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Morphological Characteristics and Evaluating Bioactive Compound Extracts of *Isotoma longiflora* and *Clitoria ternatea* Plants from Central Kalimantan as Therapeutic Agents

Utin Tria Marshanda[1], Noor Hujjatusnaini[1,*], Ridha Nirmalasari[1]

Abstract

Central Kalimantan is characterized by its diverse biological resources, including traditional medicinal plants such as *Isotoma longiflora* (known as kitolod) and *Clitoria ternatea* (often called blue pea flower). This research aims to investigate the therapeutic properties of extracts derived from these two plants while also evaluating their efficacy and safety within the public health framework in Central Kalimantan. The study focused on the bioactive compound extracts from Isotoma Longiflora and Clitoria ternatea, both sourced from this region. These plants are recognized for their secondary metabolites, including flavonoids, saponins, tannins, and alkaloids, which offer various pharmacological advantages. Employing exploratory survey techniques alongside laboratory experiments, the research examined the plants' morphological characteristics and assessed their extracts' effectiveness on mice infected with *Fusarium sp*. Findings indicated that the combined extracts significantly lowered the intraocular pressure (IOP) in the infected mice, reducing it from 25.375–33.25 mmHg to nearly normal levels, precisely 12.075–14.575 mmHg. This observed efficacy is attributed to the bioactive compounds' antioxidant, antimicrobial, and anti-inflammatory properties. The study underscores the potential of Isotoma Longiflora and Clitoria ternatea from Central Kalimantan as viable local plant-based therapeutic agents, thereby contributing to the advancement of herbal medicine and the conservation of biodiversity.

Keywords: Central Kalimantan, *Clitoria ternate*, Herbal Infection Therapy, *Isotoma longiflora*, Secondary Metabolites

1. Introduction

Central Kalimantan boasts diverse plant species recognized for their therapeutic benefits, encompassing forest-dwelling flora and wild plants frequently categorized as weeds. The region's rich biodiversity supports numerous medicinal plant species utilized in traditional practices (Sutoyo, 2010). The application of these plants for health-related purposes is deeply embedded in the area's cultural heritage. Various indigenous groups, notably the Dayak tribe, possess extensive traditional knowledge regarding using different plant species to address health issues, particularly those affecting vision in Indonesia.

The Dayak community utilizes medicinal plants to address a range of ailments, with this knowledge transmitted through generations, illustrating the profound connection between the community and its surrounding environment. Research has demonstrated that these traditional remedies are not only efficacious but also constitute a significant aspect of the cultural heritage that shapes the identity of the Dayak people. Specific plants have historically been employed to combat various infections, with some exhibiting properties as natural antimicrobial agents. Notably, *Isotoma longiflora* and *Clitoria ternatea* have garnered attention due to their bioactive compounds.

Isotoma longiflora and *Clitoria ternatea* represent two plant species with considerable promise as sources of bioactive compounds exhibiting a range of therapeutic effects. *Isotoma longiflora*, commonly referred to as kitolod, has garnered significant research interest due to its elevated levels of flavonoids, phenolic compounds, and antioxidants, which are associated with notable health

*Correspondence: noor.hujjatuusnaini@iain-palangkaraya.ac.id
1) Institut Agama Islam Negeri Palangkaraya - Jl. G. Obos, Menteng, Jekan Raya Distric, Palangka Raya City, Kalimantan Tengah 73112, Indonesia

advantages (Egarani et al., 2020; Permana et al., 2022). Conversely, *Clitoria ternatea*, known as the butterfly pea flower, has a long-standing history of use in traditional medicine across various cultures, including Indonesia. This species is recognized for its rich content of anthocyanins and flavonoids, which are linked to antioxidant, antidiabetic, and anticancer activities. Both plants offer nutritional benefits and hold the potential as therapeutic agents for managing diverse health conditions; Simarmata et al., 2024). A plethora of prior studies have investigated the therapeutic potential of *Isotoma longiflora* and *Clitoria ternatea*. Egarani et al. (2020) research underscored the elevated antioxidant content observed in *Isotoma longiflora*, particularly flavonoids and phenolics, which have been demonstrated to play a pivotal role in combating oxidative stress and inflammation. Concurrently, Bunga's (2022) research demonstrated the notable anthocyanin content in *Clitoria ternatea*, underscoring its potential as an antioxidant, antidiabetic, and anticancer agent. Another study by Mareintika (2021) identified the antibacterial activity of *Isotoma longiflora* leaves against Staphylococcus aureus, while Hamzah et al. (2024) found that *Clitoria ternatea* extract was able to inhibit Candida albicans biofilm. However, this study differs from previous studies because it focuses on evaluating the combination of extracts of the two plants to overcome *Fusarium sp*. infections in the eyes of mice. The present study's distinguishing feature is its assessment of the combination's efficacy in reducing intraocular pressure (IOP), a facet that has received scant attention in earlier research. Furthermore, integrating morphological analysis and secondary metabolite content of indigenous Central Kalimantan plants enhances our understanding of the potential for developing therapeutic agents derived from Indonesian biodiversity.

