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# Leaf trichomes identification in lamiaceae family plants and contribution to high school biology learning

Yesi Tri Agustin[1], Ermayanti[2*], Rahmi Susanti[3]

[1]Student of of Biology Education, Faculty of Teacher Training and Education, Universitas Sriwijaya, Indonesia
[2,3]Lecturer of Biology Education, Faculty of Teacher Training and Education, Universitas Sriwijaya, Indonesia

[*]Corresponding author: ermayanti@unsri.ac.id

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ABSTRACT

Many trichomes in plant organs have been studied previously, but research on leaf trichomes in several plants in the Lamiaceae tribe has never been studied before. The research has been conducted at the Laboratory of FKIP Palembang. This study using a descriptive method. The plants used in this study were from the Lamiaceae family, such as *Ocimum sanctum, Penorema canescens, Salvia splendens, Lavandula angustifolia, Hyptis rhomboides, Anisomeles indica*, and *Clerodendrum japonicum*. Observations using a binocular microscope at magnifications of 40, 100, and 400. This study was conducted by observing the type of trichome, the number of trichome cell arrangement, the shape of the trichome, and the size of the trichome. The results showed that in the Lamiaceae tribe there were glandular trichomes and non-glandular trichomes. The number of trichome cell arrangement consists of unicellular and multicellular trichomes. The longest average trichome size ranged from 89.5 microns and the shortest average ranged from 8.7 microns. The results are used as basic data in the anatomical structure of the trichomes of the Lamiaceae tribe and as learning enrichment material for KD 3.3 and KD 4.3 in the form of booklets.



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## INTRODUCTION

Plants in general have organs, namely roots, stems, leaves, flowers, fruits and seeds (Hidayat, 1995). Plant diversity can be viewed from its morphological structure, both roots, stems, leaves, flowers, and modified organs (Rosanti, 2013). Roots function to attach plants to the substrate,

absorb water and soil salts, uphold the stems, and store food reserves. While the stem functions to support the leaves so that they are in a suitable state for photosynthesis. The stem also functions as a translocation pathway for water and mineral salts to the leaves and growing points (Hidayat, 1994). Leaves function to absorb mineral substances (resorption), processing food substances (assimilation), evaporation of water (transpiration), and respiration (respiration) (Tjitrosoepomo, 2015). In addition, leaves function as a place for photosynthesis to take place, because leaves are the part of the plant that contains the most chlorophyll (Rosanti, 2016).

Each plant organ is composed of several types of tissue, such as leaves. Leaves are composed of three types of tissue, namely epidermis, parenchyma/mesophyll, and vascular tissue (Mulyani, 2017). The epidermis of leaves from different plants varies in the number of layers, shape, structure, arrangement of stomata, appearance, and arrangement of trichomes, as well as the presence of specialized cells such as stomata guard cells (Mulyani, 2017). Many plants have special epidermis called hairs (trichomes) which vary in shape, structure, and function (Suradinata, 1998). Trichoma is a derivative of the epidermal tissue that lines the outermost part of plant leaves (Anam, 2019). According to Suradinata (1998), trichomes are glandular or secretory hairs, and non-glandular hairs, scales, papillae, and root hairs for absorption. Trichomes are found in most plants that have chlorophyll (Fajri, 2013). This is related to the function of trichomes as a protective mesophyll tissue, reducing evaporation, can remove salts from leaf tissue, can prevent the accumulation of toxic salts in plants, as a defense against insects, and as a chemical defense (Suradinata, 1998). The use of trichomes in taxonomy is quite well known, certain families can be recognized easily from the type of hair (Hidayat, 1995).

This study of the Lamiaceae family is deemed necessary because the Lamiaceae have various types of hair, which are generally short-stemmed glands in the epidermis, containing specific essential oils (Dasuki, 1991). Several types of plants from the Lamiaceae family are used as medicinal ingredients because they contain essential oils (Handayani, 2015). Not only used as medicinal ingredients, the Lamiaceae family also functions as a spice (Raja, 2012). In addition, plants belonging to the Lamiaceae family are easy to find in the surrounding environment. Research on leaf trichomes, especially in the Lamiaceae family, has been studied before. Research on several plants belonging to the Lamiaceae family has been carried out by Sulistyowati & Ahmad (2018), on *Coleus amboinicus*, *Coleus scutellarioides*, and *Coleus tuberosus* plants. The results showed that capitate, peltate, conoidal, and digitiform gland trichomes were found. Meanwhile, research on plants *Hyptis capitata* Jacq., *Hyptis brevipes* Poit., *Hyptis suaveolens* (L.) Poit., found non-glandular trichomes with many cells (multicellular), glandular trichomes with long capitates, and glandular trichomes with short capitates (Fajri, et al. 2013). Peltate glandular trichomes, and capitate glandular trichomes were also found in the leaves of the *Coleus scutellarioides*, *Ocimum tenuiflorum* L., *Leucas lavandulifolia* plants (Yuliani & Ratnawati, 2018). Other research conducted by Rusydi. et al., (2013), showed that the plant *Pogostemon cablin* Benth., had simple unicellular and multicellular non-glandular trichomes, glandular trichomes of short stalk capitate, long stalk capitate, peltate, digitiform, filiform, clavate, and fusiform. However, from the results of previous research studies, information was obtained that some plants in the Lamiaceae family had never been studied before. In addition, previous research has also not revealed how the use of research data in the development of high school biology learning materials, especially KD 4.3. Therefore, the focus of the study in this article is on the types of leaf trichomes on several plants of the Lamiaceae family that have not been studied before, namely, *Ocimum sanctum, Peronema canescens*, *Salvia splendens*, *Lavandula angustifolia*, *Hyptis rhomboides*, *Anisomeles indica*, and *Clerodendrum japonicum*, and how they contribute. in high school biology learning.

