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Phytochemicals: Essential Oils and Other Extracts for Disease Prevention and Growth Enhancement in Aquaculture: Challenges and Opportunities

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Simple Summary

This review examines the potential of essential oils (EOs) as natural additives in aquaculture, emphasizing their antimicrobial, antioxidant, and immune-boosting effects that can improve fish health and resilience. EOs, sourced from plants, offer a sustainable alternative to synthetic chemicals, promoting growth, feed efficiency, and disease resistance. However, challenges such as optimizing dosages, delivery methods, and cost-efficiency remain. Techniques like microencapsulation may improve EO stability and release, but more research is needed to refine these methods and understand how EOs affect fish health and the environment. Overcoming these challenges will enable a more sustainable and eco-friendly aquaculture industry.



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Abstract

This review explores the potential of essential oils (EOs) as natural feed additives in aquaculture, highlighting their antimicrobial, antioxidant, and immunostimulatory properties, which contribute to disease prevention and improved fish resilience. EOs, derived from aromatic plants, offer a sustainable alternative to synthetic chemicals, promoting benefits such as enhanced growth rates, feed efficiency, immune function, and reduced pathogen susceptibility. However, several challenges must be addressed to fully unravel their potential, including the optimization of dosages, effective delivery methods, and cost-efficiency. Techniques such as microencapsulation are emerging as promising solutions to improve EO stability and controlled release in aquatic feeds, though further research is needed to refine these approaches and evaluate their scalability. Additionally, there is a need for more research into the mechanisms through which EOs influence fish health, the interactions between active compounds, potential synergistic effects of EO mixtures, and their impact on the aquatic environment and microbiome. Addressing these challenges will ensure the effective and sustainable application of EOs in aquaculture, reducing reliance on synthetic chemicals while fostering a more resilient and eco-friendly industry. A key feature of this review is the systematic presentation of detailed, species-specific tables summarizing the current literature on the application of EOs and plant extracts in fish health management.

Keywords: medicinal aromatic plants; essential oils; plant extracts; fish pathogens

1. Introduction

The global aquaculture industry has experienced substantial growth, producing approximately 80.0 million tons of various aquatic species in 2024 [1,2], comprising mostly fin fish, mollusks, and crustaceans. This production accounted for over half of the world's fish consumption for the first time in history [3]. However, infectious diseases pose a significant threat to the profitability of aquaculture, with pond fish aquaculture losing 60% of its production to infectious diseases [4] and the tropical marine shrimp sector experiencing losses of around 40% due to viral diseases [5]. Traditional approaches to address these challenges, such as synthetic growth promoters and antibiotics, have raised concerns regarding food safety and environmental contamination [6].

The overuse of antibiotics in aquaculture has raised concerns about antibiotic resistance and ecological impacts. As a potential solution, researchers are investigating the use of essential oils (EOs). EOs, derived from plants, possess antimicrobial and immunostimulatory properties. Additionally, EOs can enhance fish immune systems, making them more resistant to diseases. This suggests that EOs could be used as natural additives in aquaculture feed to reduce antibiotic usage and improve overall fish health [7]. Given the challenges posed by various bacterial pathogens in aquaculture, the exploration of EOs as a potential alternative is particularly relevant.

Aromatic plants produce aromatic substances, commonly found in EOs, which contain bioactive compounds such as terpenes, terpenoids, aldehydes, ketones, acids, phenols, lactones, ethers, and esters [8]. As a result, there is a growing interest in utilizing aromatic plants to produce functional feeds in aquaculture. These functional feeds aim to promote growth, enhance feed conversion, improve health, and address concerns about food safety and environmental sustainability [9,10].

The use of aromatic plants and their extracts offer a promising eco-friendly strategy to combat fish diseases in aquaculture. Their beneficial properties have been demonstrated through numerous scientific studies, often showing comparable or superior efficacy to synthetic substances like antibiotics [11–15]. Additionally, the use of aromatic plants aligns with societal demands for safe and environmentally friendly food production practices.

Furthermore, aromatic plants and their extracts serve as natural immunostimulants, enhancing the innate immune response of aquatic organisms. Unlike vaccines, which target specific pathogens, immunostimulants improve overall immune function, thereby reducing the susceptibility of fish to various opportunistic pathogens [7,16–18]. By promoting stress resistance, growth, appetite, and immune function, aromatic plants contribute to the overall health and well-being of aquatic organisms in aquaculture systems.

The integration of aromatic plants and their extracts into aquaculture practices represents a holistic and sustainable approach to disease management and health promotion. This strategy not only addresses the challenges posed by infectious diseases but also aligns with consumer preferences for safe, eco-friendly, and ethically produced seafood [14,19].

This review assesses the potential of essential oils (EOs) and selected plant extracts as natural feed additives in aquaculture. Based on studies identified in our review, we summarize the species examined, inclusion levels, and reported outcomes. The evidence is organized into sections with species-specific tables that collate the studies identified in our review and their main findings.

Recognizing that taxonomy is sometimes applied unevenly in the relevant literature, we adopted POWO [20] and WoRMS [21] to standardize names, thereby limiting ambiguity and facilitating cross-study synthesis.

2. Enhancement Overview of Reported Benefits of Essential Oils (EOs)

The growing body of research on EOs in aquaculture continues to uncover a wide range of benefits for various fish species. EOs such as Cinnamon EO and Origanum EO have been linked to enhanced growth rates, feed conversion efficiency, immune status, disease resistance, and intestinal health in species like *Dicentrarchus labrax* and *Oreochromis niloticus* [22–25]. El-Sayed et al. (2024) [26], further support the potential benefits of EOs in aquaculture. Their study demonstrated that dietary supplementation with a mixture of botanical compounds and EOs in Nile tilapia significantly improved feed efficiency, antioxidant status, immune parameters, and digestive health.

Thyme EO, particularly when combined with a prebiotic, has shown promising results in *Oncorhynchus mykiss*, significantly enhancing growth performance, digestive enzyme activity, and humoral as well as skin and intestinal immune responses [27]. In *Cyprinus carpio*, the inclusion of *Yucca schidigera* EO improved intestinal antioxidant capacity and immune response [28], while Lavender EO also promoted growth, immune-related gene expression, and reduced stress response [29]. Additionally, *Rosmarinus officinalis* EO has demonstrated the ability to control parasitic infections in *Cyprinus carpio*, particularly against monogenean infections [30].

Moreover, EOs such as Garlic EO and bioactive compounds like Carvacrol and Thymol have been shown to promote skin innate immunity, modulate transcriptional immune responses, and reduce stress and bacterial growth in the mucus of *Sparus aurata* [31]. *Cinnamomum verum* EO has demonstrated its ability to reduce the toxic effects of aflatoxin B1, improving hematological indices, serum biochemistry, and liver histopathology in *Oncorhynchus mykiss* [32]. EOs offer significant potential in promoting growth, immunity, antioxidant capacity, and intestinal health in aquaculture, providing a natural and effective approach to improving fish welfare and performance. These diverse health benefits, particularly improvements in digestion and immune function, contribute to enhanced growth and feed efficiency, paving the way for their use as growth promoters.

In addition to the potential benefits of EOs on growth in aquaculture, their impact on reducing stress is also significant. EOs, such as oregano oil, have been studied for their stress-reducing capabilities in fish, particularly under intensive farming conditions where stress levels are elevated due to high stocking densities and other environmental factors [33]. El-Hawarry et al., in 2018 [33], investigated the combined effects of rearing density and oregano oil supplementation on the growth, behavior, and stress response of Nile tilapia (*Oreochromis niloticus*). The findings demonstrated that oregano oil supplementation positively influenced growth rates and improved behavioral responses, especially under high-density conditions. Additionally, it significantly reduced stress responses in the fish, suggesting that oregano oil can act as an effective stress-reducing agent in aquaculture systems.

The stress-reducing mechanisms of EOs are believed to be linked to their antioxidant properties, which lower oxidative stress, as well as their anti-inflammatory effects, which can help to mitigate stress-induced inflammation, a significant parameter for improving the welfare of fish reared under high-density conditions [34].

Table S1 synthesizes the studies identified in our review, reporting benefits of dietary EOs in aquaculture [22–25,27–30,32,35–80].

3. The Role of EOs in Palatability and Growth Enhancement

Fish palatability is a critical factor, influencing the potential benefits of fish feed additives, directly affecting feed intake and overall growth performance [81]. There is evidence suggesting that certain MAPs extracts can actually enhance appetite and improve feed intake in fish when used at appropriate doses. Abdel-Tawwab et al. [82] reported

that dietary green tea supplementation improved feed intake and growth performance in Nile tilapia, likely due to enhanced palatability and metabolic stimulation. Similarly, Dawood et al. [83] reviewed several studies reporting that various herbal EOs can enhance fish feed palatability; however, high doses may inhibit feed consumption.

Additionally, garlic stands out as one of the most studied aromatic plants for growth promotion in fish and crustaceans [84]. Studies have shown that incorporating garlic into fish diets enhances consumption, specific growth rates, and weight gain [85]. Similar growth-promoting effects have been observed with other aromatic plants rich in compounds like thymol and carvacrol, such as thyme and oregano. Peppermint has also demonstrated growth-enhancing properties when added to fish diets, with dose-dependent improvements in growth rates [86]. Fenugreek seeds have garnered interest for their growth-stimulating effects in various fish species, showing significant improvements in growth parameters when included in the diet [87]. It is important to note that many studies have also reported beneficial effects of aromatic plant extracts and oils on other aspects of animal health and well-being, though not directly related to growth.

A period of adaptation may be required in some cases; for example, long-term dietary supplementation with lavender oil improved feed utilization and digestive enzyme activities in European seabass without negative effects on feed acceptance [54]. It can be stated that while MAPs can improve palatability and overall performance, a period of adaptation and optimization of dosage is crucial to avoid adverse effects on feed intake.

4. The Immunostimulatory Properties of Essential Oils and Applications for Disease Prevention in Aquaculture

Fish possess an immune system, which includes both innate and adaptive components. The innate immune system provides immediate, non-specific defenses against a wide range of pathogens, utilizing physical barriers such as the skin and gills, as well as cellular and humoral factors like phagocytes and complement proteins. The adaptive immune system offers long-lasting and specific protection against pathogens. Immunostimulation seeks to enhance the function of both the innate and adaptive immune systems in fish. By stimulating the production of immune cells, increasing the activity of immune-related genes, and improving the overall immune response, immunostimulation helps fish better defend against diseases [17].

Immunostimulation plays a crucial role in addressing current and future challenges in aquaculture by helping combat emerging diseases and enabling fish populations to develop resistance to pathogens. It can also help mitigate the effects of environmental stressors, such as those affected by climate change, which can compromise fish health. The expected benefits of immunostimulation include improved disease resistance, reducing mortality rates and enhancing overall health. Additionally, immunostimulants can reduce the reliance on antibiotics, thereby mitigating the risk of antibiotic resistance and contributing to the sustainability of aquaculture practices [83,88–90]. The mechanism involved in immunostimulatory effects of EOs include toll-like receptors (TLRs) of immune cells, which play a critical role in recognizing pathogens and triggering immune responses. When TLRs are activated, they stimulate the production of pro-inflammatory cytokines such as IL-1 β , which is crucial for initiating and regulating the immune response. The production of IL-1 β in response to EOs indicates their potential as immunostimulants, helping fish against infections and diseases [91–97]. However, it is essential to maintain a balance since excessive IL-1 β production could lead to harmful inflammation. Therefore, while EOs can enhance the immune system, their use should be carefully managed. This balance is crucial in ensuring that EOs contribute positively to fish health and well-being without causing detrimental inflammation-related issues [16,98–100]. Another benefit of EOs is the

functional integrity of gut health in fish. A functionally intact gut is crucial for the immune system of fish, as it helps reduce oxidative stress and enhance nutrient absorption. By reducing pathogenic bacteria and promoting beneficial gut microbiota, EOs contribute to a healthier intestinal environment [16,97,101]. By supporting gut health, EOs can indirectly bolster the immune system, making fish more resilient to diseases and improving their overall well-being.

Medicinal Aromatic Plants (MAPs) offer a promising approach to improving fish health, reducing disease outbreaks, and promoting sustainable aquaculture practices [97,102].

The fight against emerging infectious diseases in aquaculture is of paramount importance for the industry's profitability and sustainability, as outbreaks continue to inflict significant economic losses globally. These outbreaks often originate from wild hosts in surrounding waters and exploit the compromised immune systems of farmed fish, which can result from stress, confinement, and genetic factors. Over the years, these outbreaks have become a recurrent challenge in aquaculture, typically emerging a few years after the introduction of new species [103].

In response to the limitations and growing concerns surrounding the use of veterinary drugs and synthetic substances in aquaculture [104], aromatic plants and their extracts have garnered increasing attention as potential alternatives. The immunostimulating and health-promoting properties of these plants make them promising candidates for replacing antibiotics and other synthetic medicines. As a result, there has been an exponential growth in research (Table S2.), focusing on the health and immunology of fish concerning the use of aromatic plants [99,105–161].

Numerous aromatic plants have been identified for their immunostimulating properties, including garlic, onion, thyme, oregano, rosemary, peppermint, fenugreek, and cumin seeds. These plants contain bioactive compounds such as allicin, thymol, and carvacrol, which have demonstrated significant immunoregulatory effects in fish [99,102,162]. For instance, thymol, a natural compound derived from thyme EO, has gained attention as a potential feed additive in aquaculture due to its antimicrobial, antioxidant, and anti-inflammatory properties. This compound is increasingly studied for its capacity to enhance fish health and reduce dependency on antibiotics [88,102,163]. The benefits of incorporating thymol as a feed additive in aquaculture are substantial. Thymol has been shown to improve fish immune function, thereby reducing disease susceptibility and promoting overall well-being [163–165]. Additionally, research indicates that thymol supplementation can enhance growth performance, leading to better growth rates, feed efficiency, and survival in various fish species [102]. Its antimicrobial properties are particularly valuable in controlling bacterial and parasitic infections, which in turn can decrease the need for antibiotic treatments [31,74,166]. Moreover, thymol contributes to improved feed quality by inhibiting spoilage and reducing mycotoxin contamination, ensuring a healthier diet for the fish [73].

Reducing reliance on antibiotics aligns with efforts to minimize the environmental impact of aquaculture by decreasing chemical usage, decreasing parasitic infestations, and mitigating the spread of antibiotic resistance [13,167–169].

Garlic and its derivatives have been studied extensively, with research indicating improvements in fish immunity and disease resistance following dietary supplementation [31,170]. Similarly, other compounds such as carvacrol, prevalent in plants like oregano, have shown promise in enhancing immune system function and reducing mortality rates in challenged fish [162–164].

Research efforts have also focused on evaluating the immunostimulating effects of aromatic plants in various aquaculture species, including finfish and crustaceans. Studies have investigated the efficacy of different plant extracts and EOs in improving fish

health parameters, such as respiratory burst, phagocytic activity, lysozyme activity, and antioxidant enzyme levels [171]. Additionally, the use of aromatic plant extracts has shown potential in controlling bacterial and parasitic infections in aquaculture settings.

While individual plant species exhibit promising immunostimulating effects, the future of disease management in aquaculture could lie in the synergistic combination of multiple plants or phytochemicals [172,173]. However, determining optimal dosages and formulations requires a thorough understanding of the bioactive compounds present in the extracts used. As such, further research is necessary to refine dosages, evaluate efficacy across different aquaculture species, and develop practical applications for integrating aromatic plants into aquafeed formulations [174].

Across the existing literature, there are numerous reports of studies aimed to investigate ways to bolster immunity against specific pathogens. Table S2 presents reported antibacterial and antifungal activity of essential oils, including plant source/part, target pathogen(s), and outcomes. Because extraction methods and chemotypes differ across different studies, we refrain from ranking efficacy. Instead, Table S2 groups in vitro findings by target pathogen and EO/major phenolics (e.g., thymol, carvacrol), to highlight recurring compound classes. We note that MIC values are assay-dependent and do not translate directly to therapeutic doses in vivo; they are best treated as screening indicators.

5. Antiparasitic Activity

Infestations of ectoparasites pose significant health risks and economic losses for both saltwater and freshwater aquacultured fish. Among these parasites, monogeneans are particularly problematic as they inhabit the skin, gills, and even the eyes of fish [175]. Traditional treatment methods involve chemotherapy baths, but these can introduce harmful substances into the environment. To address these challenges, aromatic plant extracts and essential oils (EOs) have been assessed for potential anthelmintic effects in in vitro (Table S3) [176–208] and in vivo (Table S4) assays [209–223]. Garlic, known for its anthelmintic properties, has shown efficacy against monogeneans when administered as a preventive treatment in fish feed. Garlic extract rich in allicin has been effective in reducing infections by *Neobenedenia* sp. when administered orally, as well as in bath therapies [224]. However, it appears to be less effective against juvenile parasites, suggesting its use as a preventive measure rather than a curative treatment.

EOs from other aromatic plants have also shown promise as anthelmintics. Australian tea tree oil has demonstrated dose-dependent reductions in *Gyrodactylus* spp. prevalence when used in baths [225]. Eugenol, found in clove EO, has been effective against monogeneans in tambaqui, though its effects were observed after a week [226]. Additionally, EOs from *Lippia* sp. and clove basil have shown anthelmintic effectiveness in tambaqui.

Rosemary extracts, both ethanolic and aqueous, have shown anthelmintic properties in carp, with the aqueous extract being less toxic to fish [30]. Peppermint EO has demonstrated antiparasitic effects in Nile tilapia, reducing the prevalence of certain monogenean parasites in therapeutic baths. However, the effectiveness and safety of peppermint oil varied depending on the species and concentration used, highlighting the importance of determining optimal doses for each species and pathogens [227].

Overall, natural treatments using extracts and EOs from aromatic plants hold promise as alternative strategies for controlling ectoparasites in aquaculture. Establishing toxicity limits and optimal treatment protocols for each species and pathogen could lead to the adoption of safer and more environmentally friendly treatments, reducing contamination risks for both fish and the environment. Reported in vivo antiparasitic uses span dietary prophylaxis and short therapeutic baths, with effective exposures varying by EO, species, and life stage (e.g., dose-dependent reductions with tea tree oil baths; delayed effects with eugenol;

species- and concentration-dependent responses to peppermint; lower-toxicity aqueous rosemary extracts). Given this variability, species-specific range-finding is advisable before routine application, and dietary approaches may be more practical for prevention than repeated baths. We therefore refrain from general dosing recommendations.

Where efficacy and acute toxicity were both reported, effective bath concentrations were typically $\leq 10\text{--}20\%$ of the species-specific 96 h LC₅₀ (Table S4), indicating a workable but sometimes narrow safety margin. Given variability across species, life stage, exposure time, and chemotype—and reports of non-target toxicity (e.g., *Daphnia magna*)—species-specific titration and environmental risk assessment are advisable (Table S5) [228–260].

6. Harnessing Medicinal Aromatic Plants for Sustainable Aquaculture: Challenges and Opportunities

Using MAPs as feed additives presents challenges due to inter-species variability, dose–response effects, and plant-part chemistry. For example, dose optimization is critical for thymol in *Channa argus* [166], tamarind leaf extract in *Oreochromis niloticus* [261], and oregano essential oil in *Ictalurus punctatus* [262]. While MAPs can be beneficial as feed additives, their effectiveness is highly dependent on the appropriate dosage [83]. For example adverse effects may be attributed to strong odors from certain MAPs, which at least initially affected palatability of the feed, leading to reduced feed intake and growth performance [54]. This underscores the need for further research to verify the overall efficiency of MAP dosages in fish feeds [263]. Another challenge associated with the use of EOs in aquaculture is their potential interaction with other feed additives or medications. Certain EOs might exhibit antagonistic or synergistic effects [173] when combined with other compounds in the fish diet. This necessitates thorough research to evaluate the compatibility of EOs with commonly used feed additives and medications to ensure optimal efficacy and avoid unintended consequences [76,264].