Research indicates that the butterfly pea flower extract can suppress the proliferation of numerous pathogenic microorganisms and offers a protective effect against cellular damage induced by free radicals (Hamzah et al., 2024). Furthermore, bioactive compounds derived from these two species exhibit anti-inflammatory properties and contribute positively to overall health (Pertiwi et al., 2022). Given the growing interest in plant-derived therapies and holistic health strategies, assessing bioactive compounds from *Isotoma longiflora* and *Clitoria ternatea* is relevant (Egarani et al., 2020; Permana et al., 2022.

The objective of this study is twofold: firstly, to explore the therapeutic potential of the extracts of both plants and secondly, to assess the effectiveness and safety of their use in the context of public health in Central Kalimantan. The objective is to describe the morphological characteristics and to quantitatively analyze the compound content in the combination of medicinal plants. The observation indicators encompass the following: (a) root characteristics (color, shape, and root type); (b) floral characteristics (flower stalk length, flower stalk color, flower color, floral type, flower crown shape, and the number of flower crowns); and (c) fruit characteristics (fruit type, fruit diameter, fruit size, and fruit surface) (Bagas Setyawan et al., 2024). By enhancing our comprehension of these compounds' chemical composition and mechanism of action, we can explore novel applications in developing more effective natural health products.

2. Material and Methods

This research employed an exploratory survey methodology, which included direct observation of plant morphology. During this phase, a purposive sampling technique was utilized to identify an appropriate and representative area based on established criteria. The selected sampling site was located on Jalan G. Obos in Central Kalimantan, specifically at the coordinates 2.2097001, 113.8192631, with an elevation of approximately 12 meters above sea level. The investigation occurred at the Tadris Biologi Microbiology Laboratory at IAIN Palangkaraya from April to September 2024. This approach enabled the researchers to gather more precise data regarding the physical and morphological traits of *Isotoma longiflora* and *Clitoria ternatea* plants (Hujjatusnaini et al., 2024)

The plants under observation exhibit variations in the characteristics of their organs, facilitating their identification and classification based on morphological traits. Following field observations, the research progressed to laboratory experiments employing a post-test-only design alongside a control group. This methodology enables researchers to assess the impact of specific treatments on the plants by contrasting the outcomes of the treated group with those of the control group, which did not receive any treatment. By integrating both survey and experimental techniques, the study seeks to enhance the understanding of the morphological features of *Isotoma longiflora* and *Clitoria ternatea*, as well as the effects of laboratory treatments on these plants, particularly regarding their extracts' influence on female Balb/c mice infected with *Fusarium sp*.

The research was carried out at the Tadris Biologi Microbiology Laboratory at IAIN Palangkaraya from April to September 2024, involving a sample of 32 female mice, approximately 3–4 weeks old, with an average body weight of around ±28 grams.

The study utilized female Balb/c mice along with *Isotoma longiflora* leaf powder and *Clitoria ternatea*, each in quantities of 1500 grams. The solvents employed included 70% alcohol, 96% alcohol, chloroform, and sterile distilled water. The extraction process was performed via the maceration technique, utilizing 96% ethanol over 24 hours. Qualitative analyses were conducted to detect secondary metabolite compounds, explicitly targeting

alkaloids, flavonoids, saponins, and tannins, employing suitable reagents for identification. For the quantitative assessment, extract solutions were formulated at concentrations of 40%, 50%, 60%, 70%, 80%, and 90%, with antioxidant content evaluated through the DPPH method, utilizing a UV-Vis spectrophotometer set to a wavelength range of 200–400 nm. The mice were prepared for fungal infection by administering a *Fusarium sp*. suspension via the topical ocular method, with a dosage of 1 mL administered three times daily. Clinical evaluations were performed on the fifth day to document ocular changes in the mice, including symptoms such as redness, discharge, and swelling.

Intraocular pressure (IOP) was measured using a Schiotz tonometer before and after infection to evaluate the impact of infection on mouse eye pressure. At the same time, the number of fungal colonies was counted using a colony counter. Data analysis in this study used statistical software such as SPSS (Statistical Package for the Social Sciences) to process and analyze quantitative data. Statistical tests included the t-test to compare the average intraocular pressure before and after therapy and analysis of variance (ANOVA) to test differences between treatment groups. The area for taking samples of the research-implemented simple materials can be seen in the map image below with coordinates 2.2097001,113.8192631,12.

