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Morphological Characteristics and Content of Secondary Metabolite Compounds of Medicinal Plants for Postpartum Infection Therapy

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ABSTRACT

This study investigated the potential of medicinal plants in Central Kalimantan, Indonesia, specifically focusing on Ageratum conyzoides, Mussaenda frondosa, Curcuma longa, and Uncaria gambir, which are utilized by the Dayak tribe for treating postpartum infections. Morphological observations were conducted in two distinct locations, namely Kota Besi District and Mentaya Hulu District of East Kotawaringin. The findings of this study offer a comprehensive understanding of the morphological characteristics and secondary metabolite compounds of medicinal plants in Central Kalimantan. The research employed an exploratory survey method involving direct observations of plant morphology at the research site, with the selection of the observed area utilizing a purposive sampling technique. The study aimed to qualitatively describe the morphological characteristics and analyze the compound content of Ageratum conyzoides, Mussaenda frondosa, Curcuma longa, and Uncaria gambir. Despite morphological variations between locations, the similarities in morphological characteristics and secondary metabolite compound content suggest comparable potential uses. The analysis of secondary metabolite compounds contributes to the traditional knowledge regarding the bioactive properties of these plants. The bioactive compounds identified in these plants include flavonoids, alkaloids, tannins/phenols, steroids, triterpenoids, and saponins. The study concludes that the information obtained can enhance public awareness of the health benefits associated with traditional medicinal plants, particularly in the treatment of postpartum infections. The similarities in morphological characteristics and secondary metabolite compound content between locations indicate similar potential uses, with considerations for ecological and sustainability aspects in their utilization, which serves as the final outcome of this research.

Keywords: *Postpartum infections, Morphological Characteristics, Secondary Metabolites, Medicinal plants*

1. INTRODUCTION

Indonesia possesses a vast expanse of land that is abundant in biological natural resources and a wide array of flora and fauna. Indonesia's tropical forests alone are home to approximately

400 varieties of trees and a staggering 30,000 plant species (Sani et al., 2017; Noviani et al., 2018). The local culture and wisdom of the Indonesian people are characterized by their reliance on over 30,000 plant types for medicinal uses, which is embraced by a significant majority of the population, amounting to 80%. This cultural trait is particularly evident in the Dayak tribe residing in Central Kalimantan. According to Nugroho (2017), Indonesia's tropical forests boast one of the world's largest biodiversities. The community's utilization of more than 30,000 plant species for medicinal purposes further emphasizes the significance of this natural wealth (Amin, 2023; Andriani & Okalia, 2022).

The utilization of plants for medicinal purposes has evolved into a cultural practice. It represents the traditional knowledge of tribes in Indonesia, such as the Dayak tribe in Central Kalimantan, who rely on various plant species for treating post-natal or postpartum infections.

Central Kalimantan boasts a rich variety of plants known for their medicinal properties, sourced from both forests and wild plants that are sometimes viewed as weeds. Specific plants are traditionally used to combat various infections, with some serving as natural antimicrobial treatments. Moreover, a combination of Ageratum conyzoides, Mussaenda frondosa, Curcuma longa, and Uncaria gambir leaves has been suggested as an effective antifungal remedy (Bunga et al., 2021). Research findings indicate that post-natal infections are commonly caused by microorganisms like Candida albicans (Ayu Astria et al., 2022; Ardiansyah et al., 2021).

Plant morphology is a branch of science that focuses on the study of the shape and structure of plants. It involves analyzing the similarities in the origin of plant body shape and structure to interpret their development. Therefore, plant morphology serves as a scientific discipline that investigates and compares various aspects of plant shape and structure. It provides a foundation for understanding the differences between different types of plants. It is important to note that morphology differs from plant anatomy, as it encompasses both internal and external variations. (Sutara, 2016; Mayoru et al, 2022; Zakiah & Turnip, 2023)

By studying plant morphology, researchers can delve deeper into the characteristics of medicinal plants, gaining insights into their form and structure. This study specifically aims to observe the morphology of Ageratum conyzoides, Mussaenda frondosa, Curcuma longa, and Uncaria.

