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ANATOMY AND SECRETORY STRUCTURE OF *LEEA INDICA (BURM.F.)* MERR (MEMAYE) AS A TYPICAL MEDICINAL PLANT OF THE BESEMAH TRIBE FOR ANTI-INFECTIVE AND DEGENERATIVE IN LAHAT REGENCY SOUTH SUMATRA INDONESIA

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ABSTRACT

Leea indica (Burm.f.) Merr, commonly known as Memaye, is a shrub utilized by the Besemah tribe in Lahat Regency, South Sumatra, for treating infectious diseases such as hepatitis and warts, as well as degenerative diseases like liver disorders. This plant's medicinal properties are primarily derived from its roots and fruits, which contain secondary metabolites like alkaloids, flavonoids, and terpenoids. Anatomical studies are crucial to identify specific structures within the plant that may store these metabolite compounds. This research aims to analyze the anatomical structure and distribution of secretory structures in the vegetative organs (leaves, stems, and roots) of Leea indica. Using a descriptive method, the study employed Paraffin and Whole mount techniques to prepare samples for microscopic observation. Results revealed the presence of epidermal tissue, basic tissue, and vascular tissue. Additionally, internal secretory structures, including cavities and two types of idioblast cells, were found to function as storage sites for secondary metabolites. These secretory structures were distributed throughout the leaves, stems, and roots of the plant.

KEYWORDS *Anatomy, Structure of Secretarial, Memaye (Leea indica (Burm.f.) Merr), Antiinfectious, Degenerative.*

INTRODUCTION

The use of medicinal plants as traditional medicine is widely used by tribes in Indonesia. Each tribe has a distinctive medicinal plant for treating a disease.

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Medicinal plants can be said to be distinctive if the plants used are not used in other areas, the benefits of the same plant but their use is different from other areas, and the peculiarities of a medicinal plant can be seen from the way it is used (herbs) and the way of treatment that is different from other areas (Kondowangko *et al.* 2011). The Besemah tribe is one of the tribes that has a habit of using typical plants for traditional medicine that is still well preserved.

According to Tanzerina *et al.* (2023), there are 7 medicinal plants typical of the Besemah tribe that are used to treat infectious and degenerative diseases. According to Besung and Kerta (2009), infectious diseases are diseases caused by various infectious agents in the form of viruses, bacteria, fungi and parasites that enter the body which cause diseases in the body with symptoms such as diarrhea and skin diseases and according to Dwisatyadini (2017), degenerative diseases are non-communicable diseases that occur chronically due to the deterioration of organ function due to the aging process.

One of the typical medicinal plants of the Besemah tribe used to treat infectious and degenerative diseases is *the Leea indica* plant (burm.f.) Merr (Memaye). The Besemah tribe uses the Memaye plant as a liver medicine, which is processed by mixing Memaye root with the Original Bamboo Shoot and Yellow Bamboo root, which is processed by boiling (Irmastika, 2023). Memaye can also be used as an anti-infective drug. According to Safitri (2023), the Besemah tribe uses the Memaye root to treat hepatitis and fruit parts to treat warts.

Plants as medicines generally produce medicinal compounds that are stored in special structures called secretory structures, which can be in the form of secretory cavities, tricoma glands, oil glands, resin ducts, and secretory cavities. Secondary metabolites such as alkaloid compounds, flavonoids, terpenoids, and other compounds can be found throughout plant organs such as roots, stems, leaves, flowers, or fruits (Muliyah *et al.*, 2022). The content of metabolite compounds is found in all parts of plant organs. Therefore, scientific studies of the anatomical structure of medicinal plants need to be carried out to help in tracking special structures that have the potential to store metabolite compounds used as medicinal ingredients (Vlorenicius, 2019). Based on the research of Greeshma and Kumar (2023), on the anatomy of the root *of Leea indica* (Burn.f.) Merr was found calcium oxalate crystals and rosette crystals on the leaves were found in the form of trichomes, calcium oxalate crystals, and secretory cells.

The secretory structure is a special structure of plants that can produce secondary metabolites (Muliyah *et al.*, 2019). The secretory structure is found throughout the organs of the plant, either on the roots, stems, leaves, flowers, or fruits. Scientific studies of the anatomy and structure of secretory structures, which are special structures that produce secondary metabolite compounds, are important to be carried out, especially in *Leea indica* (Burn.f.) Merr, can potentially be a typical medicinal plant of the Besemah tribe.

RESEARCH METHOD

Sampling and Research location

This research was conducted from January to April 2024. Sampling (*Leea*

indica (Burm.f.) Merr) (Memaye) was carried out in Sukamerindu District, Lahat Regency, South Sumatra. The anatomical preparations for vegetative organs were carried out in the Microengineering Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Sriwijaya University.

