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THE POTENTIAL OF TELANG FLOWER (*Clitoria ternatea*) IN FUNCTIONAL FOOD DIVERSIFICATION IN INDONESIA

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ABSTRACT

The telang flower (Clitoria ternatea) has been traditionally utilized as a natural dye and culinary component in numerous Asian countries, including Indonesia. Interest in telang flowers has surged in recent years because of its bioactive chemicals, particularly anthocyanins, which offer numerous potential health advantages. This article intends to thoroughly examine the use of telang flowers in Indonesia's food industry, emphasizing their nutritional properties, applications in diverse food and beverage products, and their potential to advance the functional food and nutraceutical sectors. This article discloses a recent study indicating that telang flowers have the potential to serve as a natural food with abundant health advantages, including antioxidant, anti-inflammatory, neuroprotective, antibacterial, and anti-asthmatic qualities. Moreover, telang flowers have been utilized in various foods, including tea, functional drinks, ice cream, etc, showcasing their adaptability in the culinary business. Nonetheless, other obstacles persist, including the absence of standardization in the production process, variability in the concentration of active chemicals attributable to environmental factors, and insufficient regulatory frameworks. This study aimed to explain comprehensive insights into the opportunities and challenges associated with optimizing telang flowers as an important element in the diversification of functional foods in Indonesia while also promoting further innovation in tcreatingnutraceutical products derived from natural ingredients.

INTRODUCTION

The telang flower (*Clitoria ternatea*) possesses historical and cultural significance in numerous nations, including Indonesia. Telang flowers have been traditionally utilized in numerous places, particularly as a natural dye for culinary and beverage applications. Telang flowers are utilized in numerous traditional items, including *nasi kerabu*, which exhibits a vibrant blue color due to the natural dye derived from the petals, and telang flower tea, which is gaining popularity as both a daily beverage and a choice for special occasions (Ezzudin & Rabeta, 2018). Moreover, telang flowers are frequently employed in several traditional confectioneries, including *apem* cakes, *talam* cakes, and *putu mayang*, exploiting their natural blue color to enhance the visual appeal of the dishes.

In recent years, the utilization of telang flowers has increased in modern culinary inventions. Floral-infused beverages, such as butterfly pea lemonade, which transforms from blue to purple after adding lemon juice due to pH alterations, have emerged as a prominent fad, particularly among enthusiasts of health-conscious and visually appealing drinks. Besides fresh beverages, telang flowers are used in latte products and smoothie bowls, where their attractive blue color enhances visual appeal and offers health benefits due to the antioxidant properties of anthocyanins. Furthermore, its ornamental role, the telang flower, is frequently linked to traditional medicinal practices. In certain areas, this flower is thought to possess attributes that support ocular health, enhance cognitive abilities, and alleviate respiratory ailments. Recently, the telang flower has garnered more interest from scientists and the food industry due to its visual appeal, cultural significance, and bioactive compounds, which offer numerous health benefits (Lijon et al., 2017).

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One main anthocyanin content is one component that makes telang flowers attractive in healthy and functional food. Antocyanins are natural pigments that give blue color to telang flowers and have strong antioxidant properties (Adisakwattana et al., 2020; Fanany, 2020; Puspitojati et al., 2024). Antioxidants are vital in combating free radicals, chemicals that can cause oxidative damage to the body's cells, contributing to aging and many degenerative diseases such as cancer and cardiovascular disease. Furthermore, several studies have demonstrated that anthocyanins play a function in lowering inflammation (anti-inflammatory) and protecting nerve cells (neuroprotective), giving telang flowers even more significant potential in the management of chronic diseases like diabetes, Alzheimer's and hypertension (Priska et al., 2018).

Indonesia possesses significant biodiversity, presenting substantial opportunities for the application of this plant in diverse food product innovations. Despite a global trend towards functional food consumption, telang flowers represent a viable solution for food diversification utilizing local resources. Functional foods, which integrate nutritional and health benefits, are experiencing growing demand among consumers who recognize the significance of diet for wellness maintenance. The diverse applications of telang flowers, including their use as natural dyes and as sources of bioactive compounds with health benefits, can promote innovation within Indonesia's food and beverage sector. Incorporating telang flowers in the food industry enhances public health and establishes economic opportunities for farmers and small industries in Indonesia to develop telang flower-based products.

