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POTENTIAL UTILIZATION OF BUTTERFLY PEA (*CLITORIA TERNATEA*) IN AQUACULTURE ACTIVITIES (A REVIEW)

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ABSTRACT

The butterfly pea or telang plant (*Clitoria ternatea*) is a shrub that is extensively spread in Indonesia. It is a form of legume that is strong in protein and has a high nutritional value. Food and feed can be obtained from all parts of the telang plant. Telang leaves contain 18-25 percent protein, whereas the telang plant's stems and leaves together contain 9-15 percent protein. In aquaculture, the telang plant has many beneficial properties including as a source for protein, antioxidants, a source for enhancing fish color which contained fish feed, and antimicrobial properties as well. Phytochemical investigations have discovered active components such as tannins, plobatins, aponins, triterpenoids, phenols, flavonoids, alkaloids, anthraquinones, anthocyanins, flavonols, glycosides, steroids, and essential oils, which suggest the telang plant's potential as a therapeutic ingredient.

INTRODUCTION

Indonesia is a tropical country that is rich in abundant and quality biological resources. One of the plants that are abundant and spread over a wide area is the Butterfly Pea or telang plant (*Clitoria ternatea*). The telang plant is a shrub that is widely distributed in Indonesia, and belongs to the legume family with high nutritional value and is a type of legume that is rich in protein.

All parts of the telang plant can be used as a source of food and feed. Currently, the telang plant is popular for use because it has abundant properties, especially as a source of antioxidants. In livestock activities, telang is dubbed as tropical alfalfa, often referred to as a protein bank that can grow with low production costs (Cook et al. 2005). Telang leaves contain protein ranging from 18-25%, while the mixture of stems and leaves of the telang plant contains 9-15% protein (Al-Snafi, 2013).

Another benefit of telang leaves is that it is used as a protein source for the production of leaf concentrates. This plant can also be used as animal feed (Sutedi 2013). According to Reid and Sinclair (1980) apart from being used as animal feed, this plant can also be used as green fertilizer and ground cover in rubber and coffee plantations as well as used along contour lines to control erosion. This plant also has potential as an excellent feed because it has high nutritional value and is also very popular with livestock (Suarna 2005).

Similarly, in aquaculture activities, the telang plant, especially the leaves and stems part, which are not used as food for humans, has many benefits, namely as a source of protein, antioxidants, a source of pigment in fish feed, and has antibacterial properties. This paper is a review of several uses of telang plants in aquaculture activities.

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METHODS

This literature study was obtained from online journals such as Pubmed - NCBI, Elsevier, Research Gate, Springer, and Google Scholar. The keywords "butterfly pea "; "fish feed"; "*Clitoria ternatea* "; and "aquaculture" were used for the data search. Thus, the arranges of the theoretical framework will following the subject matter of the discussion.

RESULTS AND DISCUSSION

Butterfly Pea as a Sources of Antioxidants

Increased human activity at this time, accompanied by environmental quality and poor nutrition that does not meet nutritional needs, in turn creates free radicals that erode antioxidants in the human body. According to Reid and Sinclair (1980) one definition of free radicals is simply an atom that has free electrons or unpaired electrons. The unpaired electrons are unstable. In the body, free radicals become molecules that move wildly damage cell tissue, cause oxidative stress, and further impact on biological cell death.

Free radical damage not only occurs in humans, but also affects terrestrial and aquatic animals, including fish. Climate change, radiation exposure, and environmental pollution will have an impact on fish health, especially in aquaculture activities. Some actions to avoid free radicals are to consume food and feed ingredients that contain antioxidants. Antioxidants are compounds that inhibit the occurrence of oxidation reactions, namely chemical reactions that can produce free radicals and chain reactions and can damage organism cells. Some substances that have antioxidant properties are flavonoids, polyphenols, beta carotene, lutein, lycopene, selenium, zinc, anthocyanins (colorants in fruits and vegetables), as well as vitamin A, vitamin C and vitamin E.