The aim of this study was to obtain data on the characteristics of trichomes (trichome type, number of trichome cell arrangements, trichome shape, and trichome size) of leaves on several

plants of the Lamiaceae family. This research data is expected to be new data in complementing data on leaf trichomes in the Lamiaceae family. The results of the research are also expected to be used for the development of biology learning in high school which is arranged in the form of a booklet. Booklet preparation was carried out as an enrichment material for biology learning material for class XI senior hight school, in basic competence 3.3 analyzing the relationship between cell structure in plant tissue and organ function in plants and basic competence 4.3 presenting data from observations of tissue and organ structures in plants. The preparation of pictures of research results in the form of booklets is expected to provide convenience for students in analyzing the relationship between cell structure in plant tissues and organ functions in plants.

## RESEARCH METHODS

### Research Design

The research method used in this research is descriptive method. Descriptive method is a method that reveals the object of research data as it is (Nazir, 1983). The characteristics of the trichomes were analyzed descriptively, namely by making a description of the characteristics of the trichomes of each species based on the observed characteristics, so that the similarities or differences in the characteristics of the trichomes can be seen. Observations were carried out qualitatively and quantitatively, qualitatively by looking at the type, shape and number of trichome cell arrangements. Quantitatively by measuring the length of the trichomes. The results will be described descriptively and presented in tables and figures (photos).

The results of the study were in the form of pictures of trichomes, then arranged in the form of booklets (Utomo & Suharjo, 2017). The development of the booklet is carried out through several stages, namely (1) making the initial design of the booklet; (2) conducting self-evaluation, reviewing the booklet design and making revisions; (3) expert review, the booklet that was developed was then validated by two experts, consisting of one lecturer and one high school biology teacher. After being validated by the expert, the booklet is then revised based on the input given. The validation results were analyzed and then grouped based on the modification of the criteria proposed by Hamdi, et al., (2013), namely: (i) very valid (80-100); (ii) valid (60-79); (iii) less valid (40-59) and (v) invalid (<40).

### Population and Samples

The population in this study were seven plants of the Lamiaceae tribe, namely kemangi (*Ocimum sanctum*), sungkai (*Penorema canescens*), salvia merah (*Salvia splendens),* lavender (*Lavandula angustifolia*), undel-undel grass (*Hyptis rhomboides*), buakchao grass (*Anisomeles indica*), and pagoda flower (*Clerodendrum japonicum*). The sample used in this study was an incision on the upper and lower surfaces of the seven plants of the Lamiaceae family.

### Procedures

The research procedure was divided into three stages, namely the preparation stage, the implementation stage, the completion stage by observing the parameters to be observed in the form of trichome type, number of trichome cell arrangements, trichome shape, and trichome size based on sample identification on a microscope. The characteristics of the trichomes were analyzed descriptively, namely by making a description of the characteristics of the trichomes of each species based on the observed characteristics, so that the similarities or differences in the characteristics of the trichomes can be seen. Observations were carried out qualitatively and quantitatively, the qualitative method was by looking at the type, shape and number of trichome cell arrangements. Quantitatively by measuring the length of the trichome. The results will be described descriptively and presented in tables and figures (photos). The results of the study were in the form of images

and then arranged in the form of a booklet. A booklet is a thin book with no more than 30 sheets back and forth containing writing and pictures (Utomo & Suharjo, 2017).

## Data Analysis

The research data regarding the type, shape, and number of trichome cell arrangements were described descriptively and presented in the form of tables and figures (photos). Meanwhile, data regarding the length of the trichomes were analyzed by calculating the average length of the trichomes in each species. The booklet that was developed was then validated by two experts, consisting of one lecturer and one high school teacher. The validation results from two experts obtained a percentage of 76% and 80% validation values with very valid information.

