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Potential of plant as antiparasite for fish

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Abstract
Parasites are organisms that live on the body of another organism of a different type and larger in size, called the host. In the body of the host, the parasite gets several advantages, among others, as a shelter, obtaining nutrients for its survival, while for the host parasite attack gets several losses, among others, body damage occurs, growth becomes slow, and even death occurs. Various types of parasites can cause disease in various types of cultured freshwater fish, including *Lernaea* sp., *Argulus* sp., *Ergasilus* sp., all of which belong to the crustacean group of parasites. From the trematode worm group, namely *Dactylogyrus* sp., *Gyrodactylus* sp. and *Diplozoon* sp. *Ichthyophthirius multifilis*, *Trichodina* sp. and *Episthylis* belong to the Ciliata class of protozoa. All these types of parasites can reduce crop yields, causing unnecessary losses to farmers. Efforts to control diseases caused by parasites can be done by using inorganic chemical drugs, but this method can pollute the environment and food products. Parasite control using natural ingredients sourced from plants is relatively safer for fish and the environment. Plants contain various types of organic chemical compounds that act as antiparasitic, including tannins, alkaloids, phenols and saponins. The purpose of writing this article is to convey information from various research results regarding the potential of plants that can be used to treat parasites in cultured freshwater fish. Based on the results of the submission of the article, it proves that several types of plants have the potential to treat diseases caused by several types of parasites, including *Piper betle* L, *Leucas lavandulaefolia, Moringa oleifera, Morinda citrifolia, Allium sativum, Galla chinensis, Mucuna pruriens* and *Carica papaya*. The types of parasites that can be controlled with these medicinal plants include *Dactylogyrus* sp., *Trichodina* sp., *Argulus* sp. *Myxobolus* sp., *Lernaea* sp., *Neobenedenia* sp., *Ichthyophthirius multifiliis*, *Gyrodactylus turnbulli* and *Epistylis* sp. which attack the fish *Cyprinus carpio* L, *Oreochromis niloticus, Clarias* sp., *Carassius auratus, Lates calcarifer, Ictalurus punctatus* and *Ictaurus punctatus*. The application of treatment was carried out through immersion, but neither immersion time nor standard dose was obtained that could be used for all types of fish.

Keywords: Antiparasitic, disease, fish, medicinal plants

Introduction
In the field of aquaculture, disease awareness needs to be increased and gets special attention. One of the diseases in fish can be caused by disease agents from a group of parasites called parasitic diseases. These parasites are ectoparasites that attack the surface of the body, between the scales, gill skin and fins, as well as end parasites that attack internal parts of the body, such as the intestines, liver and kidneys [1]. As it is known that parasites are organisms that live in the body of another organism called the host, and are very harmful to the host. Losses caused include damage to the body, slow growth even at high attack intensity can cause death to the host (fish) [2]. This parasitic disease can attack various types of freshwater fish that are cultivated, such as carp, tilapia, and catfish and so on, this condition is very detrimental to cultivators.

The use of synthetic chemicals has proven effective in overcoming disease problems in aquaculture commodities, including diseases caused by parasites. However, the negative impact of the use of synthetic chemicals, among others, causes residues of these synthetic chemicals in the environment and in fish that are cultivated, which will certainly affect the quality of fish as a food source for humans as consumers [3].

The use of natural chemicals sourced from plants can be used as an alternative for controlling parasitic diseases for fish, because medicinal plants have pharmacological effects [4, 5]. In addition to having a therapeutic effect, medicinal plants are also safe for the environment and have minimal side effects for both fish and humans who consume them [6, 7]. Various types of plants have been used as herbal medicines by cultivators to treat diseases in fish, including

Kipahit leaves, noni, betel, papaya, guava, and turmeric rhizome. Kipahit leaf (*Tihonia diversifolia*) contains quassinoid which acts as an antibacterial, by oxidizing bacterial cell walls, noni (*Orinda citrifolia* L.) as an immunostimulant, betel (*Piper betle* L.) and turmeric rhizome (*Curcuma longa*) is a natural antibiotic used as an antibiotic. Naturally, papaya (*Carica papaya* L.) is often used as an antibacterial agent, guava (*Psidium guajava* L.) can be used as an antibacterial, and anti-parasitic [8].

