



Potential Use of Butterfly Pea (*Clitoria ternatea*) as Fish Feed Ingredient: A Minireview

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

This article aims examines the effect of giving Butterfly Pea (*Clitoria ternatea*) in feed on the growth of various types of fish and the nutritional content of Butterfly Pea. The method used in this literature study is to review several research articles on the use of Butterfly Pea on fish growth, and the nutritional content of various parts of the Butterfly Pea plant. The collected review data is then compiled into a manuscript. Various parts of the Butterfly Pea plant such as leaves, flowers, and seeds contain protein, lipids, fiber, and carbohydrates. The largest protein content is found in seeds, reaching 40.59%. The application of leaf meal, flower meal, and seed meal to tilapia (*Oreochromis niloticus*), African catfish (*Clarias Gariepinus*), Swordtail Fish Head (*Xiphophorus helleri*) was not significantly different from control and did not have a negative effect on growth. In conclusion, leaf flour, seed flour, and Butterfly Pea flour can be used as alternative protein source feed ingredients.

Keywords: *Oreochromis niloticus*; *Clarias Gariepinus*; *Xiphophorus helleri*; growth; feed.

1. INTRODUCTION

Human population in the world grow fastly. Nowadays, based on worldometer, Human population reach around 7.9 billion in June 2022.

While, human population in Indonesia reach 279 million [1]. The rapid growth of human population in the world and also in Indonesia causes increasment the need of food. If the food supply cannot be done, malnutrition will be increase.

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Humans get sick easily because their immune system decreases. So, the increasing of food production should be done.

Aquaculture is one way to supply nutritious food for human population and also in Indonesia. Fisheries products contain a lot of nutrients such as protein, fiber, omega3- fatty acids, and others which have health benefits for people. Nowadays, the development of aquaculture grow fastly. About half of the world's aquatic foods and products in developing countries are produced from aquaculture sector. Global aquaculture production is projected to reach 109 million metric tons in 2030 [2]. World Fish consumption in 2030 is projected to reach 28 million tonnes live weight equivalent or 18 percent higher than in 2018 [2].

Aquaculture production have been targeted to achieve 18.77 ton in 2022 by Ministry of Fisheries and Marine Affairs of Republic of Indonesia [3]. To achieve that target, Ministry of Fisheries and Marine Affairs of Republic of Indonesia will build 124 aquaculture village called "kampung perikanan budidaya". Based on Ministry of Fisheries and Marine Affairs of Republic of Indonesia' decree number 16 2022, These village will be built until 2024 [4].

There are obstacles to increase aquaculture production. One of obstacles is the availability of quality feed [5]. While, price of fish meal and fish oil as feed ingredients are expensive and more expensive over time [6]. So that, the finding of new alternative cheaper ingredient have to be done.

One alternative that can be use as feed ingredient is Butterfly Pea (*Clitoria ternatea*). Bunga telang This plant contains a lot of nutrient such as protein, lipid, fiber, vitamin, mineral and other bioactive compounds. Butterfly Pea easy to get in many places [7]. The aims of this article are to examined the effect of giving Butterfly Pea plants in feed on the growth of various types of fish and the nutritional content of telang flower plants.

2. MORPHOLOGY OF BUTTERFLY PEA (*Clitoria ternatea*)

Butterfly pea (*C. ternatea*) is an ornamental plant originating from tropical Asia [8]. This plant belonging to the Fabacea tribe then spread to various areas such as the East and West Indies, China, South and South Africa, Central America,

India [8], Brazil, and Africa, Java, Maluku, Sumatra, and Sulawesi are the distribution areas of this plant [9]. Because they spread in various regions, butterfly peas are known by various local names, including telang flower (Indonesia), samsamping (Philippines), đậu biếc (Vietnam) [10], kordofan pea (sudan), cunha (brazil) [8].

This plant can grow in areas with an altitude of 1-1800 m above sea level [9], open mesic forest or shrub land, sufficient light intensity, rainfall (650–1250 mm) [11], and soil pH ranges from 5.5-8.9 [8]. The optimum temperature for the growth of butterfly pea is 27°C or higher [11]. Average daily temperature tolerance can be up to 15°C but is not suitable for snowy areas [12].

Clitoria ternatea is a herbaceous plant that belongs to legumes so it has nodules in the roots to fix nitrogen. The color of the flower crown varies, including white, mauve, light blue, and dark blue. while the corolla structure has two variations: normal and multiple layered corolla [13]. Butterfly pea is a perennial plant so it can flower throughout the year if the conditions are right. Flowers can bloom 4-6 weeks after planting, but if they are at low temperatures, they can bloom first in 7-11 weeks [12]. Seeds are brown or green, olive, 4.5-7 mm long, and 3-4 mm wide. While the roots are taproots with several branches and many slender lateral roots [8].

The taxonomy of *Clitoria ternatea* is as follows [13]:

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabacea
Subfamily	Papilionoideae
Genus	<i>Clitoria</i>
Species	<i>Clitoria ternatea</i> L.

