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A mini-review: Potential utilization of *Morinda citrifolia* for health and growth of fish

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Abstract
One of the biggest losses for fish farmers is the presence of disease attacks, whether caused by bacteria, viruses or fungi. The bacterial disease is often treated with antibiotics. The use of antibiotics for a long time and in inappropriate doses will result in resistance to pathogenic bacteria, accumulation of antibiotics in the aquatic environment and fish bodies which is certainly dangerous for human health and other aquatic biota. The use of herbal ingredients is the right strategy, because it is relatively safer and cheaper to treat disease. *Morinda citrifolia* is one of the herbs that has been widely used to treat various human diseases such as diabetes, arthritis, hypertension, heart disease, relieve digestive disorders, headaches and fever. *M. citrifolia*'s ability to treat various diseases is based on its phytochemical content and pharmacological properties of *M. citrifolia*. Alkaloids, flavonoids, tannins, saponins, steroids, phenols and terpenoids, glycosides, carbohydrates and coumarine and scopoletin are secondary metabolites contained in *M. citrifolia* which have antibacterial, immunostimulants medicinal and growth effects. So the purpose of this article is to explain *M. citrifolia* to maintain fish health. Based on the above studies, *M. citrifolia* has the potential to be used as an alternative supplement for the health of various fish, because it has antibacterial, treatment, immunostimulant and growth effects.

Keywords: Disease, treatment, prevention, immunostimulant, *Morinda citrifolia*

1. Introduction
Disease control in cultured fish using drugs and antibiotics is common, but the use of these drugs and antibiotics can cause new problems, including resistance to pathogens to drugs and antibiotics, can kill non-target organisms, cause environmental pollution and residue on meat. fish and requires a fairly expensive cost [1]. Appropriate alternative disease control, both for prevention and treatment, must pay attention to food safety. One way of dealing with a disease that is relatively safe and inexpensive is to use natural ingredients sourced from plants or known as medicinal plants. One of the medicinal plants that has been widely used for efforts to cure disease or to maintain health is *Morinda citrifolia*. This plant has been widely used to treat various types of diseases, including diabetes [2, 3], arthritis [4], hypertension, heart disease, relieve indigestion, headache and fever [5]. *M. citrifolia* has potential as an antibacterial [6, 7] and antifungal [7, 8], can increase livestock growth [9] and as a patent immunostimulant for *Macrobrachium rosenbergii* shrimp [10]. Almost all parts of the *M. citrifolia* plant, namely roots, stems, leaves and fruit, have medicinal properties. *M. citrifolia* fruit with different maturity levels has different active ingredients and properties. *M. citrifolia* ripe fruit extract has antibacterial compounds [11]. Antibacterial compounds contained in ripe *M. citrifolia* fruit include Acubin, L. asperuloside, alizarin and some anthraquinone substances. In addition, noni fruit contains alkaloids and flavonoids [12]. The leaves of *M. citrifolia* contain flavonoid compounds, saponins, steroids, alkaloids, vitamins and ascorbic acid [13]. Flavonoid compounds can function as antioxidants, antibacterial, immunomodulatory, and anti-inflammatory [14]. Based on the content of phytochemical compounds and pharmacological properties of *M. citrifolia*, the purpose of this article is to describe the potential use of *M. citrifolia* plants by farmers to maintain fish health

2. Classification and morphology of *Morinda citrifolia*
Morinda citrifolia (Figure 1) belongs to the Rubiaceae family, is a polynesian plant that grows a lot in Southeast Asia [15]. According to Djauhariya (2003) [13] the taxonomy of *M. citrifolia* is as follows:

Kingdom: Plantae
Phylum : Spermatophyta
Class : Magnoliopsida
Ordo : Rubiales
Family : Rubiaceae
Genus : Morinda
Species : *Morinda citrifolia*

Fig 1: *Morinda citrifolia*

M. citrifolia is a shrub, 3-8 meters high, branched, the bark is brown. Stem leaves are dark green, sitting crosswise, opposite, oval in shape, leaf length 10-40 cm, width 5-17 cm, leaf blade thick, shiny, leaf edge flat, pointed tip, leaf base narrowed, bone pinnate. The flowers are bulb-shaped, coming out of the leaf axils. On one bulb grows more than 90 white flower crowns, tubular like trumpets that grow gradually 1-3 flower crowns every 3 days. The weevil is an ovary. The fruit is a compound buni fruit, which is gathered into one, short-stemmed, oval-shaped, 5-10 cm long. Fruit surface is uneven, mottled and warty. The young fruit is green, the more riper it is white, yellow and transparant. Ripe fruit has soft, juicy flesh and a foul smell [16].

