Leaf powder	0.5%	Giant river prawn (<i>Macrobrachium rosenbergii</i>)	Prevent high ammonia stress	Kaleo et al. (2019)
Common purslane (<i>Portulaca oleracea</i> L.)	Leaf powder	1–3%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve growth, antioxidant, and immunological responses	Abdel-Razek et al. (2019)
Maidenhair tree (<i>Ginkgo biloba</i>)	Extract	0.1–0.2%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Moderate the growth-suppressing effects, stress, and liver tissue damage induced by diazinon	Hajirezaee et al. (2019)
Aloe-emodin	Aloe-emodin	10 mg/kg	Rohu (<i>Labeo rohita</i>)	Improve innate immunity (IL-1 β , IL-8, TNF- α , iNOS)	Devi et al. (2019)
Hardy rubber tree (<i>Eucommia ulmoides</i>)	Leaf powder	5–20 g/kg	Turbot (<i>Scophthalmus maximus</i> L.)	Improve non-specific immunity (lysozyme, immune cytokines)	Zhang et al. (2019)
Icariin	Icariin	100 mg/kg	Chinese mitten crab (<i>Eriocheir sinensis</i>)	Improve non-specific immunity (transcriptional expression of MnSOD, Trx-1, Relish)	Zheng et al. (2019)
Milkvetch (<i>Astragalus</i>) polysaccharide	Astragalus polysaccharide	800 mg/kg	Sea cucumber (<i>Apostichopus japonicus</i>)	Improve non-specific immunity (NF- κ B signaling pathway)	Song et al. (2019)
Mangrove apple (<i>Sonneratia</i>)	Leaf extract	3.0–5.0%	Goldfish (<i>Carassius auratus</i>)	Improve non-specific immunity (albumin, lysozyme activity)	Afzali and Wong (2019)
Elephant's Foot (<i>Elephantopus scaber</i>)	Extracts	5 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve mucosal immunity (skin mucus immune response, serum immunity)	Van Doan et al. (2019b)
Aloe barbadensis (<i>Aloe vera</i>)	Powder	15 g/kg	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (respiratory burst activity, lysozyme activity, and complement system; TNF- α , IL-1 β , IL-6, IL-8 gene expression)	Mehrabi et al. (2019)

Table S2 to be continued

Herbal name	Compound	Dose	Species	Function	References
Fingerroot (<i>Boesenbergia rotunda</i>)	Powder	10 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (lysozyme and peroxidase activities)	Van Doan et al. (2019a)
Rosemary (<i>Rosmarinus Officinalis</i>)	Rosemary	0.5%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (complement C3, IgM)	Naïel et al. (2019)
Lemon peels	Powder	1–2%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (lysozyme and MPO activities, nitric oxide content, phagocytic activity)	Rahman et al. (2019)
Milk thistle (<i>Silybum marianum</i>)	Seed powder	7.5–10 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (IgM, SOD, CAT)	Hassaan et al. (2019)
Assam tea (<i>Camellia sinensis</i>)	Extract	2 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (serum lysozyme, peroxidase, ACH50, phagocytosis, respiratory burst activities)	Van Doan et al. (2019c)
Garlic (<i>Allium sativum</i>)	Powder	15–20 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (haemoglobin, haematocrit, white blood cells, red blood cells, mean corpuscular volume, mean corpuscular haemoglobin concentration)	Naqi et al. (2019)
Fenugreek (<i>Trigonella foenum-graecum</i>)	Seed extract	3–5%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (IL-6, IL-8 genes expressions)	Abbas et al. (2019)
Common barberry (<i>Berberis vulgaris</i>)	Root powder and methanol extract	500 mg/kg	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (lysozyme, ACH50)	Ramezanzadeh et al. (2019)
Maidenhair tree (<i>Ginkgo biloba</i>)	Leaf ethanol extract	1–2 g/kg	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (peroxidase activity, total immunoglobulin, and lysozyme activity; IL-1 β , TGF- β 1 expression)	Hajirezaee et al. (2019)
Moringa (<i>Moringa oleifera</i>), Rosemary (<i>Rosmarinus officinalis</i>), Turmeric (<i>Curcuma longa</i>)	Leaf powder	1%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (lysozyme and respiratory burst activity)	Ayoub et al. (2019)