Based on the various benefits of plants as herbal medicines that have been used, the purpose of writing this article is to describe the potential of medicinal plants as materials for controlling parasitic diseases in cultured freshwater fish.

Phytochemical content in various types of medicine plants

Based on the results of phytochemical tests, in general, plants contain several active compounds including flavonoids, saponins, tannins, terpenoids, phenols and steroids, which function as antibiotics, including ant parasitic, antibacterial, antiviral, antifungal, antioxidant and immunostimulant that can trigger body resistance. Non-specific fish [9-11]. Other active compounds contained in plants, including polypeptides, lectins, polyphenols, alkaloids, quinones, terpenoids, phenolics, have proven to be very effective alternatives to antibiotics [12]. However, each type of plant has specific bioactive compounds that are not contained in other types of plants, such as the betel plant (*Paper betle* L.) besides containing flavonoids and tannins, it also contains specific compounds eugenol, chavibetol and hydroxychavicol and essential oils that act as antimicrobials and antioxidants [13]. Specific bioactive compounds contained in garlic are allicin and organosulfur compounds that function as antioxidants, anti-microbial and anti-carcinogenic [14]. Specific bioactive compounds contained in bitter leaf (*A. paniculata Nee*s) include lipopolysaccharide, aflatoxin, and nephroprotective [15]. Turmeric (*Curcuma longa*) contains several bioactive compounds such as phenolics, terpenoids, diarylheptanoids, phenylpropene, monoterpenes, sesquiterpenes, fivediterpenes, triterpenoids, sterols, alkaloids [16], the bioactive compound found in turmeric is curcumin. Which is a phenolytic compound, which is useful antimicrobial and anti-inflammatory [17]. Papaya leaves (*C. papaya*) contain phenols, tannins, flavonoids, saponins, and alkaloids [18]. The active substance contained in papaya leaf methanol extract (*C. papaya*) is effective as a synthetic antibiotic [19], as well as papaya seeds contain tannins, polyphenols, alkaloids, flavonoids, phenols and saponins [20].

Types of parasites in freshwater fish

Many types of parasites, both ectoparasites and end parasites, can attack cultured fish and cause significant losses in fish farming businesses. However, there are several types of parasites that are often found in cultured freshwater fish, including those from the crustacean group, namely *Lernaea* sp., *Argulus* sp., *Ergasilus*. All three of which belong to the crustacean group of parasites that are ectoparasites. From the group of trematode worms (Monogenea), namely *Dactylogyrus* sp., *Gyrodactylus* sp. and *Diplozoon* sp. From the Ciliata class Protozoa group, namely *Ichthyophthirius multifilis, Trichodina* sp. and *Episthylis* sp, while from the sporozoa class, namely *Myxobolus* sp.

Lernaea sp. known as anchor worms, the cause of the disease Lerniasis. Characteristics of fish affected by this disease are visible red sores where the parasite sticks itself. This parasite is quite dangerous because it can attack and kill fish en masse, especially at the size of the fish [21, 22]. *Argulus* sp. ectoparasites that cause Argulosis disease which are quite dangerous and pose a very serious threat to fish health, can cause high morbidity and mortality, especially in seeds and juveniles of *Ergasilus* sp. is a gill parasite of freshwater and marine fish that attaches mainly to the inside and bottom of the gills. The disease it causes is called Ergasilosis [23, 56].