3. Phytochemical screening of *Morinda citrifolia*

The results of qualitative screening of *M. citrifolia* plants that have been carried out by several researchers show that different types of solvents produce different compounds. But overall, the chemical compounds contained in *M. citrifolia* are alkaloids, flavonoids, tannins, saponins, steroids, phenols and terpenoids (Table 1).

Table 1: Phytochemical Screening of *Morinda citrifolia*

Solvents extract	*Bagian tanaman*	Alkaloids	Flavonoids	Tannins	Saponins	Steroids	Phenols	Terpenoids	Ref
Water	Leaf	+	+	+	+	+	+	+	[17]
Methanol	Leaf	++	+	++	+	-	+	++	[7]
	Stem	+	-	+	-	-	-	+	
	Root	-	++	++	+	++	++	-	
Ethanol 96%	Buah matang	+	+	+	+	+	-	-	[12]
Alcohol	Leaf	+	+	+	-	+	-	+	[18]

Information: ++: quantitatively, +: present, -: absent.

M. citrifolia plants in addition to containing alkaloids, flavonoids, tannins, saponins, steroids, phenols and terpenoids, also contain glycosides in the leaves, stems and roots, mostly in the leaves [7], carbohydrates, protein and amino acids and coumarine, but not contains fat [17]. Noni fruit also contains scopoletin or 7-hydroxy-6-methoxyumarin, a hydroxy coumarin group [19].

4. Antibacterial effect of *Morinda citrifolia*

The phenolic compounds, flavonoids, saponins, alkaloids, and terpenoids contained in *M. citrifolia* have antibacterial activity against several bacteria that can infect cultured fish, such as *Aeromonas hydrophila* [20], *Escherichia coli*, *Staphylococcus aureus* [12] and *Streptococcus agalactiae* [21].

Table 2: Antibacterial activity of *M. citrifolia*

Extract solvents	Plant parts	Concentration extract	Type of bacteria	Inhibition zone (mm)	Ref.
Ethanol 96%	Leaf	7.5%	*Aeromonas hydrophila*	3.3	[20]
		15%		18.3	
		30%		27	
		60%		36.1	
Ethanol 96%	Ripe fruit	250 µg/ml	*Escherichia coli*	10.75	[12]
		500 µg/ml		15.75	
		1000 µg/ml		20	
	Ripe fruit	250 µg/ml	*Staphylococcus aureus*	13.25	[12]
		500 µg/ml		16,38	
		1000 µg/ml		19,25	
Methanol 70%	Ripe fruit	5%(50 mg/ml akuades)	*Streptococcus agalactiae.*	2,55 ± 0,72	[21]
		10%(100 mg/ml aquadest)		9,83 ± 0.80	

Table 2 shows that *M. citrifolia* extract can inhibit the growth of various types of bacteria that usually attack cultured fish, in other words, it can act as an antibacterial, indicated by the presence of an inhibition zone. The difference in the diameter of the inhibition zone was determined by differences in plant parts, extract concentrations and the type of bacteria to be inhibited. However, in general, the greater the concentration of *M. citrifolia* extract, the larger the diameter of the inhibition zone, meaning that it has a greater ability to inhibit bacterial growth. As according to Davis and Stout [22] noni fruit extract has a strong category of inhibition, because it has an inhibitory zone diameter ranging from 10 to 20 mm. Inhibition zone diameter above 20mm is categorized as a very strong antibacterial. Antibacterial compounds contained in noni fruit that have potential as antibacterial compounds include glycosides, scopoletin, acubin, L. Asperuloside, and flavonoids [23].

5. Treatment effects of *Morinda citrifolia* on fish

Several studies have shown that *M. citrifolia* can be used to treat fish infected with bacteria. The plant parts used are ripe fruit and leaves. Tawes fish infected by *Aeromonas hydrophila* bacteria with visible clinical symptoms including fading body color, opacity, hemorrhage on the body surface and ulcers, after being treated with noni fruit extract through immersion for 20 minutes began to experience healing. There is healing seen from active swimming movements, bleeding fades and ulcers begin to close. *M. citrifolia* extract at a concentration of 15,000 mg/L was the best concentration for treating Tawes fish (*Barbonymus gonionotus*) infected with *A. hydrophila*, with the highest survival rate of 70%, while the optimum concentration was obtained in fruit extract with a concentration of 14,000 mg/L [24]. Koi fish (*Cyprinus carpio*) infected with *Aeromonas hydrophila* bacteria recovered after being treated by immersion for 24 hours with 96% ethanol extract of noni leaves, which was indicated by improved histopathology of koi fish gills. The concentration of 800 ppm gave the best results as seen from the score of the smallest koi fish gill histopathological damage, which means the fish has undergone a healing process. The scoring values obtained from the fish group treated with 800 ppm were hyperplasia 1.9%, fusion 1.6% and necrosis 1.2% [25]. In addition to treating bacterial diseases in fish, noni can also be used to treat Argulosis in fish, which is caused by *Argulus* ectoparasites. Based on the results of the study, the ethanol extract of noni fruit with a dose of 2 drops/L was the best dose, it was able to release *Argulus* from the body of comet fish (*Carassius auratus*) within 2 days after immersion with noni extract and resulted in 100% survival, while at a dose of 1 drops/L *Argulus* was released from the fish body on days 3 and 4 after immersion with noni extract and resulted in 100% survival. At a dose of 3 drops/L on the 8th day, there was fish death, so that at the end of maintenance, the survival decreased to 67% [26]. This is probably because the dose is quite high and interferes with the fish's condition. Noni fruit extract that is too concentrated can disturb the environment and stress the fish, thereby reducing the resistance of fish [21].