The limited public awareness regarding the potential medicinal properties of these plants, coupled with the insufficient scientific investigation into their physical characteristics and secondary metabolite compounds, necessitates endeavors to enhance our comprehension in this area. Hence, this study not only focuses on observing the physical attributes of the plants but also aims to document the secondary metabolite compounds present within them scientifically.

Previous studies on the secondary metabolite compounds found in Ageratum conyzoides, Mussaenda frondos, and Curcuma domestica have revealed the existence of flavonoid compounds, alkaloids, tannins/phenols, steroids, triterpenoids, and saponins. These metabolite compounds possess antibacterial properties (Nada et al., 2023)

The information needs to be readily available to the public, especially millennials, to deepen their understanding of the health benefits found in traditional medicinal plants from Central Kalimantan, particularly in treating postpartum infections. The thorough documentation of the medicinal plants traditionally used for postpartum infection therapy by the Dayak tribe in Central Kalimantan is expected to provide detailed information

on the importance of preserving and scientifically validating this knowledge.

2. MATERIAL AND METHODS

This research was conducted in 2 (two) districts, namely Kota Besi and Menyata Hilir, East Kotawaringin. The coordinates of the research location at -2,2935276, 112,7964156.

Figure 1. Map Research Location

The samples obtained were then characterized at the Structure and Development Laboratory at the IAIN Palangka Raya Tadris Biology Study Program from March to September 2023. Data related to material on morphological characteristics are supported by analysis of the content of compounds of Agretum conyzoides, Mussaenda frondosa, Curcuma longa, and Uncaria gambir leaves as ingredients for postpartum infection therapy typical of Central Kalimantan.

This study uses an exploratory survey method, namely making direct observations of plant morphology at the research site, where the determination of the observed area uses a purposive sampling technique. The purpose of the study was to describe the morphological characteristics and analysis of the compound content of Agretum conyzoides, Mussaenda frondosa, Curcuma longa, and Uncaria gambir qualitatively. Morphological characters that are used as indicators of observation include a) roots (color, root branching, type of root, b) leaves (length, width, leaf blade, leaf tip shape, leaf base shape, leaf surface color), c) stem (diameter, internode, base, and color), d) flowers (flower color), and e) fruit (young fruit color and mature fruit color, f) seeds (type, color, seed shape).

Taking Research Sample

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Morphological Observation

Figure 2. Research Flow Diagram

The instrument used in this research was an observation sheet regarding the characteristics of the Agretum conyzoides, Mussaenda frondosa, Curcuma longa, and Uncaria gambir plants. The observation data was then compared with information based on the Decree of the Minister of Agriculture Number 115, 116, and 117 /Kpts/SR. 120/2/2007 and Denian et al., (2008). leaves to determine their properties and characteristics, which are then tested for secondary metabolite compounds contained in each medicinal plant.

Test the alkaloid content using Mayer, Dragendorff, and Wagner reagents. If a precipitate forms, it indicates that the sample contains alkaloids. If the sample is placed in a test tube with Mayer's reagent, a white precipitate will form. If the sample is placed in a test tube with Dragendorff's reagent, an orange-red precipitate will form. Samples in a test tube with Wagner reagent will form a brownish-red precipitate (Ergina et al., 2014).

The Flavonoid content test procedure is to prepare a thick extract of 0.1 g, then dissolve it in 10 ml of methanol and divide it into four different test tubes. The first test tube is a control, while the second, third, and fourth tubes are successively added with NaOH, concentrated H2SO4, and concentrated Mg-HCl powder. Then, compare the color that appears in the second, third, and fourth test tubes with the control test tube. If there is a color change, namely, orange-red to purple-red, it is positive for containing Flavonoids (Khotimah, 2016).

3. RESULT AND DISCUSSION

The wild plant known as Ageratum conyzoides can be found in Kalimantan and has medicinal properties for treating wounds and digestive disorders. It exhibits antibacterial activity as well. Mussaenda frondose, also known as the Kingkilaban plant, is believed by the Dayak people to have skin-smoothing properties and is used as a face mask. Curcuma longa, the main active component of turmeric, contains curcumin, which possesses strong antioxidant, wound healing, and anti-inflammatory properties. It may potentially be used as a therapy for acne and aids in the healing process of the body, including relieving menstrual pain.