Table S2 to be continued

Herbal name	Compound	Dose	Species	Function	References
Maidenhair tree (<i>Ginkgo biloba</i>)	Leaf extract	10 g/kg	Common carp (<i>Cyprinus carpio</i>)	Improve immunity by upregulate IL-1 β , IL-8, TNF- α , IL-10, TGF- β	Bao et al. (2019)
Guava (<i>Psidium guajava</i>)	Leaf	0.5–1%	Common carp (<i>Cyprinus carpio</i>)	Improve immunity (total Ig, alkaline phosphatase activity, lysozyme activity, TNF- α , IL-1 β , IL-8)	Hoseinifar et al. (2019)
Oregano (<i>Origanum vulgare</i>)	Powder	0.5–1%	Gilt-head seabream (<i>Sparus aurata</i>)	Improve both humoral (IgM, bactericidal activity in skin mucus and protease activity in serum), cellular (head kidney leucocytes phagocytic ability) immunity	Beltran et al. (2020)
Prepared foxglove root (<i>Radix Rehmanniae Preparata</i>)	–	0.2%	Bulatmai barbel (<i>Luciobarbus capito</i>)	Improve immunity (increase serum lysozyme, ACP, SOD, ALP, TP)	Wu et al. (2019)
Mexican tea (<i>Chenopodium ambrosioides</i> L.)	Powder	0.5–2%	Pacific red snapper (<i>Lutjanus peru</i>)	Improve non-specific immunity (lysozyme and peroxidase activities)	Maldonado-Garcia et al. (2019)
Ginger (<i>Zingiber officinale</i>)	Powder	2%–3%	Zebrafish (<i>Danio rerio</i>)	Elevate antioxidant and immuno-activity (decrease immunoglobulin level, alternative complement activity, lysozyme activity, up-regulate catalase, lysozyme mRNA levels)	Ahmadifar et al. (2019)
Mushroom	Extract	6%	Spiral Babylon (<i>Babylonia spirata</i>)	Enhance antioxidants (SOD, CAT)	Chelladurai and Maran (2019)
Mojave yucca (<i>Yucca schidigera</i>)	Liquid extract	0.75 mg/l	European seabass (<i>Dicentrarchus labrax</i>)	Improve the growth, improve the physiological responses, and decrease the mortality rates	Fayed et al. (2019)
Lemon	Dehydrated peel	1.5–3%	Gilt-head seabream (<i>Sparus aurata</i>)	Improve the biomolecular markers related to general stress, oxidative stress, apoptosis	Garcia Beltran et al. (2019)
Mix Fingerroot (<i>Boesenbergia pandurata</i>), Indian nightshade (<i>Solanum ferrox</i>) and Pinecone ginger (<i>Zingiber zerumbet</i>)	Plant extracts 1 : 1 : 1	3–5% of fish body weight	Nile tilapia (<i>Oreochromis niloticus</i>)	Enhance the immunomodulatory activity (white blood cell, red blood cell, phagocytic index)	Hardi et al. (2019)
Gotu kola (<i>Centella asiatica</i>)	Leaf and stem extract	10 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve mucosal immunity (serum lysozyme, serum peroxidase activities)	Srichaiyo et al. (2020b)

8 Table S2 to be continued

Herbal name	Compound	Dose	Species	Function	References
Horse mint (<i>Mentha longifolia</i>)	Stem, leaf and flower	0.2%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve mucosal immunity (lysozyme and TNF- α expression)	Heydari et al. (2020)
Fishwort (<i>Houttuynia cordata</i>)	Leaf and stem powder	10 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Increase mucosal immunity (serum lysozyme, peroxidase, ACH50, phagocytosis)	Srichaiyo et al. (2020a)
Garlic (<i>Allium sativum</i>)	Extract	0.15 ml/kg	Guppy (<i>Poecilia reticulata</i>)	Improve mucosal immunity (lysozyme, ACH50, total IgG, ALP activity)	Ahmadniaye Motlagh et al. (2020)
Olive (<i>Olea europea</i> L.)	Olive waste cake	2.5 g/kg	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve mucosal immunity (IL-1 β , IL-8, TNF- α , TGF-1 β expression)	Hoseinifar et al. (2020c)
Moringa (<i>Moringa oleifera</i>)	Leaf extract	1.5, 5%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (respiratory burst, phagocytic and lysozyme activities, IgM level)	Abd El-Gawad et al. (2020)
Rosemary (<i>Salvia rosmarinus</i>)	Leaf powder	10 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (serum catalase, alternative complement, nitroblue tetrazolium, lysozyme activities)	Naïel et al. (2020)
Fenugreek (<i>Trigonella foenum-graecum</i>)	Seed powder	3%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (IL-1 β , TNF- α expression, AST, ALT activity)	Moustafa et al. (2020)
Thumbai (<i>Leucas aspera</i>)	Powder	8 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (lysozyme activities in the serum, mucus, serum peroxidase, phagocytosis activity)	Kurian et al. (2020)
Nettle (<i>Urtica dioica</i>)	Leaf powder	0.5%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (TNF- α , IL-1 β , L-6, IL-8 expression)	Mehrabi et al. (2020)
Chinese yam (<i>Dioscorea oppositifolia</i>)	Water extract	0.4%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (serum C4 level, lysozyme activity, IL-6, TNF- α , IL-2 content; intestinal GPx1, TNF- α , factor H, HSP90BA, HSC70A expression)	Wang et al. (2020)
Indian jujube (<i>Ziziphus mauritiana</i>)	Leaf powder	10 g/kg	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (lysozyme, IL-1 β expression)	El Asely et al. (2020)
Common water hyacinth (<i>Eichhornia crassipes</i>)	Leaf extract	1%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (Ig, ACH50, respiratory burst activity)	Rufchaei et al. (2020)