Another area of interest involves optimizing the method for incorporation of aromatic plant oils and extracts into fish feed to ensure preservation, controlled release, and effectiveness [265]. Microencapsulation has emerged as a promising method to add EOs to dry feed, preventing interactions with other feed components and preserving active compounds from degradation. This approach transforms the compounds into powder additives, facilitating homogenization in water and incorporation into fish feed [266]. Microencapsulation of aromatic medicinal plants in fish feeds is a promising strategy for boosting the nutritional and therapeutic benefits of aquaculture diets [267]. This technique involves encasing bioactive compounds, such as EOs and plant extracts, in a protective layer to enhance their stability and ensure a controlled release in fish feeds. However, several challenges must be addressed for its successful implementation. The cost of microencapsulation can be high, especially at a commercial scale, which may hinder its widespread use in the aquaculture industry.

Additionally, the encapsulation process can sometimes diminish the bioactivity of these compounds, as the conditions needed for encapsulation might reduce their effectiveness. It has been reported that the effectiveness of MAPs dosages may be influenced by the microencapsulation method used. Spray drying technology based methods have been successfully used for microencapsulation but variations in the release rates of plant EO products between different microcapsule protocols suggest that the delivery and impact of the encapsulated compounds can differ [268], although some studies indicate no significant variation. Liu et al. (2023) [263], found that while both hot and cold spray microencapsulated Origanum oils (MOOs) improved the growth and health of juvenile largemouth black bass, the specific microencapsulation technique had minimal impact on the effectiveness of the dosage. The study showed that the benefits, such as enhanced antioxidant activity

and immune responses, were more dependent on the amount of MOO used rather than the method of encapsulation. This suggests that, in this case, the dosage of bioactive compounds is more critical than the microencapsulation technique. Microencapsulation of EOs from medicinal aromatic plants offers significant benefits for protecting the EOs from oxidation, and this is crucial for commercial fish feeds supplemented with EOs of MAPs. Microencapsulation provides protection from degradation by environmental factors like light, temperature, and oxygen, enhancing the stability and longevity of EOs. Furthermore, microencapsulation allows controlled release, ensuring that EOs are delivered effectively to the fish over time, maximizing their beneficial effects while minimizing losses [269]. In turn, this stability improves the handling and storage of EOs, makes the feed more stable by preserving nutrients, and reduces off-flavors, which increases the palatability of the feed for fish [270,271]. Key techniques used in microencapsulation, such as emulsion polymerization, spray drying, and coacervation, are particularly relevant for the fish feed industry because they ensure the effective delivery and sustained efficacy of EOs. Further research is needed to explore microencapsulation protocols with novel wall materials, improve scalability, enhance cost-effectiveness, and conduct more *in vivo* studies to confirm the benefits of EOs in fish feed [83,272]. This would help in developing more effective and sustainable fish feed formulations.

Another significant challenge is ensuring that the bioactive substances are released consistently within the fish's digestive system. Despite these obstacles, microencapsulation holds great potential for promoting sustainable aquaculture by allowing the integration of plant-based alternatives into fish feeds, thereby improving fish health and growth while reducing dependence on synthetic additives. Furthermore, there is potential in incorporating oils or extracts into live prey for larvae, aiming to enhance larval development and immune system function, particularly for species with challenging larval phases. Although experiences with white leg shrimp are limited, enriching brine shrimp with garlic extract has shown positive outcomes [273].

Additionally, EOs of aromatic plants are being explored as functional additives in fish feed with high proportions of vegetable ingredients, such as soy meal. High levels of soy meal in marine fish diets can lead to intestinal inflammation [274]. Researchers have investigated the use of aromatic plant extracts and EOs to mitigate these effects. For instance, compounds containing thymol and carvacrol reduced enteritis-related parameters in Japanese sea bass fed diets with partial soy meal replacement. Similarly, a combination of EOs improved protein and fat retention and minimized fecal nitrogen loss in gilthead seabream diets with high vegetable protein content [265].

A potential new application of functional feed additives containing EOs is the development of organic aquaculture. The growing demand for organic seafood has created opportunities for using aromatic plants in aquaculture. Organic certification often requires the avoidance of synthetic additives, making natural alternatives like aromatic plants particularly appealing. By incorporating aromatic plants into organic aquaculture practices, producers can enhance fish health, reduce reliance on synthetic chemicals, and meet the growing demand for sustainable, organic seafood.

While EOs hold significant promise as natural feed additives, several aspects considering their use need further exploration. Research on the long-term effects of EO supplementation on fish physiology and immune function is still limited. Furthermore, more studies are needed to determine the precise mechanisms by which EOs influence fish growth, immune responses, and disease resistance. Future research should also focus on the possible interaction of active compounds of different EOs and any synergistic effects of combining EOs with other natural feed additives, as well as the potential impact of EOs on the aquatic environment and microbiome. While EOs offer promising natural alternatives

to synthetic chemicals in aquaculture, it is imperative to conduct thorough environmental risk assessments to ensure their safe and sustainable application. Miura et al. (2021) [275] highlighted the potential toxicity of various EOs to non-target organisms like *Daphnia magna*. Published LC₅₀ values for non-target organisms such as *Daphnia magna* vary by EO and test conditions and can overlap with nominal bath concentrations used experimentally for ectoparasites; we flag this as a limitation and a priority for future synthesis and risk assessment. To minimize risks and optimize benefits, studies should focus on determining optimal dosages and delivery methods, such as dietary inclusion or controlled release systems. By understanding the environmental implications and developing targeted application strategies, we can harness the potential of EOs in aquaculture while safeguarding aquatic ecosystems. Addressing these gaps will enable a more comprehensive understanding of how to best utilize EOs in aquaculture, ensuring their effective and sustainable application in the industry.

7. Experimental Approaches to the Safety, Efficacy, Genotoxicity, and Developmental Toxicity of EOs

Acute toxicity tests are short-term bioassays and are commonly used to determine the adverse effects of MAPs on aquatic organisms, especially fish. These tests typically measure the LC₅₀ (Lethal Concentration 50%), which represents the concentration at which 50% of the test organisms die within a fixed exposure period, often at 24, 48, or 96 h. The aim is to estimate the immediate toxic potential of a compound to help inform safe usage levels, particularly for therapeutic, anesthetic, or antiparasitic applications in aquaculture. Because EOs are complex mixtures of biologically active compounds (like terpenes, alcohols, and phenolics), their toxicity can vary significantly based on the species, life stage, environmental conditions, and exposure time (Table S5).

As already mentioned, EOs are increasingly explored as alternatives to synthetic drugs. However, their natural origin does not inherently guarantee safety. Acute toxicity tests provide critical baseline data for assessing the safety margins of these bioactive agents. Without such evaluations, there is a risk of overdosing, unintended mortality, or sublethal effects such as stress, impaired behavior, or immunosuppression. Therefore, integrating acute toxicity assessments into the early stages of EO application development is vital for ensuring both therapeutic efficacy and ecological compatibility.

Although safety evaluation is essential, comprehensive toxicity testing—particularly through alternatives to traditional animal models—has been limited. Lanzerstorfer et al., in 2021 [276], proposed a strategic approach utilizing both in vitro (cell culture) and alternative in vivo models (such as *Caenorhabditis elegans* and the hen's egg test) to thoroughly assess the acute, developmental, and reproductive toxicity, as well as the potential mucous membrane irritation, of commonly used EOs.

Table S5 compiles the studies identified in the present review that have reported toxicity tests across different fish species to date.

8. Plant and Animal Nomenclature Inconsistencies and Its Importance on Future Pharmacological Evaluation Tests and Aquaculture Use

Plant and animal taxonomy is a fundamental aspect of botanical and ecological research, yet inconsistencies in species nomenclature present significant challenges to scientific communication. This issue arises from multiple factors, including the use of outdated names, typographical errors, synonymous classifications, and the omission of taxonomic authorities. Such discrepancies hinder data accuracy, reproducibility, and interdisciplinary collaboration. Additionally, the lack of standardization in manufacturing validation and experimental methodologies, particularly in low-income countries, further complicates

research on plant-derived compounds such as EOs [277]. Addressing these inconsistencies is crucial for advancing research in biodiversity conservation, pharmacognosy, and ecological studies, as well as for ensuring reliable experimental outcomes in toxicology and pharmacological evaluations [278]. Scientific nomenclature serves as the backbone of biological classification, ensuring clarity and uniformity in species identification. However, within the field of botany, plant species are frequently assigned multiple names due to historical revisions, taxonomic reclassification, and regional naming conventions. This creates ambiguity, particularly in academic publications regarding EOs, where inconsistent terminology can obscure research findings and complicate data integration across disciplines. Furthermore, experimental approaches in plant-based research, including toxicological and pharmacological studies, often lack standardized protocols, particularly in resource-limited settings, leading to variations in study outcomes and challenges in cross-study comparisons.

A single species can be described by different researchers, leading to variations in its binomial nomenclature. For example, *Piper aduncum* L. and *Piper aduncum* Vell. ambiguously refer to the same species, yet the latter has been synonymized with *Piper hispidum* Sw. (accepted nomenclature). Without clear citation of the taxonomic authority, misidentification may occur, affecting ecological and pharmacological studies [279].

Taxonomic revisions often result in species being reclassified, rendering previous names obsolete. Many scientific publications, however, continue to use outdated or synonymous names, creating inconsistencies in databases and literature searches. This is evident in medicinal plant research, where traditional and modern nomenclature frequently diverge, leading to confusion in ethnobotanical studies and pharmaceutical applications [280].

Simple typographical errors in species names can propagate throughout the literature, reducing searchability in digital databases and causing misattributions. Omitting the taxonomic authority or incorrectly formatting Latin binomials (e.g., using lowercase subgenus names, or using botanical references (flowers of *Arnica* sp. referred to as *Arnicae anthodium*, which is a botanical reference and not a species)), can further exacerbate identification challenges [281].

The use of vernacular names instead of scientific binomials in publications introduces significant ambiguity [277]. Common names often vary across languages and regions, making them unreliable for precise scientific communication. For instance, the term “mahua” can refer to different species within the *Madhuca* genus, requiring clarification through proper taxonomic citation.

All the above can make future pharmacological evaluation tests and aquaculture use quite challenging. Addressing this need requires not only deeper investigation but also greater taxonomic precision and standardization in reporting. In this context, our study follows up on several previous reviews supporting the immunostimulatory role of MAPs and EOs in aquaculture [84,86,156,158,171–173], who emphasize herbal therapies as effective alternatives for enhancing fish immunity and disease resistance. Building on this foundation, our contribution lies in the systematic presentation of detailed, species-specific tables summarizing the current literature on the application of EOs and plant extracts in fish health management.

9. Conclusions

Aromatic plants and their EOs present valuable functional feed additives for aquaculture, offering numerous benefits including enhanced fish health, growth, and disease resistance. These natural compounds align with the industry’s goals of sustainability and environmental responsibility. However, the full potential of EOs can only be realized through addressing key challenges such as optimizing dosages, improving delivery meth-

ods, and ensuring cost-effectiveness. Microencapsulation technology holds promise for enhancing the stability and efficacy of EOs in fish feed, but further research is necessary to refine these techniques and explore their scalability. The adoption of EOs in aquaculture can reduce dependency on synthetic chemicals, thereby contributing to a more resilient, eco-friendly, and profitable industry. Continued studies are essential to refine EO applications, optimize their health-promoting properties, and ensure their successful integration into diverse aquaculture systems. In conclusion, embracing aromatic plant-based feed additives presents a pathway not only by improving fish welfare and sustainability but also by addressing the economic and ecological challenges facing modern aquaculture.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/ani15182653/s1>, Table S1: List of EOs tested in different fish species and their benefits in aquaculture, compiled from published studies identified in the present review. Table S2: Antibacterial and antifungal activities of essential oils and their major compounds against fish pathogens, compiled from published studies identified in the present review. Table S3: In vitro efficacy of different essential oils and their major compounds for different fish species, compiled from published studies identified in the present review. Table S4: In vivo efficacy of different EOs and their major compounds for different fish species, compiled from published studies identified in the present review. Table S5: Acute toxicity tests of different EOs and their major compounds for different fish species, compiled from published studies identified in the present review.

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Supplementary Material

Table S1. List of EOstested in different fish species and their benefits in aquaculture.

EO Used	Aquatic Species	Dose	Improved Parameter(s)	Reference
Ajwain	<i>Chelon ramada</i> Risso 1827 (referred to as <i>Liza ramada</i>)	0.6 -1g/kg in Feed	Growth Enhancement	[35]
	<i>Dicentrarchus labrax</i> Linnaeus 1758	1.5, 2.5, and 3.5 g/kg in Feed		[36]
Anise	<i>Micropterus salmoides</i> Lacepède 1802	0.075% in Feed	Growth Enhancement	[37]
	<i>Oreochromis niloticus</i> Linnaeus 1758	1-2ml/kg in Feed		[38]
Commercial Blend of Star Anise (plus Capsaicin & Saponins)	<i>Oreochromis niloticus</i> Linnaeus 1758	0.1-0.4g/kg in Feed	Growth Enhancement	[39]
Artemisia	<i>Micropterus salmoides</i> Lacepède 1802	0.075% in Feed	Growth Enhancement	[37]
Blend of Astragalus/ Forsythia	<i>Larimichthys crocea</i> Richardson 1846	Astragalus 0.1%/Forsythia 0.05 % to 0.15% Feed Ratio	Growth Enhancement	[40]
Blend of Astragalus/ Ginseng (Siberian)	<i>Larimichthys crocea</i> Richardson 1846	Astragalus 0.1%/Siberian Ginseng 0.05 %	Growth Enhancement	[41]
Chaste Tree	<i>Oncorhynchus mykiss</i> Walbaum 1792	50-200mg/kg Feed	Growth Enhancement	[42]
Chia seed	<i>Labeo rohita</i> Hamilton 1822	1% in Feed	Growth Enhancement	[43]
	<i>Dicentrarchus labrax</i> Linnaeus 1758	1-2%	Growth,feed utilization, intestinal microbiome	[22]
Cinnamon	<i>Oncorhynchus mykiss</i> Walbaum 1792	1%	Reduced toxic effects of aflatoxin B1, improve liver health indices	[32]
Coriander	<i>Oreochromis niloticus</i> Linnaeus 1758	0.5, 10, 15 and 20 g/kg	Growth Enhancement	[44]
Coriander (Vietnamese)	<i>Oreochromis niloticus</i> Linnaeus 1758	15-50g/kg in Feed	Growth Enhancement	[45]
	<i>Cyprinus carpio</i> Linnaeus 1758	100-400mg/kg in Feed		[46]
Costmary	<i>Oreochromis niloticus</i> Linnaeus 1758	Diet A. 1 g/kg yeast (Sc), Diet B. 0.1 g/kg costmary EO (Tb), Diet C. 1 g/kg yeast + 0.1 g/kg costmary EO (Sc + Tb)	Growth Enhancement	[47]
Dill	<i>Cyprinus carpio</i> Linnaeus 1758	1-2% in Feed	No Growth Enhancement	[48]
Fennel	<i>Salmo labrax</i> Pallas 1814	50-400mg/kg in Feed	No Growth Enhancement	[49]
Fenugreek	<i>Oreochromis niloticus</i> Linnaeus 1758	0.05, 0.1, 0.15, and 0.2%	Growth Enhancement	[50]
Flaxseed	<i>Oncorhynchus mykiss</i> Walbaum 1792	0.5, 1.0, and 1.5% in Feed	Growth Enhancement	[51]
Laurel	<i>Oreochromis niloticus</i> Linnaeus 1758	50mg/Kg &100mg/kg	Growth Enhancement	[52]

	<i>Oreochromis niloticus</i> Linnaeus 1758	1.5g/kg		[53]
Lavender	<i>Cyprinus carpio</i> Linnaeus 1758	1.0 & 1.5%	Growth rate, immunity, immune-related gene expression, and stress response	[29]
	<i>Dicentrarchus labrax</i> Linnaeus 1758	2g/kg in Feed	Growth Enhancement	[54]
Lemon (Bitter)	<i>Oreochromis niloticus</i> Linnaeus 1758	0.75%, 1%	Growth, Blood Parameters, Incrised Immune Response and Oxidative Status	[55]
Lemon Pomace	<i>Oreochromis niloticus</i> Linnaeus 1758	1-2% in Feed	Growth Enhancement	[56]
Mooseer	<i>Cyprinus carpio</i> Linnaeus 1758	1-2% in Feed	No Growth Enhancement	[48]
Orange	<i>Colossoma macropomum</i> Cuvier 1816	400 -800mg/l	Growth Enhancement	[57]
	<i>Oreochromis niloticus</i> Linnaeus 1758	1%, 3%	Growth, Blood Parameters, Incrised Immune Response and Oxidative Status	[55]
Oregano	<i>Dicentrarchus labrax</i> Linnaeus 1758	0.01%	Growth, digestive enzyme activity, antioxidant defense, immuneresponse	[25]
	<i>Labeo rohita</i> Hamilton 1822	1-1.5% in Feed		[58]
	<i>Oreochromis niloticus</i> Linnaeus 1758	0.5-1.0g/kg in Feed	Growth Enhancement	[59]
	<i>Oreochromis niloticus</i> Linnaeus 1758	0.1-0.2% (a) 0.25& 0.5 % (b)	SGR, FCR, immune status and responce, disease resistance and intestinal health	(a)[23]; (b)[24]
Oregano (onites)	<i>Oncorhynchus mykiss</i> Walbaum 1792	0.5 & 3ml/kg in Feed	Growth Enhancement	[60]
Pennyroyal	<i>Cyprinus carpio</i> Linnaeus 1758	250 mg/kg in Feed	Growth Enhancement	[61]
Peppermint	<i>Oreochromis niloticus</i> Linnaeus 1758	0.6% in Feed		[62]
	<i>Oreochromis niloticus</i> Linnaeus 1758	0.6g/kg in Feed	Growth Enhancement	[63]
Peppermint (in Chitosan nanoparticles)	<i>Huso baerii</i> Brandt 1869(referred to as <i>Acipenser baerii</i>)	10g/kg in Feed	Growth Enhancement	[64]
Blend of Peppermint & Clove	<i>Clarias gariepinus</i> Burchell 1822	1-2ml/kg in Feed	Growth Enhancement	[65]
Pot Marigold	<i>Oncorhynchus mykiss</i> Walbaum 1792	1.5% in Feed	Growth Enhancement	[66]
Purple Perilla (Shiso)	<i>Micropterus salmoides</i> Lacepède 1802	0.075% in Feed	No Growth Enhancement	[37]
Quebra-faca	<i>Colossoma macropomum</i> Cuvier 1816	0.85ml/kg in Feed	Growth Enhancement	[67]
Rosmary	<i>Cyprinus carpio</i> Linnaeus 1758	0.06-0.1%	Control of monogenean infection	[30]
Sage	<i>Cyprinus carpio</i> Linnaeus 1758	1-3ml/kg in Feed	No Growth Enhancement	[68]
Savory	<i>Cyprinus carpio</i> Linnaeus 1758	2% in Feed		[48]
	<i>Rutilus caspicus</i> Yakovlev 1870	200mg/kg in Feed	Growth Enhancement	[69]
Sea Buckthorn	<i>Oncorhynchus mykiss</i> Walbaum 1792	0.5- 1% in Feed	Growth Enhancement	[70]
Tea Tree	<i>Oreochromis niloticus</i> Linnaeus 1758	0.5-2ml/kg in Feed	Growth Enhancement	[71]
Thyme	<i>Cyprinus carpio</i> Linnaeus 1758	1-2% in Feed	Growth Enhancement	[72]
	(a) <i>Oncorhynchus mykiss</i> Walbaum 1792	1%	[1]Reduced the toxic effects of aflatoxin B1, [2] improved growth and immunity status	(a) [73]
	(b) <i>Cyprinus carpio</i> Linnaeus		immune-related genes	(b) [74,75]