Uncaria gambir, a type of climbing shrub, is commonly used in the sap part, particularly as a mixture with betel nut. The morphological description of Ageratum conyzoides, Mussaenda frondose, Curcuma longa, and Uncaria gambir obtained from research observations is as follows.

Figure 3. A: *Ageratum conyzoides,* B: *Curcuma longa,* C: *Mussaenda frondose,* D: *Uncaria gambir*

The morphological characteristics obtained are as follows.

Table 1. Characterization of Medicinal Plants for Postpartum Infection Therapy

Karakteristik	Plant Organs	Types of Combination Medicinal Plants as Ingredients for Postpartum Infection Therapy			
		Ageratum conyzoides	*Mussaenda frondose*	*Curcuma longa*	*Uncaria gambir*
Root	Root Color	Brownish white	Yellowish white	Yellowish white	Yellowish white
	Root Form	Oval	Round	Elongated round	Elongated round
	Root Tip	Tapered	Almost the same as the base of the root	Almost the same as the base of the root	Almost the same as the base of the root
	Root Base	Rounded	Almost the same as the root tip	Almost the same as the base of the root	Almost the same as the base of the root
	Root Neck	Directly supports the stem	Directly supports the stem	Directly supports the pseudostem	Directly supports the stem
	Root Type	Ride	Fiber	Fiber	Fiber
	Growth Direction	Geotrop	Hydrotrope	Hydrotop	Hydrotrope
	Radix Lateralis	There is a fork	No branching	No Branching	No Branching
	Fibria Radicalis	There are root branch fibers	There are no root branches	No lint	No lint
	Root Surface	Scaly (Hairy)	Hairy	Hairy	Hairy
	Supports leaves/no	Yes	Yes	yes	Yes
Stem	Bar Color	Green	Chocolate	Pale yellowish green	Light reddish brown

	The book where the leaves are attached	There is a slight branching	Jagged	There isn't any	Type of climbing shrub
	Section (between two books)	There are segments ± 3-4cm	15 – 25cm	There isn't any	There isn't any
	Growth direction	Geotrop	Geotrop	Geotrop	Liana is related
	Branching	Yes	Yes (Tight)	Monopodial	Yes (sympodial)
	Cambium Content	Yes	Yes	Yes	Yes
	Supporting Leaves	Supports ≥1 compound interest	Supports compound interest	Support	Support
	Sprouting System	Terminal	Terminal	Knotted, short, straight, or curved	-
	Stem Length	30-90-cm	2-8m	10-15cm	40-115 cm
	Stem Shape	Tickle with hair	Round	Pseudo is slightly rounded, forming a rhizome	Irregular cube or cylindrical
	Bar Diameter	± 1-5mm	1-3 cm	0.8 – 1mm	36 cm
	Bar Surface	Sparse hair all over the body	Rough	Slippery and wet	Slippery hairless
Leaf	Leaf Color	Green	Green leaf	Pale light green	Green
	Leaf shape	Oval	Oval	Ovate (lanceolate)	Elongated oval
	Leaf Tip	Tapered	Tapered	Tapered/curved	Tapered/curved
	Leaf Base	Rounded	Rounded	Blunt	Blunt Round
	Leaf Edges	Jagged	Flat	Flat	Jagged
	Bone leaves	Pinnate	Pinnate	Pinnate	Pinnate
	Leaf Width	30.4mm	43.0mm	8-13cm	4-8 cm
	Leaf length	45.6mm	95.3mm	10-45cm	8-13 cm
	Leaf Surface	Hairy	Hairy	Rough	Slippery
	Type (Single/Compound)	Single	Single	Single	Single
	Odd-even	No	No	No	Grows on stems
	Number of leaflets	No	No	No	No
Flower	Bouquet Size	±6mm	1-1.5 cm	1-2 cm	4-5cm
	Flower stalk	Hairy, 5-16mm long	Trumpet, slightly orange-brown, ±1-2 inches	Hairy and scaly, 15-42 cm	Length 4-5cm, width 0.5-1.5cm
	Flower petals	Hairy	False flower petals	3 petals/flowers & 4 headers	5 strands
	Flower crown/petals	Bell-shaped	The oval is the size of the leaf	Cylindrical	Oval, needle-shaped buds
	Crown Size	Tub-shaped 6-8 mm	1-2 Inches	Length ±3cm, width ±1.5cm	4-5cm
	Flower Color	White or reddish-purple	Orange, hairy surface	Slightly yellowish white	Purple with 5 stamens
	Types of Flowers	Compound interest (>3-4 flowers)	Hermaphroditic Compound Interest	Compound interest	Compound, Bulky, and perfect interest
	Location of Flower Buds	Located at each end of the stalk	Spread	Between the fronds	In the leaf axils
	Flower Petal Color	Green with slightly pale reddish purple tips	White	Yellowish green	White
	Flower Shape	Compound cup flowers in	Trumpet	Cone	Bell