Table S2 to be continued

Herbal name	Compound	Dose	Species	Function	References
Ribwort Plantain (<i>Plantago lanceolata</i>)	Leaf powder	1–3 g/kg	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (oxidative radical production, lysozyme activity, total myeloperoxidase)	Elbesthi et al. (2020)
Lemon verbena (<i>Aloysia citrodora</i>)	Leaf powder	2%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (lysozyme activity, total immunoglobulin level, IL-1 β , IL-8, TNF- α , TGF- β expression)	Hoseinifar et al. (2020b)
Lemon balm (<i>Melissa officinalis</i>)	Methanol extract	0.5–1 g/kg	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (total myeloperoxidase)	Bilen et al. (2020)
Rosemary (<i>Rosmarinus officinalis</i>)	Leaf ethanol extract	1–3 g/kg	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (lysozyme, total immunoglobulin)	Karatas et al. (2020)
Aloe barbadensis miller (<i>Aloe vera</i>)	Extracts	0.5, 1.0, 2.0%	Small-scaled pacu (<i>Piaractus mesopotamicus</i>)	Improve innate immunity (hormones like cortisol)	de Assis and Urbinati (2020)
Sweet wormwood (<i>Artemisia annua</i>)	Alcohol extract	0.5%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve innate immunity (respiratory burst of leukocyte, lysozyme activity)	Soares et al. (2020)
Moringa (<i>Moringa oleifera</i>)	Leaf powder	150 g/kg	Grass carp (<i>Ctenopharyngodon idella</i>)	Improve immunity (TNF- α , IL-8, and IFN- γ expression)	Faheem et al. (2020)
Common purslane (<i>Portulaca oleracea</i> L.)	Leaf ethanol extract	0.5%	Grass carp (<i>Ctenopharyngodon idella</i>)	Improve immunity (total immunoglobulin level, lysozyme activity)	Ahmadifar et al. (2020)
Common mallow (<i>Malvae sylvestris</i>)	Flower aqueous extract	3–5%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (ACH50, total immunoglobulin, lysozyme)	Rashidian et al. (2020)
Oak (<i>Quercus castaneifolia</i>)	Leaf extract	1–2 g/kg	Common carp (<i>Cyprinus carpio</i>)	Improve immunity (reduced glutathione, lysozyme, complement, bactericidal activity, decreased malondialdehyde)	Paray et al. (2020)
Garlic (<i>Allium sativum</i>)	Extract	5 g/kg	Common carp (<i>Cyprinus carpio</i>)	Improve immunity (lysozyme, IgM, RBC, haemoglobin, haematocrit)	Karimi Pashaki et al. (2020)
Sage (<i>Salvia officinalis</i>) and Lemon verbena (<i>Lippia citriodora</i>) extracts	Extract	0.1%	Gilt-head seabream (<i>Sparus aurata</i>)	Improve immunity (upregulate lysozyme, IgM, TNF- α , IL-1 β , TNF- β 1, IL-10)	Salomon et al. (2020)
Tears of the virgin (<i>Eleutherine bulbosa</i>)	Powder	12.5 g/kg	Pacific white shrimp (<i>Litopenaeus vannamei</i>)	Improve immunity (total haemocyte count, phenoloxidase activity, and respiratory bursts)	Munaeni et al. (2020)

Table S2 to be continued

Herbal name	Compound	Dose	Species	Function	References
Geniposide	-	100 mg/kg	Crucian carp (<i>Carassius carassius</i>)	Improve immunity (increase lysozyme activity, SOD activity, C3, CAT activity)	He et al. (2020)
Horse mint (<i>Mentha longifolia</i>)	Extract	4–6%	Caspian white fish (<i>Rutilus frisii kutum</i>)	Improve immunity (increase lysozyme)	Gholamhosseini et al. (2020a)
Mongolian milkvetch (<i>Astragalus membranaceus</i>) and Bupleurum (<i>Bupleurum chinense</i>)	-	0.25–0.5%	Pacific white shrimp (<i>Litopenaeus vannamei</i>)	Improve immunity (expression of IMD, lysozyme, Toll-like receptor)	Angela et al. (2020)
Black cumin (<i>Nigella sativa</i>)	Extract	7.5 g/kg	Pacific white shrimp (<i>Litopenaeus vannamei</i>)	Improve immunity (Total Haemocyte Count, granular cells, hyalin cells, relative percent survival)	Nur et al. (2020)
Doum Palm (<i>Hyphaene thebaica</i>)	Fruit powder	10–15 g/kg	African sharp tooth catfish (<i>Clarias gariepinus</i>)	Improve non-specific immunity (lysozyme, nitric oxide production, and sialoglycans, namely α 2,3-sialyltransferase, α 2,6-sialyltransferase content)	Al-Khalafah et al. (2020)
Peppermint (<i>Mentha piperita</i>)	Powder	4 g/kg	Caspian roach (<i>Rutilus caspicus</i>)	Improve immunity (increase soluble protein, alkaline phosphatase, lysozyme enzyme activity)	Paknejad et al. (2020)
Horse mint (<i>Mentha longifolia</i>)	Leaf	40%	Gibel carp (<i>Carassius auratus gibelio</i>)	Improve immunity (increase SOD, CAT, and lysozyme activities, or decreased serum MDA, and PCC contents)	Zhang et al. (2020a)
Gale of the wind (<i>Phyllanthus amarus</i>)	Extract	20 g/kg	Pacific white shrimp (<i>Litopenaeus vannamei</i>)	Improve immunity (total haemocyte count, PO activity, phagocytic activity, O_2^- production)	Ngo et al. (2020)
Garlic (<i>Allium sativum</i>)	Extract	2–4%	Pacific white shrimp (<i>Litopenaeus vannamei</i>)	Enhance the activities of antioxidant	Chirawithayaboon et al. (2020)
Milkvetch (<i>Astragalus</i>) polysaccharides	-	0.1–0.2%	Chinese mitten crab (<i>Eriocheir sinensis</i>)	Improve immunity (phagocytic activity of haemocytes and the expression levels of the PO, GSH-Px, ALP, Crust, MasL, HSP genes)	Cui et al. (2020)
Pomegranate (<i>Punica granatum</i>)	Peel extract	2%	Goldfish (<i>Carassius auratus</i>)	Reduce the enteric gram-negative bacteria count	Ahmadifar et al. (2020)