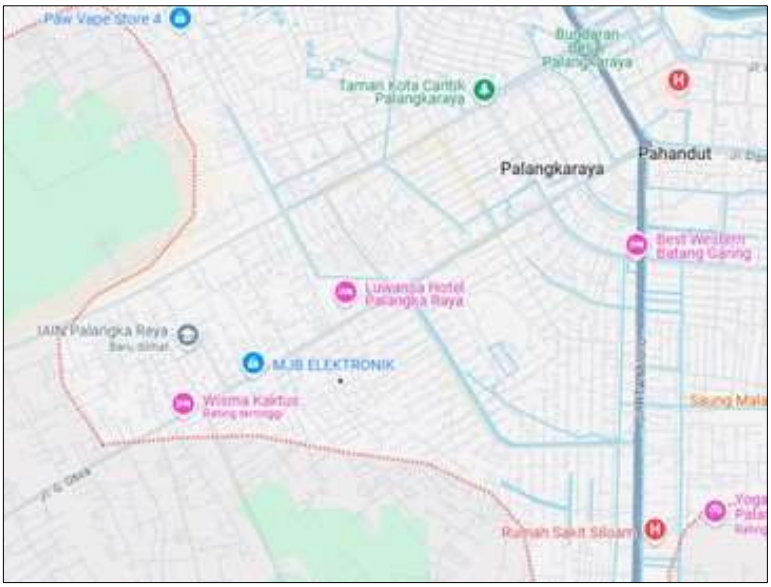

Figure 1. Sampling Location

The study employed observation sheets to document the morphological traits of *Isotoma longiflora* and *Clitoria ternatea*, focusing on aspects such as roots, stems, leaves, flowers, and fruits. The data collected from these observations were subsequently compared with existing literature to verify adherence to the expected morphological characteristics of each species. Additionally, tests were conducted to analyze the presence of secondary metabolite compounds, including flavonoids, alkaloids, tannins, and saponins.

Qualitative analyses were performed utilizing specific reaction methods with designated reagents, such as magnesium chloride (Mg-HCl), to detect flavonoids. Notable color changes, such as transitioning from reddish-orange to reddish-purple, signify an identification of flavonoids (Khotimah, 2016). Mayer's Reagent and Bouchardat's reagent were employed to assess alkaloid content. The appearance of a precipitate serves as an indicator of alkaloids; a white precipitate in the Mayer test and a brown precipitate in the Bouchardat test both confirm a positive result. Such findings suggest the presence of alkaloids, which are recognized as secondary metabolites with potential pharmacological applications.

A flavonoid assay was performed utilizing a concentrated extract derived from maceration. Specifically, 0.1 g of the extract was dissolved in 10 ml of methanol, and the resulting solution was aliquoted into multiple test tubes. During this assay, particular reagents, including Mg-HCl, were introduced to the samples. The occurrence of colorimetric changes, transitioning from reddish-orange to pink, signifies a positive indication of the presence of flavonoids, which are known to play a role in various plant species' antioxidant and anti-inflammatory properties (Khotimah, 2016).

In summary, a combination of morphological assessments and qualitative analyses of secondary metabolite compounds not only aids in identifying the chemical constituents of the examined plants but also sheds light on their potential pharmacological applications. The methodology and findings of this research are illustrated in the subsequent Diagram.

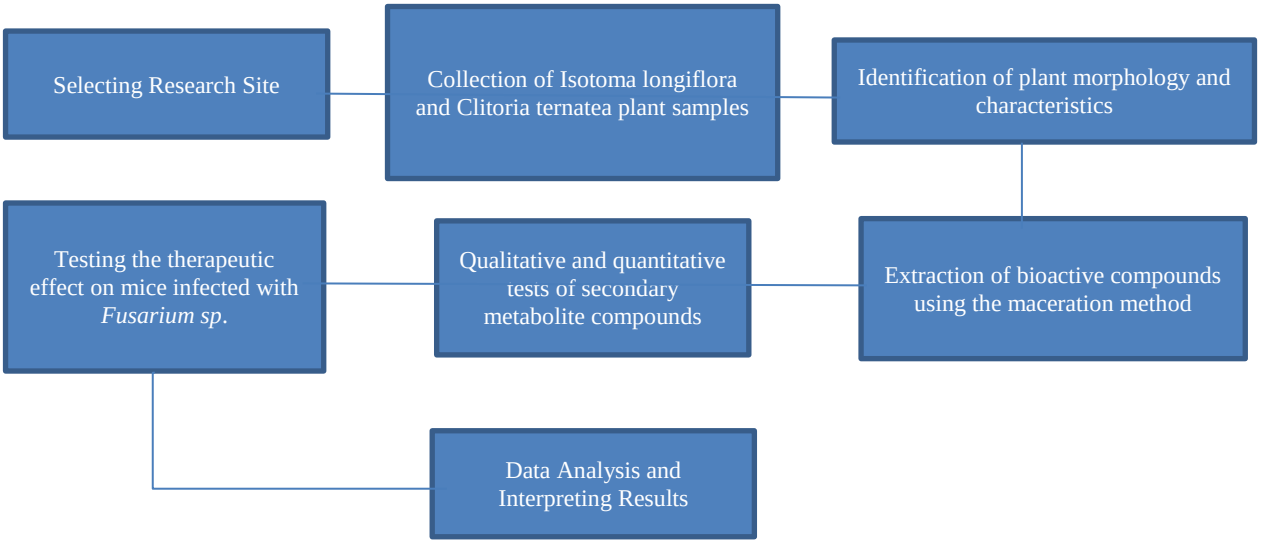

Figure 2. Research flow diagram

3. Results and Discussion

Isotoma longiflora and *Clitoria ternatea* are indigenous plants recognized for their potential health benefits and frequent application in traditional medicine. *Isotoma longiflora*, prevalent in tropical regions, is noted for its therapeutic properties in addressing infections and inflammation. This plant exhibits antimicrobial and antioxidant characteristics that facilitate wound healing, making it a common component in traditional herbal remedies. Conversely, *Clitoria ternatea*, commonly known as the butterfly pea flower, also flourishes in tropical climates (Nurhabibah et al., 2023).