		bouquets			
	Basic Flower Shapes	Bell-shaped	Tube-shaped, 4 loose ends	Pointed cone	Symmetrical
	Inflorescence System	Flat panicle shaped	Panicle shaped	Compound hairy and scaly	Like a ball consisting of male and female flowers
Fruit and Seeds	Fruit Shape	Rectangle Rectangular	Narrowed	-	Pods in tubers
	Fruit Color	Blackish white	Light green	-	Light green to dark green
	Types of Fruit	Winged dried fruit	Buni	-	Pod
	Fruit Size	Small & attached with seeds	Small covering seeds	-	3-8cm
	Seed Form	Slim and small	Lanceolate riding seeds	-	Winged and light as a needle
	Seed Size	±2mm	Small	-	1-2mm
	Seed Color	Black	Chocolate	-	Yellow
Rhizome	Rhizome Form	-	-	Round, Long, thick, straight curved	-
	Rhizome Color	-	-	Brownish orange, bright yellow, blackish yellow	-
	Rhizome Flesh Color	-	-	Yellowish orange	-
	Rhizome Aroma	-	-	Typical spicy bitterness	-
	Sprouting	-	-	Grows sideways from the main rhizome	-
	Shoot Form	-	-	Short books	-
	Sapling height	-	-	+10cm	-

Based on observations in the observed area, information was obtained that the combination of the four types of plants as therapeutic ingredients for postpartum infection is only known by traditional elders or batra. This is proportional to the limited publication of the use of the four medicinal plants in a particular combination formulation. Overall, the medicinal plant characters taken from the two observed areas have a very large degree of similarity in character. These results show that the location conditions are also almost the same geographically.

3.1 Root Morphology

Based on the findings from the examination of root morphology in Ageratum conyzoides, Mussaenda frondose, Curcuma longa, and Uncaria gambir plants, it is evident that Ageratum conyzoides plants possess a brownish color, ovoid shape, tapered root tip, rounded root base, root neck directly supporting the stem, taproot type, and a scaly (hairy) root surface. On the other hand, Mussaenda frondose plants exhibit a yellowish-white root color, round shape, root tip that is almost identical to the root base, fibrous root type, and a hairy root surface. Curcuma longa plants display a yellowish-white root color, elongated round root shape, root tip that is almost the same as the base of the root and vice versa, fibrous root type, and hairy root surfaces. Lastly, the Uncaria gambir plant shares the same root color as the Curcuma longa plant, an elongated round shape, a root tip that is almost identical to the base tip, and a fibrous root type. According to Tri et al.

(2014), these four plant types have different types of rooting, with some having taproots and others having fibrous roots. Taproots possess a well-developed structure, including a root hood that protects the root tip during soil penetration, large and strong roots, and is commonly found in dicotyledonous and Gymnospermae plants. On the other hand, fibrous roots have a fiber-like shape, relatively small sizes, and numerous branching (Puspitasari et al., 2022).