	1758			[3] intestinal enzymes, digestion, Growth performance, digestive enzyme activity, humoral immune response, skin and intestinal immune parameters, liver antioxidant capacity	[27]
Thyme and prebiotic	<i>Oncorhynchus mykiss</i> Walbaum 1792	2% EO 0.2%prebiotic			
Blend of Thymol, carvacrol and cinnamaldehyde acid	<i>Oreochromis niloticus</i> Linnaeus 1758	3.3g/kg inFeed		Growth Enhancement	[76]
Blend of Thymol, carvacrol, cinnamaldehyde, and monolaurin	<i>Ctenopharyngodon idella</i> Valenciennes 1844	Certain ratio		Growth Enhancement	[77]
	<i>Pelodiscus sinensis</i> Wiegmann 1835 (referred to as <i>Trionyx sinensis</i>)				
	<i>Danio rerio</i> Hamilton 1822				
Turmeric (Wild)	<i>Channa punctata</i> Bloch 1793	2ml/kg in Feed		Growth Enhancement	[78]
Vernonia Tree	<i>Oreochromis niloticus</i> Linnaeus 1758	300-400g/13.89m ³ water		Growth Enhancement	[79]
White Goosefoot	<i>Oreochromis niloticus</i> Linnaeus 1758	20-30g/kg in Feed		Growth EnhancementEnhancement	[80]
Yucca	<i>Cyprinus carpio</i> Linnaeus 1758	0.04%		Growth, intestinal antioxidant capacityand intestinal immune response	[28]

Table S2. Antibacterial and antifungal activity of different EOs and its major compounds for different fish pathogenic species. Plant nomenclature in this work follows the Plants of the World Online (POWO) database (accessed on April 6th, 2025). If a species name cited in a reference, differs from, or is inconsistent with the updated POWO taxonomy, the referenced name is retained and noted accordingly. **Outcome:** All units are presented exactly as they appear in the original publications. **MIC₅₀ (Minimum Inhibitory Concentration 50%):** The concentration of an antimicrobial agent that inhibits visible growth of 50% of the tested microbial population. **MIC₉₀ (Minimum Inhibitory Concentration 90%):** The concentration that inhibits 90% of the tested microbial strains—used to assess antimicrobial efficacy across a population. **MBC (Minimum Bactericidal Concentration):** The lowest concentration of an antimicrobial that kills $\geq 99.9\%$ of the bacterial population. **MFC (Minimum Fungicidal Concentration):** The lowest concentration of an antifungal agent that kills $\geq 99.9\%$ of the fungal population. **MBEC (Minimum Biofilm Eradication Concentration):** The lowest concentration of an antimicrobial required to eradicate a pre-formed microbial biofilm. **MLC (Minimum Lethal Concentration):** Similar to MBC/MFC; the lowest concentration that kills the test organism, sometimes used more generally or in toxicology contexts. **PTS (Propyl Propane Thiosulfonate).** **PTSO (Propyl Propane Thiosulfinate Oxide).** **PEG400 (Polyethylene Glycol 400).** **DMSO (Dimethyl Sulfoxide).** **n/a (not available information).**

Plant Nomenclature	Common name	Plant Part used	Outcome	Pathogen (strain code- and/or aquatic animal, and or Geographical region which was isolated)	Citation
<i>Abies alba</i> Mill.	Fir (Silver)	Needles	MIC ₅₀ 6.25 MIC ₉₀ 21.5 ($\mu\text{l/ml}$)	<i>Pseudomonas agglomerans</i>	[105]
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 ($\mu\text{l/ml}$)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25 ($\mu\text{l/ml}$)	<i>Pseudomonas frederiksbergensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 ($\mu\text{l/ml}$)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 21.5 ($\mu\text{l/ml}$)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 ($\mu\text{l/ml}$)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 ($\mu\text{l/ml}$)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 ($\mu\text{l/ml}$)	<i>Pseudomonas veronii</i>	

<i>Achillea wilhelmsii</i> K.Koch	Yarrow (achillea)	Aerial parts	MIC 4.0 MFC 8.0 ($\mu\text{g/ml}$)	<i>Saprolegnia parasitica</i>	[106]			
<i>Achyrocline satureioides</i> (Lam.) (referred to as <i>Achyrocline satureioides</i>)	Marcela	n/a	MIC >6.4 MBC >6.4 (mg/ml)	<i>Aeromonas hydrophila</i>	[107]			
			MIC >6.4 MBC >6.4 (mg/ml)	<i>Citrobacter freundii</i>				
<i>Alhagi maurorum</i> Medik.	Camelthorn	Aerial parts	MIC >1000 MLC >1000 ($\mu\text{l/ml}$)	<i>Lactococcus garviae</i>	[108]			
<i>Allium cepa</i> L.	Onion	Bulb	MIC 2.5 (mg/ml)	<i>Aeromonas hydrophila</i>	[109]			
			MBC PTS 625.0 MBC PTSO 78.125 ($\mu\text{g/ml}$)	<i>Photobacterium damsela</i> subsp. <i>damsela</i>	[110]			
			MBC PTS 625.0 MBC PTSO 156.25 ($\mu\text{g/ml}$)	<i>Photobacterium damsela</i> subsp. <i>piscicida</i>				
			MBC PTS 312.5 MBC PTSO 39.06 ($\mu\text{g/ml}$)	<i>Pseudomonas anguilliseptica</i>	[109]			
			MIC 2.5 (mg/ml)	<i>Pseudomonas fluorescens</i>				
			MBC PTS 2500.0 MBC PTSO 1250.0 ($\mu\text{g/ml}$)	<i>Tenacibaculum maritimum</i>	[110]			
			<i>Allium sativum</i> L.	Garlic	stalk	(Peg400) MIC 5415.0 MBC 10830.0 (DMSO) MIC 5415.0 MBC 10830.0 (% v/v)	<i>Aeromonas hydrophila</i>	[111]
						(Peg400) MIC 10830.0 MBC 21660.0 (DMSO) MIC 10830.0 MBC 21660.0 (% v/v)	<i>Aeromonas jandaei</i>	
MIC 0.5 MBC 1.0 ($\mu\text{l/ml}$)	<i>Lactococcus garviae</i>	[112]						
Bulb	MIC 0.6 (mg/ml)	<i>Aeromonas hydrophila</i>			[109]			
	MIC 0.6 (mg/ml)	<i>Pseudomonas fluorescens</i>						
	MIC 2.5 (mg/ml)	<i>Edwardsiella tarda</i>						
<i>Allium tuberosum</i> Rottler ex Spreng.	Chinese chive	Leaves	MIC 40.0 ($\mu\text{g/ml}$)	<i>Flavobacterium columnare</i> (ATCC49512)	[113]			
			MIC 40.0 ($\mu\text{g/ml}$)	<i>Flavobacterium columnare</i> (FC1)				

			MIC 20.0 ($\mu\text{g/ml}$)	<i>Flavobacterium columnare</i> (FC2)	
			MIC 80.0 ($\mu\text{g/ml}$)	<i>Flavobacterium columnare</i> (FC2)	
<i>Amyris balsamifera</i> L.	Amyris	Wood bark	MIC 12.5 ($\mu\text{l/ml}$)	<i>Aeromonas</i> spp.	[114]
			MIC 12.5 ($\mu\text{l/ml}$)	<i>Aeromonas salmonicida</i>	
			MIC 3.12 ($\mu\text{l/ml}$)	<i>Enterococcus faecium</i>	
			MIC 12.5 ($\mu\text{l/ml}$)	<i>Pseudomonas fluorescens</i>	
			MIC 6.25 ($\mu\text{l/ml}$)	<i>Yersinia</i> spp.	
			MIC 12.5 ($\mu\text{l/ml}$)	<i>Yersinia ruckeri</i>	
<i>Anethum graveolens</i> L.	Indian Dill	Seeds	MIC 62.4 MBC 125.0 ($\mu\text{g/ml}$)	<i>Lactococcus garviae</i>	[115]
<i>Angelica sinensis</i> (Oliv.) Diels	Angelica root	Whole plant	MIC 12.5 MBC 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas fluorescens</i>	[116]
<i>Aniba parviflora</i> (Meisn.) Mez	Pau-rosa	Leaves	MIC 0.8 MBC 1.6 (mg/ml)	<i>Aeromonas hydrophila</i>	[107]
			MIC 3.2 MBC 6.4 (mg/ml)	<i>Citrobacter freundii</i>	
<i>Aniba rosodora</i> Ducke (referred to as <i>Aniba rosaeodora</i>)	Rosewood Pau-rosa	Leaves	MIC 3.2 MBC 3.2 (mg/ml)	<i>Aeromonas hydrophila</i>	[107]
			MIC 3.2 MBC 3.2 (mg/ml)	<i>Citrobacter freundii</i>	
<i>Apium graveolens</i> L.	Celery	seed	MIC 125.0 MBC 125.0 ($\mu\text{l/ml}$)	<i>Pseudomonas fluorescens</i>	[117]
			MIC 3.9 MBC 3.9 ($\mu\text{l/ml}$)	<i>Vibrio alginolyticus</i>	
Arnica sp. (referred to as <i>Arnicae anthodium</i> which is a botanical reference and not a species)	Arnica	Dried Plant parts	MIC 0.1 MBC 0.1 ($\mu\text{g/ml}$)	<i>Pseudomonas aeruginosa</i>	[118]
<i>Arnica Montana</i> L.	Arnica	Dried Plant parts	MIC 4.69 ($\mu\text{g/ml}$)	<i>Candida albicans</i>	[118]
<i>Artemisia annua</i> L.	Wormwood (Sweet)	Aerial parts	MIC 3.6 MFC 7.2 (ppm)	<i>Saprolegnia</i> sp.	[119]

			MIC 15.6 MFC 31.2 (ppm)	<i>Fusarium solani</i>		
			MIC 6.2 MFC 12.4 (ppm)	<i>Aspergillus flavus</i>		
			MIC 12.4 MBC 24.8 (µg/ml)	<i>Streptococcus iniae</i> (LMG14520)		
			MIC 1.6 MBC 3.2 (µg/ml)	<i>Yersinia ruckeri</i> (KC291153)		
			MIC 3.2 MBC >6.4 (µg/ml)	<i>Aeromonas hydrophila</i> (LMG3770)		
			MIC 6.4 MBC 12.8 (µg/ml)	<i>Lactococcus garviae</i>		
<i>Artemisia vulgaris</i> L.	Mugwort	Leaves	(Peg400) MIC 18610.0 MBC 18610.0	(DMSO) MIC 37220.0 MBC 37220.0	<i>Aeromonas hydrophila</i>	[111]
			(% v/v)			
			(Peg400) MIC 18610.0 MBC 18610.0	(DMSO) MIC 37220.0 MBC 37220.0	<i>Aeromonas jandaei</i>	
<i>Bacopa scoparioides</i> (Cham. & Schltdl.) Scatigna (referred to as <i>Cono-bea scoparioides</i>)	Pataqueira	Leaves	MIC 0.2 MBC 0.2 (mg/ml)		<i>Aeromonas hydrophila</i>	[107]
			MIC 3.2 MBC 3.2 (mg/ml)		<i>Citrobacter freundii</i>	
<i>Bergera koenigii</i> L. (referred to as <i>Murraya koenigii</i>)	Curry leaf	Several plant parts	MIC 0.39 (µg/ml)		<i>Streptococcus agalactiae</i>	[120]
<i>Boswellia sacra</i> Flüch. (referred to as <i>Boswellia carterii</i>)	Frankincense (<i>carterii</i>)	Trunk exuded resin	MIC 12.5 (µl/ml)		<i>Aeromonas</i> spp.	[114]
			MIC 12.5 (µl/ml)		<i>Aeromonas salmonicida</i>	
			MIC 3.12 (µl/ml)		<i>Enterococcus faecium</i>	
			MIC 25.0 (µl/ml)		<i>Pseudomonas fluorescens</i>	
			MIC 6.25 (µl/ml)		<i>Yersinia</i> spp.	
			MIC 12.5 (µl/ml)		<i>Yersinia ruckeri</i>	
			(Peg400) MIC 16952.0 MBC 16952.0	(DMSO) MIC 33904.0 MBC 33904.0	<i>Aeromonas hydrophila</i>	[111]

			(% v/v)			
			(Peg400) MIC 16952.0 MBC 16952.0	(DMSO) MIC 8476.0 MBC 16952.0		
			(% v/v)		<i>Aeromonas jandaei</i>	
<i>Calotropis gigantean</i> (L.) W.T.Aiton	Crown flower	Fresh leaves	MIC 10.0 (mg/ml)		<i>Aeromonas hydrophila</i>	[109]
			MIC 10.0 (mg/ml)		<i>Pseudomonas fluorescens</i>	
			MIC 0.6 (mg/ml)		<i>Edwardsiella tarda</i>	
<i>Camphora officinarum</i> Boerh. Ex Fabr. (referred to as <i>Cinnamomum camphora</i>)	Camphor (Standard)	Wood bark	MIC 3.12 (µl/ml)		<i>Aeromonas</i> spp.	[114]
			MIC 3.12 (µl/ml)		<i>Aeromonas salmonicida</i>	
			MIC 1.56 (µl/ml)		<i>Enterococcus faecium</i>	
			MIC 25.0 (µl/ml)		<i>Pseudomonas fluorescens</i>	
			MIC 25.0 (µl/ml)		<i>Yersinia</i> spp.	
			MIC 25.0 (µl/ml)		<i>Yersinia ruckeri</i>	
		Leaf	MIC 625.0 (µg/ml)		<i>Pseudomonas aeruginosa</i>	[121]
			MIC 625.0 (µg/ml)		<i>Serratia marcescens</i>	
			MIC 312.0 (µg/ml)		<i>Candida albicans</i>	
		Branch	MIC 625.0 (µg/ml)		<i>Pseudomonas aeruginosa</i>	
			MIC 625.0 (µg/ml)		<i>Serratia marcescens</i>	
			MIC 312.0 (µg/ml)		<i>Candida albicans</i>	
		Wood	MIC 625.0 (µg/ml)		<i>Pseudomonas aeruginosa</i>	
			MIC 39.1 (µg/ml)		<i>Serratia marcescens</i>	
			MIC 312.0 (µg/ml)		<i>Candida albicans</i>	
		Root	MIC 312.0 (µg/ml)		<i>Pseudomonas aeruginosa</i>	
			MIC 625.0 (µg/ml)		<i>Serratia marcescens</i>	
			MIC 312.0 (µg/ml)		<i>Candida albicans</i>	
Leaf/branch	MIC 625.0 (µg/ml)		<i>Pseudomonas aeruginosa</i>			

		Leaf/ branch/ wood	MIC 625.0 ($\mu\text{g/ml}$)	<i>Serratia marcescens</i>	
			MIC 312.0 ($\mu\text{g/ml}$)	<i>Candida albicans</i>	
			MIC 625.0 ($\mu\text{g/ml}$)	<i>Pseudomonas aeruginosa</i>	
			MIC 625.0 ($\mu\text{g/ml}$)	<i>Serratia marcescens</i>	
			MIC 312.0 ($\mu\text{g/ml}$)	<i>Candida albicans</i>	
<i>Camphora officinarum</i> var. <i>officinarum</i> (referred to as <i>Cinnamomum camphora</i> var. <i>Linalolifera</i>)	Camphor (linalolifera)	Trunks	MIC 3.12 ($\mu\text{l/ml}$)	<i>Aeromonas</i> spp.	[114]
			MIC 3.12 ($\mu\text{l/ml}$)	<i>Aeromonas salmonicida</i>	
			MIC 1.56 ($\mu\text{l/ml}$)	<i>Enterococcus faecium</i>	
			MIC 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas fluorescens</i>	
			MIC 25.0 ($\mu\text{l/ml}$)	<i>Yersinia</i> spp.	
			MIC 12.5 ($\mu\text{l/ml}$)	<i>Yersinia ruckeri</i>	
<i>Cananga odorata</i> (Lam.) Hook.f. & Thomson	Ylang Ylang	Flower	(Peg400) MIC 36600.0 MBC 36600.0	(DMSO) MIC 36600.0 MBC 36600.0	[111]
			(% v/v)		
			(Peg400) MIC 18300.0 MBC 18300.0	(DMSO) MIC 18300.0 MBC 18300.0	
		(% v/v)			
<i>Canarium luzonicum</i> (Blume) A.Gray	Elemi	Trunk exuded resin	MIC 12.5 ($\mu\text{l/ml}$)	<i>Aeromonas</i> spp.	[114]
			MIC 12.5 ($\mu\text{l/ml}$)	<i>Aeromonas salmonicida</i>	
			MIC 6.25 ($\mu\text{l/ml}$)	<i>Enterococcus faecium</i>	
			MIC 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas fluorescens</i>	
			MIC 25.0 ($\mu\text{l/ml}$)	<i>Yersinia</i> spp.	
			MIC 12.5 ($\mu\text{l/ml}$)	<i>Yersinia ruckeri</i>	
<i>Carum carvi</i> L.	Caraway	Seeds	MIC 0.938 MBC 3.750 (mg/ml)	<i>Vibrio alginolyticus</i>	[122]
			MIC 0.234 MBC 1.875 (mg/ml)	<i>Vibrio parahaemolyticus</i>	

			MIC 0.059 MFC 0.469 (mg/ml)	<i>Candida albicans</i>	
			MIC 0.022 MBC 11.562 (mg/ml)	<i>Aeromonas hydrophila</i>	[123]
			MIC 0.045 MBC 5.781 (mg/ml)	<i>Listonella anguillarum</i>	
			MIC 0.022 MBC 11.562 (mg/ml)	<i>Vibrio alginolyticus</i> (ATCC 33787)	
			MIC 0.045 MBC 2.890 (mg/ml)	<i>Vibrio alginolyticus</i> (ATCC 17749)	
			MIC 0.022 MBC 5.781 (mg/ml)	<i>Vibrio harveyi</i> (ATCC 18293)	
			MIC 0.022 MBC 11.562 (mg/ml)	<i>Vibrio parahaemolyticus</i> (ATCC 17802)	
			MIC 0.022 MBC 2.890 (mg/ml)	<i>Vibrio parahaemolyticus</i> (ATCC 43996)	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (µl/ml)	<i>Pseudomonas agglomerans</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (µl/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (µl/ml)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (µl/ml)	<i>Pseudomonas frederiksbergensis</i>	
		Fruits	MIC ₅₀ 12.5 MIC ₉₀ 25.0 (µl/ml)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (µl/ml)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (µl/ml)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (µl/ml)	<i>Pseudomonas proteolytica</i>	

			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas veronii</i>	
<i>Cedrus atlantica</i> (Endl.) Manetti ex Carrière	Cedarwood (Atlas)	Wood bark	MIC ₅₀ : 15.36 MIC ₉₀ : 23.38 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	[124]
			MIC 5.0 MBC 5.0 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	[125]
			MIC ₅₀ 21.18 MIC ₉₀ 35.16 (μ l/ml)	<i>Pseudomonas fluorescence</i>	[124]
			MIC ₅₀ 21.43 MIC ₉₀ 32.36 (μ l/ml)	<i>Serratia marcescens</i>	
		MIC ₅₀ 17.32 MIC ₉₀ 22.62 (μ l/ml)	<i>Candida albicans</i>		
		Cones	MIC 10.0 (μ g/ml)	<i>Proteus vulgaris</i>	[126]
Wood bark	MIC 5.0 MFC 5.0 (μ g/ml)	<i>Candida albicans</i>	[125]		
<i>Chamaemelum nobile</i> (L.) All.	Common Chamomile (Roman)	Flower leaves	MIC 5.0 MBC 5.0 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	[124]
			MIC 5.0 MFC 5.0 (μ g/ml)	<i>Candida albicans</i>	
<i>Chamaemelum nobile</i> (L.) All. (referred to as <i>Anthemis nobilis</i>)		Leaves	MIC 6.4 MBC 6.4 (mg/ml)	<i>Aeromonas hydrophila</i>	[107]
			MIC >6.4 MBC >6.4 (mg/ml)	<i>Citrobacter freundii</i>	
<i>Chrysopogon zizanioides</i> (L.) Roberty (referred to as <i>Vetiveria zizanioides</i>)	Vetiver	Fibrous roots	MIC 12.5 (μ l/ml)	<i>Aeromonas</i> spp.	[114]
			MIC 12.5 (μ l/ml)	<i>Aeromonas salmonicida</i>	
			MIC 6.25 (μ l/ml)	<i>Enterococcus faecium</i>	
			MIC 25.0 (μ l/ml)	<i>Pseudomonas fluorescens</i>	
			MIC 25.0 (μ l/ml)	<i>Yersinia</i> spp.	
			MIC 25.0 (μ l/ml)	<i>Yersinia ruckeri</i>	