Renowned for its striking blue blossoms, this plant serves as a natural dye for food and beverages and boasts a high concentration of flavonoids and anthocyanins. These bioactive compounds are potent antioxidants, safeguarding the body against free radicals and enhancing cognitive health. Furthermore, butterfly pea flowers are frequently utilized in herbal medicine to promote overall well-being.

Comparison of characteristics of plant organs in two types of medicinal plants used as potions. Identification and differentiation between the two types of medicinal plants based on morphological traits used as observation indicators include a) roots (color, shape, type of roots), b) flowers (length of flower stalk, color of flower stalk, flower color, type of flower, shape of flower crown, number of flower crowns), and c) fruit (type of fruit, fruit diameter, fruit size, fruit surface). Can be seen in Table 1.

3.1. Root Morphology

A taproot system, a distinguishing feature of dicotyledonous plants, characterizes *Isotoma longiflora* plants. The primary root grows vertically, with secondary roots emerging around it. The root coloration is typically pale brown, exhibiting a smooth surface texture. The length of these roots varies between 5 and 7 centimeters, with the precise measurement contingent upon the age and growth conditions of the plant.

The function of this root system is twofold: it provides support for the stem, enabling it to maintain an upright position, and it facilitates the absorption of water and nutrients from the soil, thereby meeting the plant's nutritional requirements for growth. Notably, the *Clitoria ternatea* plant exhibits a taproot system, a distinctive feature characteristic of dicotyledonous plants.

The primary root grows straight down, with secondary roots emerging around it and spreading in various directions. The color of this root tends to be brownish on the outside, with a yellowish-white inside, and it has a smooth surface texture. The length of the primary root can reach 10–15 cm, depending on the age and growth conditions of the plant. This root system supports climbing plants in remaining sturdy in the soil, especially when climbing on other media. In addition, this plant's roots help absorb water and nutrients from the soil that are needed for growth and development. Another uniqueness is the presence of root nodules formed due to symbiosis with Rhizobium bacteria, which play a role in the nitrogen fixation process from the air.

This process is beneficial for the *Clitoria ternatea* plant and increases the fertility of the surrounding soil, so this plant is often used as a ground cover plant. This can be seen in Figure 3.

3.2. Stem Morphology

The *Isotoma longiflora* exhibits a cylindrical morphology with a light green hue and a smooth, slippery surface texture. This herbaceous stem, lacking a woody structure, typically measures between 10 and 20 centimeters in height. Distinct segments along the stem are

readily observable, marking the locations of leaf and branch growth. Furthermore, the stem exhibits an upright growth habit, with branching occurring at the apex, providing structural support for the leaves, flowers, and fruits.

Table 1. Characteristics of *Isotoma longiflora* and *Clitoria ternatea* plants

Characteristics	Plant organs	Types of Medicinal Plants Combined as Potion	
		Isotoma longiflora	*Clitoria ternatea*
Root	Root Color	Pale brown	Light brown-s dark brown
	Root Form	Long, slender, and slightly branched	Elongated and branched
	Root Types	Ride	Ride
	Root Structure	Cylindrical with several small branches	Cylindrical and branched
	Root texture	Rough with a slightly hairy surface	Fine
	Primary root length	5-15 cm	50-100 cm
	Lateral root length	2-5 cm	20-30 cm
	Root diameter	1-3 cm	2-5 cm
Stem	Bar color	Light green to dark green	Light green to brown
	Stem shape	Elongated cylindrical with segments	Cylindrical and elongated
	Stem diameter	2-5 mm	0.5-2 cm
	Length of the stem	10-20 cm	1-3 M
	Surface of the stem	Smooth, slightly textured, with fine hairs on the surface.	Smooth with a few fine hairs
	Stem internodes	2-4 cm between one leaf and another	3-5 cm
	Stem book (node)	Has a book where leaves, branches, and shoots emerge	Has a book where the leaves of the branches emerge
	Branching	Slightly branched with branches emerging from the leaf axils.	A little branching
	Stem strength	Strong enough to support leaves and flowers	Strong enough to support branches and leaves
Leaf	Leaf color	Light green to dark green	Light green to dark green
	Leaf shape	Lancet, elongated and tapering	Oval with a blunt tip and rounded base
	Leaf tip	Tapered (accuminatus)	Obtuse
	leaf stalk	Short (petiolus)	Short
	Edge of the two	Sharply curved	Flat
	Leaf bone	pinnate	Fins
	Leaf width	2-3 cm	1-3 cm
	Leaf length	6-8 cm	2-6 cm
	Leaf surface	Smooth and shiny	Smooth, sleek and shiny
	Leaf type	Single (folium simplex), not compound	Compound (pinnate compound leaf)
	Leaf base	tapered	Rounded
	Leaf arrangement	Spiral on the stem	Parallel
	Texture of the leaves	Thin but strong enough	Smooth and hairless
Flower	Flower stem length	5-6 cm	1-2 cm
	Flower stalk color	Pale green	Dark green to brown
	Flower Color	Pure white	Bright blue with white spots
	Janis Flowers	Compound/single	Axillary compound
	Flower petals		
	Flower Crown Color	Clean beads	Bright blue
	Flower Crown Shape	Funnel-shaped	vexillum
	Number of Crowns	5 strands	5 to 6 strands
Fruit	Fruit shape	Elongated and cylindrical	capsule
	Fruit color	Light green to dark brown	Bright green to brown
	Types of fruit	Capsules include dehiscent fruit	Pod
	Fruit diameter	0.3-0.5	1-2 cm
	Fruit size	2.5-3 cm	5-10 cm
	Fruit surface	Smooth, hairless	Fine
	Fruit stalk length	1-2 cm	2-5 cm
	Fruit stalk color	Light green	Green
	Fruit stalk texture	straight, sharp, and smooth	Thin and flexible
	Fruit texture	Hard and dry	Fine

