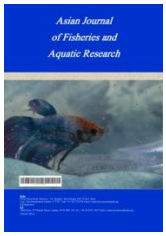

Asian Journal of Fisheries and Aquatic Research

19(2): 1-5, 2022; Article no.AJFAR.90418
ISSN: 2582-3760

The Effect of Butterfly Pea (*Clitoria ternatea)* Against Fish Pathogens: A Mini-review

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJFAR/2022/v19i230468

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/90418

Mini-review Article

Received 13 June 2022
Accepted 17 August 2022
Published 22 August 2022

ABSTRACT

Butterfly pea (*Clitoria ternatea)* is a plant with the potentiality to inhibit the fish pathogens because its rich of bioactive compounds. Leaves, stems, roots and flowers contain diverse substances among which there are alkaloids, tannins, glycosides, terpenoids, phenols, reducing sugars, flavonoids etc. The secondary metabolites in leaves reported can inhibit the pathogens such as *Aeromonas formicans, Aeromonas hydrophilia, Streptococcus agalactiae, Escherichia coli, Klebsiella pneumoniae, Bacillus subtilis.* The roots can inhibit *Pseudomonas aeruginosa* and *K. pneumoniae*. The bioactive compounds in flowers and seeds can inhibit *B. subtilis, E. coli, P. aeruginosa, Klebsiella spp*. Different part of plant give different effect to inhibit the growth of pathogens because it contains different types and levels of secondary metabolites. In addition, the different solvent used in extraction process give difference result to prevent the growth of disease microorganism in fish with the inhibition zone ranged 7-28 mm.

Keywords: Clitoria ternatea; fish pathogens; antimicrobial; disease; chemical compounds.

1. INTRODUCTION

Pathogens are one of the inhibiting factors in the success of fish cultivation or fish life in nature. Fish pathogens can cause economic losses because they can cause mass death of fish [1]. In 2015, Shinn et.al [2] predicted that global economic losses due to disease attacks on

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cultivation would range from US$ 1.05 to US$ 9.58 billion/year. In 2004, the average economic loss in fish farming due to disease in 5 areas (Comilla, Dinajpur, Mymensingh, Jessore, Natore) in Bangladesh was USS 344 [3]. While Diaz and Martin in 2017 [4] estimated the economic loss due to disease attacks on finfish in Brazil reaches US 84 per year. Losses to infectious disease in aquaculture in China alone were estimated at 5.3 billion US dollars in 2017, up 1.2 billion from 2016 [5]. Economic losses due to disease attacks on fish also occur in Indonesia, which is around 5.2 million rupiah [6].

One way to overcome this problem is the use of antibiotics. However, the use of antibiotics in the long term also has a negative impact. The use of antibiotics can stimulate bacteria to modify themselves so that they are resistant to these antibiotics. If the microorganism is resistant, the fish can get diseased so that re-cultivation activities will decrease [7]. The use of antibiotics will also leave residues in water bodies. Residues in these water bodies will re-enter and accumulate in fish and other aquatic organisms. Antibiotic residues can also accumulate in sediments in the water so that they pollute the waters which will gradually have an impact on humans [8]. Therefore, the development of natural ingredients that have potential as antimicrobials needs to be done.

Butterfly pea (*Clitoria ternatea*) is a plant that is familiarly used in medicine in India. This plant contains many bioactive compounds that can inhibit the growth of microorganisms such as lactones, phydroxycinnamic acid polypeptide, palmitic, stearic, kaempferol, phenol glycoside, tannins, resins, oleic, linolcic, linolenic acids, finotin, and others [9]. With these ingredients, butterfly pea has the potential to be used as an inhibitory agent for fish pathogenic microorganisms. The purpose of this article is to examine the content of bioactive compounds in Butterfly pea and their effects on several fish pathogens.

2. BUTTERFLY PEA (*Clitoria ternatea)* AS HUMAN AND ANIMAL MEDICINE

Butterfly pea (*C. ternatea*) is originated from Ternate Island, Indonesia Archipelago [10]. Another article also said that Butterfly pea originated from Latin America and spreads into Asia, Australia, and Africa [11]. In Indonesia, the spread of this plant from Sumatra to Papua. In traditional medicine, this plant is known by various names including aparajita (Bengali), aparajit (hindi), kokkattan (tamil) (Zingare), sankhupushpi in Indian traditional medicine [10].

Various parts of this plant have been used for various traditional treatments in various regions. Various regions in Indonesia use butterfly pea flowers to treat eye diseases such as the Sumenep area (Madura), Lake Buyan-Tamblingan (Bali), Jagaraga Village-West Lombok (West Nusa Tenggara). The flowers and roots are also used to treat boils and fever in Malenge Island, Talatako, Tojo Una-Una (Central Sulawesi) [10]. In Sri Lanka, this plant has been used traditionally to treat various diseases such as irritation of the urethra and bladder, liver, anasarca, hemicrania, ascites [12]. In the ayurvedic system, the roots of this plant have been used to treat laxative, purgative, diuretic, inflammation, indigestion, constipation, fever, arthritis, eye,ailments, sore throat, and anthelmintic [13]. In traditional Chinese medicine, this plant is believed to affect the female reproductive organ [14].