Despite its significant potential, several challenges must be addressed to optimize the use of telang flowers. A primary challenge is the standardization of production. The cultivation, harvesting, and post-harvest processes are predominantly conducted using traditional methods, resulting in inconsistencies in the quality of the final product. Standardization is essential for maintaining consistent levels of anthocyanins and other bioactive compounds across product batches, mainly to comply with the quality and safety standards of the functional food and nutraceutical industries. Prior studies indicated that the drying process of simplicia telang influences anthocyanin content and free radical inhibition activity (Puspitojati et al., 2023). Therefore, post-harvest handling of telang must be considered. The purpose of this article was to comprehensively review the use of telang flowers as a food ingredient in Indonesia, especially in terms of nutritional value, health benefits, and its application in food products. This article will also discuss the challenges and opportunities in developing telang flowers as a functional food ingredient in Indonesia.

METHODS

This article was compiled using the literature review method, where various literature sources such as scientific articles, books, reports, and policy documents relevant to telang flowers were collected, analyzed, and synthesized. The literature review process was carried out with the following steps:

1. **Data Collection**: Literature studies were collected from various academic databases such as Google Scholar, PubMed, and ScienceDirect, focusing on the latest research on telang flowers and their uses in food (Data published from 2012 to 2024)
2. **Inclusion Criteria**: The articles selected for review discussed the use of telang flowers in the context of food, their bioactive compounds, and their potential health benefits.
3. **Data Analysis**: The articles were then analyzed to obtain in-depth information regarding the content of active compounds, processing processes, health benefits, and their applications in food products.

RESULTS AND DISCUSSION

3.1. Potential for Telang Flower Development

Telang flower (*Clitoria ternatea*) is one of the plants with great potential to be developed in the functional food industry in Indonesia. Some key factors that make telang flowers promising are the content of bioactive compounds, ease of cultivation, and flexibility in the processing process into various food and beverage products.

3.1.1. Nutritional Content and Bioactive Compounds of Telang Flowers

Telang flowers are rich in bioactive compounds, especially anthocyanins, which give this flower its distinctive blue color. In addition to anthocyanins, telang flowers also contain flavonoids, peptides, and several types of amino acids (Salleh, 2012; Lijon et al., 2017; Fanany, 2020). Anthocyanins are compounds known to have high antioxidant activity, which can help fight free radicals in the body. These compounds have also been linked to various health benefits, including cardiovascular health, reduced risk of cancer, and improved cognitive function (Lijon et al., 2017).

3.1.2. Ease of Cultivation and Productivity

One of the advantages of telang flowers is the ease of cultivation. This plant can grow well in various environmental conditions, including less fertile soils, and does not require intensive maintenance (Sulistyowati et al., 2023). Telang flowers are drought-resistant and can grow well in tropical areas such as Indonesia. With minimal care, this plant can produce a large number of flowers. In one hectare of land, telang flower plants can produce up to 1.5-2 tons of fresh flowers

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per season. This high productivity makes it attractive to smallholder farmers and the agricultural industry who want to develop new commodities with high economic value. The stages of telang flower cultivation are as follows (Puspitasari et al., 2022) :

1. The first step is to prepare telang flower seeds that can be purchased directly at the seed store.
2. To find out which telang flower seedlings are suitable for planting, soak them in water and let them sit for approximately 5 minutes. If there are seeds that float, then they are not suitable for planting.
3. Next, the seeds or seeds are placed in the ground regularly watered every morning and evening.
4. If the flowers have grown, the flowers are picked in the afternoon. Put the telang flowers in a tray that should be far from dust, and do not expose them to the hot sun directly
5. Preservation of telang flowers can be done by drying telang flowers without direct sunlight

3.1.3. Ease of Processing

Besides their simplicity in cultivation, telang flowers exhibit diversity in processing, serving as both fresh components and as dried or powdered goods. Telang flowers can be used in their fresh state for beverages like blue tea or as a natural meal dye. Dried flowers can be ground into powder and utilized in various food products, including health drinks, cakes, and confections. The drying process of telang flowers is straightforward and can be accomplished by traditional techniques or utilizing a drying oven for larger-scale production. The simplicity of processing is a significant factor contributing to the substantial potential of telang flowers for development in the functional foods business.

3.1.4. Increasing Market Demand

Modern consumers are progressively aware of the significance of selecting foods and beverages that furnish energy and promote health. Functional food products, which integrate health advantages with nutritional value, are preferred. Telang flowers possess significant anthocyanin content and potent antioxidant capabilities, which make them a promising component in this category. Products derived from the telang flower, including telang flower tea, blue smoothies, and assorted natural health beverages, are experiencing heightened demand because of their perceived benefits for cardiovascular, cognitive, and dermal health.