<i>Cinnamomum verum</i>]. Presl	Cinnamon (Common)	Wood bark	(Peg400) MIC 662.5 MBC 1325.0	(DMSO) MIC 1325.0 MBC 2650.0	<i>Aeromonas hydrophila</i>	[111]		
			(% v/v)		(Peg400) MIC 2650.0 MBC 2650.0		(DMSO) MIC 2650.0 MBC 2650.0	<i>Aeromonas jandaei</i>
			(% v/v)		MIC 120.0 MBC 120.0 (µg/ml)			<i>Lactococcus garviae</i>
<i>Cinnamomum verum</i>]. Presl(referred to as <i>Cinnamomum zeylanicum</i>)	Cinnamon (Ceylon)	Wood bark	MIC 0.5 MBC 0.5 (µl/ml)		<i>Lactococcus garviae</i>	[112]		
			MIC ₅₀ 3.125 MIC ₉₀ 6.25 (µl/ml)		<i>Pseudomonas agglomerans</i>	[105]		
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (µl/ml)		<i>Pseudomonas antarctica</i>			
			MIC ₅₀ 3.125 MIC ₉₀ 6.25 (µl/ml)		<i>Pseudomonas brassicacearum</i>			
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (µl/ml)		<i>Pseudomonas frederiksbergensis</i>			
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (µl/ml)		<i>Pseudomonas koreensis</i>			
			MIC ₅₀ 3.125 MIC ₉₀ 6.25 (µl/ml)		<i>Pseudomonas lundensis</i>			
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (µl/ml)		<i>Pseudomonas mandelii</i>			
			MIC ₅₀ 3.125 MIC ₉₀ 6.25 (µl/ml)		<i>Pseudomonas proteolytica</i>			
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (µl/ml)		<i>Pseudomonas synxantha</i>			
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (µl/ml)		<i>Pseudomonas veronii</i>			
			MIC 0.003 MBC 0.007 (% v/v)		<i>Photobacterium damsela</i> (FP4101)	[128]		
			MIC 0.003 MBC 0.015 (% v/v)		<i>Edwardsiella tarda</i> (FP5060)			

			MIC 0.003 MBC 0.015 (% v/v)	<i>Edwardsiella tarda</i> (ED47)	
			MIC 0.001 MBC 0.003 (% v/v)	<i>Edwardsiella tarda</i> (Yoshida)	
			MIC 0.001 MBC 0.007 (% v/v)	<i>Edwardsiella tarda</i> (ED45)	
			MIC 0.015 MBC 0.031 (% v/v)	<i>Lactococcus garviae</i> (FP5245)	
			MIC 0.031 MBC 0.062 (% v/v)	<i>Streptococcus iniae</i> (FP3287)	
			MIC 0.015 MBC 0.031 (% v/v)	<i>Streptococcus iniae</i> (S186)	
			MIC 0.015 MBC 0.062 (% v/v)	<i>Streptococcus iniae</i> (S530)	
			MIC 0.015 MBC 0.062 (% v/v)	<i>Streptococcus iniae</i> (S131)	
			MIC 0.07 MBC 0.031 (% v/v)	<i>Streptococcus parauberis</i> (S124)	
			MIC 0.007 MBC 0.015 (% v/v)	<i>Streptococcus parauberis</i> (S527)	
			MIC 0.007 MBC 0.015 (% v/v)	<i>Streptococcus parauberis</i> (1466)	
<i>Citrus x aurantiifolia</i> (Christm.) Swingle	Lime	Fruit peels	MIC 0.031 MBC 0.125 (%v/v)	<i>Streptococcus parauberis</i> (S124)	[129]
			MIC 0.125 MBC 1 (%v/v)	<i>Vibrio harveyi</i>	
			MIC 0.125 MBC 0.5 (%v/v)	<i>Vibrio ichthyenteri</i>	
			MIC 0.062 MBC 0.125 (%v/v)	<i>Photobacterium damsela</i>	
			MIC 0.062 MBC 0.125 (%v/v)	<i>Photobacterium damsela</i>	
			MIC 0.25 MBC 1 (%v/v)	<i>Edwardsiella tarda</i> (ED47)	
			MIC 0.125 MBC 1 (%v/v)	<i>Lactococcus garviae</i>	
			MIC 0.125 MBC 1 (%v/v)	<i>Streptococcus iniae</i>	

<i>Citrus x aurantium f. deliciosa</i> (Ten.) M.Hiroe (referred to as <i>Citrus x clementina</i>)	Clementine	Fruit peels	Sensitive		<i>Vibrio harveyi</i>	[130]
			Sensitive		<i>Listonella anguillarum</i>	
<i>Citrus x aurantium f. deliciosa</i> (Ten.) M.Hiroe (referred to as <i>Citrus x deliciosa</i>)	Mandarin (Yellow)	Fruit peels	Sensitive		<i>Vibrio harveyi</i>	[130]
			Sensitive		<i>Listonella anguillarum</i> (referred to as <i>Vibrio anguillarum</i>)	
			MIC 2.5 (mg/ml)		<i>Pseudomonas fluorescens</i>	[109]
			MIC 2.5 (mg/ml)		<i>Edwardsiella tarda</i>	
<i>Citrus x aurantium</i> L.	Orange (Bitter) Pummelo	Fruit peels	Sensitive		<i>Vibrio harveyi</i>	[130]
			Sensitive		<i>Listonella anguillarum</i> (referred to as <i>Vibrio anguillarum</i>)	
			MIC 25.0 (µl/ml)		<i>Aeromonas</i> spp.	[114]
			MIC 12.5 (µl/ml)		<i>Aeromonas salmonicida</i>	
			MIC 6.25 (µl/ml)		<i>Enterococcus faecium</i>	
			MIC 25.0 (µl/ml)		<i>Pseudomonas fluorescens</i>	
			MIC 12.5 (µl/ml)		<i>Yersinia</i> spp.	
			MIC 12.5 (µl/ml)		<i>Yersinia ruckeri</i>	
		Flower Leaves	MIC 5.0 MBC 5.0 (µl/ml)	<i>Pseudomonas aeruginosa</i>	[125]	
		n/a	MIC ₅₀ 98.64 MIC ₉₀ 101.27 (µl/ml)	<i>Pseudomonas aeruginosa</i>	[131]	
			MIC ₅₀ 0.75 MIC ₉₀ 1.13 (µl/ml)	<i>Candida albicans</i>		
		Flower Leaves	MIC 5.0 MFC 5.0 (µg/ml)	<i>Candida albicans</i>	[125]	
Leaves Branches Fruits	(Peg400) MIC 35560.0 MBC 35560.0	(DMSO) MIC >35560.0 0 MBC >35560.0	<i>Aeromonas hydrophila</i>	[111]		
	(% v/v)					
Leaves Branches Fruits	(Peg400) MIC 35560.0 MBC 35560.0	(DMSO) MIC >35560.0 0 MBC >35560.0	<i>Aeromonas jandaei</i>			

		Pericarp	(% v/v)		
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas agglomerans</i>	[105]
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas veronii</i>	
<i>Citrus x aurantium f. aurantium</i> (referred to as <i>Citrus x sinensis</i>)	Orange	Fruit peels	Sensitive	<i>Vibrio harveyi</i>	
			Sensitive	<i>Listonella anguillarum</i> (referred to as <i>Vibrio anguillarum</i>)	
			MIC 125.0 MBC 250.0 (μ l/ml)	<i>Vibrio vulnificus</i>	[132]
		MIC >1000.0 MBC >1000.0 (μ l/ml)	<i>Aeromonas hydrophila</i>		
		MIC >1000.0 MBC >1000.0 (μ l/ml)	<i>Vibrio parahaemolyticus</i>		
		Pericarp	MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas agglomerans</i>	[105]
MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas antarctica</i>				

			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas brassicacearum</i>		
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>		
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas koreensis</i>		
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas lundensis</i>		
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas mandelii</i>		
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>		
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas synxantha</i>		
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas veronii</i>		
<i>Citrus x bergamia</i> (Risso) Risso & Poit. (referred to as <i>Citrus bergamia</i>)	Bergamot	Fruit peels	Sensitive	<i>Vibrio harveyi</i>	[130]	
			Sensitive	<i>Listonella anguillarum</i>		
			(Peg400) MIC 8740.0 MBC 8740.0 (% v/v)	(DMSO) MIC 17480.0 MBC 17480.0	<i>Aeromonas hydrophila</i>	[111]
			(Peg400) MIC 17480.0 MBC 17480.0 (% v/v)	(DMSO) MIC 8740.0 MBC 8740.0	<i>Aeromonas jandaei</i>	
					Reduced mortalities	<i>Edwardsiella tarda</i>
<i>Citrus x limon</i> (L.) Osbeck	Eureka Lemon	Fruit peels	Sensitive	<i>Vibrio harveyi</i>	[130]	
			Sensitive	<i>Listonella anguillarum</i> (referred to as <i>Vibrio anguillarum</i>)		
			MIC 6.25 (μ l/ml)		<i>Aeromonas</i> spp.	[114]
			MIC 12.5 (μ l/ml)		<i>Aeromonas salmonicida</i>	
		MIC 6.25 (μ l/ml)		<i>Enterococcus faecium</i>		
n/a		MIC ₅₀ 5.56 MIC ₉₀ 7.23 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	[131]		

			MIC ₅₀ 1.21 MIC ₉₀ 3.18 (μ l/ml)	<i>Candida albicans</i>	
		Fruit peels	MIC 25.0 (μ l/ml)	<i>Pseudomonas fluorescens</i>	[114]
			MIC 12.5 (μ l/ml)	<i>Yersinia</i> spp.	
			MIC 12.5 (μ l/ml)	<i>Yersinia ruckeri</i>	
			Sensitive	<i>Aeromonas hydrophila</i>	[134]
<i>Coriandrum sativum</i> L.	Coriander	Seeds	MIC 0.234 MBC 1.875 (mg/ml)	<i>Vibrio alginolyticus</i>	[122]
			MIC 1.875 MBC 7.500 (mg/ml)	<i>Vibrio parahaemolyticus</i>	
		n/a	MIC ₅₀ 11.56 MIC ₉₀ 13.35 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	[131]
			MIC ₅₀ 5.56 MIC ₉₀ 7.23 (μ l/ml)	<i>Candida albicans</i>	
		Seeds	MIC 0.469 MFC 1.875 (mg/ml)	<i>Candida albicans</i>	[122]
		Dried fruit	MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas agglomerans</i>	[105]
			MIC ₅₀ 12.5 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas mandelii</i>	
		MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>		

			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>	
<i>Corymbia citriodora</i> (Hook.) K.D.Hill & L.A.S.Johnson	Gum (Lemon scented)	Leaves	(Peg400) (DMSO) MIC 4315.0 MIC 17260.0 MBC 4315.0 MBC 17260.0	<i>Aeromonas hydrophila</i>	[111]
			(% v/v)		
			(Peg400) (DMSO) MIC 17260.0 MIC 34520.0 MBC 17260.0 MBC 34520.0	<i>Aeromonas jandaei</i>	
			(% v/v)		
<i>Cuminum cyminum</i> L.	Cumin	Aerial parts	MIC 0.5 MFC 0.5 (μ g/ml)	<i>Saprolegnia parasitica</i>	[106]
<i>Cupressus sempervirens</i> L.	Cypress (Italian)	Several plant parts	MIC 0.75 (μ g/ml)	<i>Aeromonas hydrophila</i>	[135]
		Leaves	(Peg400) (DMSO) MIC 17260.0 MIC 34520.0 MBC 17260.0 MBC 34520.0	<i>Aeromonas hydrophila</i>	[111]
			(% v/v)		
		n/a	MIC >6.4 MBC >6.4 (mg/ml)	<i>Aeromonas hydrophila</i>	[107]
		Leaves	(Peg400) (DMSO) MIC 17260.0 MIC 4315.0 MBC 17260.0 MBC 4315.0	<i>Aeromonas jandaei</i>	[111]
(% v/v)					
n/a	MIC >6.4 MBC >6.4 (mg/ml)	<i>Citrobacter freundii</i>	[107]		
<i>Cymbopogon citratus</i> (DC.) Stapf	Lemongrass	Leaves	(Peg400) (DMSO) MIC 2185.0 MIC 2185.0 MBC 4370.0 MBC 4370.0	<i>Aeromonas hydrophila</i>	[111]
			(% v/v)		
			(Peg400) (DMSO) MIC 4370.0 MIC 4370.0 MBC 4370.0 MBC 4370.0	<i>Aeromonas jandaei</i>	
			(% v/v)		
<i>Cymbopogon flexuosus</i> (Nees ex Steud.) Will. Watson	Lemongrass (Cochin grass)	Leaves	MIC 0.25 MBC 2.0 (% v/v)	<i>Photobacterium damsela</i> (FP4101)	[136]
			MIC 0.5 MBC 4.0 (% v/v)	<i>Edwardsiella tarda</i> (FP5060)	
			MIC 0.032 MBC 0.125 (% v/v)	<i>Edwardsiella tarda</i> (ED47)	

			MIC 0.032 MBC 0.125 (% v/v)	<i>Edwardsiella tarda</i> (Yoshida)	
			MIC 0.063 MBC 0.25 (% v/v)	<i>Edwardsiella tarda</i> (ED45)	
			MIC 0.25 MBC 0.5 (% v/v)	<i>Lactococcus garviae</i> (FP5245)	
			MIC 0.125 MBC 0.25 (% v/v)	<i>Streptococcus iniae</i> (FP3287)	
			MIC 0.063 MBC 0.25 (% v/v)	<i>Streptococcus iniae</i> (S186)	
			MIC 0.125 MBC 0.5 (% v/v)	<i>Streptococcus iniae</i> (S530)	
			MIC 0.032 MBC 0.125 (% v/v)	<i>Streptococcus iniae</i> (S131)	
			MIC 0.125 MBC 0.5 (% v/v)	<i>Streptococcus parauberis</i> (S124)	
			MIC 0.032 MBC 0.032 (% v/v)	<i>Streptococcus parauberis</i> (S527)	
			MIC 0.016 MBC 0.063 (% v/v)	<i>Streptococcus parauberis</i> (1466)	
<i>Cymbopogon nardus</i> (L.) Rendle	Citronella (Grass)	Leaves	MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas</i> <i>agglomerans</i>	[105]
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas</i> <i>brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25 (μ l/ml)	<i>Pseudomonas</i> <i>frederiksbergensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas lundensis</i>	

			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50. (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>	
<i>Cymbopogon winterianus</i> Jowitt ex Bor	Citronella (Java)	Aerial parts	MIC 0.488 (μ g/ml)	<i>Edwardsiella</i> spp. (<i>Lates calcarifer</i>)	[137]
			MIC 0.488 (μ g/ml)	<i>Edwardsiella</i> spp. (<i>Macrobrachium rosenbergii</i>)	
			MIC 0.977 (μ g/ml)	<i>Edwardsiella</i> spp. (<i>Rana catesbeiana</i>)	
			MIC 0.488-0.977 (μ g/ml)	<i>Edwardsiella tarda</i> (<i>Clarias gariepinus</i>)	
			MIC 0.244 (μ g/ml)	<i>Edwardsiella tarda</i> (<i>Tilapia</i> sp.)	
			MIC 0.244-0.488 (μ g/ml)	<i>Edwardsiella tarda</i> (<i>Monopterus albus</i>)	
			MIC 0.244-0.488 (μ g/ml)	<i>Edwardsiella tarda</i> (<i>Trichogaster pectoralis</i>)	
			MIC 0.244 (μ g/ml)	<i>Vibrio</i> spp. (<i>Macrobrachium rosenbergii</i>)	
			MIC 0.244 (μ g/ml)	<i>Vibrio</i> spp. (<i>Penaeus monodon</i>)	
			MIC 0.244 (μ g/ml)	<i>Vibrio</i> spp. (<i>Penaeus vannamei</i>)	
			MIC 0.244 (μ g/ml)	<i>Vibrio</i> spp. (<i>Rana catesbeiana</i>)	
			MIC 0.244 (μ g/ml)	<i>Vibrio</i> spp. (<i>Scylla</i> sp.)	
			MIC 0.488 (μ g/ml)	<i>Photobacterium damsela</i> subsp. <i>damsela</i> (<i>Lates calcarifer</i>)	
			MIC 0.488 (μ g/ml)	<i>Aeromonas</i> spp. (<i>Macrobrachium rosenbergii</i>)	
			MIC 0.977 (μ g/ml)	<i>Aeromonas</i> spp. (<i>Rana catesbeiana</i>)	
			MIC 0.488 (μ g/ml)	<i>Escherichia coli</i> (<i>Lates calcarifer</i>)	

			MIC 0.488 ($\mu\text{g/ml}$)	<i>Salmonella</i> spp. (<i>Macrobrachium</i> <i>rosenbergii</i>)	
			MIC 0.244 ($\mu\text{g/ml}$)	<i>Salmonella</i> spp. (<i>Lates</i> <i>calcarifer</i>)	
			MIC 0.977 ($\mu\text{g/ml}$)	<i>Flavobacterium</i> spp. (<i>Rana catesbeiana</i>)	
			MIC 0.244 ($\mu\text{g/ml}$)	<i>Pseudomonas</i> spp. (<i>Lates</i> <i>calcarifer</i>)	
			MIC 0.488 ($\mu\text{g/ml}$)	<i>Streptococcus</i> spp. (<i>Lates</i> <i>calcarifer</i>)	
<i>Daucus carota</i> L.	Carrot seed	seed	MIC 31.25 MBC 31.25 ($\mu\text{l/ml}$)	<i>Aeromonas hydrophila</i>	[117]
			MIC 31.25 MBC 31.25 ($\mu\text{l/ml}$)	<i>Edwardsiella tarda</i>	
			MIC 31.25 MBC 62.5 ($\mu\text{l/ml}$)	<i>Pseudomonas fluorescense</i>	
			MIC 0.97 MBC 3.9 ($\mu\text{l/ml}$)	<i>Vibrio alginolyticus</i>	
<i>Echinophora platyloba</i> DC.	Khousharizeh	Aerial parts	MIC >1000 MLC >1000 ($\mu\text{g/ml}$)	<i>Lactococcus garviae</i>	[108]
<i>Elettaria cardamomum</i> (L.) Maton	Cardamom (Green)	n/a	MIC 2.0 ($\mu\text{l/ml}$)	<i>Candida albicans</i>	[138]
<i>Elwendia persica</i> (Boiss.) Pimenov & Kljukov (referred to as <i>Bunium</i> <i>persicum</i>)	Cumin (Black)	Fruits	MIC 8 MLC 16 ($\mu\text{l/ml}$)	<i>Lactococcus garviae</i>	[108]
<i>Eryngium campestre</i> L.	Eryngo	aerial parts	MIC 1.0 MFC 2.0 ($\mu\text{g/ml}$)	<i>Saprolegnia parasitica</i>	[106]
<i>Eucalyptus</i> <i>camaldulensis</i> Dehnh.	Eucalyptus (camaldulensis)	Leaves	MIC 62.5 MBC 125 ($\mu\text{l/ml}$)	<i>Vibrio parahaemolyticus</i>	[132]
			MIC 125 MBC 500 ($\mu\text{l/ml}$)	<i>Aeromonas hydrophila</i>	
			MIC 31.25 MBC 32.5 ($\mu\text{l/ml}$)	<i>Vibrio vulnificus</i>	
<i>Eucalyptus globulus</i> Labill.	Eucalyptus (globulus)	Leaves	(Peg400) (DMSO) MIC 18240.0 MIC 18240.0 MBC 18240.0 MBC 18240.0 (% v/v)	<i>Aeromonas hydrophila</i>	[111]