Preparation of anatomical preparations

The anatomical preparations were carried out using transverse slicing and paradermal with the Paraffin and whole mount methods. For the leaf and stem organs, transverse incisions are made using the paraffin method with safranin - fastgreen staining. For transverse root and paradermal incisions, the Whole mount method with safranin staining is used. The fixation solution uses FAA, and the dehydration solution uses Johansen's solution, slicing with a rotary microtome (Sass, 1958).

This study uses a descriptive method, which describes the results of qualitative observations of the structure of vegetative organs in terms of morphology, anatomy, and secretory structure. Morphological observations are carried out directly in the field. The morphological characters observed are leaves, stems, and roots.

RESULT AND DISCUSSION

Morphology of Vegetative Organs *of Leea indica* (Burm. f.) Merr (Memaye)

Based on the results of research that has been carried out on the morphological observations of *Leea indica* (Burm.f.) Merr.) It can be reported that *Leea indica* (Burm.f.) Merr.) It is a shrub plant with a perpendicular growth direction (*erectus*) with a green round-shaped woody stem. According to Khumaid *et al.* (2022), *Leea indica* is a shrub plant with a height ranging from 2-16 meters. The node of the memaye stem is purplish-red with a ribbed rod surface. *Leea indica* (Burm.f.) Merr.) has many branches, and according to the research of Amalia *et al.* (2023), *Leea indica* (Burm.f.) Merr.) has a sympodial branching type and according to Gembong (1985), sympodial branching is a branch whose trunk is difficult to find.

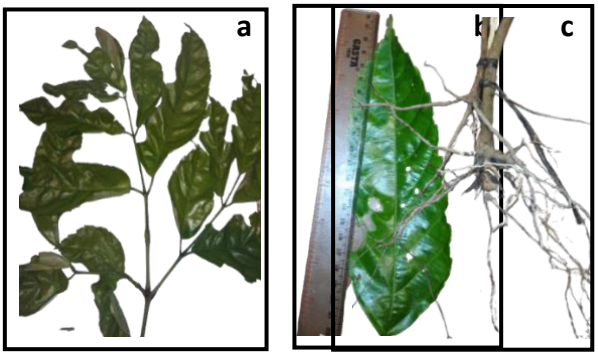

Figure 1. Morphology *of Leea indica* (Burm. f.) Merr;
a. Stem, b. Leaf, c. Root

Leea indica leaf (Burm. f.) Merr has a compound leaf type consisting of a petiole mother a petiole. The petioles are round-shaped with a length ranging from 1.5 to 2 cm. The leaf blades are *oblongus* or round, elongated with pinnate leaf bones (*penninervis*), pointed leaf tips, and serrated leaf edges. According to Lok *et*

al. (2011), on the mother of the petiole *Leea indica* (Burm.f.) Merr.) There are 7 leaves. Leaf length *of Leea indica* (Burm. f.) The merr is around 19 cm long and 6 cm wide (Figure 1). The young leaves are reddish-brown, and the old leaves will be green with a smooth top surface and a rough bottom surface.

The compound leaves are pinnate with paired leaflets. According to Gembong (1985), it is said that the leaves are paired, that is, when the position of the leaf on the mother of the stem is facing each other. The petiole has a unique feature where the base of the petiole is reddish. Leea *indica* root (Burm.f.) is a type of brown taproot.

Leaf Anatomical Structure of Leea *indica* (Burm.f.) Merr (Memaye)

Based on the research that has been conducted, it is known that the anatomical structure of the leaves *of Leea indica* (Burmf.) Merr. Through a cross-section with a thickness of 12 µm composed of dermal tissue consisting of upper epidermal tissue and lower epidermis, mesophyll tissue in the form of palisade parenchyma and spongy parenchyma, vascular tissue, secretory cavity, and idioblasts. (Fig.2.)

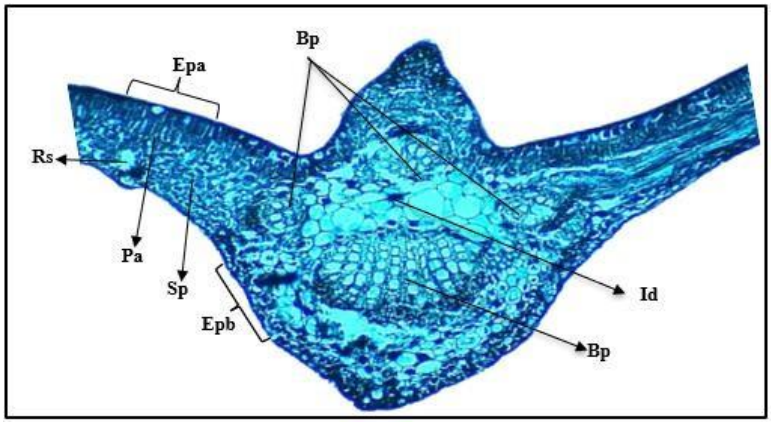

Figure 2. Cross-section of the leaf (*Leea indica* (Burm. f.) Merr) with the paraffin method (4x10 magnification)