Dactylogyrus sp. known as gill parasites, because the fish's organs are infected specifically with the gills. This parasite attacks many freshwater fish, especially the cyprinid group. The disease caused by this parasite is called Dactylogyrosis. *Gyrodactylus* sp. infects many freshwater and marine fish, known as skin parasites, because the body organs that are often attacked are the skin. *Diplozoon* sp. as the cause of diplozooniasis disease known as twin worms or twin worms, because two individuals merge into one. This parasite attacks the gill organs, resulting in damage to the gill lamellae [21, 22, 56].

Ichthyophthirius multifiliis is a highly pathogenic parasite, has a very fast and abundant multiplication ability. The disease it causes is called lchthyophthiriasis or known as White spot disease or "ICH" disease. This parasite can infect almost all types of freshwater fish and can kill fish at various stages, but the larval and seed stages are the stages that are susceptible to this disease and can be deadly en masse. The clinical sign of this parasite attack is that white spots appear on the surface of the fish's body [23]. *Trichodina* sp. The cause of Trichodinosis disease or called itching disease, the organs of the body of the fish that are attacked are the skin, fins, especially the gills. Fish attacked by *Trichodina* sp. will show several symptoms including irregular swimming, wounds to the skin and gills, excessive mucus secretion on the skin and gills, the color of the fish's body looks pale, dark or even slightly gray. Other symptoms of fish will experience a decrease in appetite, which results in weight loss. If this parasite attacks seed size fish with high intensity, the fry will die. *Epistylis* sp. is a parasite that causes Red Sore Disease. The organs of the fish that are attacked are the skin and gills. This parasite is found in freshwater fish populations as well as in marine fish and shrimp. The specific feature of this parasite is to colonize and is sessile (not moving). Fish infected with *Epistylis* sp. characterized by body surface (scales and skin) such as cotton, bleeding / wound on the skin of the body and even ulcers occur. *Myxosoma cerebralis*, the disease caused by it is called whirling disease, attacks cultured fish or fish in public waters, especially at the size of the seed, its pathogenicity is quite high, it can cause fish seed mortality to reach 90 % [22].

Application of plant as ant parasite

The application of plants as alternative medicine for disease control in fish is starting to be widely used. The ability of plants to overcome various diseases in fish, including diseases caused by parasites, is due to the presence of natural products in the form of chemical compounds in organic form, so it is safe to use, does not pose a risk that is harmful to fish, to humans who consume it and to the environment and does not cause harm to fish resistance to parasites [11, 25].

Parts of plants that can be used as medicine include leaves, fruits, stems, roots, and rhizomes of various plants. Each type and part of the plant contains certain compounds that can be used as alternative drugs to replace inorganic chemical drugs. However, compounds or organic substances contained in these plants can be used as medicine, if they have gone through a filtering or extraction process to get the chemical

compounds needed as drugs. For example, part of the lime plant (*Citrus aurantifolia*) which can be utilized and is quite effective for treating attacks of *Dactylogyrus* sp. (gill worms) in carp (*Cyprinus carpio* L) is part of the fruit through the process of squeezing and filtering, in order to obtain a solution form. These fish after treatment resulted in the highest survival (80 %) [26]. The ability of lime in treating fish infected by the parasite is due to the content of saponins, flavonoids, essential oils, citral, innone, fenchon and terpenoids which have anti-bacterial and anti-inflammatory properties [27].