Due to heightened environmental consciousness, numerous food and beverage firms are transitioning from synthetic dyes to natural dyes. Telang flowers yield a vivid blue hue naturally and are a favored alternative to natural dyes. The blue hue of the anthocyanins in telang blossoms is visually attractive and conveys a sense of being natural and devoid of chemicals. This trend is propelling market demand, particularly from the food and beverage sector, which aims to address consumers' preferences increasingly focused on health and sustainability. Moreover, telang blossoms have been utilized in several culinary applications, such as blue rice, cakes, and confections. This product diversity enhances the appeal of telang flowers and stimulates market demand across multiple sectors, from health foods to novel culinary goods.

The demand for telang interest originates not only from the domestic market but also from the foreign market. In nations like Thailand, Malaysia, and India, telang flowers have historically been used as a natural dye and culinary ingredient. This flower is beginning to capture the interest of consumers in Western nations who are more receptive to foreign foods that provide health advantages. The global market for natural functional ingredients, such as telang flowers, is anticipated to expand by the rising demand for superfoods and plant-based goods.

The expansion of digital platforms and e-commerce has facilitated consumer access to telang interest. Sales of telang flower products, including dried tea, telang flower powder, and other processed items, are rising across multiple online markets. This platform enables smallholder farmers and large-scale entrepreneurs to access a broader consumer base, including international exports. In Indonesia, social media serves as a significant marketing instrument for promoting telang flowers, particularly among youthful consumers seeking healthful and aesthetically pleasing products.

3.2 Application of Telang Flower in Food

Telang flowers are extensively utilized in diverse cuisine dishes throughout Indonesia. This flower is a natural dye for rice and beverages in specific areas. Telang flowers are favored as a natural dye due to their absence of synthetic ingredients that could harm health. Moreover, telang tea, brewed from this flower, is gaining popularity as it is believed to induce relaxation and enhance cognitive performance. Various commercial food products in Indonesia have started incorporating telang flowers, including functional

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beverages, ice cream, puddings, and cakes. Incorporating telang flowers in these products enhances their aesthetic appeal and contributes to their functional value owing to their high antioxidant content.

The Telang flower possesses significant potential for incorporation into diverse functional food items due to its bioactive component concentration, including anthocyanins. The diversification of telang flower-derived goods include visual or aesthetic elements, such as natural dyes, and their health advantages. Functional food products derived from telang flowers in Indonesia are increasingly being utilized in many formats, including functional beverages, nutritious snacks, and dietary supplements. This table includes examples of functional food product diversification derived from telang flowers in Indonesia and supporting studies as shown in Table 1.

Table 1. Application of Telang Flowers in Functional Food

No	Products	Application	Function	References
1	Tea	Herbal teas, functional drinks	Antioxidants, relaxation, improvement of cognitive function	(Ansori et al., 2023; Aprilia, 2023; Sari, 2023)
2	Blue Rice	Natural dyes for rice (nasi kerabu)	Natural dyes rich in anthocyanins	(Neda et al., 2013; Aweng et al., 2014)
3	Ice Cream	Healthy ice cream products	Antioxidant, anti-inflammatory	(Yusmaniar et al., 2023)
4	Pudding	Plant-based pudding	Rich in flavonoids, boosts immunity	(Adrikayana, Eva Stia; Pratiwi, Eri; Putri, 2022)
5	Functional Drinks	Health drinks (smoothies, juices)	Antioxidant, high in anthocyanins	(Puspitojati et al., 2024)
6	*Jamu* Telang Flower	Herbs based on spices and telang flowers	Antimicrobial, improved digestive function	(Adi Permadi et al., 2022)

Interest-based food diversification in Indonesia offers excellent opportunities, especially in the growing functional food sector. Products such as telang flower tea and health drinks have become popular among the public due to their antioxidant effects and potential to maintain neurological and cognitive health. Several studies in Indonesia have documented the health benefits of these products, such as reducing oxidative stress and improving cognitive function.

In addition, the application of telang flowers in products such as blue rice and healthy ice cream shows that their use as a natural dye is safe and offers added value in the form of high antioxidant content. With the increasing demand for natural and healthy products, the diversification of telang flowers can be an innovative solution to present functional food products that are attractive and beneficial to health.

3.3 Biological Activity and Potential Health Benefits of Telang Flower

The telang flower has been extensively researched for its various significant biological benefits. Extracts from this plant's flower, leaf, and root parts show potential for use as a natural therapeutic agent in various applications. Table 2 describes the biological effects of telang flowers that have been proven through scientific research.