Telang plant is a type of legume that has a high antioxidant content. The results of the laboratory analysis showed that the stem of the peas has the highest antioxidant content compared to other parts (Table 1). However, in terms of abundance, leaves are the largest part of the telang plant, so it is more potential to be used in feed.

Tabel 1. Antioxidant activity of various Telang plant parts

Parts	Antioxidant Activity (IC_{50} ppm value)	
	DPPH Methods	SOD Methods
Leaves	150,67	360
Stems	251,09	1310
Seed	184,87	1200
Seed coat	220,88	380

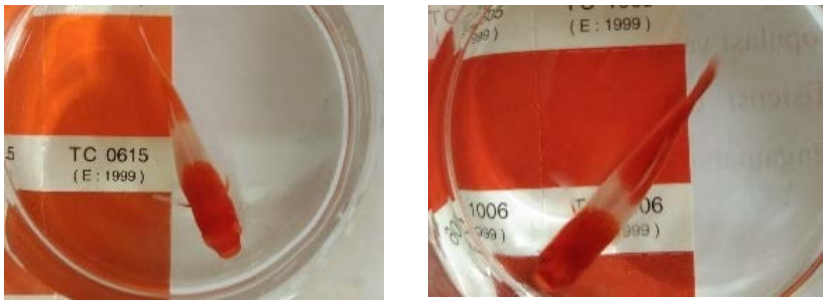
Source: Andriani (2020)

The potential of the telang plant as a medicinal ingredient is supported by phytochemical studies that found active ingredients such as tannins, plobatins, aponins, triterpenoids, phenols, flavonoids, alkaloids, anthraquinones, anthocyanins, flavonols, glycosides, steroids, essential oils, and stigmas-4-ena-3,6-dion (Budiasih 2017). Laksmi (2014) identified the presence of bioactive components by FTIR analysis and in vitro antioxidant activity of the leaves and flowers of the telang plant. The methanol extract from the leaves and flowers of the telang plant has various bioactive compounds such as phenols, flavonoids, alcohols, secondary amines, carboxylic acids, nitro compounds, etc. The leaves of the telang plant showed the amount of phenol of 358.99 6.21 mg/g and flavonoids of 123.75 2.84 mg/g (Al-Snafi 2016).

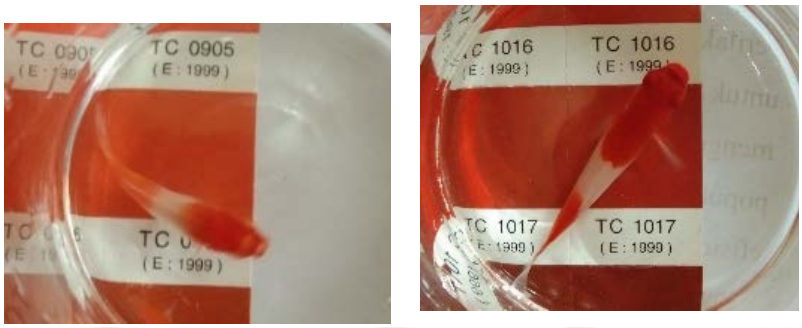
Butterfly Pea as a Source of Fish Feed Pigments

In addition to the high protein content, the telang plant can also be used as a source of pigment in fish feed. Red or yellow is the color that dominates many ornamental fish. The main components that make up these red and yellow pigments are carotenoid pigments. The addition of color enhancing sources in fish feed will result in an increase in color pigments in the fish's body, at least the fish are able to maintain color pigments in their bodies during the maintenance period. Carotenoids are lipid-soluble yellow, orange and reddish-orange pigments that include a hydrocarbon group called carotene and its oxygenated derivative xanthophylls (Pardosi et al. 2014). Based on the results of laboratory tests, telang leaves contain high carotenoids, namely 9,076 mg/kg (Julia et al. 2019), higher than the statement by Sutedi (2013) which stated that the carotene content of the telang plant was 587 mg/kg dry matter. The carotenoid content of telang leaves is greater than that of marigold flowers. According to Gupta et al. (2007) marigold flower petals contain very high carotenoids, namely 7,000 mg/kg of its dry weight.