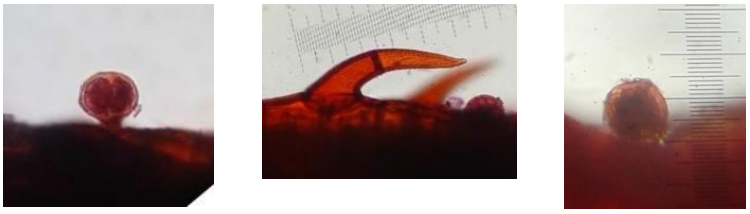
## RESULTS

### Leaf Trichomes on Kemangi Plants *(Ocimum sanctum)*

Based on the results of the study, it is known that the *Ocimum sanctum* plant has trichomes found on the upper and lower surfaces of the leaves. The types of trichomes found were glandular and non-glandular. While the number of cell arrangements including multicellular groups. The shape and size of the trichomes vary greatly (Table 1; Figure 1 dan 2).

**Table 1.** Characteristics of trichomes in kemangi plants (*Ocimum sanctum*).

| Leaf Surface | Trichomes Type | Trichomes Shape | Number of Trichome Cell Arrangements | Trichome Size (µm) | Description |
|---|---|---|---|---|---|
| *Adaksial* ( Upper surface of the leaf ) | Glandular | Glandular capitate trichomes type II | Multicellular | 13 | Figure 1a |
| | Non-glandular | Linked ends trichomes | Multicellular | 25 | Figure 1b |
| | Glandular | Glandular peltate trichomes type IV | Multicellular | 15 | Figure 1c |
| *Abaksial* ( Lower surface of the leaf ) | Glandular | Oval-headed capitate trichomes | Multicellular | 25 | Figure 2a |
| | Glandular | Glandular peltate trichomes type II | Multicellular | 12 | Figure 2b |
| | Glandular | Glandular capitate trichomes type I | Multicellular | 11 | Figure 2c |
| | Glandular | Glandular peltate trichomes type I | Multicellular | 15 | Figure 2d |
| **Average size of trichomes** | | | | **16.6** | |



(a) (b) (c)

**Figure 1.** Characteristics of trichomes on the upper surface of Kemangi leaves (*Ocimum Sanctum*). (a). glandular capitate trichomes type II; (b). non-glandular linked ends trichomes; (c). glandular peltate trichomes type IV.

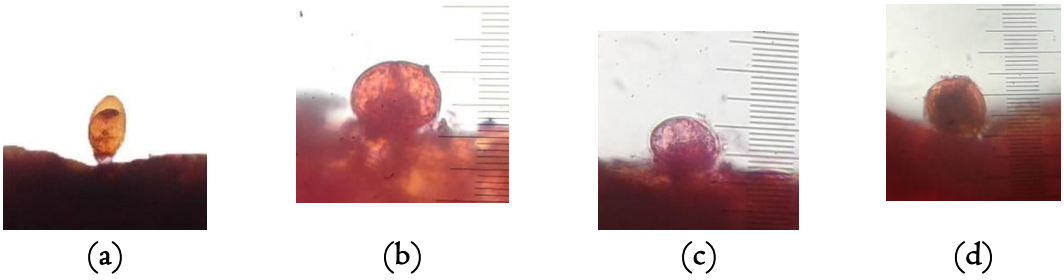



**Figure 2.** Characteristics of trichomes on the lower surface of Kemangi leaves *(Ocimum sanctum)*. a. glandular capitate oval-headed trichomes; b. glandular peltate trichomes type II; c. glandular capitate trichomes type I; d. glandular peltate trichomes type I.

## Leaf Trichomes on Sungkai Plants (*Peronema canescens*)

Based on the results of the study, it is known that the *Peronema canescens* plant has trichomes found on the upper and lower surfaces of the leaves. The types of trichomes found were glandular and non-glandular. While the number of trichome cell arrangements found unicellular and multicellular groups. The shapes and trichomes found vary (Table 2; Figure 3 and 4).

**Table 2.** Leaf Trichomes on sungkai plants (*Peronema canescens*).

| Leaf Surface | Trichomes Type | Trichomes Shape | Number of Trichome Cell Arrangements | Trichome Size (µm) | Description |
|---|---|---|---|---|---|
| *Adaksial* (Upper surface of the leaf ) | Non-glandular | Simple trichomes shaped like thorns | Multicellular | 7 | Figure 3 |
| *Adaksial* (Lower surface of the leaf ) | Non-glandular | Simple trichomes shaped like thorns | Unicellular | 13 | Figure 4a |
| | Glandular | Glandular capitate trichomes type II | Multicellular | 6 | Figure 4b |
| | | **Average size of trichomes** | | **8.7** | |

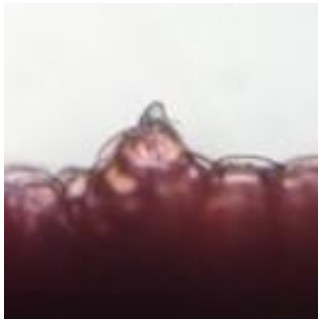


**Figure 3.** Characteristics of trichomes on the upper surface of the leaves of the Sungkai plant (*Peronema canescens*). Simple trichomes shaped like thorns (multicellular).