Overall, the medicinal plant samples taken in the Kota Besi and Mentaya Hulu sub-districts of East Kotawaringin have a root morphology similarity of 67%. There are differences in the roots of plants from the two sample observation locations, especially in root length and root color. This difference is thought to be influenced by environmental factors where the plants grow. According to Sari (2016), the altitude of the sampling area affects variations in shape, behavior, and anatomy. Similarly, soil condition factors affect morphological differences where the sampling location is a peat soil environment, causing the root color to be relatively lighter.

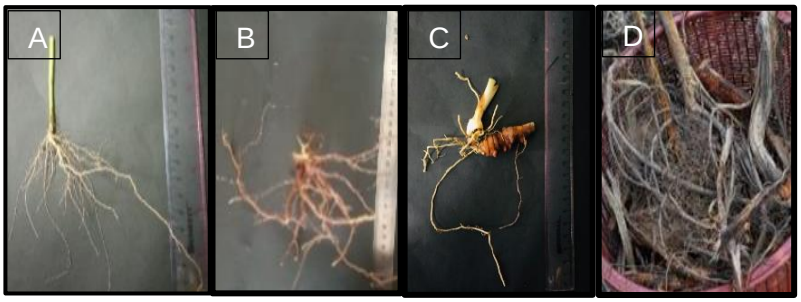

Figure 4. Root Morphology A: *Ageratum conyzoides,* B: *Mussaenda frondose,* C: *Curcuma longa,* D: *Uncaria gambir*

3.2 Stem Morphology

The results of stem morphology research on Ageratum conyzoides, Mussaenda frondose, Curcuma longa, and Uncaria gambir plants show that Ageratum conyzoides plants have a geogtrop growth direction, 30-90 cm long stems, Gilig stem shape with hair, stem diameter ± 1-5mm, sparsely hairy surface throughout the body, green in color, the direction of growth there are internodes, hydro top branching, and can support ≥1 compound flower. Mussaenda frondose plants have brown stem color, round shape, 1-3 cm in diameter, 15-25 cm internodes, serrated leaf attachment books, geogtrop growth direction, 2-8 m stem length, and have a single root system. Curcuma longa has a pale yellowish-green stem, open and upright shape, 1-3 cm in diameter, pseudo-stem type, the tip of the stem forms a rhizome, the direction of growth is geogtrop, with a stem length of 40-115 cm, and the budding system is hairy, short straight, or curved. Uncaria gambir plants have a light brown stem color, irregular cuboid or cylindrical shape, 36 cm in diameter, climbing shrub stem type, 1-5 m stem height, 49-115 cm stem length, and smooth hairless stem surface.

Figure 4. Stem Morphology A: *Ageratum conyzoides,* B: *Mussaenda frondose,* C: *Curcuma longa,* D: *Uncaria gambir*

Stems in plants generally have different types, colors, and shapes. Still, the stem has a very important main function, namely as a distributor of food whose process starts from the roots and then transferred to the leaves, and the results of photosynthesis throughout the plant supporting leaves, flowers, and fruit (Hasanuddin et al., 2018; Dwipa & Martinsyah, 2022). The lack of nutrients in the peatland where the samples were taken affects the differences in stem length and diameter. However, the Kota Besi and Mentaya Hulu sub-districts of East Kotawaringin have 89% similarity in stem morphology.

3.3 Leaf Morphology

The results of leaf morphology research on plants Ageratum conyzoides, Mussaenda frondose, Curcuma longa, and Uncaria gambir show that Ageratum conyzoides plants have green leaves, ovoid shape, tapered leaf tip, rounded leaf base, serrated edges, pinnate leaf bones, 30.2 mm wide, 45.6 mm long, hairy surface and included in the type of single leaf. Mussaenda frondose has almost the same parts as Tambora plants, but the leaf width has a size of 43.0 mm, 95.3 mm in length, hairy leaf surface, and is included in the type of single leaf. Curcuma longa has a pale light green leaf color, ovoid shape, tapered tip, and blunt leaf base. Flat leaf edges, pinnate bones, width of 8-13 mm, length of 10-45 mm, rough surface, complete leaf type, and included in the type of single leaf. At the same time, the Uncaria gambir plant has green leaves, an elongated oval shape, tapered tip, blunt rounded base, serrated leaf edges, pinnate bones, 4-8 mm wide, 8-13 mm long, hairless surface (slippery), pinnate reinforcement type and included in the type of single leaf growing on the petiole.