		Aerial parts	MIC 250.0 MBC 250.0 ($\mu\text{g/ml}$)	<i>Lactococcus garviae</i>	[115]	
		Leaves	(Peg400) MIC 18240.0 MBC 18240.0	(DMSO) MIC 18240.0 MBC 18240.0	<i>Aeromonas jandaei</i>	[111]
			(% v/v)			
		Leaves & flowers	MIC 2.5 ($\mu\text{l/ml}$)	<i>Saprolegnia parasitica</i>	[139]	
		Leaves & flowers	MIC <20.0 ($\mu\text{l/ml}$)	<i>Aspergillus fumigatus</i>		
		n/a	MIC 50 ($\mu\text{g/ml}$)	<i>Yersinia ruckeri</i>	[140]	
<i>Foeniculum vulgare</i> Mill.	Purple Fennel (Bitter)	Dried fruits	MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas agglomerans</i>	[105]	
			MIC ₅₀ 12.5 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas antarctica</i>		
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas brassicacearum</i>		
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas frederiksbergensis</i>		
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas koreensis</i>		
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas lundensis</i>		
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas mandelii</i>		
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas proteolytica</i>		
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas synxantha</i>		
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas veronii</i>		
<i>Gaultheria procumbens</i> L.	Wintergreen Partridge Berry	Green leaves	MIC 3.12 ($\mu\text{l/ml}$)	<i>Aeromonas</i> spp.	[114]	
			MIC 3.12 ($\mu\text{l/ml}$)	<i>Aeromonas salmonicida</i>		
			MIC 3.12 ($\mu\text{l/ml}$)	<i>Enterococcus faecium</i>		

			MIC 25.0 (μ l/ml)	<i>Pseudomonas fluorescens</i>	
			MIC 6.25 (μ l/ml)	<i>Yersinia spp.</i>	
			MIC 6.25 (μ l/ml)	<i>Yersinia ruckeri</i>	
<i>Glycyrrhiza glabra</i> L.	Liquorice	Leaves	MIC 920 (μ g/ml)	<i>Lactococcus garviae</i>	[141]
		Roots	MIC >1000 MLC >1000 (μ g/ml)	<i>Lactococcus garviae</i>	[108]
<i>Illicium verum</i> Hook.f.	Star Anise	n/a	MIC 1.6 MBC 3.2 (mg/ml)	<i>Aeromonas hydrophila</i>	[107]
			MIC >6.4 MBC >6.4 (mg/ml)	<i>Citrobacter freundii</i>	
<i>Jasminum grandiflorum</i> L.	Jasmine	Flowers	MIC ₅₀ 11.36 MIC ₉₀ 15.26 (μ l/ml)	<i>Pseudomonas fluorescens</i>	[142]
			MIC ₅₀ 3.18 MIC ₉₀ 5.24 (μ l/ml)	<i>Candida albicans</i>	
<i>Juglans regia</i> L.	Common walnut	seeds	MIC 510 (μ g/ml)	<i>Lactococcus garviae</i>	[141]
<i>Juniperus communis</i> L.	Juniper (Common)	Aerial parts, leaves & cones	MIC 0.57-0.75 (mg/ml)	<i>Candida albicans</i>	[143]
<i>Juniperus deltooides</i> R.P.Adams (referred to as <i>Juniperus oxycedrus</i> L. subsp. <i>deltooides</i>)	Juniper (Eastern prickly)		MIC 1.15 (mg/ml)	<i>Candida albicans</i>	
<i>Juniperus drupacea</i> Labill.	Juniper (Syrian)		MIC 0.75-0.79 (mg/ml)	<i>Candida albicans</i>	
<i>Juniperus excelsa</i> M.Bieb.	Juniper (Greek)		MIC 0.85-0.88 (mg/ml)	<i>Candida albicans</i>	
<i>Juniperus foetidissima</i> Willd.	Juniper (Stinking)		MIC 0.62-0.97 (mg/ml)	<i>Candida albicans</i>	
<i>Juniperus macrocarpa</i> Sm.	Juniper (Largefruited)		MIC 0.83-0.88 (mg/ml)	<i>Candida albicans</i>	
<i>Juniperus turbinata</i> Guss.	Juniper (Mediterranean)		MIC 0.5-0.67 (mg/ml)	<i>Candida albicans</i>	
<i>Juniperus Sabina</i> L.	Juniper (Sarin)		MIC 0.9-0.98 (mg/ml)	<i>Candida albicans</i>	
<i>Kelussia odoratissima</i> Mozaff.	Karafse kouhi	Leaves	MIC >1000 MLC >1000 (μ g/ml)	<i>Lactococcus garviae</i>	[108]
<i>Kunzea flavescens</i> C.T.White & W.D.Francis	Kunzea (Yellow)	Leaves	MIC 1875.0-2320.0 (μ g/ml)	<i>Aeromonas hydrophila</i>	[144]

<i>Larix decidua</i> Mill.	Larch	Young shoots	MIC 50.0 MBEC 25.0 (μ l/ml)	<i>Pseudomonas aeruginosa</i> (ATCC27853)	[145]
			MIC 50.0 MBEC 25.0 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	
			MIC 25.0 MBEC 12.5 (μ l/ml)	<i>Candida albicans</i>	
<i>Laurus nobilis</i> L.	Bay Laurel	Leaves	MIC 5.0 MBC 5.0 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	[125]
			MIC 5.0 MFC 5.0 (μ g/ml)	<i>Candida albicans</i>	
<i>Lavandula angustifolia</i> Mill.	Lavender (angustifolia)	Flowers	MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas agglomerans</i>	[105]
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>				
<i>Lavandula angustifolia</i> Mill. (not <i>Lavandula angustifolia</i> Moench based on Distribution Data of the species and Authors reports that was collected	Lavender (angustifolia)	n/a	MIC 0.125 MBC 0.25 (% v/v)	<i>Photobacterium damsela</i> (FP4101)	[146]
			MIC 1.0 MBC 4.0 (% v/v)	<i>Edwardsiella tarda</i> (FP5060)	

from Romania (referred to as <i>Lavendular angustifolia</i>)			MIC 2.0 MBC 8.0 (% v/v)	<i>Edwardsiella tarda</i> (ED47)	
			MIC 0.5 MBC 4.0 (% v/v)	<i>Edwardsiella tarda</i> (Yoshida)	
			MIC 2.0 MBC 8.0 (% v/v)	<i>Edwardsiella tarda</i> (ED45)	
			MIC 1.0 MBC 4.0 (% v/v)	<i>Lactococcus garviae</i> (FP5245)	
			MIC 0.5 MBC 2.0 (% v/v)	<i>Streptococcus iniae</i> (FP5228)	
			MIC 0.125 MBC 4.0 (% v/v)	<i>Streptococcus iniae</i> (S186)	
			MIC 0.063 MBC 0.5 (% v/v)	<i>Streptococcus iniae</i> (S530)	
			MIC 0.125 MBC 1.0 (% v/v)	<i>Streptococcus iniae</i> (S131)	
			MIC 0.5 MBC 2.0 (% v/v)	<i>Streptococcus parauberis</i> (S124)	
			MIC 0.125 MBC 0.5 (% v/v)	<i>Streptococcus parauberis</i> (S527)	
			MIC 0.25 MBC 1.0 (% v/v)	<i>Streptococcus parauberis</i> (1466)	
<i>Lippia origanoides</i> Kunth	Oregano (Mexican)	Leaves	MIC 0.2 MBC 0.2 (mg/ml)	<i>Aeromonas hydrophila</i>	[107]
			MIC 0.8 MBC 0.8 (mg/ml)	<i>Citrobacter freundii</i>	
<i>Lippia origanoides</i> Kunth (referred to as <i>Lippia sidoides</i>)	Pepper rosmarin	Inflorescences and leaves	MIC 625.0 MFC 625.0 (μ g/ml)	<i>Aeromonas hydrophila</i>	[147]
			MIC 625.0 MFC 625.0 (μ g/ml)	<i>Aeromonas spp</i> (248)	
		Leaves	(Peg400) MIC 2245.0 MBC 4490.0 (% v/v)	(DMSO) MIC 8980.0 MBC 17960.0 (% v/v)	<i>Aeromonas hydrophila</i>

			(Peg400) MIC 17960.0 MBC 17960.0	(DMSO) MIC 17960.0 MBC 17960.0	<i>Aeromonas jandaei</i>	
			(% v/v)			
<i>Litsea cubeba</i> (Lour.)Pers.	Mountain Pepper	Whole Plant	MIC 12.5 (µl/ml)		<i>Aeromonas</i> spp.	[114]
			MIC 12.5 (µl/ml)		<i>Aeromonas salmonicida</i>	
			MIC 3.12 (µl/ml)		<i>Enterococcus faecium</i>	
			MIC 25.0 (µl/ml)		<i>Pseudomonas fluorescens</i>	
			MIC 6.25 (µl/ml)		<i>Yersinia</i> spp.	
			MIC 6.25 (µl/ml)		<i>Yersinia ruckeri</i>	
<i>Matricaria chamomilla</i> L. (referred to as <i>Matricaria recutita</i>)	Chamomile (German)	Leaves & flowers	MIC 5.0 (µl/ml)		<i>Saprolegnia parasitica</i>	[139]
			MIC 5.0 (µl/ml)		<i>Aspergillus fumigatus</i>	
		n/a	MIC ₅₀ 11.56 MIC ₉₀ 13.35 (µl/ml)		<i>Pseudomonas aeruginosa</i>	[131]
			MIC ₅₀ 11.56 MIC ₉₀ 13.35 (µl/ml)		<i>Candida albicans</i>	
<i>Melaleuca alternifolia</i> (Maiden & Betche) Cheel	Tea Tree	Leaves	MIC 3.2 MBC 6.4 (mg/ml)		<i>Aeromonas hydrophila</i>	[107]
			MIC >6.4 MBC >6.4 (mg/ml)		<i>Citrobacter freundii</i>	
<i>Melaleuca cajuputi</i> Maton & Sm. Ex R.Powell	Cajeput	Leaves	MIC 6.25 MBC 25.0 (mg/ml)		<i>Vibrio harveyi</i>	[148]
			MIC 6.25 MBC 25.0 (mg/ml)		<i>Vibrio parahaemolyticus</i>	
<i>Melaleuca ericifolia</i> Sm.	swamp paperbark	Wood bark	MIC 6.25 (µl/ml)		<i>Aeromonas</i> spp.	[114]
			MIC 12.5 (µl/ml)		<i>Aeromonas salmonicida</i>	
			MIC 6.25 (µl/ml)		<i>Enterococcus faecium</i>	
			MIC 12.5 (µl/ml)		<i>Pseudomonas fluorescens</i>	
			MIC 6.25 (µl/ml)		<i>Yersinia</i> spp.	
			MIC 12.5 (µl/ml)		<i>Yersinia ruckeri</i>	

<i>Melaleuca leucadendra</i> (L.)L (referred to as <i>Melaleuca leucadendron</i> and <i>Melaleuca leucadendra</i>)	Paperbark (White Weeping)	Wood bark	MIC 6.25 (µl/ml)	<i>Aeromonas</i> spp.	
			MIC 12.5 (µl/ml)	<i>Aeromonas salmonicida</i>	
			MIC 6.25 (µl/ml)	<i>Enterococcus faecium</i>	
			MIC 12.5 (µl/ml)	<i>Pseudomonas fluorescens</i>	
			MIC 12.5 (µl/ml)	<i>Yersinia</i> spp.	
			MIC 12.5 (µl/ml)	<i>Yersinia ruckeri</i>	
<i>Melissa officinalis</i> L.	Melissa (Leomn Balm)	Aerial parts	MIC 1.0 MBC 2.0 (µl/ml)	<i>Acinetobacter baumannii</i> (ATCC 19606)	[149]
			MIC 0.5 MBC 1.0 (µl/ml)	<i>Pseudomonas aeruginosa</i> (ATCC 25922)	
			MIC 1.0 MBC 2.0 (µl/ml)	<i>Staphylococcus aureus</i> (ATCC 9144)	
<i>Mentha longifolia</i> (L.)L.	Mint (Horsemint)	Leaves & flowers	MIC 10.0 (µl/ml)	<i>Saprolegnia parasitica</i>	[139]
			MIC 20.0 (µl/ml)	<i>Aspergillus fumigatus</i>	
<i>Mentha × piperita</i> L.	Mint (Peppermint)	Aerial parts	MIC 1.0 MFC 2.0 (µg/ml)	<i>Saprolegnia parasitica</i>	[106]
		n/a	MIC ₅₀ 11.56 MIC ₉₀ 13.35 (µl/ml)	<i>Pseudomonas aeruginosa</i>	[131]
			MIC ₅₀ 5.56 MIC ₉₀ 7.23 (µl/ml)	<i>Candida albicans</i>	
		Leaves	MIC ₅₀ 12.5 MIC ₉₀ 25.0 (µl/ml)	<i>Pseudomonas agglomerans</i>	[105]
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (µl/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (µl/ml)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (µl/ml)	<i>Pseudomonas frederiksbergensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (µl/ml)	<i>Pseudomonas koreensis</i>	

			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas agglomerans</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>	
			MIC 1.2 (mg/ml)	<i>Aeromonas hydrophila</i>	[109]
			MIC 1.2 (mg/ml)	<i>Pseudomonas fluorescens</i>	
<i>Mentha spicata</i> L.	Spearmint	Leaves			
<i>Momordica charantia</i> L.	Melon (Bitter Gourd)	Fresh leaves			

			MIC 2.5 (mg/ml)	<i>Edwardsiella tarda</i>		
<i>Monodora myristica</i> (Gaertn.) Dunal	Nutmeg (African)	Seeds	MIC 150.0 MBC 150.0 (mg/ml)	<i>Pseudomonas aeruginosa</i> (AAU2)	[150]	
			MIC 600.0 MBC 600.0 (mg/ml)	<i>Pseudomonas aeruginosa</i> (PB112 165)		
			MIC 300.0 MFC 300.0 (mg/ml)	<i>Aspergillus flavus</i>		
<i>Myristica fragrans</i> Houtt.	Nutmeg	Seeds	MIC >2000.0 (mg/L)	<i>Pseudomonas aeruginosa</i>	[151]	
			MIC 2000.0 MFC >2000.0 (mg/L)	<i>Candida albicans</i>		
<i>Myrtus communis</i> L.		Leaves	MIC >1000 MLC >1000 (μ l/ml)	<i>Lactococcus garviae</i>	[108]	
			MIC 672.0 (μ g/ml)	<i>Lactococcus garviae</i>	[141]	
<i>Myrtus communis</i> L. (not <i>Myrtus communis</i> Blanco -synonym of <i>Decaspermum blancoi</i> - based on Distribution Data of the species and Authors reports that specimen can be found in Mediterranean region (referred to as <i>Myrtus communis</i>))	Myrtle (Common)	Leaves & flowers	MIC 10.0 (μ l/ml)	<i>Saprolegnia parasitica</i>	[139]	
			MIC 20.0 (μ l/ml)	<i>Aspergillus fumigatus</i>		
<i>Ocimum americanum</i> L.	Basil (Hoary)	Inflorescences and leaves	MIC 6400.0 (μ g/ml)	<i>Aeromonas hydrophila</i>	[152]	
<i>Ocimum basilicum</i> L.	Basil	n/a	MIC 9.0 (μ l/ml)	<i>Aeromonas veronii</i>	[153]	
			MIC 3.0 (μ l/ml)	<i>Aeromonas hydrophila</i>		
		Leaves	(Peg400) MIC 8740.0 MBC 8740.0 (% v/v)	(DMSO) MIC 17480.0 MBC 17480.0	<i>Aeromonas hydrophila</i>	[111]
			(Peg400) MIC 17480.0 MBC 17480.0 (% v/v)	(DMSO) MIC 8740.0 MBC 8740.0	<i>Aeromonas jandaei</i>	
		n/a		MIC 9.0 (μ l/ml)	<i>Pseudomonas fluorescens</i>	[153]

		Aerial parts	MIC 0.019 MBC >2.5 ($\mu\text{g/ml}$)	<i>Aeromonas hydrophila</i>	[154]
			MIC 0.039 MBC >5.00 ($\mu\text{g/ml}$)	<i>Vibrio vulnificus</i> (S5 - <i>Dicentrarchus labrax</i> , Chebba)	
			MIC 0.019 MBC >2.5 ($\mu\text{g/ml}$)	<i>Vibrio vulnificus</i> (V30 - <i>Sparus aurata</i> , Hergla)	
			MIC 0.039 MBC 10.0 ($\mu\text{g/ml}$)	<i>Vibrio parahaemolyticus</i> (S949- <i>Mytilus edulis</i> , Bizerte)	
			MIC 0.019 MBC 10.0 ($\mu\text{g/ml}$)	<i>Vibrio parahaemolyticus</i> (S950 - <i>Mytilus edulis</i> , Bizerte)	
		Leaves	MIC 500 ($\mu\text{g/ml}$)	<i>Vibrio parahaemolyticus</i>	[155]
		Stem	MIC 250 ($\mu\text{g/ml}$)	<i>Vibrio parahaemolyticus</i>	
		Aerial parts	MIC 0.019 MBC >5.0 ($\mu\text{g/ml}$)	<i>Vibrio alginolyticus</i> (S6 - <i>Dicentrarchus labrax</i> , Chebba)	[154]
			MIC 0.019 MBC >5.0 ($\mu\text{g/ml}$)	<i>Vibrio alginolyticus</i> (S7 - <i>Mytilus edulis</i> , Bizerte)	
			MIC 0.039 MBC >5.0 ($\mu\text{g/ml}$)	<i>Vibrio alginolyticus</i> (S8 (<i>Sparus aurata</i> , Hergla)	
			MIC 0.019 MBC >5.0 ($\mu\text{g/ml}$)	<i>Listonella anguillarum</i> (Malaga, Spain)(referred to as <i>Vibrio anguillarum</i>)	
		Leaves	MIC 0.019 MBC >5.0 ($\mu\text{g/ml}$)	<i>Vibrio harveyi</i> (ATCC 18293) (referred to as <i>Vibrio harveyii</i>)	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas</i> <i>agglomerans</i>	[105]
			MIC ₅₀ 12.5 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas</i> <i>brassicacearum</i>	
MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas</i> <i>frederiksbergensis</i>				
MIC ₅₀ 25.0 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas koreensis</i>				

			MIC ₅₀ 12.5 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>	
<i>Ocimum gratissimum</i> L.	Basil (Clove)	Inflorescences and leaves	MIC 5000.0 MBC 5000.0 (μ g/ml)	<i>Aeromonas hydrophila</i>	[147]
			MIC 2500.0 MBC 5000.0 (μ g/ml)	<i>Aeromonas</i> spp (248)	
<i>Ocimum tenuiflorum</i> L. (referred to as <i>Ocimum sanctum</i>)	Basil (Holy)	Leaves	MIC 240.0 (μ g/ml)	<i>Lactococcus garviae</i>	[127]
<i>Origanum vulgare</i> L.	Oregano	n/a	MIC ₅₀ 3.22 MIC ₉₀ 5.46 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	[131]
			MIC ₅₀ 3.22 MIC ₉₀ 5.46 (μ l/ml)	<i>Candida albicans</i>	
		Whole Herb	MIC ₅₀ 6.25 MIC ₉₀ 21.5 (μ l/ml)	<i>Pseudomonas agglomerans</i>	[105]
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas lundensis</i>	