Figure 3. Root morphology A: *Clitoria ternatea*, B: *Isotoma longiflora*

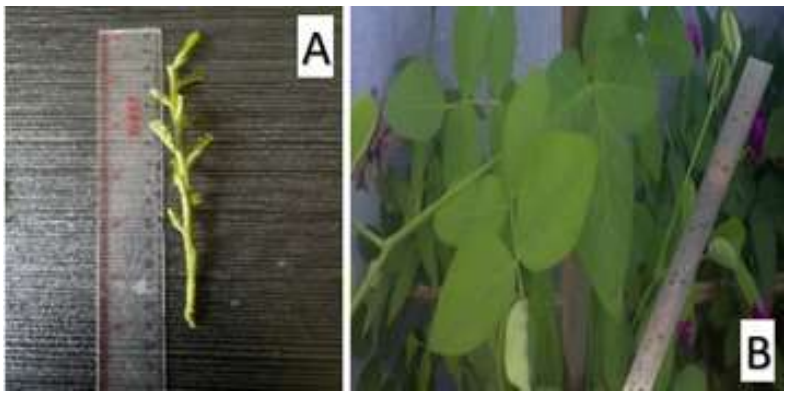

Figure 4. Morphology of stem A: *Isotoma longiflora*, B: *Clitoria ternatea*

The stem's green pigmentation indicates chlorophyll presence, enabling the stem to contribute to photosynthesis, albeit to a lesser extent than the leaves (Shelemo, 2023; Armanda, 2018). In contrast, the *Clitoria ternatea* plant features a green cylindrical stem during its juvenile phase and possesses a surface texture ranging from smooth to slightly hairy. Like *Isotoma longiflora*, this stem is also herbaceous, lacking a rigid woody composition, and can attain lengths of 50 to 200 centimeters, contingent upon the surrounding environmental conditions.

The segments on the stem are quite clearly visible, indicating the growing points of leaves, flowers, and branches. The stems of this plant are climbing or creeping, often wrapping around supports such as fences or other plants around them. The green color of the stem indicates the chlorophyll content, so the stem can also play a role in photosynthesis, although not as effectively as leaves. With its flexible nature, the stem supports plant organs such as leaves, flowers, and fruit, allowing the plant to reach a wider growing area. See Figure 3 below (Husen et al., 2023).

3.3. Leaf Morphology

Isotoma longiflora leaves have an elongated lanceolate shape with a length of about 6–8 cm and a width of 1–2 cm. The edges of the leaves are sharply notched or known as pinnate, creating a distinctive leaf appearance. The pinnate leaf veins extend from the base to the tip of the leaf, with a bright green leaf color and a smooth and thin surface texture.

These leaves grow alternately on the stems or branches of the plant. Leaves play an essential role in photosynthesis, respiration, and transpiration, which support the overall growth and development of the plant. *Clitoria ternatea* leaves have an elliptical to oval shape with a length of about 2–6 cm and a width of 1–3 cm. The leaf edges are flat without sharp curves, creating a simple and elegant appearance. The pinnate leaf veins extend from the base to the tip of the leaf, with a striking dark green color and a smooth and slightly shiny leaf surface (Nuraini et al., nd).

These leaves grow in a compound pinnate manner, usually consisting of 5–7 leaflets neatly arranged on one stalk. *Clitoria ternatea* leaves play an essential role in photosynthesis, respiration, and transpiration, which support the overall growth and development of the plant.

3.4. Flower Morphology

Isotoma longiflora flowers have an elongated and graceful trumpet (tubular) shape with a pure white color. Small green petals that taper to the tip are arranged at the base of the flower. The flower is about 5–7 cm long with a slender, greenish stalk.

This flower has 5 tapering sepals and a tubular corolla that attract pollinators. Flowers appear at the end of the stalk or branch of the plant and play an essential role in the

plant's reproduction process. *Clitoria ternatea* flowers have a distinctive butterfly-like shape, about 4–5 cm long. The corolla consists of five symmetrically arranged strands, where the upper (standard) corolla is rounded with a striking blue or purple color, often with a yellowish-white pattern in the middle. The two side corollas (wings) are smaller, while the two lower (soft) corollas are attached to form a boat-like structure.