All medicinal plant samples taken in the Kota Besi sub-district and Mentaya Hulu sub-district of East Kotawaringin have 82% similarity in stem morphology. There are differences in the stems of plants from both locations, namely in the length of the leaves, leaf width, and leaf color. Samples from the Kota Besi sub-district have wider leaf morphology with a clearer color (dark green). This difference is thought to be influenced by environmental factors in the form of soil texture (Sari et al., 2021; Tiarani & Kristina, 2023). It is known that the soil texture of the Kota Besi sub-district is denser than the Mentaya Hulu sub-district of East Kotawaringin.

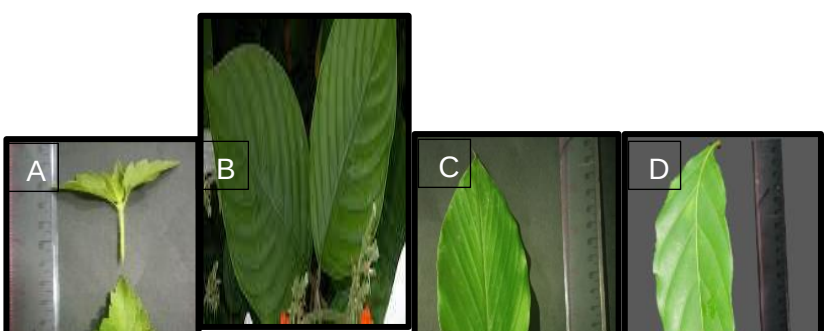

Figure 5. Leaf Morphology A: *Ageratum conyzoides,* B: *Mussaenda frondose,* C: *Curcuma longa,* D: *Uncaria gambir*

3.4 Flower Morphology

The results of research on flower morphology in Ageratum conyzoides, Mussaenda frondose, Curcuma longa, and Uncaria gambir plants show that Ageratum conyzoides plants have a flower coral size of ± 6mm, hairy stalks, hairy petals, bell-shaped crowns, compound flower types (>3-4 florets) and the location of florets is located at each end of the stalk. Mussaenda frondose has orange flowers with a hairy surface, false petals, oval shape the size of a leaf, white petals, asymmetrical flowers, compound type, tubular flower base, 4 loose ends, crown size 1-2 inches, stalk size ± 1 inch, and panicle-shaped arrangement system. Curcuma longa has a slightly light yellow buga, white base, conical shape, 3 petals per flower, 3 pieces of crown, 4 stamens, symmetrical flowers, compound flower type, hairy and scaly stalk, stalk length of 15-42 cm, crown in the form of cylindrical petals, and crown size with a length of ± 3 cm, width ± 1.5 cm.

The characteristics of flowers in the two sampling locations have a very small difference of 12%. The same is true for the rhizome of Curcuma longa or the fruit and seed organs of Ageratum conyzoides, Mussaenda frondose, and Uncaria gambir. Several references state that flower morphology is influenced to a small extent by humidity and temperature levels. (Sudarmono & Sahromi, 2017; Rastono, 2023).

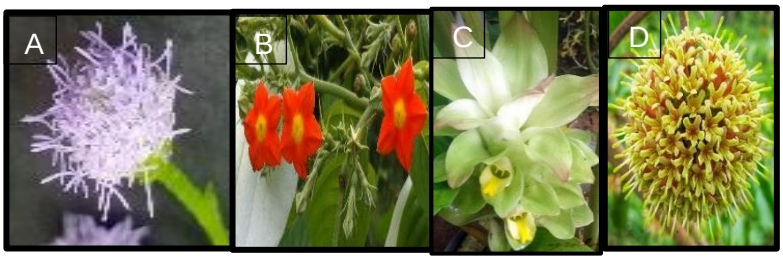

Figure 6. Flower Morphology A: *Ageratum conyzoides,* B: *Mussaenda frondose,* C: *Curcuma longa,* D: *Uncaria gambir*