(a) (b)

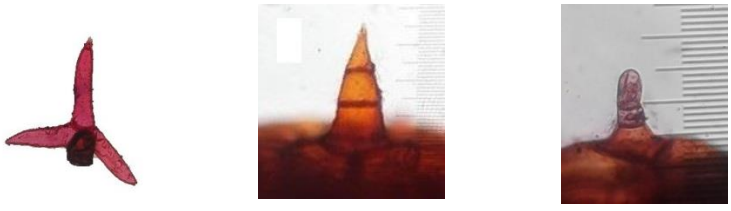
**Figure 4.** Characteristics of trichomes on the lower surface of the Sungkai plant leaves (*Peronema canescens*). Simple non-glandular trichomes shaped like thorns (unicellular); b. glandular capitate trichomes type II.

### Leaf Trichomes on Salvia merah Plants *(Salvia splendens)*

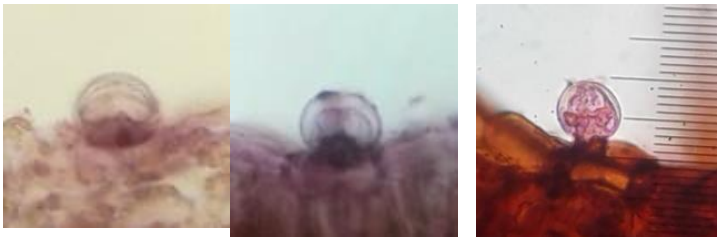
Based on the results of the study, it was known that the *Salvia splendens* plant had trichomes found on the upper and lower leaf surfaces. The types of trichomes found were glandular and non-glandular. While the number of cell arrangements there are multicellular and unicellular groups. The shape and size of the trichomes vary greatly (Table 3; Figure 5 and 6).

**Table 3.** Characteristics of trichomes in salvia merah plants (*Salvia splendens*).

| Leaf Surface | Trichomes Type | Trichomes Shape | Number of Trichome Cell Arrangements | Trichome Size (µm) | Description |
|---|---|---|---|---|---|
| *Adaksial* (Upper surface of the leaf ) | Non-glandular | Three-branched trichomes | Multicellular | 7 | Figure 5a |
| | Non-glandular | Needles trichomes | Multicellular | 34 | Figure 5b |
| | Glandular | Warty ends trichomes | Multicellular | 10 | Figure 5c |
| | Glandular | Glandular peltate trichomes type I | Multicellular | 11 | Figure 5d |
| | Glandular | Glandular peltate trichomes type II | Multicellular | 14 | Figure 5e |
| | Glandular | Glandular capitate trichomes type I | Multicellular | 9 | Figure 5f |
| *Abaksial* (Lower surface of the leaf ) | Non-glandular | Simple trichomes shaped like thorns | Unicellular | 12 | Figure 6a |
| | Glandular | Glandular capitate trichomes type II | Multicellular | 10 | Picture 6b |
| **Average size of trichomes** | | | | **13.4** | |



(a) (b) (c)



(d) (e) (f)

**Figure 5.** Characteristics of trichomes on the upper surface of salvia merah leaves (*Salvia splendens*). a. non-glandular three-branched trichomes; b. non-glandular needles trichomes; c. glandular warty ends trichomes; d. glandular peltate trichomes type I; e.glandular peltate trichomes type II; f. glandular capitate trichomes type I.

(a) (b)

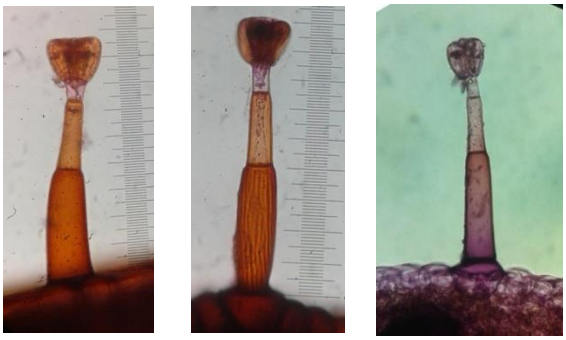
**Figure 6.** Characteristics of trichomes on the lower surface of salvia merah leaves (*Salvia splendens*). a. simple non-glandular trichomes shaped like thorns; b. glandular capitate trichomes type II.