Information:

Epa	: Upper Epidermis
Pa	: Palisade
Sp	:Sponge
Epb	: Lower Epidermis
Rs	: Secretory cavity
Bp	: Vascular Files
Id	: Idioblas

Epidermal tissue of Leea *indica* leaves (Burm. f.) Merr consists of one upper epidermis layer and one lower epidermis layer. The upper epidermis tissue is composed of a layer of epidermal cells that are tightly arranged without gaps, and there is no space between cells are rectangular in shape, while the lower epidermis is composed of a layer of epidermal cells with an irregular shape, rectangular to oval which is smaller in size when compared to the upper epidermis. According to Awotedu and Ogunbamowo (2019), *Leea guineensis* (*Leaceae*) has a single layer

of epidermis that is irregular, rectangular, to polygonal.

Epidermal tissue is the outermost tissue of the plant that plays a role in protecting the tissue inside. According to Kartasapoetra (1998), the epidermal tissue on the leaves can be modified into stomata and trichomes. Epidermal tissue shape of *Leea indica* leaf ((Burm. f.) The merr in the paradermal cross-section has the shape of a notched cell wall on both leaf surfaces (Figure 3).

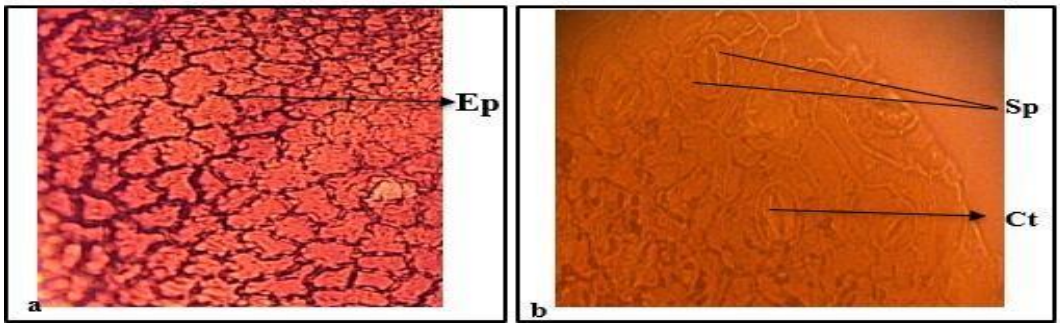

Figure 3. Paradermal cross-section of *Leea indica* leaf ((Burm. f.) Merr with the Whole mount method;

a. Epidermis (4x10 magnification)
b. Stomata (40x10 magnification)

Ep: Epidermis; Ct: Stomata slit; Sp: Cover cell; Rs: Secretarial cavity.

On the paradermal cross-section of the leaf, there are stomata on the upper and lower surfaces of the leaves. Stomata are small gaps on the surface of the leaf that are bounded by guard cells. According to Qodariyah et al. (2021), stomata are modifications of epidermal cells that function as a place for water and air to enter and exit on the leaf surface. Based on the results of the study, it is known that the type of leaf stomata *Leea indica* ((Burm. f.) Merr is an endocytic type, in which the cover cell is surrounded by three neighboring cells that are not of equal size. Based on the research of Pandey et al. (2020), who examined *Leea Asiatica* (L.) also found an anisocytic type of stomata on the abaxial surface of its leaves.

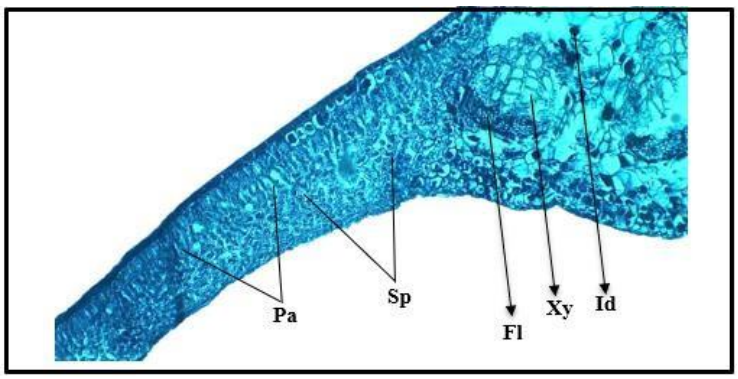

Figure 4. Cross-section of the leaves *of Leea indica* (Burm. f.) Merr with the Paraffin method.