			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas mandelii</i>		
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>		
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>		
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>		
<i>Pandanus amaryllifolius</i> Roxb. Ex Lindl.	Pandan	Leaves	MIC 62.5 (μ g/ml)	<i>Pseudomonas aeruginosa</i>	[156]	
<i>Peganum harmala</i> L.	Harmala (Syrian rue)	Leaves	MIC 105 (μ g/ml)	<i>Lactococcus garviae</i>	[141]	
<i>Pelargonium graveolens</i> L'Her.	Geranium (Rose)	Leaves	(Peg400) MIC 2222.5 MBC 2222.5	(DMSO) MIC 4444.5 MBC 4444.5	<i>Aeromonas hydrophila</i>	[111]
			(% v/v)			
			(Peg400) MIC 4444.5 MBC 4444.5	(DMSO) MIC 4444.5 MBC 4444.5	<i>Aeromonas jandaei</i>	
<i>Persicaria hydropiper</i> (L.) Delarbre (referred to as <i>Polygonum hydropiper</i>)	Water pepper	Fresh leaves	MIC 1.2 (mg/ml)	<i>Aeromonas hydrophila</i>	[109]	
			MIC 1.2 (mg/ml)	<i>Pseudomonas fluorescens</i>		
			MIC 2.5 (mg/ml)	<i>Edwardsiella tarda</i>		
<i>Persicaria odorata</i> (Lour.) Soják	Coriander (Vietnamese)	Several plant parts	MIC 3.13 (μ g/ml)	<i>Staphylococcus aureus</i>	[120]	
<i>Petroselinum crispum</i> (Mill.) Fuss	Parsley	Aerial parts	MIC 0.022 MFC >11.25 (μ g/ml)	<i>Aeromonas Hydrophila</i>	[154]	
			MIC 0.011 MFC 5.62 (μ g/ml)	<i>Vibrio vulnificus</i> (S5 - <i>Dicentrarchus labrax</i> , Chebba)		
			MIC 0.011 MFC >5.62 (μ g/ml)	<i>Vibrio vulnificus</i> (V30 - <i>Sparus aurata</i> , Hergla)		
			MIC 0.022 MFC >11.25 (μ g/ml)	<i>Vibrio parahaemolyticus</i> (S949 - <i>Mytilus edulis</i> , Bizerte)		
			MIC 0.044 MFC >11.25 (μ g/ml)	<i>Vibrio parahaemolyticus</i> (S950 - <i>Mytilus edulis</i> , Bizerte)		

			MIC 0.011 MFC >5.62 ($\mu\text{g/ml}$)	<i>Vibrio alginolyticus</i> (S6 - <i>Dicentrarchus labrax</i> , Chebba)	
			MIC 0.011 MFC >11.25 ($\mu\text{g/ml}$)	<i>Vibrio alginolyticus</i> (S7 - <i>Mytilus edulis</i> , Bizerte)	
			MIC 0.022 MFC >2.81 ($\mu\text{g/ml}$)	<i>Vibrio alginolyticus</i> (S8 - <i>Sparus aurata</i> , Hergla)	
			MIC 0.011 MFC >11.25 ($\mu\text{g/ml}$)	<i>Listonella anguillarum</i> (Malaga, Spain)(referred to as <i>Vibrio</i> <i>anguillarum</i>)	
			MIC 0.011 MFC >11.25 ($\mu\text{g/ml}$)	<i>Vibrio harveyi</i> (ATCC 18293)(referred to as <i>Vivrio harveyii</i>)	
<i>Picea abies</i> (L.) H.Karst.	Spruce (Norway)	Young shoots	MIC 50.0 MBEC 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas aeruginosa</i> (ATCC 27853)	[145]
			MIC 50.0 MBEC 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas aeruginosa</i>	
			MIC 6.25 MBEC 3.13 ($\mu\text{l/ml}$)	<i>Candida albicans</i>	
<i>Pimpinella affinis</i> Ledeb.	Anise (Aniseed)	Aerial parts	MIC 2.0 MFC 4.0 ($\mu\text{g/ml}$)	<i>Saprolegnia parasitica</i>	[106]
<i>Pimpinella anisum</i> L.	Anise (burnet saxifrage)	Fruits	MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas</i> <i>agglomerans</i>	[105]
			MIC ₅₀ 12.5 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas</i> <i>brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas</i> <i>frederiksbergensis</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas mandelii</i>	

			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas veronii</i>	
<i>Pinus mugo</i> Turra	Pine (Swiss Mountain)	Needles	MIC ₅₀ 6.25 MIC ₉₀ 21.5 (μ l/ml)	<i>Pseudomonas agglomerans</i>	[105]
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas veronii</i>	
<i>Pinus nigra subsp. pallasiana</i> (Lamb.) Holmboe (referred to as <i>Pinus nigra</i> Arn. sub sp <i>pallasiana</i>)	Pine (European black pine)	Several plant parts	MIC 0.5 (μ g/ml)	<i>Aeromonas hydrophila</i>	[135]
		Young shoots	MIC 25.0 MBEC 12.5 (μ l/ml)	<i>Pseudomonas aeruginosa</i> (ATCC27853)	[145]
			MIC 25.0 MBEC 12.5 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	
MIC 6.25 MBEC 3.13 (μ l/ml)	<i>Candida albicans</i>				

<i>Pinus sylvestris</i> L.	Pine (Scots)	Needles	MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas agglomerans</i>	[105]
			MIC ₅₀ 12.5 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>	
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 21.5 (μ l/ml)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas veronii</i>	
<i>Piper betle</i> L.	Betel (Sireh)	Leaves	MIC 25.0 MBC 50.0 (mg/ml)	<i>Aeromonas hydrophila</i> (ATCC 49140)	[157]
<i>Piper nigrum</i> L.	Black Pepper	Leaves	MIC 12.5 MBC 100.0 (mg/ml)	<i>Aeromonas hydrophila</i> (ATCC 49140)	
Referred to as <i>Piper sarmentosum</i> (Thus indistinguishable between <i>Piper sarmentosum</i> Roxb. or <i>Piper sarmentosum</i> Wall. (a synonym of <i>Piper longum</i>), as both species can be found in Malaisia where specimen purchased)	Pepper (Lolot)	Leaves	MIC 12.5 MBC 100.0 (mg/ml)	<i>Aeromonas hydrophila</i> (ATCC 49140)	
<i>Pistacia lentiscus</i> L.	Mastic	Leaves	MIC 5.0 MBC 5.0 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	[125]
			MIC 5.0 MFC 5.0 (μ g/ml)	<i>Candida albicans</i>	

<i>Pogostemon cablin</i> (Blanco) Benth.	Patchouli	Leaves	MIC 3.12 (μ l/ml)	<i>Aeromonas</i> spp.	[114]
			MIC 6.25 (μ l/ml)	<i>Aeromonas salmonicida</i>	
			MIC 6.25 (μ l/ml)	<i>Enterococcus faecium</i>	
			MIC 12.5 (μ l/ml)	<i>Pseudomonas fluorescens</i>	
			MIC 12.5 (μ l/ml)	<i>Yersinia</i> spp.	
			MIC 12.5 (μ l/ml)	<i>Yersinia ruckeri</i>	
<i>Pseudevernia furfuracea</i> (L.)Zopf.	Tree moss	Whole Lichen	MIC 125.0, 250.0 (μ g/ml)	<i>Aeromonas hydrophila</i> (DSM 30187)	[158]
			MIC 250.0 (μ g/ml)	<i>Pseudomonas</i> <i>anguiliseptica</i> (DSM 12111)	
			MIC 125.0 (μ g/ml)	<i>Edwardsiella tarda</i> (DSM 30052)	
			MIC 250.0, 500.0 (μ g/ml)	<i>Listonella anguillarum</i> (ATCC 19264)	
			MIC 250.0 (μ g/ml)	<i>Yersinia ruckeri</i> (ATCC 29473)	
<i>Pseudotsuga menziesii</i> (Mirb.) Franco	Fir (Douglas)	Young shoots	MIC 25.0 MBEC 12.5 (μ l/ml)	<i>Pseudomonas aeruginosa</i> (ATCC27853)	[145]
			MIC 25.0-50.0 MBEC 12.5-25.0 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	
			MIC 25.0 MBEC 12.5 (μ l/ml)	<i>Candida albicans</i>	
<i>Psidium guajava</i> L.	Guava	Fresh leaves	MIC 1.2 (mg/ml)	<i>Aeromonas hydrophila</i>	[109]
			MIC 1.2 (mg/ml)	<i>Pseudomonas fluorescens</i>	
			MIC 5.0 (mg/ml)	<i>Edwardsiella tarda</i>	
<i>Punica granatum</i> L.	Pomegranate	Flowers	MIC >1000.0 MLC >1000.0 (μ g/ml)	<i>Lactococcus garviae</i>	[108]
<i>Quercus brantii</i> Lindl.	Brant's oak Persian oak	Seed (flour)	MIC >1000.0 MLC >1000.0 (μ g/ml)	<i>Lactococcus garviae</i>	[108]
		Leaves	MIC 978.0 (μ g/ml)	<i>Lactococcus garviae</i>	[141]
<i>Salvia officinalis</i> L.	Salvia	Leaves	MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas</i> <i>agglomerans</i>	[105]

			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>	
<i>Salvia rosmarinus</i> Spenn. (referred to as <i>Rosmarinus officinalis</i>)	Rosemary	Aerial parts	MIC 15.6 MBC 31.2 (μ g/ml)	<i>Lactococcus garviae</i>	[115]
		n/a	MIC ₅₀ 23.45 MIC ₉₀ 26.15 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	[131]
			MIC ₅₀ 3.22 MIC ₉₀ 5.46 (μ l/ml)	<i>Candida albicans</i>	
		Whole herb	MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas agglomerans</i>	[105]
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 (μ l/ml)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>	

			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas koreensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas lundensis</i>	
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas mandelii</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>	
<i>Salvia sclarea</i> L.	Sage (Clary)	n/a	MIC ₅₀ 11.56 MIC ₉₀ 13.34 (μ l/ml)	<i>Pseudomonas aeruginosa</i>	[131]
			MIC ₅₀ 1.21 MIC ₉₀ 3.18 (μ l/ml)	<i>Candida albicans</i>	
<i>Santalum album</i> L.	Sandalwood (Indian)	Wood bark	MIC 1.56 (μ l/ml)	<i>Aeromonas</i> spp.	[114]
			MIC 3.12 (μ l/ml)	<i>Aeromonas salmonicida</i>	
			MIC 6.25 (μ l/ml)	<i>Enterococcus faecium</i>	
			MIC 25.0 (μ l/ml)	<i>Pseudomonas fluorescens</i>	
			MIC 25.0 (μ l/ml)	<i>Yersinia</i> spp.	
<i>Satureja bachtiarica</i> Bunge	Savory (Bakhtiarian)	Leaves	MIC 126.0 (μ g/ml)	<i>Lactococcus garviae</i>	[141]
		Leaves & flowers	MIC 5.0 (μ l/ml)	<i>Saprolegnia parasitica</i>	[139]
MIC 20.0 (μ l/ml)	<i>Aspergillus fumigatus</i>				
<i>Satureja hortensis</i> L.	Savory (Summer)	Aerial parts	MIC ₅₀ 12.5 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas agglomerans</i>	[105]
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas antarctica</i>	

			MIC ₅₀ 12.5 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas brassicacearum</i>		
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>		
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas koreensis</i>		
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas lundensis</i>		
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas mandelii</i>		
			MIC ₅₀ 25.0 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>		
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>		
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>		
<i>Stachys lavandulifolia</i> Vahl	Pink cotton lamb's ear	Flowers	MIC >1000.0 MLC >1000.0 (μ g/ml)	<i>Lactococcus garviae</i>	[108]	
<i>Styrax pohlii</i> A.D.C. (referred to as <i>Styrax ferrugineus</i>)	Styrax (Strigilia)	Leaves	MIC 2500.0 MFC 5000.0 (μ g/ml)	<i>Candida albicans</i>	[159]	
			MIC 2500.0 MBC 5000.0 (μ g/ml)	<i>Staphylococcus aureus</i>		
<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	Clove	Leaves	(Peg400) MIC 662.5 MBC 1325.0	(DMSO) MIC 662.5 MBC 1325.0	<i>Aeromonas hydrophila</i>	[111]
			(% v/v)			
		Several plant parts	MIC 12.5 (μ g/ml)		<i>Aeromonas hydrophila</i>	[120]
		Leaves	(Peg400) MIC 2650.0 MBC 2650.0	(DMSO) MIC 2650.0 MBC 2650.0	<i>Aeromonas jandaei</i>	[111]
			(% v/v)			
Flower buds	MIC 30.0 MBC 30.0 (μ g/ml)		<i>Lactococcus garviae</i>	[127]		
Several plant parts	MIC 1.56 (μ g/ml)		<i>Vibrio parahaemolyticus</i>	[120]		
	MIC 3.13 (μ g/ml)		<i>Vibrio vulnificus</i>			

<i>Tanacetum parthenium</i> (L.) Sch.Bip.	Manzanila Feverfew	Leaves	MIC 824.0 ($\mu\text{g/ml}$)	<i>Lactococcus garviae</i>	[141]
<i>Tamarindus indica</i> L.	Tamarind	Fresh leaves	MIC 5.0 (mg/ml)	<i>Aeromonas hydrophila</i>	[109]
			MIC 5.0 (mg/ml)	<i>Pseudomonas fluorescens</i>	
			MIC 5.0 (mg/ml)	<i>Edwardsiella tarda</i>	
<i>Tetrataenium lasiopetalum</i> (Boiss.) Manden (referred to as <i>Heracleum lasiopetalum</i>)	Golpar-e-barfi	Leaves	MIC >1000.0 MLC >1000.0 ($\mu\text{g/ml}$)	<i>Lactococcus garviae</i>	[108]
<i>Teucrium polium</i> L.	Felty germander	Aerial parts	MIC >1000.0 MLC >1000.0 ($\mu\text{l/ml}$)	<i>Lactococcus garviae</i>	
<i>Thymbra spicata</i> L.	Savory (Spiked)	Aerial parts (Inflorescences)	MIC 8.0 MLC 16.0 ($\mu\text{l/ml}$)	<i>Lactococcus garviae</i>	
<i>Thymus daenensis</i> čelak.	Thyme (Denaian)	Aerial Parts (Inflorescences)	MIC 8.0 MLC 16.0 ($\mu\text{l/ml}$)	<i>Lactococcus garviae</i>	
		Leaves & flowers	MIC 5.0 ($\mu\text{l/ml}$)	<i>Saprolegnia parasitica</i>	[139]
			MIC 10.0 ($\mu\text{l/ml}$)	<i>Aspergillus fumigatus</i>	
<i>Thymus eigii</i> (Zohary & P.H.Davis) Jalas	Thyme (West Asia)	Several plant parts	MIC 0.05 ($\mu\text{g/ml}$)	<i>Aeromonas hydrophila</i>	[135]
<i>Thymus serpyllum</i> L.	Thyme (Breckland, creeping)	n/a	MIC ₅₀ 11.56 MIC ₉₀ 13.34 ($\mu\text{l/ml}$)	<i>Pseudomonas aeruginosa</i>	[131]
			MIC ₅₀ 3.22 MIC ₉₀ 5.46 ($\mu\text{l/ml}$)	<i>Candida albicans</i>	
		Leaves	MIC ₅₀ 25.0 MIC ₉₀ 50.0 ($\mu\text{l/ml}$)	<i>Pseudomonas agglomerans</i>	[105]
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 ($\mu\text{l/ml}$)	<i>Pseudomonas antarctica</i>	
			MIC ₅₀ 50.0 MIC ₉₀ 100.0 ($\mu\text{l/ml}$)	<i>Pseudomonas brassicacearum</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas frederiksbergensis</i>	
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 ($\mu\text{l/ml}$)	<i>Pseudomonas koreensis</i>	

			MIC ₅₀ 12.5 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas lundensis</i>			
			MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas mandelii</i>			
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>			
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>			
			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>			
<i>Thymus vulgaris</i> L.	Thyme (European)	Leaves	(Peg400) MIC 294.06 MBC 588.13	(DMSO) MIC 294.06 MBC 588.13	<i>Aeromonas hydrophila</i>	[111]	
			(Peg400) MIC 2352.5 MBC 2352.5	(DMSO) MIC 2352.5 MBC 2352.5	<i>Aeromonas jandaei</i>		
				(% v/v)			
				MIC ₅₀ 6.25 MIC ₉₀ 21.5 (μ l/ml)	<i>Pseudomonas agglomerans</i>		
				MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas antarctica</i>		
				MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas brassicacearum</i>		
				MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas frederiksbergensis</i>		
				MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas koreensis</i>	[105]	
				MIC ₅₀ 12.5 MIC ₉₀ 50.0 (μ l/ml)	<i>Pseudomonas lundensis</i>		
				MIC ₅₀ 6.25 MIC ₉₀ 12.5 (μ l/ml)	<i>Pseudomonas mandelii</i>		
		MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas proteolytica</i>				
		MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas synxantha</i>				

			MIC ₅₀ 12.5 MIC ₉₀ 25.0 (μ l/ml)	<i>Pseudomonas veronii</i>	
		n/a	MIC 40.0 (μ g/ml)	<i>Yersinia ruckeri</i>	[140]
<i>Trachyspermum ammi</i> (L.) Sprague	Ajowan	seeds	MIC 0.04 MFC 0.1 (μ l/ml)	<i>Fusarium</i> sp.	[160]
			MIC 0.043 MFC 0.07 (μ l/ml)	<i>Saprolegnia parasitica</i>	
<i>Trachyspermum ammi</i> (L.) Sprague referred to as <i>Trachyspermum copticum</i>)	Ajowan (Carum- bishop's weed)	Leaves	MIC 453.0 (μ g/ml)	<i>Lactococcus garviae</i>	[141]
<i>Zataria multiflora</i> Boiss.	Thyme (Shirazi)	Aerial parts (Infloresce nces)	MIC 4.0 MLC 8.0 (μ l/ml)	<i>Lactococcus garviae</i>	[108]
		Aerial parts	MIC 7.8 MBC 15.6 (μ g/ml)	<i>Lactococcus garviae</i>	[115]
			MIC 0.12 MBC 0.12 (μ l/ml)	<i>Lactococcus garviae</i>	[112]
<i>Zingiber officinale</i> Roscoe	Ginger	Rhizome	MIC 31.25 MBC 62.5 (μ l/ml)	<i>Aeromonas hydrophila</i>	[132]
			MIC 5000.0 MFC 5000.0 (μ g/ml)	<i>Aeromonas hydrophila</i>	[147]
			MIC 2500.0 MFC 5000.0 (μ g/ml)	<i>Aeromonas</i> spp (248)	
			MIC 120.0 (μ g/ml)	<i>Lactococcus garviae</i>	[127]
			MIC 2.0 MBC 2.0 (% v/v)	<i>Lactococcus garviae</i> (FP5245)	[161]
			MIC 4.0 MBC 8.0 (% v/v)	<i>Photobacterium damsela</i> (FP4101)	
			MIC 31.25 MBC 125 (μ l/ml)	<i>Vibrio parahaemolyticus</i>	[132]
			MIC 31.23 MBC 31.25 (μ l/ml)	<i>Vibrio vulnificus</i>	
		n/a	MIC 2.0 (μ l/ml)	<i>Candida albicans</i>	[138]

Table S3. In vitro efficacy of different essential oils and their major compounds for different fish species. Plant and Animal nomenclature in this work follows the Plants of the World Online (POWO) and World Register of Marine Species (WoRMS) databases (accessed on April 6th, 2025). If a species name cited in a reference, differs from, or is inconsistent with the updated POWO & WoRMS taxonomy, the referenced name is retained and noted accordingly. Efficacy (%): The percentage reduction of a microorganism's population. 100- indicates full inhibition, 0-indicates no inhibition. NOTE: in some instances instead of Efficacy (%), there are EC₅₀ or LC₅₀ values. Values are shown as reported in the source studies. As a guide, for aqueous exposures, 1 ppm ≈ 1 mg·L⁻¹; for dietary inclusion, 1% w/w = 10 g·kg⁻¹ feed; for EO volumes, 1% v/v = 10 mL·kg⁻¹ feed. Where conversion would require assumptions (e.g., density, chemotype), no transformation is applied