Table S2 to be continued

Herbal name	Compound	Dose	Species	Function	References
Rock-tea (<i>Jasania glutinosa</i>)	Powder	10–30%	Gilt-head seabream (<i>Sparus aurata</i>)	Have antioxidant protection and immunostimulant effects (peroxidase activity, immunoglobulin M levels, complement activity, phagocytic, respiratory burst, peroxidase activities)	Espinosa et al. (2020)
Antraquinone	Water extracts	0.25–0.5 g/kg	Freshwater shrimp (<i>Macrobrachium nipponense</i>)	Improve hyperthermia tolerance	Song et al. (2020)
Turmeric (<i>Curcuma longa</i>)	–	10 g/kg	Common carp (<i>Cyprinus carpio</i>)	Improve anti-stress against copper exposure	Rajabiesterabadi et al. (2020)
Sweet wormwood (<i>Artemisia annua</i>)	Leaf extract	0.5%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve innate immunity (respiratory burst of leukocyte, lysozyme activity)	Soares et al. (2020)
Mojave yucca (<i>Yucca schidigera</i>)	Extract	0.75 mg/l	Common carp (<i>Cyprinus carpio</i>)	Anti-inflammation influences induced by acute ammonia stress, improve growth and antioxidant (CAT, SOD, IL-10), decrease TNF- α , IFN- γ , HSP-70, IL-1 β	Dawood et al. (2021)
Allicin	Allicin	1 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve innate immunity (IgG and IgM)	Hamed et al. (2021)
Siberian ginseng (<i>Acanthopanax senticosus</i>)	Powder	2–4 %	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (plasma and hepatic non-specific immune indexes)	Li et al. (2021)
Licorice (<i>Glycyrrhiza glabra</i> L.)	Root powder	10 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve immunity (lysozyme activity, respiratory burst, total immunoglobulin)	Abdel-Tawwab and El-Araby (2021)
Wild tarragon (<i>Artemisia dracunculoides</i>)	Methanol extract	2%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve immunity (ACH50, mucus bactericidal activity)	Gholamhosseini et al. (2021)
Milkvetch (<i>Astragalus</i>) polysaccharides	Powder	1 g/kg	Grass carp (<i>Ctenopharyngodon idella</i>)	Improve immunity (TNF- α , IL-1 β , CSE, ILF2, DCLK1, TAGAP expression)	Shi et al. (2021)
Marjoram (<i>Origanum majorana</i>)	Extract	200 mg/kg	Common carp (<i>Cyprinus carpio</i>)	Improve immunity (increase lysozyme, total immunoglobulin levels, mucosal complement, lysozyme, alkaline phosphatase activities)	Yousefi et al. (2021)
Grape seed (<i>Vitis vinifera</i>)	Extract	20–30 g/kg	Common carp (<i>Cyprinus carpio</i>)	Improve immunity (increase serum total protein, globulin, lysozyme activity)	Mehrinakhi et al. (2021)

Table S2 to be continued

Herbal name	Compound	Dose	Species	Function	References
Jamun (<i>Syzygium cumini</i>)	Leaf extract	10 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Increase immunological antioxidant parameters	Kannan et al. (2022)
Fenugreek (<i>Trigonella foenum-graecum</i>)	Methanolic extract	0.2%	Nile tilapia (<i>Oreochromis niloticus</i>)	Increase antioxidant enzyme, lysozyme, phagocytic activities	Diab et al. (2023)

IL-1 β = Interleukin-1 β ; TNF- α = Tumor Necrosis Factor- α ; AST = Aspartate transaminase; ALT = Alanine transaminase; ALP = Alkaline phosphatase; SOD = Superoxide dismutase; IgM = Immunoglobulin M; HSP70 = Heat Shock Protein 70; HSP90 = Heat Shock Protein 90; IkB- α = nuclear factor of kappa light polypeptide gene enhancer in B-cells inhibitor, α ; GR = Glucocorticoid Receptor; H₂O₂ = Hydrogen peroxide; IL-8 = Interleukin-8; iNOS = Inducible Nitric Oxide Synthase; MnSOD = Manganese superoxide dismutase; Trx-1 = Thioredoxin 1; NF- κ B = Nuclear factor kappa B; IL-6 = Interleukin-6; C3 = Complement Component 3; MPO = Myeloperoxidase; CAT = Catalase; ACH50 = Alternative Complement Activity; TGF- β 1 = Transforming Growth Factor β 1; IL-10 = Interleukin-10; ACP = Acid Phosphatase; TP = total protein; mRNA = Messenger Ribonucleic acid; IgG = Immunoglobulin G; C4 = Complement Component 4; IL-2 = Interleukin-2; GPx = Glutathione Peroxidase; HSC70 = Heat Shock cognate 70; Ig = Immunoglobulin; IFN- γ = Interferon Gamma; RBC = Red Blood Cell; IMD = Immune Deficiency; MDA = Malondialdehyde; PCC = Prothrombin Complex Concentrate; O₂⁻ = Superoxide anion radical; PO = Phenoloxidase; GSH-Px = Glutathione peroxidase; ALF = TFIIIAalpha/beta-like factor; Crus1 = Crustin 1; MasL = Maackia Amurensis Seed Lectin; HSP = Hereditary Spastic Paraplegia; CSF = Cerebrospinal Fluid; ILF2 = Interleukin enhancer-binding factor 2; DCLK1 = Doublecortin Like Kinase 1; TAGAP = T cell activation RhoGTPase activating protein