Description: Sp: Sponge; Pa: Palisade; Id: Idioblas; Fl: Floem; Xy: Xylem

Mesophyll tissue of *Leea indica* leaves (Burm. f.) Merr consists of parenchymal tissue palisade and sponge palisade tissue is found in the adaxial epidermis, composed of two layers of cells with an elongated and tightly arranged shape, while parenchyma sponge has an irregular oval shape and is not too tight.

The vascular tissue in the form of xylem and phloem is arranged in groups of varying sizes and is located between mesophyll tissues, with the number of vascular tissues on the leaves ranging from three to six pieces. Vascular tissue on the leaf leaves *of Leea indica* (Burm. f.) Merr is an open collateral type, where the xylem and phloem are located side by side. According to Greeshma and Kumar (2023), on the transverse part of the mother petiole *of Leea indica* (Burm. f.) Merr consists of a network of open vessels that are not surrounded by a layer of fibers.

In Figure (5.), it can be seen that in the cross-section of the leaf, secretory structures in the form of secretory cavities and spherical idioblast cells are found scattered in the parenchymal tissue. Idioblast cells are secretory cells that secrete metabolite compounds. According to Fahn (1979), in general, idioblast cells are differentiated from parenchymal tissue, but there are also those found in epidermal tissue. Idioblast cells in *Leea indica* (Burm. f.) Merr is on the basic network. This discovery is also supported by the research of Greeshma and Kumar (2023), wherein the cross-section of the leaves *of Leea indica* (Burm. f.) Merr is found in the form of secretory cells with a round cell shape.

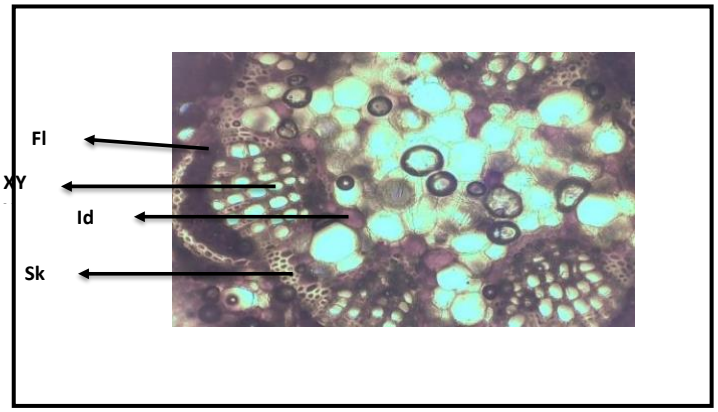

Figure 5. Idioblast cells in the cross-section of the leaf *of Leea indica* (Burm. f.) Merr with *Whole mount* method (10X10)

Id Description: Idioblas; Xy: Xylem; Fl: Floem; Sk: Sklerenkim

On the leaf bones *of Leea indica* (Burm. f.) Merr was found to be a drug crystal. (Figure 6). According to Greeshma and Kumar (2023), on the transverse cross-section of the leaves *of Leea indica* (Burm. f.) Merr found calcium oxalate crystals, and based on the research of Najmaddin *et al.* (2013) on *Leea indica* (Burm. f.) Merr found calcium oxalate crystals in the form of drugs. This is also supported by the research of Anitha and Sandhiya (2014); in *Cissus quadrangularis* (Vitaceae) it is also found in the form of dull gray drus crystals that are close to the leaf vascular bundle. According to Seker *et al.* (2016) Drus crystals are more commonly found on petioles than other types of crystals. These crystals are commonly found in cells close to vascular tissues.

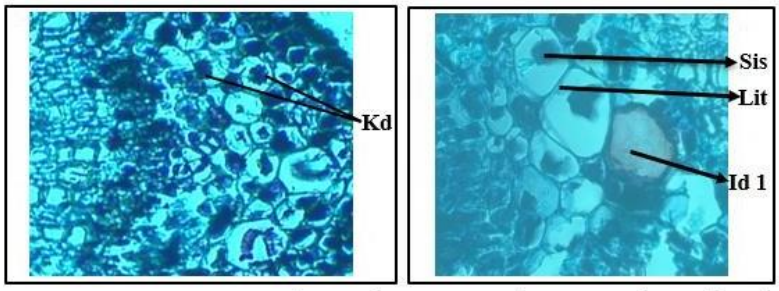

Figure 6. Cross-section of the leaves *of Leea indica* (Burm. f.) Merr with paraffin method