### Leaf Trichomes on Lavender Plants *(Lavandula angustifolia)*

Based on the results of the study, it was found that the Lavandula angustifolia plant had the same trichomes found on the upper and lower leaf surfaces. The trichomes found were glandular trichomes only. While the number of cell arrangements including multicellular groups. The shape of the trichome is only one but has a variety of sizes (Table 4 and Figure 7).

**Table 4.** Characteristics of trichomes in lavender plants (*Lavandula angustifolia*).

| Leaf Surface | Trichomes Type | Trichomes Shape | Number of Trichome Cell Arrangements | Trichome Size (µm) | Description |
|---|---|---|---|---|---|
| *Adaksial* (Upper surface of the leaf) | Glandular | Glandular capitate trichomes type V | Multicellular | 89 | Figure 7a |
| *Abaksial* (Lower surface of the leaf ) | Glandular | Glandular capitate trichomes type V | Multicellular | 90 | Figure 7b; Figure 7c |
| | | Average size of trichomes | | 89.5 | |



A (a) B (b-c)

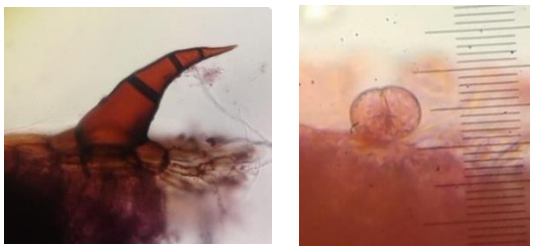
**Figure 7.** Characteristics of leaf trichomes on lavender plants (*Lavandula angustifolia*). A. Upper surface of the leaf. (a); glandular capitate trichomes type V; B. Lower surface of the leaf. (b); (c). glandular capitate trichomes type V.

### Trichomes on Undel-undell Grass Plant Leaves (*Hyptis rhomboides)*

Based on the results of the study, it was known that the Hyptis rhomboides plant had trichomes found on the upper and lower leaf surfaces. The types of trichomes found were glandular trichomes and non-glandular trichomes. While the number of cell arrangements including multicellular groups. The shape and size of the trichomes vary (Table 5; Figure 8 and 9).

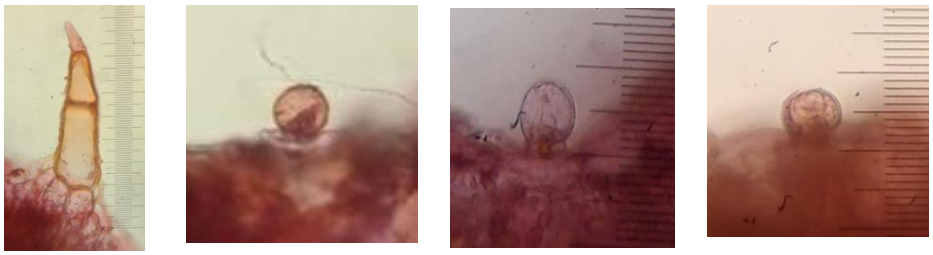
**Table 5.** Characteristics of trichomes in undel-undel grass plants *(Hyptis rhomboides).*

| Leaf Surface | Trichomes Type | Trichomes Shape | Number of Trichome Cell Arrangements | Trichome Size (µm) | Description |
|---|---|---|---|---|---|
| *Adaksial* (Upper surface of the leaf) | Non-glandular | Linked ends trichomes | Multicellular | 69 | Figure 8a |
| | Glandular | Glandular peltate trichomes type II | Multicellular | 9 | Figure 8b |
| *Abaksial* (Lower surface of the leaf ) | Non-glandular | Needles trichomes | Multicellular | 70 | Figure 9a |
| | Glandular | Glandular peltate trichomes type I | Multicellular | 10 | Figure 9b |
| | Glandular | Glandular capitate trichomes type I | Multicellular | 9 | Figure 9c |
| | Glandular | Glandular capitate trichomes type II | Multicellular | 8 | Figure 9d |
| **Average size of trichomes** | | | | **18.7** | |



(a) (b)

**Figure 8.** Characteristics of trichomes on the upper surface of the leaves of the undel-undel grass plant (*Hyptis rhomboides*). a. non-glandular linked ends trichomes; b. glandular peltate type II.