Table S3. Use of medicinal plants as anti-virus and anti-bacteria in aquaculture

Anti-virus					
Herbal name	Compound	Dose	Fish species	Virus	References
Mexican poppy (<i>Argemone mexicana</i>)	Ethyl acetate extracts of stem and root	100–400 mg/kg	Pacific white shrimp (<i>Penaeus vannamei</i>)	WSSV	Palanikumar et al. (2018)
Sabah Snake Grass (<i>Clinacanthus nutans</i>)	Extract	0.1–2.5 mg/ml	Common carp (<i>Cyprinus carpio</i> koi)	CyHV-3	Haetrakul et al. (2018)
Magnolol	–	0.62–2.46 mg/l	Grass carp (<i>Ctenopharyngodon idella</i>)	GCRV	Chen et al. (2018)
Coumarin derivative	–	10 µl/fish	Zebrafish (<i>Danio rerio</i>)	SVCV	Shen et al. (2018)
Saikosaponin D	–	6 mg/kg	Common carp (<i>Cyprinus carpio</i>)	SVCV	Shen et al. (2019)
Cape jasmine (<i>Gardenia jasminoides</i>)	Extract	100 µl/fish	Red swamp crayfish (<i>Procambarus clarkii</i>)	WSSV	Huang et al. (2019a, 2019b)
Hesperetin	–	40–60 mg/kg	Red swamp crayfish (<i>Procambarus clarkii</i>)	WSSV	Qian and Zhu (2019)
Plant mixture	Mixture of <i>Allium sativum</i> (40%), <i>Zingiber officinale</i> (20%), Eastern purple coneflower (<i>Echinacea purpurea</i>) (20%), and Holy basil (<i>Ocimum sanctum</i>) (20%)	4 g/kg	Pacific white shrimp (<i>Penaeus vannamei</i>)	WSSV	Fierro-Coronado et al. (2019)
Chinese Violet (<i>Viola philippica</i>)	Aqueous extract	1 mg/fish	<i>Epinephelus</i> spp.	GIV	Yu et al. (2019)
Star anise (<i>Illicium verum</i> Hook. f.)	Extract	125–500 µg/ml	Grouper	GIV	Liu et al. (2020)
Olive (<i>Olea europaea</i>)	Methanolic extract	50–200 mg/kg	Pacific white shrimp (<i>Penaeus vannamei</i>)	WSSV	Gholamhosseini et al. (2020b)
Geniposidic acid	–	50 mg/kg	Red swamp crayfish (<i>Procambarus clarkii</i>)	WSSV	Huang et al. (2020)
Chinese goldthread (<i>Coptis chinensis</i> Franch)	Berberine	30–50 mg/kg	Prussian carp (<i>Carassius gibelio</i>)	CyHV-2	Su et al. (2021)

Table S3 to be continued

Anti-bacteria					
Herbal name	Compound	Dose	Fish species	Function	References
Holy basil (<i>Ocimum Sanctum</i>)	Methanolic extract	100–200 mg/kg	Greasy grouper (<i>Epinephelus tauvina</i>)	Against <i>Vibrio harveyi</i> infection	Sivaram et al. (2004)
Guava (<i>Psidium guajava</i>)	Leaf extracts	1–10 mg/g	Nile tilapia (<i>Oreochromis niloticus</i>)	Enhance the resistance to <i>Aeromonas hydrophila</i>	Gobi et al. (2016)
Peppermint (<i>Mentha piperita</i>)	Extract	3%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve against <i>Yersinia ruckeri</i>	Adel et al. (2016)
Chinaberry tree (<i>Melia Azedarach</i>)	Extract	1.5 g/kg	Major south asian carp (<i>Catla catla</i>)	Against <i>Aeromonas hydrophila</i> infection	Rajeshwari et al. (2016)
Pumpkin (<i>Cucurbita mixta</i>)	–	4, 6 g/kg	Mozambique tilapia (<i>Oreochromis mossambicus</i>)	Enhance disease resistance against <i>Aeromonas hydrophila</i>	Musthafa et al. (2017)
Lead tree (<i>Leucaena leucocephala</i>)	Powder	33%	African sharp-tooth catfish (<i>Clarias gariepinus</i>)	Enhance against infection by <i>Vibrio harveyi</i> , <i>Pseudomonas aeruginosa</i>	Verma et al. (2018)
Velvet bean (<i>Mucuna pruriens</i>)	Powder	4–6 g/kg	Mozambique tilapia (<i>Oreochromis mossambicus</i>)	Against <i>Aeromonas hydrophila</i> infection	Musthafa et al. (2018)
Mongolian wild onion (<i>Allium mongolicum</i> Regel)	Flavonoids	40 mg/kg	Northern snakehead (<i>Channa argus</i>)	Increase disease resis- tance against <i>Aeromonas hydrophila</i>	Li et al. (2018)
Basil (<i>Ocimum gratissimum</i>)	Leaf extract	12 g/kg	African sharp-tooth catfish (<i>Clarias gariepinus</i>)	Enhance fish challenge against <i>Listeria monocytogenes</i>	Abdel-Tawwab et al. (2018)
Mangrove apple (<i>Sonneratia caseolaris</i>)	Extract	3.17 mg/ml	African sharp-tooth catfish (<i>Clarias gariepinus</i>)	Prevent against <i>Edwardsiella tarda</i> infection	Aznan et al. (2018)
Common purslane (<i>Portulaca oleracea</i> L.)	Leaf powder	1%–3%	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve resistance against <i>Aeromonas hydrophila</i> infection	Abdel-Razek et al. (2019)