Description: Id: Type 1 idioblast; Kd: Crystal drus; Sis: Cystolites; Lit: Litosis (10x10 magnification)

On the leaf bones of *Leea indica* (Burm. f.) Merr was also found in lithotic cells and cystolites. Litosis is one of the derivatives of the epidermal tissue and contains calcium crystals in it called cystolites (Rasyid *et al.,* 2017). Not much has been explained about lithocyte and systolite cells in *Leea indica* (Burm. f.) Merr

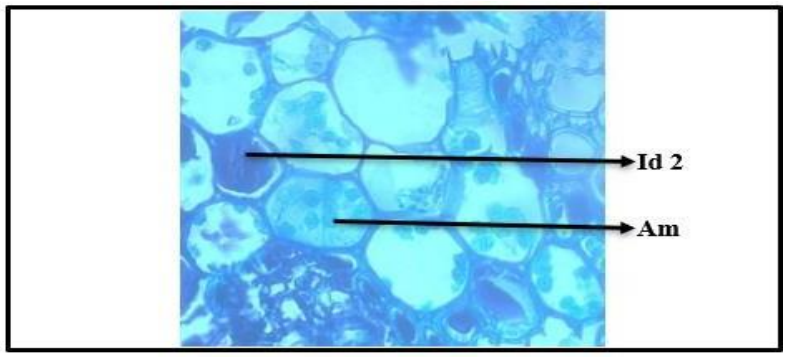

Figure 7. Cross-section of the leaves *of Leea indica* (Burm. f.) Merr with the paraffin method (10X10)

Description: General: Amilum; Id: Type 2 idioblasts

Other structures found in the transverse incision of the leaves *of Leea indica* (Burm.f.) Merr is in the form of an amylem in the form of small grains (Figure 7.). This is supported by the research of Greeshma and Kumar (2023) who found an amylum located close to the leaf vascular bundle of *Leea indica*. According to Gunawan (2004), amylum is a product of photosynthesis that is usually stored in the organs that store food reserves in plants.

Leea indica (Burm.f.) Merr is used as an ingredient in traditional medicine because it contains compounds that play a role in the healing process of a disease. Based on research by Nasution *et al.* (2017), *Leea indica leaf water extract* contains flavonoid compounds, terpenoids, tannins, alkaloids, and saponins. The content of flavonoids is suspected to play a role in the anti-inflammatory process. The existence of secretory structures in the form of secretory cavities, idioblast cells, and calcium oxalate crystals in memaye leaves contains active ingredients in the form of metabolite compounds that can be used as medicinal ingredients.

Anatomical Structure of the Stem *of Leea indica* (Burm.f.) Merr (Memaye)

The anatomical structure of the cross-sectional stem *of Leea indica* (Burm.f.) Merr comprises the epidermis, cortex, or basal tissue that contains crystals and secretory cavities, vascular bundles, and piths. The arrangement can be seen in Figure 8.

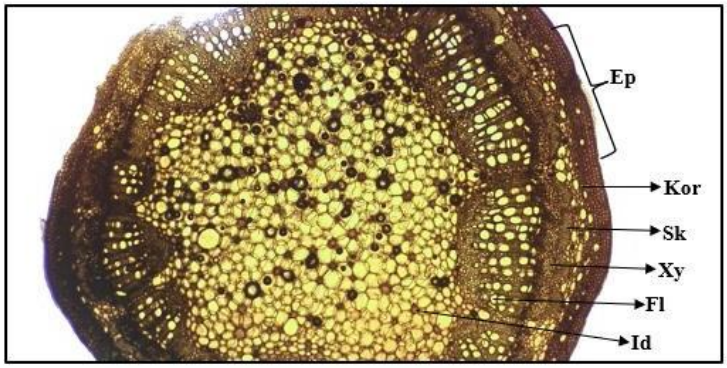

Figure 8. Cross-section of the stem *of Leea indica* (Burm.f.) Merr) with *the whole mount* method (4x10 magnification)

Information:

Ep	:Epidermis	Fl	: Floem
Kor	:CortexXY	: Xylem	
Sk	: Sklerenkim	Id	: Idioblas

The epidermis is a tissue that plays a role in protecting plant organs such as roots, stems, leaves, flowers, and fruits. Based on the results of the study, it is known that the stem *of Leea indica* (Burm.f.) Merr) is composed of one layer of epidermal tissue in the shape of a round, small, and tightly arranged epidermal tissue. Greeshma and Kumar (2023) stated that in the transverse part *of the stem of Leea indica* (Burm.f.) Merr) consists of one layer of epidermal cells.