(a) (b) (c) (d)

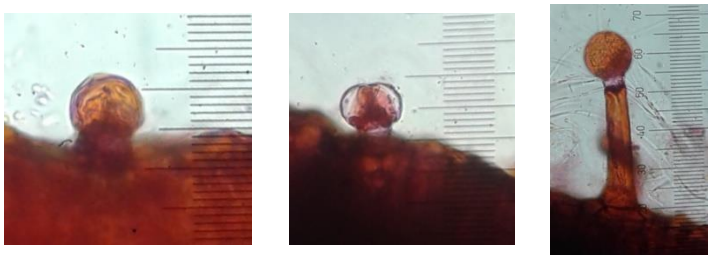
**Figure 9.** Characteristics of trichomes on the underside of leaves of undel-undel grass plants (*Hyptis rhomboides*). a. non-glandular needles trichomes; b. glandular peltate trichomes type I; c. glandular capitate trichomes type I; d. glandular capitate trichomes type II.

### Trichomes on Buakchao Grass Leaves *(Anisomeles indica)*

Based on the research results, it is known that the Anisomeles indica plant has trichomes found on the upper and lower leaf surfaces. The types of trichomes found were glandular trichomes and non-glandular trichomes. While the number of cell arrangements including multicellular groups. The shape and size of the trichomes vary greatly (Table 6; Figure 10 and 11).

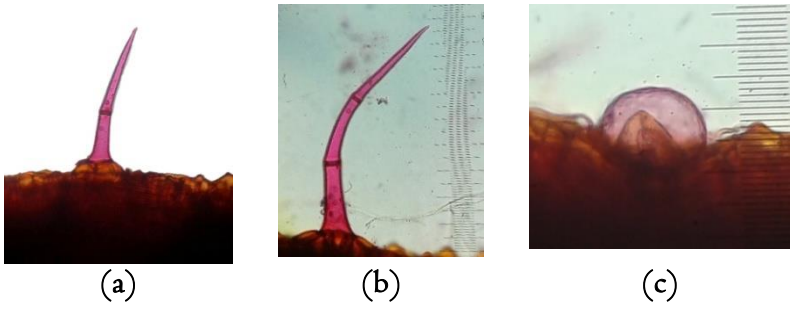
**Table 6.** Characteristics of Trichomes in Buakchao Grass Plants (*Anisomeles indica*).

| Leaf Surface | Trichomes Type | Trichomes Shape | Number of Trichome Cell Arrangements | Trichome Size (µm) | Description |
|---|---|---|---|---|---|
| *Adaksial* (Upper surface of the leaf) | Glandular | Glandular capitate trichomes type I | Multicellular | 11 | Figure 10a |
| | Glandular | Glandular capitate trichomes type II | Multicellular | 10 | Figure 10b |
| | Glandular | Long stalk glandular peltate trichomes type I | Multicellular | 47 | Figure 10c |
| *Abaksial* (Lower surface of the leaf ) | Non-glandular | Needles trichomes | Multicellular | 50 | Figure 11a |
| | Non-glandular | Linked ends trichomes | Multicellular | 82 | Figure 11b |
| | Glandular | Glandular peltate trichomes type I | Multicellular | 15 | Figure 11c |
| | Glandular | Glandular peltate trichomes type II | Multicellular | 8 | Figure 11d |
| | Glandular | Glandular capitate trichomes type II | Multicellular | 12 | Figure 11e; Figure 11f |
| **Average size of trichomes** | | | | **29.4** | |

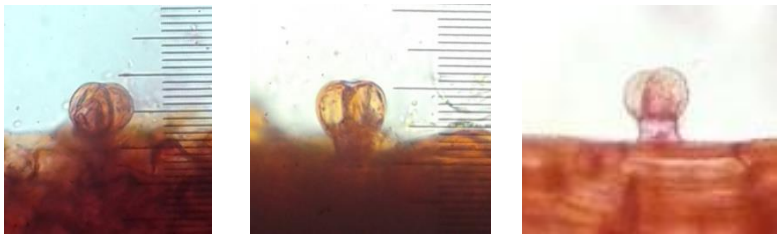


(a) (b) (c)

**Figure 10.** Characteristics of trichomes on the upper surface of buakchao grass leaves (*Anisomeles indica*). a. glandular capitate trichomes type I; b. glandular capitate trichomes type II; c. long stalk glandular peltate trichomes type I



(a) (b) (c)



(d) (e) (f)

**Figure 11.** Characteristics of trichomes on the underside of buakchao grass leaves *(Anisomeles indica)*. a. non-glandular needles trichomes; b. non-glandular linked ends trichomes; c. glandular peltate trichomes type I; d. glandular peltate trichomes type II; e,f. glandular capitate trichomes type II.

### Trichomes on Pagoda Flower Leaves *(Clerodendrum japonicum)*

Based on the results of the study, it was known that *Clerodendrum japonicum* had trichomes found on the upper and lower leaf surfaces. The type of trichome found was only the non-glandular trichome type. While the number of cell arrangements including multicellular groups. The shape and size of the trichomes vary (Table 7; Figure 12 and 13).