Table S3 to be continued

Anti-bacteria					References	
Herbal name	Compound	Dose	Fish species	Function	References	
San-Huang-San	–	500 mg/kg	Pacific white shrimp (<i>Litopenaeus vannamei</i>)	Enhance resistance to <i>Vibrio parahaemolyticus</i>	Zhai and Li (2019)	
Garlic (<i>Allium sativum</i>)	Extract	1.0 g	Nile tilapia (<i>Oreochromis niloticus</i>)	Prevent <i>Streptococcus iniae</i> infection	Foyosal et al. (2019)	
Smoketree (<i>Cotinus coggygia</i>)	Methanolic extract	24 mg/32.34 g body weight	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Against <i>Aeromonas hydrophila</i> infection	Bilen and Elbeshti (2019)	
Jojoba (<i>Simmondsia chinensis</i>)	Powder	0.5–2 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Against <i>Aeromonas hydrophila</i> infection	Sarhan et al. (2019)	
Assam tea (<i>Camellia sinensis</i>)	Extract	2 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Offer resistance against <i>Streptococcus agalactiae</i> infection	Van Doan et al. (2019c)	
Beard lichen (<i>Usnea barbata</i>)	Extract	4 mg/ 17.41 ± 0.3 g body weight/day	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Prevent against <i>Lactococcus garvieae</i> infection	Bilen et al. (2019)	
Peppermint (<i>Mentha piperita</i>)	Essential oil	0.25%	Nile tilapia (<i>Oreochromis niloticus</i>)	Prevent against <i>Streptococcus agalactiae</i> infection	de Souza Silva et al. (2019)	
Mix Fingerroot (<i>Boesenbergia pandurata</i>), Indian nightshade (<i>Solanum nigrum</i>), Pinecone ginger (<i>Zingiber zerumbet</i>)	Plant extracts	Fingerroot (<i>Boesenbergia pandurata</i>) 600 mg/l, Indian nightshade (<i>Solanum nigrum</i>) 900 mg/l, Pinecone ginger (<i>Zingiber zerumbet</i>) 200 mg/l	Nile tilapia (<i>Oreochromis niloticus</i>)	Enhance the resistance to <i>Aeromonas hydrophila</i> and <i>Pseudomonas fluorescens</i>	Hardi et al. (2019)	
Maidenhair tree (<i>Ginkgo biloba</i>)	Leaf extract	10 g/kg	Common carp (<i>Cyprinus carpio</i>)	Improve survival rate of common carp after <i>Aeromonas hydrophila</i> infection	Bao et al. (2019)	

Table S3 to be continued

Anti-bacteria					
Herbal name	Compound	Dose	Fish species	Function	References
Coriander (<i>Coriandrum sativum</i>)	Extract	2%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve resistance against <i>Yersinia ruckeri</i> infection	Naderi Farsani et al. (2019)
Prepared foxglove root (<i>Radix Rehmanniae Pre-parata</i>)	–	0.2%	Bulatmai barbel (<i>Luciobarbus capito</i>)	Enhance the disease resistance of <i>Aeromonas hydrophila</i>	Wu et al. (2019)
Lingzhi mushroom (<i>Ganoderma lucidum</i>) polysaccharides	–	2 g/kg	Giant river prawn (<i>Macrobrachium rosenbergii</i>)	Enhance the disease resistance of <i>Aeromonas hydrophila</i>	Mohan et al. (2019)
Gale of the wind (<i>Phyllanthus amarus</i>)	Extract	20 g/kg	Pacific white shrimp (<i>Litopenaeus vannamei</i>)	Enhance resistance to <i>Vibrio alginolyticus</i>	Ngo et al. (2020)
Moringa (<i>Moringa oleifera</i>)	Leave	40%	Gibel carp (<i>Carassius auratus gibelio</i>)	Increase disease resistance against <i>Aeromonas hydrophila</i> via TLR2 pathway	Zhang et al. (2020b)
Fern (<i>Adiantum capillus-veneris</i>)	Leave	2%	Common carp (<i>Cyprinus carpio</i>)	Enhance serum and mucosal bactericidal activities against different pathogenic bacteria	Hoseinifar et al. (2020a)
Tears of the virgin (<i>Eleutherine bulbosa</i>)	Powder	12.5 g/kg	Pacific white shrimp (<i>Litopenaeus vannamei</i>)	Enhance resistance against <i>Vibrio parahaemolyticus</i> infection	Munaeni et al. (2020)
Thumbai (<i>Leucas aspera</i>)	Powder	8 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Increase resistance against <i>Streptococcus</i> infection	Kurian et al. (2020)
Geniposide	–	100 mg/kg	Crucian carp (<i>Carassius carassius</i>)	Improve disease resistance against <i>Aeromonas hydrophila</i> infection	He et al. (2020)
Horse mint (<i>Mentha longifolia</i>)	Hydroalcoholic extract	0.2%	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Improve resistance to bacterial disease	Heydari et al. (2020)