The flower petals are elongated tubular with a pale green color. *Clitoria ternatea* flowers grow solitary on stalks that emerge from the leaf axils, producing a graceful and striking appearance. In addition to being the plant's main attraction, these flowers play an essential role in the reproductive process by attracting pollinating insects (Armanda, 2018; Winneta & Kristiani, 2021).

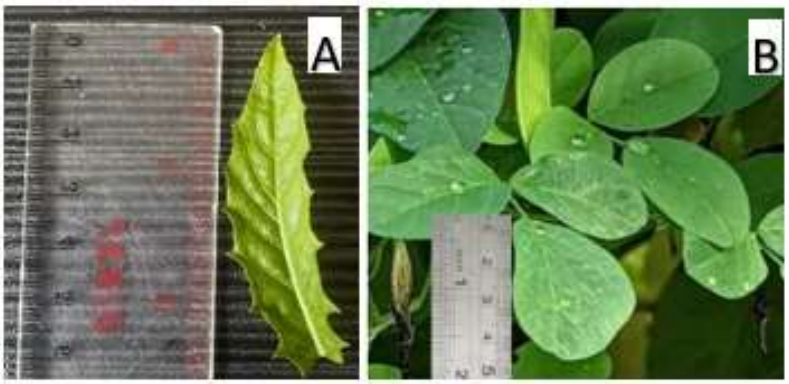

Figure 5. Leaf Morphology A: *Isotoma longiflora*, B: *Clitoria ternatea*

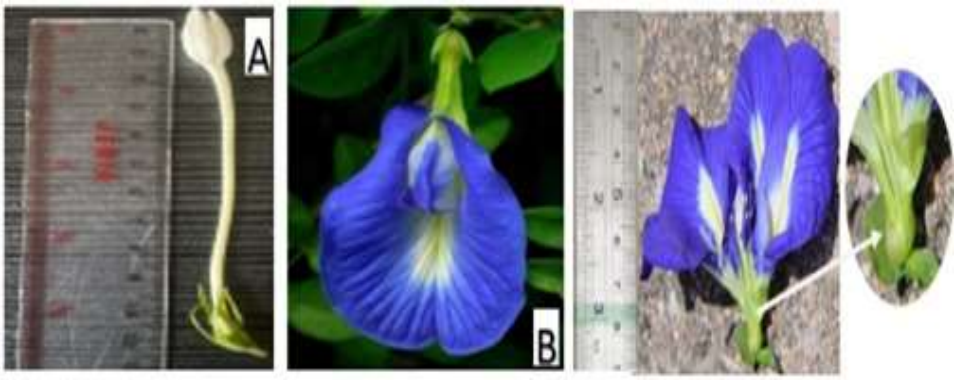

Figure 6. Morphology of Flower A: *Isotoma longiflora*, B: *Clitoria ternatea*

3.5. Fruit Morphology

The fruit of the *Isotoma longiflora* plant has an elongated capsule shape, with a length of about 2.5–3 cm and a diameter of 0.3–0.5 cm. The fruit is green when young and turns dark brown when ripe. The fruit is dehiscent, bursting when ripe to spread its seeds into the surrounding environment. At the fruit's base are remnants of pointed petals, which provide a distinctive characteristic (Selviana, 2016).

This structure serves to protect the seeds and help them spread naturally. Inside the fruit are tiny seeds that are the primary tool for plant regeneration. *Clitoria ternatea* fruit has an elongated pod shape with a length of about 5-10 cm and a width of 1-2 cm. The surface of the fruit looks smooth and green when young, then turns blackish brown when ripe. These pods have visible edges with a slender structure, creating a distinctive fruit appearance. Each pod contains small round to oval seeds that are neatly arranged inside.

Clitoria ternatea fruit grows from the stem or branches of the plant, often in the leaf axils. This fruit plays an essential role in the plant's reproductive process by storing and spreading seeds for regeneration and new plant growth; Nada et al., 2023).

Based on the results of the secondary metabolite content test, several active compounds were successfully identified, including flavonoids, which are essential compounds in this study. The samples analyzed, namely Isotoma longinflora and *Clitoria ternatea*, showed positive results (+) for flavonoids. The color variations observed in these samples included orange, pink, and dark red, indicating various types of flavonoids that may contribute to the antioxidant and antimicrobial properties of the plant. Furthermore, alkaloid compounds were also detected in Isotoma longinflora, which showed positive results (+) with white deposits based on Meyer's parameters. This indicates the presence of alkaloid compounds known to have pharmacological potential. However, *Clitoria ternatea* did not show results in the alkaloid test, meaning that this compound was not detected in the plant.