The cortex region is composed of parenchyma and sclerenchyma networks. The parenchymal tissue is located below the epidermis, round in shape, and tightly arranged with various sizes. According to Hindriana and Handayani (2023), parenchyma tissue is a basic tissue found in various plant organs and is composed of living cells that have various shapes with different functions.

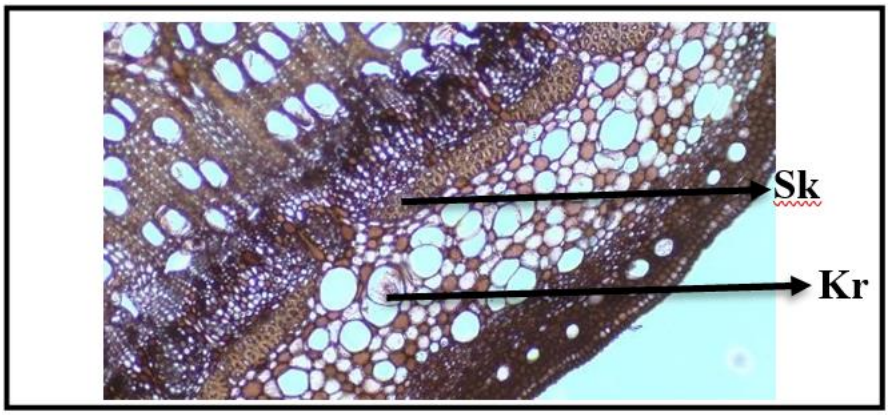

Figure 9. Cross-section of the stem *of Leea indica* (Burm.f.) Merr) with *the whole mount* method (10x10 magnification); Kr: rosette crystal; Sk: Sklerenkim

Based on Figure (9.) on the cortex of the rod, a rosette-shaped crystal was found. According to Greeshma and Kumar (2023), on the stem of *Leea indica* (Burm.f.) Merr) there are rosette crystals, which are mostly scattered in the pith of the stem. According to Suradinata (1998), all parts of plants can contain crystals, such as in piths, vascular tissues, and others.

The anatomical structure of the stem *of Leea indica* (Burm.f.) Merr) inside, there is a closed collateral-type vascular network. According to Greeshma and Kumar (2023), vascular tissue on the stem *of Leea indica* (Burm.f.) Merr) is a network of closed vessels surrounded by a layer of fibers and secretory cells. The vascular tissue ranges from 10-15, and there is a sclerenchymal tissue outside the phloem.

The center of the stem *of Leea indica* (Burm.f.) Merr) comprises piths consisting of a tightly arranged polygonal-shaped parenchyma network. Based on figure (10), in this pith it is found that there is a secretory structure in the form of idioblast cells with a polygonal shape and is scattered in the pith of the stem. According to Khafagi (2007), idioblast cells are specialized plant cells and contain chemical compounds with different compositions from the surrounding cells. The size and shape of idioblast cells in the stem pith *of Leea indica* (Burm.f.) Merr) are not the same as the other.

On the transverse incision of the stem *of Leea indica* (Burm.f.) Merr) was also found to be a rosette crystal. These crystals are scattered in the cortex, vessels and also the pith of the trunk. According to Mulyani (2006), many plants store organic matter in their cells, where this organic matter can be in the form of Ca salt, and Ca salt is usually found as crystals. Based on the research of Masram and Harisha (2012), in Asthishrinkhla (Vitaceae), it was found in the form of rosette crystals scattered in the pith of the stem and based on the research of Greeshma and Kumar (2023) in the pith of the stem *of Leea indica* (Burm.f.) Merr) was found in the form of rosette crystals.

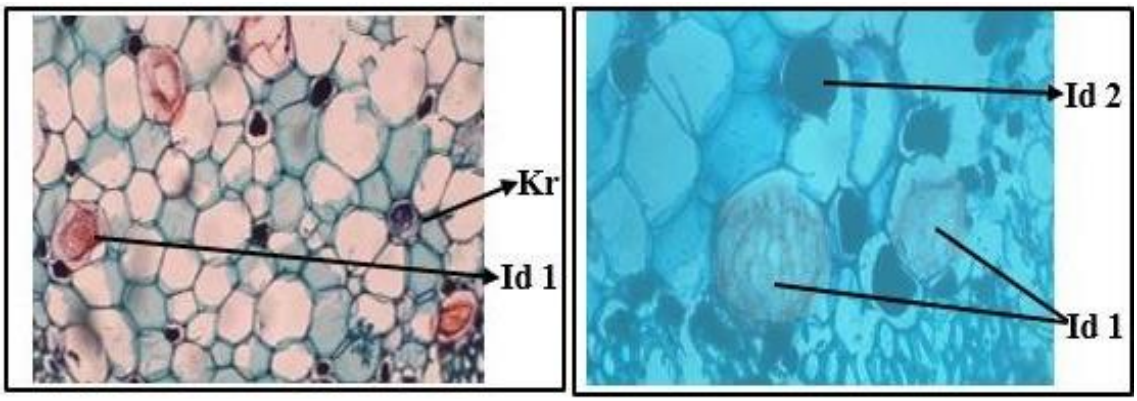

Figure 10. Cross-section of the stem *of Leea indica* (Burm.f.) Merr) with the paraffin method (40x10 magnification)