Various scientific studies have also proven the benefits of butterfly pea as medicine. Jacob and Latha [15] showed that treatment using methanol extract of *C. ternatea* (MECT) at doses of 100 and 200 mg/kg for 14 days in mice induced by Dalton's lymphoma (DLA) can reduce tumor volume. This suggests that MECT exhibits significant antitumour effects in DLA bearing mice. Parvathi and Ravishankar [16] showed that Ethanolic Root Extract of *Clitoria Ternatea* has potential as a natural ingredient for psychotherapeutic agents against depression and mood disorders. In addition, fermented butterfly peas can prevent redness, itching, allergies, and irritation to the skin. Butterfly pea flowers also have antioxidant activity that can whiten the face, and promote moisture retention [17].

3. BIOACTIVE COMPOUNDS OF BUTTERFLY PEA (*Clitoria ternatea)*

Butterfly pea has the potential to be used as a medicinal ingredient because it contains various secondary metabolites. The results of research conducted by Kumar and More [18] show that secondary metabolites contained in butterfly pea leaves include alkaloids, tannins, glycosides, terpenoids, phenols. The stems contain tannins, reducing sugars, terpenoids, and phenols. The roots contain alkaloids, tannins, flavonoids, reducing sugars, terpenoids, phenols. Flowers

contain alkaloids, tannins, flavonoids, reducing sugars, terpenoids, and phenols. Buttrefly pea leaves also contain steroids [19]. In the butterfly pea flower, 5 types of anthocyanins have been identified, namely delphinidin-3-(6″-p-coumaroyl)-rutinoside, cyanidin 3-(6″-p-coumaroyl)-rutinoside, delphinidin-3-(p-coumaroyl) glucose in both cis- and trans-isomers, cyanidin-3-(p-coumaroyl-glucoside) and delphinidin-3-pyranoside [20]. Butterfly pea seeds also contain various secondary metabolites including alkaloids, glycosides, flavonoids, phenols, tannins, saponins, terpenoids, quinones [21].

4. EFFECT OF BUTTERFLY PEA (*Clitoria ternatea)* AGAINST FISH PATHOGENS

Various studies have shown the potential of butterfly peas as antimicrobials against various types of fish pathogens. The zones of inhibition of various parts of the butterfly pea plant against various microbes can be seen in Table 1.

Table 1. The inhibition zones of various parts of the butterfly pea plant against various microbes

Part of Plants	Microorganism	Solvent	Concentration	Inhibition zone (mm)	Reference
Root	*Pseudomonas aeruginosa*	Alcohol	100 µg/mL	22	[22]
			50 µg/mL	15	
			25 µg/mL	10	
	Klebsiella pneumoniae		100 µg/mL	28	[22]
			50 µg/mL	17	
			25 µg/mL	9	
Leaves	*Aeromonas formicans*	Ethanol	100 µL	0	[9]
			200 µL	12	
			400 µL	18	
	Aeromonas hydrophilia		100 µL	0	[9]
			200 µL	11	
			400 µL	15	
	Streptococcus agalactiae		100 µL	0	[9]
			200 µL	8	
			400 µL	12	
	Escherichia coli		100 µL	7	[9]
			200 µL	11	
			400 µL	12	
	K. pneumonia		100 µL	9	[9]
			200 µL	13	
			400 µL	16	
	Bacillus subtilis		100 µL	9	[9]
			200 µL	14	
			400 µL	18	
Flower	*B. subtilis*	Methanol	100 mg/mL	12.7	[23]
	E. coli			13	
	P. aeruginosa			11.3	
	Klebsiella spp.			12.7	
Seed	*B. subtilis*	Methanol	100 mg/mL	12	[23]
	E. coli			12.7	
	P. aeruginosa			12.3	
	Klebsiella spp.			13	
Stem	*B. subtilis*	Methanol	100 mg/mL	12	[23]
	E. coli			14.3	
	P. aeruginosa			10.7	
	Klebsiella spp.			11.7	

The results of the literature study above show that various parts of the butterfly pea plant can inhibit the growth of various microorganisms. Plant parts and solvents have different effects on the inhibition of the growth of microorganisms. This is because the differences of secondary metabolites content in the various plants. The solvent used will also affect the content of secondary metabolites in the extract so that different solvents will have different effects.

5. CONCLUSIONS

In conclusion, the roots, leaves, flowers, seeds, and stems of butterfly pea extract can inhibit the growth of fish pathogens. Butterfly pea can be used as a treatment to prevent fish diseases caused by pathogens because it is deeply rich of bioactive compounds such as alkaloids, tannins, glycosides, terpenoids, and phenols. The inhibition effect of the butterfly pea plant depends on the parts of the plant and solvents used in extraction.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/90418