<i>Parasite Species</i>	<i>Essential Oil /Active Substance</i>	<i>Concentrations</i>	<i>Exposure Time</i>	<i>Efficacy (%)</i>	<i>Aquatic Animal Species</i>	<i>Citation</i>
<i>Anacanthorus spathulatus</i> Thatcher & Kayton, 1979	<i>Minthostachys mollis</i> (Benth.) Griseb.	80mg/ml	2h 50min	100	<i>Piaractus brachypomus</i> (Cuvier, 1818)	[176]
		200mg/ml	2h	100		
		400mg/ml	1h	100		
		600mg/ml	7min	100		
		1000mg/ml	3min	100		
	<i>Origanum vulgare</i> L.	1500mg/ml	4min	100		
		1000mg/ml	8min	100		
		800mg/ml	25min	100		
		600mg/ml	40min	100		
		400mg/ml	1h	100		
		200mg/ml	1h 50min	100		
		80mg/ml	3h	100		
	<i>Salvia rosmarinus</i> Spenn.	1500mg/ml	8min	100		
		1000mg/ml	20min	100		
		800mg/ml	1h 5min	100		
		600mg/ml	1h 15min	100		
		400mg/ml	1h 50min	100		
		200mg/ml	2h 55min	100		
80mg/ml		4h	100			
<i>Argulus sp.</i> Müller O.F., 1785	<i>Azadirachta indica</i> A.Juss(Azadirachtin)	75mg/L	15h	100	<i>Carassius auratus</i> Linnaeus 1758	[177]
		100mg/L	12h	100		
	<i>Curcuma longa</i> L.	50ppm	18h	100		[178]
		100ppm	6h	100		

		200ppm	3h	100		
	Pellitorine	5mg/ml	12h	80		[179]
<i>Argulus foliaceus</i> (Linnaeus, 1758)	<i>Madhuca longifolia</i> var. <i>latifolia</i> (Roxb.) A.Chev. (referred to as <i>Madhuca latifolia</i>)	25mg/L	36h	100	<i>Cyprinus carpio</i> Linnaeus 1758	[180]
<i>Cichlidogyrus tilapiae</i> Paperna, 1960	<i>Carica papaya</i> L.	2ml/L	50min	100	<i>Oreochromis niloticus</i> Linnaeus 1758	[181]
<i>Clinostomatopsis intermedialis</i> Lamont, 1920 Lunaschi & Drago, 2009 (referred to as <i>Clinostomum phalacrocoracis</i>)	<i>Verbesina alternifolia</i> (L.) Britton ex Kearney	400ppm	24h	EC ₅₀	<i>Coptodon zillii</i> Gervais, 1848 Referred to as <i>Tilapia zillii</i>)	[182]
<i>Cryptocaryon irritans</i> Brown, 1951	Nerolidol	10µl/L	30min	100	<i>Trachinotus ovatus</i> Linnaeus 1758	[183]
<i>Dactylogyrus</i> sp.Diesing, 1850	<i>Allium cepa</i> L.	0.4-1.8mg/ml	15min	100	<i>Oreochromis niloticus</i> Linnaeus 1758	[184]
	<i>Allium sativum</i> L.	0.02-0.18mg/ml	5min	100		
	<i>Mentha x piperita</i> L.	1µl/ml	15min	100	<i>Cyprinus carpio</i> Linnaeus 1758	[185]
		2.5µl/ml	8min	100		
		5µl/ml	7min	100		
		10µl/ml	2min	100		
	<i>Citrus x limon</i> (L.) Osbeck	1µl/ml	10min	100		
		2.5µl/ml	5min	100		
		5µl/ml	4min	100		
		10µl/ml	3min	100		
	<i>Melaleuca alternifolia</i> (Maiden & Betche) Cheel	0.5µl/ml	3min	100		
1µl/ml		2min	100			
2.5µl/ml		1min	100			
<i>Electrotaenia malapteruri</i> (Fritsch, 1886) Nybelin, 1942 (referred to as <i>Electrotaenia</i> sp. but according to WoRMS there is only one direct species within the genus)	<i>Aframomum melegueta</i> K.Schum.(referred to as <i>Afranamum melegueta</i>)	68.36mg/L	1.5min	98.8	<i>Clarias gariepinus</i> Burchell 1822	[186]
<i>Enteromyxum leei</i> (Diamant, Lom & Dyková, 1994)	Citral	100µg/ml	6h	20	<i>Paralichthys olivaceus</i> Temminck & Schlegel, 1846	[187]
		100µg/ml	12h	85		
		250µg/ml	6h	60		
		250µg/ml	12h	100		
<i>Gyrodactylus</i> sp.von Nordmann, 1832	<i>Azadirachta indica</i> A.Juss(Azadirachtin)	25mg/L	4h	100	<i>Carassius auratus</i> Linnaeus 1758	[177]
		30mg/L	3h	100		

<i>Gyrodactylus kobayashii</i> Kobayashii Hukuda, 1940	<i>Curcuma longa</i> L.	12mg/L	24h	100	<i>Carassius auratus</i> Linnaeus 1758	[188]
	<i>Cymbopogon martini</i> (Roxb.) Will Watson (Palmarosa oil) (referred to as <i>Cymbopogon martinii</i>)	10mg/L	24h	100		
<i>Ichthyophthirius multifiliis</i> Fouquet, 1876	<i>Azadirachta indica</i> A. Juss (Azadirachtin)	20-40mg/L	12h	100	<i>Carassius auratus</i> Linnaeus 1758	[177]
		50mg/L	6h	100		
	<i>Carica papaya</i> L.	200mg/L	6h	100	<i>Carassius auratus</i> Linnaeus 1758 (referred to as <i>Carassius auratus auratus</i>)	[189]
	<i>Macleaya cordata</i> (Willd.) R.Br. (sanguinarine)	0.7mg/L	4h	100	<i>Ctenopharyngodon idella</i> Valenciennes 1844	[190]
	<i>Macleaya microcarpa</i> (Maxim.) Fedde (dihydrosanguinarine)	7mg/L	4h	100	<i>Squaliobarbus curriculus</i> Richardson 1846	[191]
		10mg/L	4h	100		
	<i>Mucuna pruriens</i> (L.) DC.	150mg/L	6h	100	<i>Carassius auratus</i> Linnaeus 1758 (referred to as <i>Carassius auratus auratus</i>)	[189]
<i>Sophora flavescens</i> Aiton (sophoraflavanone)	4mg/L	3.3min	100	<i>Ctenopharyngodon idella</i> Valenciennes 1844	[192]	
	1mg/L	16min	100			
<i>Ichthyophthirius multifiliis</i> (protomonts)	<i>Magnolia officinalis</i> Rehder & E.H. Wilson (Mangolol)	0.8mg/L	6h	100	<i>Carassius auratus</i> Linnaeus 1758	[193]
	<i>Zingiber officinale</i> Roscoe (10-gingerol)	8mg/L	4h	100	<i>Ctenopharyngodon idella</i> Valenciennes, 1844 (referred to as <i>Ctenopharyngodon idellus</i>)	[194]
<i>Ichthyophthirius multifiliis</i> (tomonts)	<i>Magnolia officinalis</i> Rehder & E.H. Wilson (Mangolol)	1.0mg/L	6h	100	<i>Carassius auratus</i> Linnaeus 1758	[193]
		10mg/L	20h	91,3		[195]
		20mg/L	20h	100		
	<i>Rhus chinensis</i> Mill. (pentagalloylglucose extracted from galls) (referred to as <i>Gall chinensis</i>)	80mg/L (fresh solution)	4h	100	<i>Ictalurus punctatus</i> Rafinesque 1818	[196]
	<i>Sophora alopecuroides</i> L.	320mg/L	20h	100	<i>Carassius auratus</i> Linnaeus 1758	[195]
	<i>Zanthoxylum asiaticum</i> (L.) Appelhans, Groppo & J. Wen (Chelerythrine) (referred to as <i>Toddalia asiatica</i>)	1.2mg/L	4h	100		[197]
		3.5mg/L	4h	100		
<i>Zingiber officinale</i> Roscoe (10-gingerol)	16mg/L	4h	100	<i>Ctenopharyngodon idella</i> Valenciennes, 1844 (referred to as <i>Ctenopharyngodon idellus</i>)	[194]	
<i>Ichthyophthirius multifiliis</i> (trophonts)	<i>Allium cepa</i> L.	0.25ml/L	1h	≈94	<i>Silurus glanis</i> Linnaeus 1758	[198]
		0.5ml/L	1h	94		

	<i>Allium sativum</i> L.	0.5ml/L	1h	92		
	<i>Lavandula angustifolia</i> subsp. <i>Angustifolia</i> Mil l. (referred as <i>Lavandula officinalis</i>)	0.25ml/L	1h	100		
		0.5ml/L	1h	100		
	<i>Mentha spicata</i> L.(referred as <i>Menthe spicata</i>)	0.5ml/L	1h	94		
	<i>Origanum onites</i> L.	0,1ml/L	1h	100		
		0.25ml/L	1h	100		
		0.5ml/L	1h	100		
<i>Salvia officinalis</i> L.	0.5ml/L	1h	100			
<i>Ichthyophthirius multifiliis</i> (theronts)	<i>Zingiber officinale</i> Roscoe (10-gingerol)	2mg/L	4h	100	<i>Ctenopharyngodon idella</i> Valenciennes, 1844(referred to as <i>Ctenopharyngodon idellus</i>)	[194]
	<i>Rhus chinensis</i> Mill.(pentagalloylglucose extracted from galls) (referred to as <i>Gall chinensis</i>)	20mg/L (fresh solution)	5.6min (\pm 1.0)	100	<i>Ictalurus punctatus</i> Rafinesque 1818	[196]
		10mg/L (fresh solution)	11.6min (\pm 1.4)	100		
		5mg/L (fresh solution)	2h 45.min (\pm 5.2)	100		
		2.5mg/L (fresh solution)	3h 48min (\pm 4.5)	100		
	<i>Aquilaria sinensis</i> (Lour.) Spreng.	10mg/L	4h	61.3	<i>Carassius auratus</i> Linnaeus 1758	[195]
	<i>Areca catechu</i> L.	10mg/L	4h	10.3		
	<i>Asparagus cochinchinensis</i> (Lour.) Merr.	10mg/L	4h	20.3		
	<i>Bassia scoparia</i> (L.)Voss(referred to as <i>Kochia scoparia</i>)	10mg/L	4h	39.3		
	<i>Citrus medica</i> L.	10mg/L	4h	67.7		
	<i>Combretum indicum</i> (L.)DeFilipps(referred as <i>Quisqualis indica</i>)	10mg/L	4h	78.3		
	<i>Croton tiglium</i> L.	10mg/L	4h	78.3		
	<i>Dictamnus dasycarpus</i> Turcz.	10mg/L	4h	51		
	<i>Eclipta prostrata</i> (L.)L.	10mg/L	4h	88.3		
	<i>Foeniculum vulgare</i> Mill.(referred to as <i>Foeniculum uulgare</i>)	10mg/L	4h	72.3		
	<i>Gardenia jasminoides</i> J.Ellis	10mg/L	4h	71		
	<i>Gentiana manshurica</i> Kitag.	10mg/L	4h	25.3		
<i>Geranium wilfordii</i> Maxim.	10mg/L	4h	16.7			
<i>Glycyrrhiza uralensis</i> Fisch. Ex DC.	10mg/L	4h	70.3			

	<i>Salvia rosmarinus</i> Spenn.	800mg/ml	25min	100			
		1000mg/ml	8min	100			
		1500mg/ml	4min	100			
		80mg/ml	4h	100			
		200mg/ml	2h 55min	100			
		400mg/ml	1h 50min	100			
		600mg/ml	1h 15min	100			
		800mg/ml	1h 5min	100			
		1000mg/ml	20min	100			
		1500mg/ml	8min	100			
<i>Neobenedenia melleni</i> (MacCallum, 1927) Yamaguti, 1963	<i>Lippia origanoides</i> Kunth	600mg/L	1min	100	<i>Mugil liza</i> Valenciennes 1836	[199]	
	<i>Lippia origanoides</i> Kunth (referred to as <i>Lippia sidoides</i>)	700mg/L	4min	100			
	<i>Mentha x piperita</i> L.	700mg/L	9min	100			
<i>Neoechinorhynchus (Neoechinorhynchus) buttnerae</i> Golvan, 1956	<i>Aloysia citrodora</i> Paláu (referred to as <i>Aloysia triphylla</i>)	3.35mg/mL	2h	EC ₅₀	<i>Colossoma macropomum</i> Cuvier 1816	[200]	
		1.88mg/mL	6h	EC ₅₀			
	<i>Croton cajucara</i> Benth.(red morphotype)	3.51mg/mL	2h	EC ₅₀			
		1.97mg/mL	6h	EC ₅₀			
	<i>Croton cajucara</i> Benth.(white morphotype)	1.03mg/mL	24h	EC ₅₀			
		3.51mg/mL	2h	EC ₅₀			
		2.72mg/mL	6h	EC ₅₀			
	<i>Curcuma longa</i> L.	1.49mg/mL	24h	EC ₅₀			
37.89mg/mL		2h	EC ₅₀				
<i>Neoechinorhynchus (Neoechinorhynchus) buttnerae</i> (referred to as <i>Neoechinorhynchus buttnerae</i>)	<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants(referred to as <i>Chenopodium ambrosioides</i>)	10% dried extract/ml	30min	100	<i>Colossoma macropomum</i> Cuvier 1816	[201]	
		5% dried extract/ml	15min	96,7			
<i>Neoechinorhynchus (Neoechinorhynchus) buttnerae</i> Golvan, 1956	Eugenol	1.01mg/mL	2h	LC ₅₀	<i>Colossoma macropomum</i> Cuvier 1816	[202]	
		0.79mg/mL	6h	LC ₅₀			
		0.41mg/mL	24h	LC ₅₀			
	<i>Lippia grata</i> Schauer (referred to as <i>Lippia gracilis</i> Schauer)	1.38mg/mL	2h	EC ₅₀			
		0.96mg/mL	6h	EC ₅₀			
		0.86mg/mL	24h	EC ₅₀			
	<i>Lippia origanoides</i> Kunth	1.20mg/mL	2h	EC ₅₀			[200]

		0.86mg/mL	6h	EC ₅₀		
		0.76mg/mL	24h	EC ₅₀		
	<i>Mentha arvensis</i> L.	0.66mg/mL	24h	EC ₅₀		
	<i>Ocimum gratissimum</i> L.	3.51mg/mL	2h	EC ₅₀		
		1.97mg/mL	6h	EC ₅₀		
		1.03mg/mL	24h	EC ₅₀		
	<i>Piper aduncum</i> L.	0.73mg/mL	2h	EC ₅₀		
		1.52mg/mL	6h	EC ₅₀		
		1.52mg/mL	24h	EC ₅₀		
	Tannic acid	4.68mg/mL	2h	LC ₅₀		
		1.79mg/mL	6h	LC ₅₀		
		1.30mg/mL	24h	LC ₅₀		
	Thymol	1.97mg/mL	2h	LC ₅₀		
0.96mg/mL		6h	LC ₅₀			
0.92mg/mL		24h	LC ₅₀			
<i>Procamallanus</i> sp. Baylis, 1923	<i>Aframomum melegueta</i> K. Schum. (referred to as <i>Aframomum melegueta</i>)	68.36mg/L	6.00min	98.2	<i>Clarias gariepinus</i> Burchell 1822	[186]
	<i>Azadirachta indica</i> A. Juss. (Azadirachtin)	319.38mg/L	6.5min	95.2		
<i>Salmincola salmoneus</i> (Linnaeus, 1758) (referred to as <i>Lernaea cyprinacea</i>)	<i>Illicium verum</i> Hook. f.	12.5µg/ml	2h	EC ₅₀	<i>Carassius auratus</i> Linnaeus 1758	[203]
		25µg/ml	1h	EC ₅₀		
<i>Schyzocotyle acheilognathi</i> (Yamaguti, 1934) Brabec, Waeschenbach, Scholz, Littlewood & Kuchta, 2015 (referred to as <i>Bothriocephalus acheilognathi</i>)	<i>Dianthus chinensis</i> L.	10g/100ml	90min	100	<i>Cyprinus carpio</i> Linnaeus 1758	[204]
		20g/100ml	45min	100		
<i>Sparicotyle chrysophrii</i> (Van Beneden & Hesse, 1863) Mamaev, 1984	Cedrol	0.11mM	4h	EC ₅₀	<i>Sparus aurata</i> Linnaeus 1758	[205]
	Curcumin	0.24mM	4h	EC ₅₀		
	Eucalyptol	0.67mM	4h	EC ₅₀		
	Garlicin 80%	0.6mM	4h	EC ₅₀		
	1R- Camphor	0.91mM	4h	EC ₅₀		
	(+)-trans-Chrysanthenic acid	0.84mM	4h	EC ₅₀		
<i>Tenuisentis niloticus</i> (Meyer, 1932) Van Cleave, 1936 (referred to as <i>Tenuisentis</i> sp. but according to	<i>Aframomum melegueta</i> K. Schum. (referred to as <i>Aframomum melegueta</i>)	68.36mg/L	3.75min	96.5	<i>Clarias gariepinus</i> Burchell 1822	[186]

WoRMS there is only one direct species within the genus)	<i>Azadirachta indica</i> A.Juss	319.38mg/L	2.75min	97.4		
<i>Trichodina</i> sp.Ehrenberg, 1830	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	130ppm	60min	100	<i>Lates calcarifer</i> Bloch 1790	[206]
<i>Wenyonia</i> sp.Woodland, 1923	<i>Aframomum melegueta</i> K.Schum.(referred to as <i>Afranamum melegueta</i>)	68.36mg/L	5.75min	95.6	<i>Clarias gariepinus</i> Burchell 1822	[186]
	<i>Azadirachta indica</i> A.Juss	319.38mg/L	3.75min	97.1		
<i>Zeylanicobdella arugamensis</i> Silva, 1963	<i>Curcuma longa</i> L.	25mg/ml	10.5min	100	<i>Epinephelus fuscoguttatus</i> x <i>Epinephelus lanceolatus</i>	[207]
		50mg/ml	8.06min	100		
		100mg/ml	6.12min	100		
	<i>Senna alata</i> (L.) Roxb.	100mg/ml	≈2.38min	100		[208]

Table S4. *In vivo* efficacy (or EC₅₀ values, depending on reported data) of different EOs and their major compounds for different fish species. Plant and Animal nomenclature in this work follows the Plants of the World Online (POWO) and World Register of Marine Species (WoRMS) databases (accessed on April 6th, 2025). If a species name cited in a reference, differs from, or is inconsistent with the updated POWO & WoRMS taxonomy, the referenced name is retained and noted accordingly. **Efficacy (%)**: The percentage reduction of a microorganism's population. 100- indicates full inhibition, 0-indicates no inhibition. Efficacy of inhibition is reported with concentrations either per volume or per parts, according to the data reported and based on the application method (e.g., feed or solution dipping).