Table 2. Secondary Metabolite Compound Content

Compound identification	Parameter	*Ageratum conyzoides*	*Mussaenda frondose*	*Curcuma longa*	*Uncaria gambir*
Flavonoid	Orange, brick red, pink, dark red	(+)	(+)	(+)	(+)
Meyer	White precipitate	(+)	(-)	(+)	(+)
Dragendrof	Orange precipitate	(-)	(-)	(+)	(-)
Bouchardat	Brown deposits	(+)	(-)	(+)	(-)
Tanin/fenol	Blackish brown, blue	(+)	(+)	(+)	(+)
Steroid	Bluish-green	(-)	(-)	(-)	(-)
Triterpenoid	Orange, orange-brown	(+)	(+)	(+)	(+)
Saponin	Permanent foam	(+)	(+)	(+)	(+)

Based on the test results for compounds were identified, with secondary metabolite content, Flavonoids being the compounds

identified in this study. The samples analyzed, namely Ageratum conyzoides, Mussaenda frondose, Curcuma longa, and Uncaria gambier, showed positive results (+). Color variations observed included orange, brick red, pink, and dark red. Additionally, alkaloids were detected in the samples. Ageratum conyzoides and Curcuma longa samples showed positive results (+) with the presence of white precipitate based on the Meyer parameters. In contrast, the Mussaenda frondose sample showed negative (-) results in the test.

The dragendroff compound yielded negative results (-) in the Ageratum conyzoides and Mussaenda frondose samples. In contrast, the Curcuma longa rhizomes displayed positive results (+) with an orange precipitate according to the Dragendroff parameter. Bouchardat compounds were detected in the samples analyzed. The Tambora sample exhibited a positive result (+) with brown sediment based on the Bouchardat parameter, while the wind constipation sample showed a negative result (-). Additionally, Curcuma longa rhizomes demonstrated positive results (+) with brown deposits, while Uncaria gambier showed negative results (-).

Tannins and phenols were present in all samples. The phytochemical screening test yielded positive results (+) for Ageratum conyzoides, Mussaenda frondose, and Curcuma longa, with the presence of blackish brown and blackish blue colors. However, terpenoids were not found in any of the three samples. The Steroid parameters showed a negative result (-) with a bluish-green color. On the other hand, triterpenoids were identified with positive results (+), exhibiting orange and brownish-orange colors in Ageratum conyzoides, Mussaenda frondose, and Curcuma longa. Lastly, saponins were also detected in all samples, as indicated by the appearance of permanent foam on Ageratum conyzoides, Mussaenda frondose, and Uncaria gambir.

The differences in the location and time of sample collection can have an impact on the secondary metabolite compounds present in natural materials. Despite the similarities in the characteristics of the sampling locations, such as soil conditions and area, there is a notable resemblance in the morphological features of the plants. This similarity also affected the test results for the secondary metabolite compounds in four medicinal plants that were collected at the same time, resulting in more consistent outcomes.

4. CONCLUSION

According to the findings of the study, it can be deduced that medicinal plants utilized as a treatment for postpartum infections in the observed region possess relatively similar physical attributes. However, there are variations in these attributes that are influenced by environmental factors such as soil conditions and altitude. The plants in question, namely Ageratum conyzoides, Mussaenda frondose, Curcuma longa, and Uncaria gambier, exhibit resemblances in terms of their roots, stems, leaves, and flowers. Although there are differences in the length, diameter, and color of these organs, the analysis of secondary metabolite content reveals the presence of compounds like flavonoids, alkaloids, tannins/phenols, triterpenoids, and saponins in all samples. It is believed that environmental factors, including soil texture and moisture levels, contribute to the variations in morphology and compound content. The similarities in physical characteristics and secondary metabolite compounds between medicinal plants from the two observation sites suggest their equal potential for use. However, further consideration is required regarding their ecological impact and sustainability.

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