Description: Id: Type 1 and type 2 idioblasts; Kr: Rosset crystal

Rosset crystals are a form of calcium oxalate crystals. Oxalate crystals are sometimes formed in special cells that only function to form crystals; these cells are called crystal idioblasts (Franceschi and Nakata, 2005). Presence of calcium oxalate crystals in the stem pith *of Leea indica* (Burm.f.) Merr) is quite widespread.

Anatomical Structure of the Stem *of Leea indica* (Burm.f.) Merr (Memaye)

In the cross-section of the root *of Leea indica* (Burm.f.) Merr comprises cork tissue, basal tissue, vascular tissue, crystals, and pith.

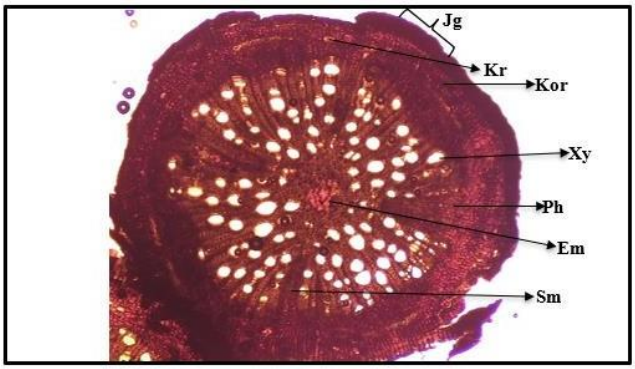

Figure 11. Cross-section of the roots *of Leea indica* by *the whole mount* method (4x10 magnification).

Description: Jg: Cork tissue Ph: Phloem; Corps: Xy cortex: Xylem; Kr: Rosset crystal; Em: Sm's pith: Medulla rays

The outer surface of the root is composed of a thick, dark-colored outer cork tissue and consists of several layers. According to Greeshma and Kumar (2023), the cross-section of the root *of Leea indica* (Burm.f.) Merr comprises an outer cork consisting of 2 to 5 layers of intersecting and thick-walled elongated cells. According to Hindriana and Handayani (2023), in dicot plants, cork tissue is formed by cork cambium (felogen) located at the bottom of the epidermis. The activity of cork cambium produces cells that undergo thickening and function to replace the epidermis as a protector.

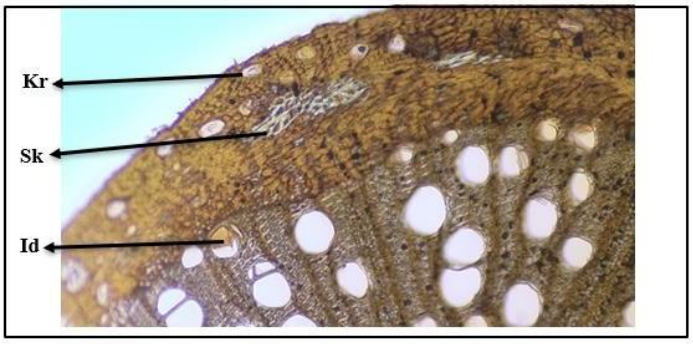

Figure 12. Cross-section of *the root of Leea indica* by *the whole mount* method (magnification 10x10)

Information:
Kr : Rosset crystal
Id : Idioblas
Sk : Sklerenkim

In the root cortex *of Leea indica* (Burm.f.) Merr is composed of tightly arranged parenchyma and sclerenchyma cells. According to Malak (2017), parenchyma acts as a tissue that fills the plant body and is also a tissue that is meristatical. round shape. According to Greeshma and Kumar (2023), the cortex on the root *of Leea indica* (Burm.f.) Merr comprises sparsely arranged parenchymal cells.

Figure (12.) shows that in the root cortex of *Leea indica* (Burm.f.) Merr, there are crystals. According to Oliveira *et al.* (2012), the cortex of *Cissus verticillata* (Vitaceae) was also found in the form of idioblast cells containing phenolic compounds, tannins, and essential oils. Crystals found in the root cortex of *Leea indica* (Burm.f.) Merr is suspected to be a rosette-shaped calcium oxalate crystal. This is supported by the research of Greeshman and Kumar (2023), which stated that the parenchymal cells *of Leea indica* (Burm.f.) Merrcontains rosette crystals.