**Table 7.** Characteristics of trichomes in pagoda flower plants (*Clerodendrum japonicum*).

| Leaf Surface | Trichomes Type | Trichomes Shape | Number of Trichome Cell Arrangements | Trichome Size (µm) | Description |
|---|---|---|---|---|---|
| *Adaksial* (Upper surface of the leaf) | Non-glandular | Needles trichomes | Multicellular | 60 | Figure 12 |
| *Abaksial* (Lower surface of the leaf ) | Non-glandular | Linked ends trichomes | Multicellular | 7 | Figure 13 |
| | | Average size of trichomes | | 33.5 | |

**Figure 12.** Characteristics of trichomes on the upper surface of the leaves of the pagoda flower plant *(Clerodendrum japonicum)*. Non-glandular needles trichomes.

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**Figure 13.** Characteristics of trichomes on the underside of pagoda flower leaves *(Clerodendrum japonicum*). Non-glandular linked ends trichomes..

## DISCUSSION

Trichome identification aims to determine the diversity of leaf trichomes on kemangi *(Ocimum sanctum*), sungkai (*Penorema canescens*), salvia merah (*Salvia splendens*), lavender (*Lavandula angustifolia*), undel-undel grass (*Hyptis rhomboides*), buakchao grass (*Anisomeles indica*). , and pagoda flower (*Clerodendrum japonicum*) which have different types, shapes, numbers of cell arrangements, and sizes of trichomes. Trichomes found on the upper surface of the leaves (adaxial) and the lower surface of the leaves (abaxial) of the kemangi plant (*Ocimum sanctum)*, namely, glandular peltate trichomes and glandular capitate trichomes are classified based on the number of secretory cells forming the head and shape (Aprilia, 2016). Due to the variation in the number of secretory cells that make up the head and their shape, glandular peltate trichomes and glandular capitate trichomes are further divided into several types. Glandular peltate trichomes type I, type II, and type IV are glandular trichomes that have 1-4 head-forming secretory cells with varying stalk cells and have a thick cuticle layer on the head-forming secretory cells. Likewise, glandular capitate trichomes type I, type II, and type capitate oval head are glandular trichomes that have 1-3 head-forming secretory cells that are oval and round in shape with variable stalk cells, and have a thinner cuticle layer on the secretory cells forming the head. Than peltate trichomes (Yuliani & Ratnawati, 2018). Glandular capitate trichomes found in kemangi plants are composed of basal cells, short and medium stalk cells, and 1-2 secretory cells that form a head covered by a thin cuticle. The shape of the head of the trichome is round and there is also an oval coconut. Clear yellow and some are brown. Glandular peltate trichomes types I, II, and IV were found to be composed of basal cells, short stalk cells, and 1-3 secretory cells forming the head of the trichomes, which were covered by a thick cuticle. The head of the trichome is round and has a blackish brown and reddish brown color. The glandular capitate and peltate trichomes are almost similar to the trichomes found by Yuliani & Ratnawati (2018) on the jawer kotok plant, namely glandular capitate trichomes which are composed of basal cells, stalk cells, and 1-2 secretory cells forming the head. The head of the trichome is round or oval with a thin cuticle layer. The size ranges from 30 microns, while the glandular trichomes found are composed of basal cells, stalk cells, and 1-4 secretory cells forming the head which are covered by a thick cuticle layer. The color is golden

yellow to blackish, with sizes varying between 30-50 microns. According to Yuliani & Ratnawati (2018) also glandular peltate and capitate trichomes found in the klampes plant (*Ocimum tenuiflorum*) contain alkaloid and terpenoid compounds. Non-glandular linked ends trichomes. This trichome is composed of 2 cells with pointed and curved ends. The color of the trichomes is reddish brown. The non-glandular trichomes were also discovered by Dewi. et al., (2015), in their research on the *Capsicum frustescens* plant, the trichomes found in the shoots of the trichomes were bent like they had hooks.