Parasite Species	Essential Oil /Active Substance	Exposure	Concentrations	Efficacy (%) - EC ₅₀	Aquatic Animal Species	Citation
<i>Anacanthorus spathulatus</i> Thatcher & Kayton 1979	<i>Carapa guianensis</i> Aubl.	1h bath/day, for 5 days	500mg/L	91,4	<i>Colossoma macropomum</i> Cuvier 1816	[209]
	<i>Copaifera epunctata</i> Amshoff (Oleoresin)(referred to as <i>Copaifera reticulata</i>)	1h bath/day, for 3 days	100mg/L	48.5		[210]
	<i>Piper hispidum</i> Sw.	1h bath/d (3 baths -48h Interval between baths)	100mg/L	78.6		[211]
	<i>Piper marginatum</i> Jacq.	20min bath/d (3 baths -48h Interval between baths)	100mg/L	42,8		[212]
<i>Argulus sp.</i> Müller O.F. 1785	<i>Azadirachta indica</i> A.Juss (Azadirachtin)	9h	≈62mg/L	EC ₅₀	<i>Carassius auratus</i> Linnaeus 1758	[177]
		12h	≈37mg/L	EC ₅₀		
		15h	≈28mg/L	EC ₅₀		
	<i>Curcuma longa</i> L.	72h	12.5ppm	62.8		[178]
		48h	12.5ppm	≈56		
<i>Argulus coregoni</i> Thorell 1865	<i>Artemisia sp.</i> L.	5min	Dipping in 1.8 to 3.6 mg/L (not specified concentration of active compounds)	100	<i>Cyprinus carpio</i> Linnaeus 1758	[213]
<i>Argulus foliaceus</i> Linnaeus 1758	<i>Madhuca longifolia</i> var. <i>latifolia</i> (Roxb.) A.Chev (referred to as <i>Madhuca latifolia</i>)	96h	16.45 mg/L	EC ₅₀	<i>Cyprinus carpio</i> Linnaeus 1758	[180]
<i>Centrocestus formosanus</i> (Nishigori, 1924) Price, 1932	<i>Azadirachta indica</i> A.Juss	long bath, 7 days	3g/L	reduced intensity	<i>Oreochromis niloticus</i> Linnaeus 1758	[214]
<i>Dactylogyridae</i> Bychowsky 1933	<i>Mentha × villosa</i> Huds.	1h	20ml/L	73,5	<i>Oreochromis urolepis</i> Norman 1922 (referred to as <i>Oreochromis hornorum</i>)	[215]
		1h	20ml/L	79	<i>Oreochromis aureus</i> Steindachner, 1864	
		1h	20ml/L	80,7	<i>Oreochromis mossambicus</i> Peters 1852	
		1h	20ml/L	84,5	<i>Oreochromis</i>	

<i>Dactylogyrus</i> sp. Diesing 1850	<i>Allium sativum</i> L.	72h	0.08g/L (^{1/5} of 96h- LC ₅₀)	85.7	<i>niloticus</i> Linnaeus 1758	[210][184]	
		72h	0.04g/L (^{1/10} of 96h- LC ₅₀)	64.7			
	<i>Allium cepa</i> L.	72h	0.708g/L (^{1/5} of 96h- LC ₅₀)	100.0			
		72h	0.354g/L (^{1/10} of 96h- LC ₅₀)	90.5			
	<i>Azadirachta indica</i> A. Juss	long bath, 7 days	3g/L	reduced intensity		<i>Carassius auratus</i> Linnaeus 1758	[214]
	<i>Azadirachta indica</i> A. Juss (Azadirachtin)	2h	≈23mg/L	EC ₅₀			[177]
		3h	≈15mg/L	EC ₅₀			
		4h	≈5mg/L	EC ₅₀			
<i>Dactylogyrus intermedius</i> Wegener 1910	Cinnamaldehyde	48h	5mg/L	100	[216]		
	Cinnamic acid	48h	16mg/L	100			
<i>Gyrodactylus kobayashii</i> Hukuda 1940	<i>Neolitsea cassia</i> (L.) Kosterm. (referred to as <i>Cinnamomum cassia</i>)	24h	14mg/L	94.57	<i>Carassius auratus</i> Linnaeus 1758	[188]	
	<i>Citrus x limon</i> (L.) Osbeck	24h	10mg/L	5.62			
	<i>Curcuma longa</i> L. (Curcuma oil)	2h	3.48mg/	EC ₅₀			
		24h	5.72mg/	EC ₅₀			
		24h	12mg/L	100			
	<i>Curcuma zedoaria</i> (Christm.) Roscoe	24h	15mg/L	100			
	<i>Cymbopogon martini</i> (Roxb.) Will Watson (Palmarosa oil) (referred to as <i>Cymbopogon martinii</i>)	2h	9.87mg/L	EC ₅₀			
		24h	4.98mg/L	EC ₅₀			
		24h	10mg/L	100			
	<i>Eucalyptus globulus</i> Labill.	24h	100mg/L	90.84			
	<i>Foeniculum vulgare</i> Mill.	24h	40mg/L	10.10			
	<i>Melaleuca alternifolia</i> (Maiden & Betche) Cheel	24h	40mg/L	100			
	<i>Melia azedarach</i> L. (referred to as <i>Melia azedarace</i>)	24h	40mg/L	100			
	<i>Mentha canadensis</i> L. (referred to as <i>Mentha sachalinensis</i>)	24h	40mg/L	10.45			
	<i>Nigella sativa</i> L. (Thymoquinone (1,4-benzoquinone))	48h	0.303 mg/L	EC ₅₀			[217]
	<i>Origanum vulgare</i> L.	24h	10mg/L	23.36		[188]	
<i>Pimpinella anisum</i> L.	24h	10mg/L	21.92				
<i>Pogostemon cablin</i> (Blanco) Benth.	24h	10mg/L	100				
<i>Ruta graveolens</i> L.	24h	25mg/L	100				

	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	24h	16mg/L	45.06		
	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry(leaf extract)	24h	18mg/L	36.02		
<i>Haplorchis taichui</i> (Nishigori, 1924) Witenberg 1930	<i>Eurycoma longifolia</i> Jack	12h	400mg/ml	100	cyprinid fish	[218]
	<i>Thunbergia laurifolia</i> Lindl.	12h	400mg/ml	100		
	<i>Allium sativum</i> L.	12h	5mg/ml	100		
		3h	20mg/ml	100		
		4 days bath	0.1g/L	100	<i>Poecilia reticulata</i> Peters 1859	[219]
<i>Ichthyophthirius multifiliis</i> Fouquet 1876	<i>Azadirachta indica</i> A.Juss(Azadirachtin)	3h	≈47mg/L	EC ₅₀	<i>Carassius auratus</i> Linnaeus 1758	[177]
		4h	≈38mg/L	EC ₅₀		
		6h	≈32mg/L	EC ₅₀		
		9h	≈23mg/L	EC ₅₀		
		12h	≈13mg/L	EC ₅₀		
	<i>Carica papaya</i> L.	72h	200mg/L	90	<i>Carassius auratus</i> Linnaeus 1758 (referred as <i>Carassius auratus auratus</i>)	[189]
	<i>Macleaya cordata</i> (Willd.)R.Br.(sanguinarine)	48h	0.9mg/L	96,8	<i>Ctenopharyngodon idella</i> Valenciennes 1844	[190]
	<i>Macleaya microcarpa</i> (Maxim.) Fedde (dihydrosanguinarine)	48h	5.18mg/L	100	<i>Squaliobarbus curriculus</i> Richardson 1846	[191]
		48h	9.43mg/L	100		
	<i>Matricaria chamomilla</i> L.	6 days bath	0.4g/L	100	<i>Poecilia reticulata</i> Peters 1859	[219]
1h/day, 4days		50 µl/L	94.8	<i>Rhamdia quelen</i> Quoy & Gaimard, 1824	[220]	
<i>Mucuna pruriens</i> (L.) DC.	96h	250mg/L	90	<i>Carassius auratus</i> Linnaeus 1758 (referred as <i>Carassius auratus auratus</i>)	[189]	
<i>Lernaea cyprinacea</i> Linnaeus 1758	<i>Artemisia</i> sp.L.	5min	Dipping in 60% Artemisia Extract Solution	100	<i>Cyprinus carpio</i> Linnaeus 1758	[213]
<i>Linguadactyloides brinkmanni</i> Thatcher & Kritsky 1983	<i>Piper hispidum</i> Sw.	1h bath/d (3 baths -48h Interval between baths)	100mg/L	78.6	<i>Colossoma macropomum</i> Cuvier 1816	[212]
	<i>Piper marginatum</i> Jacq.	20min bath/d (3 baths -48h Interval between baths)	100mg/L	42,8		
<i>Mymarothecium boegeri</i> Cohen & Kohn 2005	<i>Carapa guianensis</i> Aubl.	1h bath/day, for 5 days	500mg/L	91,4		

	<i>Copaifera epunctata</i> Amshoff (Oleoresin)(referred to as <i>Copaifera reticulata</i>)	1h bath/day, for 3 days	100mg/L	48.5		[210]
	<i>Piper hispidum</i> Sw.	1h bath/d (3 baths -48h Interval between baths)	100mg/L	78.6		[212]
	<i>Piper marginatum</i> Jacq.	20min bath/d (3 baths -48h Interval between baths)	100mg/L	42,8		
<i>Notozothecium janauachense</i> Belmont-Jégu, Domingues & Martins 2004(referred to as <i>Notozothecium janauachensis</i>)	<i>Carapa guianensis</i> Aubl.	1h bath/day, for 5 days	500mg/L	91,4	[209]	
	<i>Copaifera epunctata</i> Amshoff (Oleoresin)(referred to as <i>Copaifera reticulata</i>)	1h bath/day, for 3 days	100mg/L	48.5	[210]	
	<i>Piper hispidum</i> Sw.	1h bath/d (3 baths -48h Interval between baths)	100mg/L	78.6	[212]	
	<i>Piper marginatum</i> Jacq.	20min bath/d (3 baths -48h Interval between baths)	100mg/L	42,8		
<i>Piscinoodinium pillulare</i> (Schäperclaus) Lom 1981	<i>Piper aduncum</i> L.	15min bath/day, for 3 days	20mg/L	83,8	[221]	
<i>Zeylanicobdella arugamensis</i> Silva, 1963 (referred to as <i>Zeylanicobdella</i> sp.but according to WoRMS there is only one direct species within the genus)	<i>Curcuma longa</i> L.(referred to as <i>Curcuma domestica</i>)	30min	1.2ml/L	12.9	<i>Epinephelus fuscoguttatus</i> x <i>Epinephelus lanceolatus</i>	[222]
		60min	1.2ml/L	24		[223]
	<i>Salvia rosmarinus</i> Spenn. (referred to as <i>Rosmarinus officinalis</i>)	60min	15ml/L	44.85		

Table S5. Acute toxicity tests of different EOs and their major compounds for different fish species. Plant and Animal nomenclature in this work follows the Plants of the World Online (POWO) and World Register of Marine Species (WoRMS) databases (accessed on April 6th, 2025). If a species name cited in a reference, differs from, or is inconsistent with the updated POWO & WoRMS taxonomy, the referenced name is retained and noted accordingly. **LC₅₀ (Lethal Concentration 50%):** MAPs concentration in water that causes death in 50% of a test population within a specified period of exposure. It is commonly used in toxicology to assess the acute toxicity of chemicals, including pollutants, pesticides, or natural compounds such as EOs, especially in aquatic organisms like fish. The lower the LC₅₀ value, the more toxic the substance is considered to be.

Fish Species	Plant Nomenclature/ Active substance	Exposure Time	LC ₅₀	Citation
<i>Arapaima gigas</i> Schinz, 1822	<i>Mentha × piperita</i> L.	4h	38.0mg/L	[228]
<i>Betta splendens</i> Regan, 1910	<i>Citrus × aurantium</i> f. <i>aurantium</i> (referred to as <i>Citrus sinensis</i>)	48h	49.17 µL/L	[229]
	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	48h	30.63mg/L	[230]
	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry (Eugenol)	48h	29.95mg/L	
<i>Carassius auratus</i> Linnaeus 1758	<i>Azadirachta indica</i> A.Juss (Azadirachtin)	3h	≈74mg/L	[177]
		4h	≈67mg/L	
		6h	≈60mg/L	
		12h	≈39mg/L	
		15h	≈22mg/L	
	<i>Cinnamomum burmanni</i> (Nees & T.Nees) Blume (referred to as <i>Cinnamomum cassia</i> -Cortex cinnamon (Cinnamaldehyde)	48h	13.34mg/L	[216]
	<i>Cinnamomum tamala</i> (Buch.-Ham.) T.Nees & C.H.Eberm.	48h	59.66mg/L	[231]
	<i>Curcuma longa</i> L. (Curcuma oil)	24h	31.73mg/L	[188]
		48h	28.85mg/L	
		24h	40.8mg/L	
		48h	39.15mg/L	
	<i>Cymbopogon martini</i> (Roxb.) Will Watson (Palmarosa oil) (referred to as <i>Cymbopogon martinii</i>)	96h	6.02mg/L	[193]
	<i>Magnolia officinalis</i> Rehder & E.H.Wilson (Mangolol)	96h	≈2.796 mg/L	[217]
<i>Nigella sativa</i> L. (Thymoquinone (1,4-benzoquinone))	96h	11.39g/L	[231]	
<i>Swietenia mahagoni</i> (L.) Jacq.	48h	3.3mg/L	[197]	
<i>Zanthoxylum asiaticum</i> (L.) Appelhans, Groppo & J.Wen (Chelerythrine) (referred to as <i>Toddalia asiatica</i>)	48h	3.5-10ppm	[232]	
<i>Channa punctata</i> Bloch, 1793	<i>Sapindus mukorossi</i> Gaertn. (pericarp)	48h	3.5-10ppm	[232]
<i>Clarias gariepinus</i> Burchell 1822	<i>Aframomum melegueta</i> K.Schum. (referred to as <i>Afranum melegueta</i>)	96h	68.36mg/L	[186]
	<i>Albizia gummifera</i> (J.F.Gmel.) C.A.Sm.	96h	94.58mg/L	[233]
	<i>Azadirachta indica</i> A.Juss	96h	319.38mg/L	[186]
	<i>Melaleuca cajuputi</i> Maton & Sm. Ex R.Powell	96h	127mg/L	[234]
	<i>Phragmanthera capitata</i> (Spreng.) Balle (referred to as <i>Phragmenthera capitata</i>)	96h	37.65mg/L	[235]
	<i>Tephrosia vogelii</i> Hook.f.	96h	277.82mg/L	[233]
<i>Colossoma macropomum</i> Cuvier 1816	<i>Aloysia citrodora</i> Paláu (referred to as <i>Aloysia triphylla</i>)	4h	109.57mg/L	[236]
	<i>Lippia grata</i> Schauer (referred to as <i>Lippia gracilis</i>)	4h	41.63mg/L	
	<i>Piper aduncum</i> L.	4h	48.17mg/L	
<i>Ctenopharyngodon idella</i> Valenciennes 1844	<i>Sophora flavescens</i> Aiton (sophoraflavanone)	96h	46.6mg/L	[192]
<i>Cyprinus carpio</i> Linnaeus 1758	<i>Madhuca longifolia</i> var. <i>latifolia</i> (Roxb.) A.Chev. (referred to as <i>Madhuca latifolia</i>)	96h	26.79mg/L	[180]
	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry (referred to as <i>Eugenia aromatica</i> & <i>Eugenia caryophyllata</i>)	96h	18.1mg/L	[237]
<i>Danio rerio</i> Hamilton, 1822	<i>Cinnamomum verum</i> J. Presl (cinnamaldehyde)	96h	7.2ppm	[238]
	Eugenol	96h	21.0mg/L	[239]
	<i>Melia azedarach</i> L.	96h	51.41mg/L	[240]
	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry (referred to as <i>Eugenia aromatica</i> & <i>Eugenia caryophyllata</i>)	96h	18.2mg/L	[241]
<i>Danio rerio</i> Hamilton, 1822 (embryonic stages)	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry (referred to as <i>Eugenia aromatica</i> & <i>Eugenia caryophyllata</i>)	144h	15.64mg/L	[242]
<i>Danio rerio</i> Hamilton, 1822 (Juveniles)		96h	18.8mg/L	

<i>Epinephelus coioides</i> Hamilton, 1822	<i>Allium sativum</i> L.	96h	74.78mg/L	[243]
<i>Epinephelus fuscoguttatus</i> × <i>Epinephelus lanceolatus</i>	<i>Allium sativum</i> L.	96h	993.11ppm	[244]
<i>Gambusia affinis</i> Baird & Girard, 1853	<i>Azadirachta indica</i> A.Juss (Leaf Extracts)	24h	6.00ml/L	[245]
		48h	3.43ml/L	
		96h	3.00ml/L	
	<i>Mallotus nudiflorus</i> (L.) Kulju & Welzen (referred to as <i>Trewia nudiflora</i>)	96h	26537.05µg/L	[246]
	<i>Zanthoxylum schreberi</i> (J.F.Gmel.) Reynel ex C.Nelson (referred to as <i>Zanthoxylum monophyllum</i>)	240h (10d)	4234.07µg/ml	[247]
	<i>Zanthoxylum schreberi</i> (J.F.Gmel.) Reynel ex C.Nelson (referred to as <i>Zanthoxylum monophyllum</i>) (Germacrene D-4-ol)	240h (10d)	414.05µg/ml	
<i>Zanthoxylum schreberi</i> (J.F.Gmel.) Reynel ex C.Nelson (referred to as <i>Zanthoxylum monophyllum</i>) (α -Cadinol)	240h (10d)	635.12µg/ml		
<i>Heteropneustes fossilis</i> Bloch, 1794	<i>Azadirachta indica</i> A.Juss (Azadirachtin)	24h	173.06mg/L	[248]
		48h	80.69mg/L	
		72h	58.57mg/L	
		96h	52.35mg/L	
<i>Sapindus mukorossi</i> Gaertn. (pericarp)	48h	3.5-10ppm	[232]	
<i>Ictalurus punctatus</i> Rafinesque, 1818	<i>Rhus chinensis</i> Mill. (pentagalloylglucose extracted from galls - referred to as <i>Gall chinensis</i>)	24h	151.3mg/L	[196]
<i>Labeo rohita</i> Hamilton, 1822	<i>Azadirachta indica</i> A.Juss (Azadirachtin)	96h	44.61 ppm	[249]
<i>Oncorhynchus kisutch</i> Walbaum, 1792	Eugenol	96h	66.1mg/L	[250]
<i>Oncorhynchus mykiss</i> Walbaum 1792	<i>Carum carvi</i> L.	96h	14.0mg/L	[251]
	<i>Cuminum cyminum</i> L.	96h	35.0mg/L	
	<i>Thymus vulgaris</i> L.	96h	6.6mg/L	
	<i>Thymus vulgaris</i> L. (Thymol)	96h	2.6mg/L	
<i>Oreochromis niloticus</i> Linnaeus 1758	<i>Achyranthes aspera</i> L.	96h	1063.9mg/L	[252]
	<i>Allium sativum</i> L.	96h	0.4g/L	[184]
		96h	3.54g/L	
		96h	3.54g/L	
	<i>Azadirachta indica</i> A.Juss (Leaf Extracts)	24h	6.4ml/L	[245]
		48h	3.22ml/L	[253]
		48h	1.64 g/L	
	96h	2.57ml/L	[245]	
	<i>Carica papaya</i> L.	24h	1310.74mg/L	[254]
	Eugenol	10min	184.26mg/L	[255]
	<i>Indigofera articulata</i> Gouan (referred to as <i>Indigofera tinctoria</i>)	96h	1.3mg/L	[256]
	<i>Ocimum gratissimum</i> L.	96h	523.63mg/L	[257]
<i>Piaractus mesopotamicus</i> Holmberg, 1887	<i>Azadirachta indica</i> A.Juss (Leaf Extracts)	96h	1.18- 1.20mg/L	[258]
<i>Poecilia reticulata</i> Peters, 1859	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry (referred to as <i>Eugenia aromatica</i> & <i>Eugenia caryophyllata</i>)	96h	21.7mg/L	[241]
<i>Poecilia reticulata</i> Peters, 1859 (females)	<i>Heterotheca inuloides</i> Cass.	96h	103.67ppm	[259]
	Thymol	24h	12.51mg/L	[260]
	1,8-cineole	24h	3997.07mg/L	
<i>Poecilia reticulata</i> Peters, 1859 (fingerlings)	<i>Heterotheca inuloides</i> Cass.	96h	12.39ppm	[259]
<i>Poecilia reticulata</i> Peters, 1859 (males)	<i>Heterotheca inuloides</i> Cass.	96h	62.94ppm	[260]
	Thymol	24h	10.99mg/L	
	1,8-cineole	24h	1701.93mg/L	
<i>Squaliobarbus curriculus</i> Richardson, 1846	<i>Macleaya microcarpa</i> (Maxim.) Fedde (dihydrosanguinarine)	48h	13.3mg/L	[191]
		48h	18.2mg/L	
<i>Trichogaster fasciata</i> Bloch & Schneider, 1801 (referred to as <i>Colisa fasciatus</i>)	<i>Euphorbia royleana</i> Boiss.	24h	8.6ppm	[261]
	<i>Euphorbia lactea</i> Haw.	24h	7.6ppm	
	<i>Euphorbia antisiphilitica</i> Zucc. (referred to as <i>Euphorbia antisiphilitica</i>)	24h	16ppm	
	<i>Jatropha gossypifolia</i> L. (referred to as <i>Jatropha gossypifolia</i>)	24h	37ppm	