3. NUTRIENT CONTENTS OF BUTTERFLY PEA (*Clitoria ternatea*)

Clitoria ternatea contains various chemical components. Several researchers have analyzed the nutritional content of flowers, leaves, and seeds of *C. ternatea*. This plant contains protein, carbohydrates, fat, fiber, minerals and various other compounds. The fatty acids contained in this plant are oleic, linolenic acids, linoleic, palmitic, stearic. In addition to fatty acids, this plant also contains 18 amino acids such as

Table 1. Proximate analysis of *C. ternatea* on various plant parts meal

Chemical compounds	Parts of plant		
	Leaf	Seed	Flower
Protein (%)	14.00 ± 0.43	40.59	0.32 ± 0.03
Fat (%)	5.5 ± 0.1	12.26	2.5 ± 0.1
Fiber (%)	8.45 ± 0.05	NT	2.1 ± 0.2
Ash (%)	8.73 ± 0.22	NT	0.45 ± 0.15
Moisture (%)	74.51 ± 0.38	10	92.4 ± 0.1
Carbohydrate (%)	0.080 ± 0.002 g/100 g	36.69	2.23 ± 0.3
Reference	[17]	[18]	[19]

NT = Non Tested

Table 2. Minerals of *C. ternatea* on flower and leaf meal

Minerals	Leaf	Flower
Sodium	0.27 ± 0.07 g/100 g	0.1413 ± 0.003 mg/g
Potassium	1.60 ± 1.42 g/100 g	1.2506 ± 0.235 mg/g
Calcium	0.78 ± 0.025 g/100 g	3.0953 ± 0.09 mg/g
Iron	6.33 ± 0.35 mg/100g	0.1441 ± 0.007 mg/g
Magnesium	0.58 ± 0.02 g/100 g	2.2306 ± 0.134 mg/g
Copper	2.23 ± 0.12 mg/100g	0.0103 ± 0.0004 mg/g
Zinc	4.43 ± 0.15 mg/100g	0.5980 ± 0.006 mg/g
Mangan	3.24 ± 0.13 mg/100g	0.0249 ± 0.003 mg/g
	[17]	[19]

lysine, histidine, threonine, phenylalanine, valine, leucine, cysteine, methionine, isoleucine [14]. The nutritional content of different varieties and plant parts also showed differences. Other factors that cause differences in nutrient content are harvesting age [15], and environmental physical factors [16]. Proximate analysis of *C. ternatea* can be seen in Table 1. While the mineral content of *C. ternatea* can be seen in Table 2.

4. EFFECT OF BUTTERFLY PEA (*Clitoria ternatea*) AS FISH FEED

Several researchers have tested the effect of giving *C. ternatea* plants to several types of fish. The addition of butterfly pea leaves in various concentrations did not significantly affect the growth of Tilapia (*O. niloticus*) with the control. However, giving the plant leaf flour did not have a negative effect. This indicates that the leaf flower can be used as an additional source of protein in feed without any negative effects [20].

The addition of *C. ternatea* seeds to African Catfish (*C. Gariepinus*) with a concentration of 50% showed a positive effect on weight gain, specific growth rate, protein efficiency ratio, feed intake, and feed conversion ratio. The addition of 50% of *C.ternatea* in seeds can replace other protein sources, namely soybean flour [21].

The addition of *C. ternatea* leaf meal showed positive results on body weight gain of Swordtail Fish Head (*X. helleri*) although it was not significant when compared to the control. However, the leaf flour of this plant can still be used as a protein source. The increase in fish growth can be influenced by various internal and external factors. Feed is the main factor that affects the growth of fish. In addition to the nutrients contained in the feed, feed intake and feed conversion ratio also affect the growth rate of fish [22]. The higher the feed intake will increase the chances of the feed being used by fish. The feed conversion ratio shows is the quantity of feed required to produce one unit weight of fish. The higher the FCR, the more inefficient the use of feed for growth [21]. A summary of the effects of the addition of flower, seeds, and leaves of butterfly pea on various fish can be seen in Table 3.

Butterfly pea leaf meal not only has a positive effect on growth, but also on fish color. The application of 6% *Clitoria ternatea* leaf powder can improve the color quality of Swordtail Fish Head (*X. helleri*) [22]. The color quality of fish can be increased by giving leaf flour because of the carotene content. Carotene is a pigment that has the potential to improve the color quality of fish. The color quality of fish is expected to continue to increase with time of cultivation and

Table 3. The effects of the addition of flower, seeds, and leaves of butterfly pea on fish

Fish	Parts of butterfly pea	Concentration of Addition (%)	Daily Growth rate (g)	Reference
Tilapia	Leaf	0	2.43	[20]
		5	2.28	
		10	2.29	
		15	2.43	
Fish	Part of Butterfly Pea	Concentration of Addition (%)	Average Weight Gain	
African catfish	Seeds	0	27.7 ± 1.11	[21]
		25	25.3 ± 0.71	
		50	27.23 ± 0.94	
		100	22.2 ± 1.73	
Swordtail Fish Head	Leaf	0	0.33 ± 0.083	[22]
		1	0.39 ± 0.090	
		6	0.33 ± 0.053	
		12	0.29 ± 0.033	

age of fish due to the increasing amount of carotene that can be absorbed [22].

4. CONCLUSION

Leaf meal, seed meal, and flower meal contain carbohydrates, proteins, lipids, and fiber. The highest protein content is found in seed flour. The provision of leaf flour, seed meal, and flower meal did not have a negative effect on the growth of African catfish, tilapia, and Swordtail Fish Head. Leaf meal, seed meal, and flower meal can be used as feed ingredients for alternative protein sources.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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