Leea *indica* root (Burm.f.) Merr has a system of scattered vascular networks where one vascular bond comprises a scattered xylem and phloem. According to Greeshma and Kumar (2023), the phloem on the root *of Leea indica* (Burm.f.) Merr consists of 5-10 densely arranged multi-layered cells, and the xylem consists of filter vessels and other xylem elements. According to Mursidawati *et al.* (2021), the core region *of Tetrastigma leucostaphylum* (Vitaceae) has a vascular bundle with a secondary xylem and a secondary phloem, with vascular cambium in between.

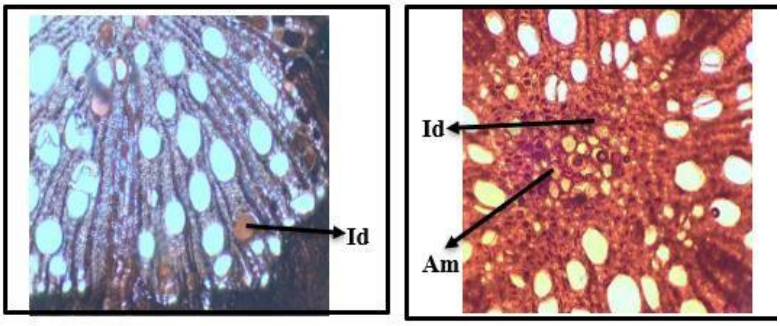

Figure 13. Cross-section of *Leea indica* roots by *whole mount* method (10x10 magnification)

Description: Id: Idioblasts; Warm: Amilum

In the vascular tissue, secretory structures are found in the form of idioblast cells. According to Hindriana and Handayani (2023), idioblast cells can be secretory devices or glands in plant tissues and can contain typical substances such as mucus, oil, tannins and calcium oxalate in crystalline form. Amylum grains are also found in the root pith. This discovery is also supported by the research of Greeshma and Kumar (2023), who also found an amylum in *the pith of Leea indica*. Based on research by Mahmud *et al.* (2011), in the root pith *of Leea macrophylla* Robx. is also found in the form of amylum.

Secretory structure found in the root *of Leea indica* (Burm.f.) Merr is an idioblast cell that is a storage place for secondary metabolite compounds. According to Tanzeina *et al*. (2023), The Besemah tribe utilizes *the roots of Leea indica* (Burm.f.) Merr as an anti-infectious and degenerative drug, whereas the Besemah people use its roots as a liver and hepatitis medicine. Hossain *et al.* (2021) state that *Leea indica* (Burm.f.) Merr plays the role of hepatoprotective, whereas in *Leea indica* (Burm.f.), Merr contains drugs that play a role in maintaining, restoring, and treating damage to the liver.

According to Khafagi (2007), idioblast cells are cells that grow specifically and contain chemical compounds that are different in composition from the surrounding cells. Leea *indica* root (Burm.f.) Merr is used as a medicinal ingredient because the root contains substances or compounds that can potentially be used as medicine. According to Rahmani *et al.* (2022), *Leea indica* root (Burm.f.) Merr contains saponins, quinones, tannins, and steroid compounds. The content of this compound comes from secretory cells found in the root *of Leea indica* root (Burm.f.) Merr, United States

CONCLUSION

Based on research that has been carried out on the anatomical structure and secretory structure *of Leea indica* (Burm.f.) Merr, then it can be concluded:

Leea *indica* (Burm.f.) leaves Merr. is composed of the upper epidermis and lower epidermal tissue, mesophyll tissue in the form of palisade parenchyma and sponge parenchyma, and vascular tissue. The secretory structure is in the form of a cavity, two types of idioblast cells, and drus crystals.

Leea indica stem (Burm.f.) Merr. It is composed of epidermal tissue, cortex or basic tissue in the form of collenchyma and parenchyma, vascular bundles. It piths containing rosette crystals, amylum, and secretory structures in the form of two types of idioblast cells.

Leea *indica* root (Burm.f.) Merr. It is composed of cork tissue, basal tissue, vascular tissue, rosette crystals, and pith-containing idioblast and amylum cells.

Dissemination of the secretory structure *of Leea indica* (Burm.f.) Merr is on the leaves, stems, and roots. On the leaves, there are 2 types of idioblast cells (dark idioblast cells and brownish idioblast cells), and on the roots, only 1 type of idioblast cells are found in a round shape. Three types of crystals were found, namely drus crystals, cystolites on leaves, and rosette crystals on stems and roots.

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