Table 2. Biological Activity of Telang Flowers

Benefit	Biological Effects	Mechanism	References
Antioxidant	Able to ward off free radicals, especially at high concentrations of extracts.	The anthocyanin content absorbs UV rays and prevents the formation of *reactive oxygen species* (ROS).	(Jeyaraj et al., 2022)
Antidiabetics	Lowers blood sugar, cholesterol, and triglyceride levels.	Increases insulin and HDL levels lowers blood glucose and glucose-bound hemoglobin. The extract improved liver histopathology, reduced serum glucose, and enhanced insulin levels.	(Widowati et al., 2023)
Antimicrobial	Effective against pathogenic bacteria such as *Bacillus*	The content of flavonoids and phenolics inhibits the growth of bacteria and fungi.	(Jeyaraj et al., 2022)

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Benefit	Biological Effects	Mechanism	References
	cereus, Bacillus subtilis, and *Escherichia coli*		
Anthelmintics	Paralyzes and kills parasites such as earthworms.	Phenolic compounds such as tannins interfere with the function of parasite proteins, causing paralysis and death.	(Lijon et al., 2017)
Hepatoprotective	Protects the liver from damage induced by paracetamol and CCl4.	The phenolic and flavonoid content helps regenerate damaged liver cells.	(Chandra, 2019)
Anti asma	Reducing the number of leukocytes and eosinophils in animal models.	Antihistamine and anti-inflammatory effects of flavonoids and saponins reduce inflammation in the airways.	(Taur & Patil, 2011)
Neuropharmacological	Improving cognitive function and memory in animal models.	Increases acetylcholine levels and dendriticion of neurons in the hippocampus.	(Boominathan et al., 2003))

3.4. Challenges and Opportunities for the Development of Telang Flower as a Functional Food

Despite the telang flower's numerous potential advantages, certain hurdles must be addressed to advance its development as a functional food ingredient in Indonesia. A primary difficulty is the absence of standardization in the processing and production procedures. Furthermore, rules governing the incorporation of telang flowers in food items remain insufficient, necessitating further research and supportive policies. The potential to cultivate telang flowers as a functional food ingredient in Indonesia is substantial. The increasing demand for natural and functional products in domestic and international markets presents a significant opportunity for producers to create products derived from telang flowers. The diversification of food products derived from the telang flower can enhance the well-being of local farmers who cultivate these plants. Below are additional details regarding the challenges and opportunities for developing telang flower as a functional food in Indonesia, formatted as Table 3.

Table 3. The Challenges and Opportunities of Telang Flowers Development

Aspects	Challenges	Opportunities
Processing Standardization	Lack of standardization in processing telang flowers, from cultivation harvesting to packaging.	The potential to develop national or international standards related to telang flower processing to improve product quality.
Research and Development	There is still a limited amount of comprehensive scientific research related to the health benefits and commercial potential of telang flowers.	Opportunities to conduct further research that can open up innovations in new products based on telang flowers.
Food Regulation	Limitations of regulations on the use of telang flowers in functional food products in Indonesia.	Regulations that support and harmonize with international standards will encourage the development of the functional food industry.
Consumer Awareness	Lack of public knowledge about the health benefits of telang flowers.	Increasing consumer awareness of functional and natural food products supporting health is driving telang flowers' adoption.
Cultivation and Availability of Raw Materials	Cultivating telang flowers has not been widely optimal in various regions of Indonesia.	Potential to improve the welfare of local farmers through diversification of telang flower-based commodities.
Processing Technology	Telang flower processing technology is still simple and limited to a small scale.	Processing technology innovations, such as the extraction of active compounds, can increase the added value of telang flower-based products.

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Aspects	Challenges	Opportunities
International Markets	Competition with similar products from other countries and lack of promotion in the international market.	Global demand for natural and functional products continues to increase, providing export opportunities for telang flower-based products.
Product Innovation	Lack of diversification of telang flower-based products in the domestic market.	Opportunities to develop various products such as functional drinks, health supplements, and telang flower-based cosmetics.

The main challenges include a lack of standardization in processing, leading to product quality variations. In addition, unclear regulations regarding the use of telang flowers in food limit its development. Challenges in marketing also arise due to low consumer awareness regarding the benefits of telang flowers as a functional food. However, the opportunities are enormous, mainly due to the increasing demand for natural and functional products in domestic and international markets. Telang flowers can be processed into various innovative products, such as herbal teas and healthy foods, which allows product diversification. In addition, developing telang flowers can provide added value for local farmers, opening opportunities for small and medium-sized enterprises (MSMEs) to develop telang flower-based products.

CONCLUSIONS

Telang flower (*Clitoria ternatea*) is a natural food ingredient with great potential to support the functional food industry in Indonesia. Its bioactive compound content, especially anthocyanins, provides various health benefits, ranging from antioxidant to neuroprotective properties. Its use as a natural dye and ingredient in food products continues to grow, although there are still challenges in standardization and regulation. With further research and supportive policies, telang flowers can become one of the important components in the diversification of functional foods in Indonesia.

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