Table S3 to be continued

Anti-bacteria					
Herbal name	Compound	Dose	Fish species	Function	References
Berberine	–	1 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Boost disease resistance	Hoseinifar et al. (2020a)
Rosemary (<i>Salvia rosmarinus</i>)	Leaf powder	10 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Improve disease resistance of <i>Oreochromis niloticus</i>	Naïel et al. (2020)
Garlic (<i>Allium sativum</i>)	Ethanol extract	200 mg/kg	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Prevent fungal growth in the culturing centre	Amani Denji et al. (2020)
Black cumin (<i>Nigella sativa</i>)	Extract	7500 mg/kg	Pacific white shrimp (<i>Litopenaeus vannamei</i>)	Control vibriosis	Nur et al. (2020)
Mongolian milkvetch (<i>Astragalus membranaceus</i>)	–	100 mg/kg	Goldfish (<i>Carassius auratus</i>)	Improve disease resistance	Wu (2020)
Chinese rhubarb (<i>Rheum officinale</i>)	Extract	0.1, 1.0 g/kg	Orange-spotted grouper (<i>Epinephelus coioides</i>)	Against <i>Vibrio</i> <i>parahaemolyticus</i> , <i>Vibrio vulnificus</i> , <i>Vibrio alginolyticus</i> , <i>Vibrio carchariae</i> , <i>Aeromonas</i> , <i>Edwardsiella tarda</i>	Kuo et al. (2020)
Yucca (<i>Yucca filamentosa</i>)	Extract	0.1%	Nile tilapia (<i>Oreochromis niloticus</i>)	Increase disease resistance	Abeer and Naena (2020)
Tamarind (<i>Tamarindus indica</i> L.)	Extract	15 g/kg	Nile tilapia (<i>Oreochromis niloticus</i>)	Protect against <i>Aeromonas hydrophila</i> infection	Adeniyi et al. (2021)
Box myrtle (<i>Myrica esculenta</i>)	Ethanol extract	40 mg/l (immerse)	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Increase haematological indices and non-specific immunological parameters	Bhat et al. (2021)
Marjoram (<i>Origanum majorana</i>)	Extract	200 mg/kg	Common carp (<i>Cyprinus carpio</i>)	Suppress fish mortality during <i>Aeromonas hydrophila</i>	Yousefi et al. (2021)

Table S3 to be continued

Anti-bacteria					
Herbal name	Compound	Dose	Fish species	Function	References
Common water hyacinth (<i>Eichhornia crassipes</i>)	Leave	2.5, 5%	Spotted snakehead (<i>Channa punctata</i>)	Enhance disease resistance against <i>Vibrio harveyi</i> infection	Verma et al. (2021)
Double-bladed sargassum (<i>Sargassum cristaeifolium</i>)	Powder	10, 20 g/kg	Pacific white shrimp (<i>Litopenaeus vannamei</i>)	Inhibit <i>Vibrio</i> spp. in the intestine of <i>Litopenaeus vannamei</i>	Jahromi et al. (2021)
Grape seed	Extract	20, 30 g/kg	Common carp (<i>Cyprinus carpio</i>)	Enhance disease resistance against <i>Aeromonas hydrophila</i>	Mehrinakhi et al. (2021)
Greek juniper (<i>Juniperus excelsa</i>)	Extract	4, 8 mg/kg	Rainbow trout (<i>Oncorhynchus mykiss</i>)	Provides protection against <i>Yersinia ruckeri</i>	Bilen et al. (2021)

WSSV = White Spot Syndrome Virus; CyHV-3 = Cyprinid Herpesvirus 3; GCRV = Grass Carp Reovirus; SVCV = Spring Viraemia of Carp Virus; GIV = Groupers Iridovirus; CyHV-2 = Cyprinid Herpesvirus 2; TLR2 pathway = Toll-Like Receptor 2

Table S4. Use of medicinal plants as anti-parasite in aquaculture

Parasite	Herbal name	Compound	Fish species	Dosage & function	References
White spot disease (<i>Ichthyophthirius multifiliis</i>)	Garlic (<i>Allium sativum</i>) and Chamomile (<i>Matricaria chamomilla</i>)	Extract	Sailfin molly (<i>Poecilia latipinna</i>)	Bath with 0.1 g/l Garlic (<i>Allium sativum</i>) and 0.4 g/l Chamomile (<i>Matricaria chamomilla</i>)	Sahandi et al. (2012)
White spot disease (<i>Ichthyophthirius multifiliis</i>)	Chinese gall (<i>Galla chinensis</i>)	Ethanol extract	Channel catfish (<i>Ictalurus punctatus</i>)	Kill all theronts at concentrations of 2.5–20 mg/l; terminate reproduction of tomonts at 40 mg/l	Zhang et al. (2013)
White spot disease (<i>Ichthyophthirius multifiliis</i>)	Orange climber (<i>Toddalia asiatica</i>)	Chelerythrine, oroxylonine	Goldfish (<i>Carassius auratus</i>)	Two bioactive compounds: chelerythrine and chloroxylonine; the EC50 were 0.55 mg/l and 1.90 mg/l	Shan et al. (2014)
Gill fluke (<i>Dactylogyrus</i>) <i>Vastator</i>	Spurge (<i>Euphorbia fischeriana</i>)	Ethyl acetate extract	Goldfish (<i>Carassius auratus</i>)	The ethyl acetate extract could kill adult parasite at 10–20 mg/l	Zhang et al. (2014)
Gill fluke (<i>Dactylogyrus</i>)	Yam (<i>Dioscorea zingiberensis</i>)	Ethanol extract	Goldfish (<i>Carassius auratus</i>)	EC50 of extract was 3.427 mg/l	Jiang et al. (2014)
Gill fluke (<i>Dactylogyrus</i>)	Maidenhair tree (<i>Ginkgo biloba</i>)	Ethanol extract	Goldfish (<i>Carassius auratus</i>)	EC50 of extract was 3.544 mg/l	Jiang et al. (2014)
White spot disease (<i>Ichthyophthirius multifiliis</i>)	Babchi (<i>Psoralea corylifolia</i>)	Methanol extract	Goldfish (<i>Carassius auratus</i>)	Reduced the number of theronts released from tomonts at 2.5 mg/l	Song et al. (2015)
Salmon fluke (<i>Gyrodactylus turnbulli</i>)	Ginger (<i>Zingiber officinale</i>)	Ethanol ginger extract	Guppy [<i>Poecilia reticulata</i> (Peters)]	Significantly reduced infection bathing in ethanolic ginger extract (i.e. 5 and 7.5 ng/l for 90 and 30 min respectively)	Levy et al. (2015)
Gill fluke (<i>Dactylogyrus</i>)	Yam (<i>Dioscorea zingiberensis</i> C.H.)	Gracillin	Goldfish (<i>Carassius auratus</i>)	Gracillin was the main active compound, which showed the highest synergy rate (71.4%) and increased anthelmintic efficacies	Luo et al. (2016)
White spot disease (<i>Ichthyophthirius multifiliis</i>)	English lavender (<i>Lavandula angustifolia</i>)	Linalyl acetate (45.44%) and linalool (35.94%)	Small-scaled pacu (<i>Piaractus mesopotamicus</i>)	EC was 114 µl/l <i>in vitro</i>	Valladao et al. (2016)
White spot disease (<i>Ichthyophthirius multifiliis</i>)	Peppermint (<i>Mentha piperita</i>)	d-menthol (44.57%), p-menthone (22.95%)	Small-scaled pacu (<i>Piaractus mesopotamicus</i>)	EC was 227 µl/l <i>in vitro</i>	Valladao et al. (2016)