6. Effect of *Morinda citrifolia* as an immunostimulant

Several studies have proven that noni leaves and fruit can be used as immunostimulants that can increase fish resistance to disease. Jelawat fish (*Leptobarbus hoevenii*) fed with 96% ethanol extract of noni (*M. citrifolia*) leaves through feed could increase their resistance to *Aeromonas hydrophila* attack. The dose of 5 g/kg feed is the best dose by producing an average survival of 79.17% the fastest healing process for clinical symptoms, and has a positive effect on increasing the response to food and organs in jelawat fish, namely the liver, bile and kidneys [27]. Noni fruit flour given to tilapia with feed for 45 days can increase the immune response against the attack of *Streptococcus innae* bacteria. The dose of noni flour of 6 g/kg feed gave the best effect on the test fish, which was indicated by an increase in total phagocytic activity by 56% (from 35% to 54.66%), the highest increase in hemoglobin levels, which was 24% (from 5, 06 g% to 6.33 g%). The best erythrocyte total occurs at a dose of 9 g/kg feed, the increase in erythrocytes reached 41% (from 1.55 x106 cells/mm^3 to 2.20 x106 cells/mm^3) [28]. Another study showed that *Cyprinus carpio* carp after being given noni leaf extract with feed for 28 days, there was an increase in leukocyte levels, this indicated an increase in the fish's body resistance. The leukocyte level in control fish was 8.77x10^5 cells/mm^3, while the test fish given noni leaf extract resulted in higher leukocyte levels, namely 13.34 x10^5 cells/mm^3 (dose of 5 g/kg feed) and 19.30 x10^5 cells/mm3. (Dose of 10 g/kg feed). After being challenged with the bacterium *Aeromonas hydrophila* carp that was given noni leaf extract resulted in higher survival rates than the control, respectively 53.33% (control), 70% (dose of 5 g/kg feed) and 90% (dose of 10 g/kg feed) [29]. This data shows that noni can be used as an immunostimulant that can increase the body's resistance to disease.

7. Growth activity

Research has shown that several medicinal plants have been successfully used as supplements to trigger growth and feed conversion in fish and shrimp, including garlic [30], turmeric [31], black cumin [32], *Aloe vera* [37], *Andrographis paniculata* [34] and so on. Likewise noni, apart from being an antibacterial and immunostimulant, can also trigger the growth of fish. As the results of the study showed that administration of noni fruit extract mixed with commercial feed on red tilapia for 30 days could increase the specific growth rate, daily length growth rate, decrease feed conversion ratio, and increase protein retention of the red tilapia (*Oreochromis niloticus*). In addition, the addition of noni fruit extract in commercial feed did not show a toxic effect on red tilapia. Among the treatments given, feeding mixed with 500 mL kg-1 commercial feed with noni fruit extract showed the highest fish growth rate in terms of weight parameters, namely Daily length growth rate: 1.599±1.312% and SGR: 0.0150±0.0009%. The lowest feed conversion ratio (FCR) of red tilapia was found at a dose of noni fruit 300 mL kg-1 feed was 0.846-2.712%. Test fish given 100 mL kg-1 noni fruit extract produced the highest protein retention, which was 12.6246±0.3074% [35]. During the 84-day rearing period, goldfish whose diet was added with noni fruit extract showed higher growth than the control. Goldfish (*Carassius auratus*) that were given noni extract at a dose of 1000 mg/kg of feed produced the highest growth rate, seen from the parameters of the average weight gain, length, which were 16.61 g and 8.45 cm, respectively. This dose also resulted in a higher survival rate, which was 98.44% [36].

8. Conclusion

Based on the results of research and testing on several fish that have been described above, it can be seen that *Morinda citrifolia* has potential utilization of fish farming, because it can be used as a source of antibacterial, treatment, immunostimulants and growth in cheap and efficient fish feed.

9. Competing interests

Author has declared that no competing interests exist.

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