The use of telang leaf as a pigment in fish feed has been carried out on several types of fish, one of which is the Swordtail Fish Head (*Xiphophorus helleri*). The results of Julia et al. (2019) study showed that the addition of 6% telang leaf flour to commercial feed was able to increase the best coloration on the tail and head of the Kohaku sword platy fish with color values of 73.8 and 82.2 (Fig. 1).



(a) Day-0 (b) Day-40



(c) Day-0 (d) Day-40

Figure 1. The color comparison between Tail part (a and b) and Head part (c and d) of Kohaku platy sword fish before (Day-0) and after (Day-40) the Telang leave extract supplementation.

So far, there has not been much research done on the use of the telang plant as a source of pigment in fish feed. Another study to increase the color brightness of platy fish has been carried out using a pigment source from marigold flower petals (Ezhil et al. 2008). The results showed that the two pigment sources could increase the body color of platy fish, but the carotenoid content of telang leaf was considered more able to increase the brightness of the fish's color. Marigold enhances the best color of platy fish in 15g/100g feed formulation, which is equivalent to the addition of 0.12g or 12% of Telang leaf meal in the feed.

Butterfly Pea as an Antibacterial Agent

Telang leaf has potential as an antibacterial for fish. According to Suarna (2012), telang leaf contains flavonoids and triterpenoids that function as antibacterial. This triterpenoid compound works as an anti-fungal, insecticide, anti-predator, anti-bacterial and anti-virus (Widiyanti 2006). Meanwhile, flavonoids are derivatives of phenolic compounds and act as protein coagulators that form complexes with bacterial cell proteins through hydrogen bonds which can cause the structure of cell walls and bacterial cell membranes to become unstable and result in cell lysis.

Several research results show that the leaves of the telang are effective as an antibacterial for aquatic organisms. The results of Riswadi's research (2010) showed that the soluble methanol extract of the telang leaf gave bacterial activity against *Escherichia coli* and *Pseudomonas aeruginosa* bacteria, and the active compound that had antibacterial activity in the soluble methanol extract was thought to be a steroid class compound. The mechanism of action of steroids as antibacterial is to damage the lipid membrane so that liposomes leak (Sudarmi et al. 2017). Meanwhile, the research of Andriani et al (2020) showed that telang leaf extract with a concentration of 300 ppm was effective for treating koi fish infected with Aeromonas hydrophila bacteria and helping recovery from inflammation (hemorrhage) of injection sites in koi fish infected with bacteria (Figure 2).

Figure 2. Reduction of inflammation on Koi fish after Telang leaf extract treatment

Treatment was carried out through the process of soaking Koi fish seeds using telang leaf extract for 48 hours. The results of observations on fish soaked with telang leaf extract experienced healing on the 9th day. One of the ingredients contained in the leaves of the telang is saponins, as evidenced by the amount of foam on the surface of the aquarium. Saponins are surface active compounds that are soap-like, work to hemolyze blood cells, and are toxic to cold-blooded animals (Faisal et al. 2016). Saponins are also toxic compounds that can inhibit the exchange of oxygen for breathing and eventually suffocate (Faisal et al. 2016). When compared with the study of Prayitno et al. (2014) using ketapang leaf extract, the goldfish infected with *A. hydrophila* bacteria experienced the fastest healing (ulcer drying and closing) on day-10 with 1500 ppm ketapang leaf extract treatment. This difference is thought to be due to differences in the strength of the plant content used and differences in body strength of fish, but it can be said that telang leaf is better than Moringa leaves because a concentration of 300 ppm of telang leaf extract can produce the fastest recovery, which is on the 9th day.

Conclusion

Based on the results of a literature search, it can be concluded that the Butterfly Pea (*Clitoria ternatea*) has great potential to be used in aquaculture activities as a source of antioxidants and pigments in feed, as well as being used as an antibacterial in fish.

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