The leaf part of the betel plant through an extraction process using water solvents [28] and ethanol [29] was able to significantly reduce the intensity of *Trichodina* sp. which attacks the body surface and gills of *Oreochromis niloticus* fish. However, betel leaf ethanol extract was more effective and able to free fish seeds infected with T*richodina* sp. [29] and resulted in 100 % survival. The essential oil content of betel leaf (*Piper betle* L.), which consists of kavikol which is able to inhibit the growth of parasites [30-32]. Other ingredients that can reduce the intensity of *Trichodina* sp. in fish seed (*Clarias* sp.) is the leaf part of the Paci-paci plant (*Leucas lavandulaefolia*). The leaves of *Leucas lavandulaefolia* can be used as an antiparasitic in the form of a solution, which is the result of leaf juice that has been crushed with a blender [33]. Noni plant (*Morinda citrifolia*), in addition to the leaves, the fruit is also widely used as medicine, including as an antiparasitic. The solution of noni leaves from boiling can reduce the intensity of the attack of the parasite *Trichodina* sp. significantly in *Oreochromis niloticus* fish fry, the highest decrease was 92.7 % [34]. The ability of noni leaves as an antiparasitic, because it contains active compounds including flavonoids, saponins, alkaloids, carotenes and tannins [35]. Flavonoids can cause damage to cell membranes due to the protein denaturation process that occurs in cell membranes, resulting in growth inhibition and the death of parasites [36]. Saponins can form complex compounds through hydrogen bonds in the cell membrane which will damage the permeability of the parasite cell wall so that it can cause [37]. Tannins are spasmolytic which can cause cell membranes to shrink and interfere with the permeability of cell membranes, so that cell activities will be disrupted, inhibited growth and can even die [38]. The process of damage to the parasite cell membrane is caused by protein denaturation and the dissolution of fat contained in the cell membrane caused by phenol components [39]. The ethanol extraction of noni fruit can help release the parasite *Argulus* sp. from the body of the fish *Carassius auratus* [40]. The juice of noni fruit was quite effective in reducing the size of the nodules and reducing the degree of *Myxobolus* sp.infection in koi carp through immersion [41]. Noni fruit juice (*Morinda citrifolia*) can also release *Lernaea* sp. from the body of the fish *Carassius auratus*, but cannot control *Lernaea* sp. [42]. The ability of noni fruit in controlling parasites, possibly due to the alkaloid compounds it contains. It is reported that the noni fruit contains active substances such as alkaloids, terpenoids, scopoletin, anti-cancer substances and many nutrients that have many benefits, and the most active ingredients are alkaloids [42]. The part of the Moringa oleifera plant that can be used as an antiparasitic is the leaf. Leaf parts that have been extracted with ethanol can reduce Argulus sp ectoparasite infestation in comet fish (*Carassius auratus auratus*) through immersion for 12 hours. It is proven that Moringa (Moringa oleifera) leaves contain anthraquinones and flavonoids which act as anti-parasitic [43]. *Moringa oleifera* leaves in the form of extracts are also effective for eliminating *Epistylis* sp. in tilapia (O*reochromis niloticus*) significantly [44]. Garlic (*Allium sativum*) is a promising alternative against *Gyrodactylus turnbulli* [45]. *Camellia sinensis* was quite effective in overcoming the attack of *Ichthyobodo necator* on *Oncorhynchus keta, Oncorhynchus masou* [46]. *Galla chinensis* [47], *Mucuna pruriens, Carica papaya* [48] have effective therapeutic and preventive effects against *Ichthyophthirius multifilis* (Table 1).