Table S4 to be continued

Parasite	Herbal name	Compound	Fish species	Dosage & function	References
White spot disease (<i>Ichthyophthirius multifiliis</i>)	Tea tree (<i>Melaleuca alternifolia</i>)	1-terpinen-4-ol (44.60%), cterpinene (22.36%), cterpinene (11.14%)	Small-scaled pacu (<i>Piaractus mesopotamicus</i>)	EC was 57 µl/l <i>in vitro</i>	Valladao et al. (2016)
White spot disease (<i>Ichthyophthirius multifiliis</i>)	Sweet wormwood (<i>Artemisia annua</i>)	Powder	Goldfish (<i>Carassius auratus</i>)	20 g/kg feed protects fish against Ichthyophthirius multifiliis infection	Wu et al. 2017
Salmon fluke (<i>Gyrodactylus kobayashii</i>)	Plume poppy (<i>Macleaya cordata</i>)	Methanol extract	Goldfish (<i>Carassius auratus</i>)	EC50 and EC90 of methanol extract were 8.6 and 25.5 mg/l respectively	Zhou et al. (2017)
Gill fluke (<i>Dactylogyrus minutus</i>)	Rosemary (<i>Rosmarinus officinalis</i>)	Aqueous extract	Common carp (<i>Cyprinus carpio</i>)	60–100 ml aqueous extract/100 g feed	Zoral et al. (2017)
Monogeneans	Copaiba Rana (<i>Copaifera duckei</i>)	Oleoresin	Small-scaled pacu (<i>Piaractus mesopotamicus</i>)	50 mg/l is effective against monogeneans and did not affect the health of <i>Piaractus mesopotamicus</i>	da Costa et al. (2017)
White spot disease (<i>Ichthyophthirius multifiliis</i>)	Tea tree (<i>Melaleuca alternifolia</i>) essential oil	Tea tree (<i>Melaleuca alternifolia</i>) essential oil	Pale catfish (<i>Rhandaia quelen</i>)	Significant reduction in the number (94.87%)	Baldissera et al. (2017, 2018)
Monogenea (<i>Cichlidogyrus Tilapiae</i>)	Basil (<i>Ocimum gratissimum</i>)	Ethanol extract	Nile tilapia (<i>Oreochromis niloticus</i>)	320 mg/l can kill the monogenean	Meneses et al. (2018)
White spot disease (<i>Ichthyophthirius multifiliis</i>)	Ginger (<i>Zingiber officinale</i>)	6-dehydroshogaol, 6-dehydro-10-ingerol	Grass carp (<i>Ctenopharyngodon idella</i>)	Sharply decreased the number of theronts released from encysted tomonts	Fu et al. (2019)
Salmon fluke (<i>Gyrodactylus kobayashii</i>)	Whorled Honey Flower (<i>Paris polyphylla</i>)	Methanol extract	Goldfish (<i>Carassius auratus</i>)	Kill <i>Gyrodactylus kobayashii</i> at 20 mg/l, the TI reached 37.9	Zhou et al. (2020)
Gill fluke (<i>Dactylogyrus vastator</i>)	Tridax daisy (<i>Tridax procumbens</i>)	80% ethanol leaves extract	Nile tilapia (<i>Oreochromis niloticus</i>)	4–6 g/kg diet stimulated fish performance, intestinal morphometry, antioxidants, immunity responses and resistance to <i>Dactylogyrus vastator</i>	Adeshina et al. (2021)
White spot disease (<i>Ichthyophthirius multifiliis</i>)	Mixture of Bai Wei (<i>Cynanchum atratum</i>) and Shrubby sophora (<i>Sophora flavescens</i>)	Ethanol extracts	Grass carp (<i>Ctenopharyngodon idella</i>)	6 mg/l with continuous usage for 10 days cured the infected grass carp	Fu et al. (2021)

EC50 = Median Effective Concentration; EC = Effective Concentration; EC90 = 90% Effective Concentration; TI = Therapeutic Index

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