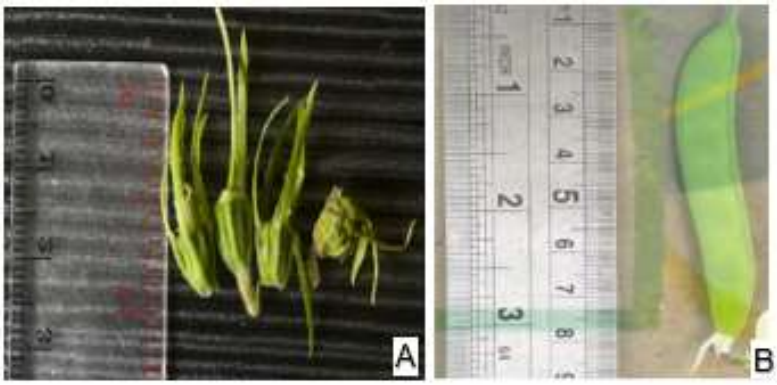

Figure 7. Morphology of Fruit A: *Isotoma longiflora*, B: *Clitoria ternatea*

Table 2. Results of the secondary metabolite content test

Compound content	Parameter	*Isotoma longiflora*	*Clitora ternatea*
Flavonoid	Red-orange, Pink, Dark red	(+)	(+)
Meyer	White sediment	(+)	(-)
Degendrof	Orange sediment	(-)	(-)
Bouchardat	Brown sediment	(+)	(-)
Tannins/phenols	Brownish-yellow, blackish-brown, blackish blue	(+)	(+)
Steroid	bluish green	(-)	(-)
Triterpenoid	Orange, brownish orange	(+)	(+)
Saponins	Permanent foam	(+)	(+)

For drag-drop compounds, the results showed negative (-) in both samples, namely Isotoma longinflora and *Clitoria ternatea*. This means that these two plants did not find compounds usually associated with particular biological activities. The bouchardat compound was also detected in the analysis. Isotoma longinflora showed a positive result (+) with a brown precipitate, indicating that this compound may contribute to the plant's medicinal properties. However, *Clitoria ternatea* showed a negative result (-), indicating the absence of this compound. Tests for tannins and phenols showed that both compounds were present in both samples (Muh.Amin et al., 2023).

Phytochemical screening test yielded positive (+) results for Isotoma longinflora and *Clitoria ternatea*, with the appearance of a blackish-brown color, indicating the presence of these compounds. Tannins and phenols are known to have anti-inflammatory and antimicrobial activities; thus, their presence adds to the plant's therapeutic value. However, terpenoid compounds were not detected in both samples, indicating that these compounds are absent in Isotoma longinflora and *Clitoria ternatea*.

The results of the steroid parameters also showed negative (-),indicated by the appearance of a greenish color, indicating that steroid compounds were absent in both plants (Pertiwi et al., 2022) . On the other hand, triterpenoid compounds were identified with positive results (+), indicating the presence of orange and orange-brown colors in both plants. Triterpenoids have various health benefits, including anti-inflammatory and antitumor properties. Finally, the presence of saponins was confirmed in both samples, indicated by the presence of permanent foam in Isotoma longinflora and *Clitoria ternatea*. Saponins have the potential to be an antimicrobial agent and can also increase the immune response.

These plants show similarities in terms of morphological characteristics, such as roots, stems, leaves, and flowers, although there are variations in the size and color of these organs. Analysis of secondary metabolite content in various samples showed the presence of compounds such as flavonoids, alkaloids, tannins/phenols, triterpenoids, and saponins, which can potentially provide therapeutic benefits. Environmental factors such as soil texture and humidity levels are believed to play a role in these compounds' variation in morphology and content. Although both plants show the same potential for use in medicine, further consideration is needed regarding their ecological impact and sustainability (Hujjatusnaini et al., 2021).

In the initial condition before fungal infection, the IOP values in groups P1, P2, P3, P4, P5, P6, P7, and P8 varied, ranging from 10.9 to 15.875 mmHg. After being infected with *Fusarium sp*. fungus, the IOP values increased significantly in all groups, ranging from 25.375 to 33.25 mmHg, indicating additional pressure due to infection. The IOP decreased in each group after being given combination therapy for *Isotoma longiflora* (L.), C. Presl and *Clitoria ternatea* extracts. The IOP values after therapy were 14.575 mmHg at P1, 13.35 mmHg at P2, 12.75 mmHg at P3, 12.55 mmHg at P4, 13.175 mmHg at P5, 13.35 mmHg at P6, 13.825 mmHg at P7, and 14.575 mmHg at P8. Groups P1, P2, P3, P4, P5, P6, P7, and P8 experienced a decrease in IOP, with a range of values between 12.075 and 14.575

mmHg, approaching the initial conditions before infection. This decrease indicates that the combination therapy of the extracts effectively reduces intraocular pressure caused by fungal infections, thus potentially helping restore the condition of the mice's eyes.