Table 1: Applications of Plants medicine sebagai antiphrasis

Plant	Treatment	Preparation	Dosage	Type of fish	Type of parasite	Ref
Citrus aurantifolia	Bath for 24 h	Fruit juice	35%	*Cyprinus carpio* L	*Dactylogyrus* sp.	[26]
Piper betle L	Bath for 2 h	Leaf powder water extract	100 Dan 200 ppm	*Oreochromis niloticus*	*Trichodina* sp.	[28]
Piper betle L	Bath for 2 h	Leaf powder ethanol extract	0,01 ppm	*Oreochromis niloticus*	*Trichodina* sp.	[29]
Leucas lavandulaefolia	bath for 24 h	Leaf solution	2000 ppm	*Clarias* sp.	*Trichodina* sp.	[33]
Moringa oleifera	Bath for 12 h	Leaf ethanol extract solution	25, 37,5, 50 Dan 62,5 ppm	*Carassius auratus auratus*	*Argulus* sp.	[43]
Morinda citrifolia	Bath for 5 min	leaf solution	750 Dan 100 ppm	*Oreochromis niloticus*	*Trichodina* sp.	[34]
Morinda citrifolia	Bath for 7 h	fruit juice	1-3%	*Cyprinus carpio* L.	*Myxobolus* sp.	[41]
Morinda citrifolia	Bath for 60 min	fruit juice	4%	*Carassius auratus*	*Lernaea* sp.	[45]
Allium sativum	Bath for 60 min	extract Water	1, 2, and 10 ml/l	*Lates calcarifer*	*Neobenedenia* sp.	[46]
Galla chinensis	Bath for 10 d	Ethyl acetate extract	20 mg/l	*Ictalurus punctatus*	*Ichthyophthirius multifiliis*	[47]
Allium sativum	Bath for 60 min	Aqueous extract	7.5 and 12.5 ml/l	*Poecilia reticulata*	*Gyrodactylus turnbulli*	[48]
Mucuna pruriens	Bath for 72 min	Methanolic extract of leaves	200 mg/l	*Carassius auratus*	*Ichthyophthirius multifiliis*	[49]
Carica papaya	Bath for 96 h	Petroleum ether extract of seeds	200 mg/l	*Carassius auratus*	*Ichthyophthirius multifiliis*	[49]
Camellia sinensis	Bath for 1–5 min	Extract	0.3–0.9%	*Oncorhynchus keta, Oncorhynchus masou*	*Ichthyobodo necator*	[50]
Moringa oleifera	Bath for 18 h	Extract alcohol 95%	62,5 mg/L	*Oreochromis niloticus*	*Epistylis* sp.	[44]

The application of plants for the treatment and prevention of disease in cultured fish can be done in several ways, including through feed as a supplement, through immersion and injection both intraperitoneally and intramuscularly [51, 52]. However, based on Table 1. It can be seen that the application of parasite control (ectoparasites) is only carried out using the immersion method. According to Wu *et al*. (2011) and Thanigaivel *et al.* (2015) treatment of fish by immersion method in the right dose and the appropriate density of fish is quite effective to use. Table 1 also shows that there is no standard soaking time for disease treatment, depending on the type of plant, the type of fish and the type of parasite. In addition, there is no standard plant dose for use in all types of fish. As according to [55], the dosage of medicinal plants for treatment or prevention is different for each type of plant. The difference in the extraction solvent used also gives the impact

of different biological tests. As the results of the study showed that the extraction of piper bethel using ethanol as a solvent was more effective for the control of *Trichodina* sp. parasites compared to using water as a solvent. Ethanol extract of Piper betle leaves was able to free *Trichodina* sp. attack on *Oreochromis niloticus*, while using water as a solvent was only able to reduce the intensity of *Trichodina* sp. parasite in these fish [28, 29]. The same opinion has been expressed by Caruso *et al.* (2017) different extraction methods produce different biological test effects, such as ethanol extraction of herbal ingredients giving better results than using water. This shows that the difference in the supply of herbal ingredients affects the biological test.

Conclusion

Several studies have shown that many types of medicinal plants have the potential to treat diseases caused by several types of parasites, including *Piper betle* L, *Leucas lavandulaefolia, Moringa oleifera, Morinda citrifolia, Allium sativum, Galla chinensis, Mucuna pruriens* and *Carica papaya.* The types of parasites that can be controlled with these medicinal plants include *Dactylogyrus* sp., *Trichodina* sp., *Argulus* sp. *Myxobolus* sp., *Lernaea* sp., *Neobenedenia* sp., *Ichthyophthirius multifiliis, Gyrodactylus turnbulli and Epistylis* sp. *that attack the fish Cyprinus carpio* L, *Oreochromis niloticus, Clarias* sp., *Carassius auratus, Lates calcarifer, and Ictaurus punctatus*. The application of treatment was carried out through immersion, but neither immersion time nor standard dose was obtained that could be used for all types of fish.

Competing Interests

Author has declared that no competing interests exist.

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