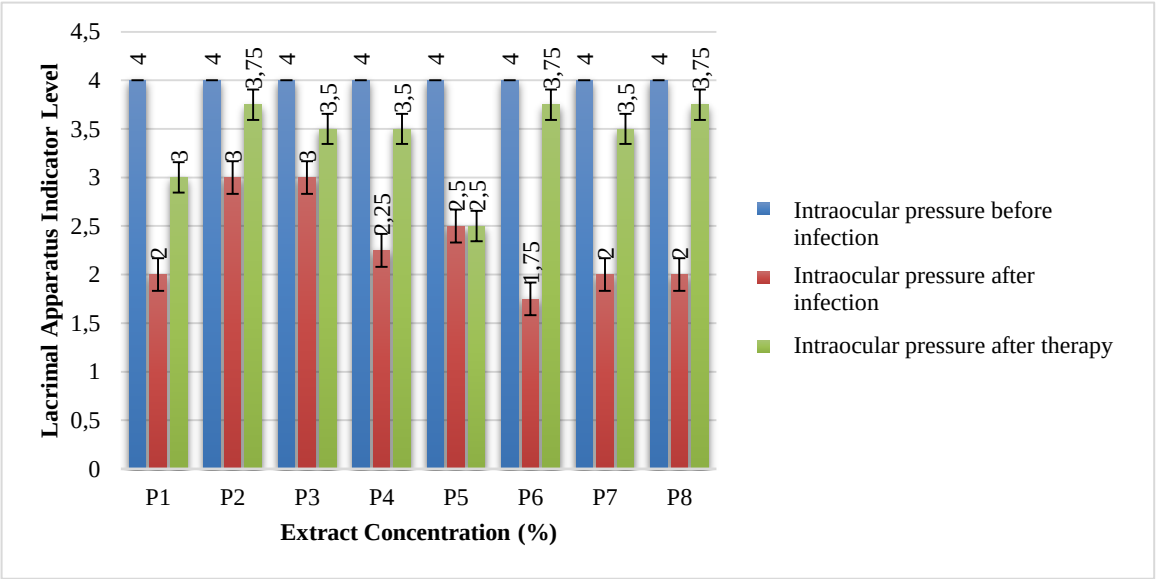

Figure 7. Recapitulation of intraocular pressure data in mice after therapy

The effectiveness of this combination therapy can be attributed to the content of secondary metabolite compounds found in *Isotoma longiflora* and *Clitoria ternatea*. The extracts of both plants are known to contain bioactive compounds such as flavonoids, alkaloids, saponins, tannins, and phenolics, which have various pharmacological activities, including anti-inflammatory, antimicrobial, and antioxidant. Flavonoids are known to have anti-inflammatory activity by inhibiting the enzymes cyclooxygenase (COX) and lipoxygenase (LOX), thereby reducing the formation of inflammatory mediators such as prostaglandins and leukotrienes. This compound has an antimicrobial effect that can inhibit the growth of *Fusarium sp*., thereby reducing the burden of infection. It acts as an immunomodulator that increases the body's immune response, lowering local inflammation due to illness. Several types of alkaloids have a relaxing effect on smooth muscles, including the ciliary muscle of the eye, which can help reduce IOP. Combining these compounds contributes to a synergistic therapeutic effect in reducing inflammation, fighting fungal infections, and lowering intraocular pressure.

The plant samples utilized in this study were obtained from Central Kalimantan, an area characterized by its rich biodiversity and frequent occurrence of plants with high secondary metabolite content (Pardede & Alicia, 2015). The ecosystem environment in Central Kalimantan, characterized by mineral-rich soil, a tropical climate, and rainforest conditions, can potentially influence the biosynthesis of bioactive compounds in plants. These environmental factors are hypothesized to contribute to increased content and potential of secondary metabolites in local plants, including *Isotoma longiflora* and *Clitoria ternatea*.

The findings of this study suggest that the combination extracts of indigenous Central Kalimantan plants possess significant therapeutic potential in addressing fungal infections that compromise ocular health. The utilization of indigenous flora fosters the development of natural resource-based pharmaceuticals and presents prospects for biodiversity conservation and local economic empowerment through the development of herbal medicines. Further research is needed to identify specific active compounds, mechanisms of action, and clinical trials on a broader scale.

4. Conclusion

The research findings demonstrated a notable elevation in intraocular pressure (IOP) values, which ranged from 25.375 to 33.25 mmHg, attributed to infection. Following the administration of a combination therapy utilizing extracts from *Isotoma longiflora* and *Clitoria ternatea*, a reduction in IOP was observed across all experimental groups. This reduction signifies the therapeutic efficacy of the treatment in alleviating intraocular pressure associated with infection. Specifically, the IOP values recorded post-therapy were 14.575 mmHg for group P1, 13.35 mmHg for group P2, 12.75 mmHg for group P3, 12.55 mmHg for group P4, 13.175 mmHg for group P5, 13.35 mmHg for group P6, 13.825 mmHg for group P7, and 14.575 mmHg for group P8. Each group, P1 through P8, exhibited a decline in IOP, with values ranging from 12.075 to 14.575 mmHg, nearing the baseline measurements before the onset of infection. This reduction underscores the effectiveness of

the combined extracts in mitigating intraocular pressure elevations induced by fungal infections, specifically those caused by *Fusarium sp*. The results affirm that the combination therapy of *Isotoma longiflora* and *Clitoria ternatea* extracts is a promising approach for managing increased IOP resulting from *Fusarium sp*. fungal infections, highlighting its potential as a therapeutic option for ocular fungal infections, as corroborated by this study.

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