Trichomes found in sungkai plants (Penorema canescens), are non-glandular trichomes shaped like thorn. This trichome is composed of more than one cell (multicellular). Shaped in the form of a bulge with a slightly pointed tip on the surface of the epidermis of Sungkai leaves. Slightly sharp protrusions resembling thorns. Non-glandular trichomes shaped like thorn are found on the upper surface of the leaf (adaxial). Non-glandular trichomes shaped like thorn are also found on the underside of leaves (abaxial), but differ in that they are composed of only one cell (unicellular). The next trichome found on the sungkai plant is glandular capitate trichome type II. Glandular capitate trichomes type II are composed of basal cells, medium stalk cells, and 2 head-forming secretory cells covered by a thin cuticle layer. Round in shape and brown in color. According to Pratiwi (2016), in his research that all glandular capitate trichomes on sungkai (*Peronema canescens*) leaves contain alkaloids, terpenoids, and lipophilic compounds, while phenolic and flavonoid compounds are also found in capitate trichomes which have one head cell. Trichomes found on the upper surface of the leaves (adaxial) and the lower surface of the leaves (abaxial) of salvia merah plants (*Salvia splendens*), namely, non-glandular three-branched trichomes are composed of basal cells, stalk cells and 3 cells attached to form like branches with pointed ends , hence the name non-glandular three-branched trichomes. Furthermore, the non-glandular trichomes are shaped like needles, as the name suggests that the shape of these trichomes resembles a needle. Composed of 3 trichome cells. Then, glandular trichomes with warty ends. Trichomes are composed of basal cells, medium stalk cells, and tip cells that are bulging. Dewi, et al., (2015) also found non-glandular trichomes in the form of needles and glandular trichomes with warty tips on *Solanum tuberosum* and *Lycopersicon pimpinellifolium* trichomes with pointed tips and trichomes with warty spots on *Physalis minima* plants. Glandular peltate trichomes types I and II are almost similar to glandular peltate trichomes in the kemangi plant (*Ocimum sanctum*), which are composed of basal cells, stalk cells, and 1-2 secretory cells, except that the shape of the glandular peltate trichomes is type I, II in salvia merah plants. This salvia merah (*Salvia splendens*) has a stalk that looks less obvious because it is covered by a larger head shape. This is because the cuticle layer is thicker. The color of the trichomes looks pale brown. Glandular capitate trichomes type I, and II in salvia merah plants are composed of basal cells, medium stalk cells, and 1-2 head-forming secretory cells covered by a thin cuticle layer. Has a clear color. Then non-glandular trichomes shaped like thorns are also found in salvia merah plants. Almost the same as non-glandular trichomes shaped like thorns on Sungkai plants, that trichomes are only composed of 1 cell (unicellular), and are slightly pointed at the tip of the trichomes.

The trichomes found in lavender plants (*Lavandula angustifolia*) are glandular capitate trichomes type V. Only one type of trichomes is found in lavender plants. Very beautiful trichomes composed of basal cells, 3 stalk cells, and 2-8 head-forming secretory cells. The cuticle layer on the head is not clearly visible, because it is too thin. Clear yellow. Glandular capitate trichomes type V were not only found on the upper surface of the leaves (adaxial) but also on the lower surface of the leaves (abaxial) of lavender which had the same shape. Glandular capitate trichomes type V are similar to trichomes that have been found by Yuliani & Ratnawati (2018) in the arm plant (*Leucas lavandulifolia*) which has basal cells, long stalk cells, and 2-8 head-forming secretory cells with a thin cuticle sheath. . The size of the trichomes is 20-100 microns, with clear

and yellowish variations in color. Trichomes found on the undel-undel grass plant (*Hyptis rhomboides*) on the upper surface of the leaves (adaxial) namely, non-glandular trichomes with linked ends, glandular peltate trichomes type II. On the underside of the leaves (abaxial) of undel-undel grass, non-glandular needles trichomes were found, glandular peltate trichomes type I, glandular capitate type I, and capitate type II trichomes. Non-glandular trichomes with linked ends are composed of basal cells and 4 trichome-forming cells, the tips of the trichomes are pointed and bent to form a hook. It has a brownish red color. Glandular peltate trichomes type I and II were also found in this undel-undel grass plant. Peltate trichomes type I and II were found to be composed of basal cells, stem cells were not clearly visible because they were too short, and 1-2 secretory cells formed a head. Covered by a thick cuticle. Has a brown color. Furthermore, glandular capitate trichomes types I and II were also found in undel-undel grass plants. Glandular capitate trichomes type I and II have the characteristics of basal cells to which the trichomes are attached, rather wide stalk cells, and 1-2 head-forming secretory cells covered by a thin cuticle layer. The color of the trichomes is brown. Then there are non-glandular needles trichomes. This trichome is composed of basal cells and 3 constituent cells. Has a pointed tip. Yellowish in color.

Trichomes found in buakchao grass plants (*Anisomeles indica*) on the upper and lower leaf surfaces, namely, capitate trichomes types I and II in buakchao grass plants are composed of basal cells, medium stalk cells, and 1-2 head-forming secretory cells. Covered by a thin layer of cuticle. The color of the trichomes is slightly brown. Glandular capitate trichomes type II is not only found on the upper surface of the leaf (adaxial) but also on the lower surface of the leaf. Glandular capitate trichomes type II on the lower surface of the leaf is almost the same as that found on the upper surface of the leaf (adaxial), only differing in color. The color of the glandular capitate trichomes type II on the underside of the leaves is clearer and slightly yellowish. Furthermore, the trichomes found on buakchao grass plants, namely glandular peltate trichomes types I and II. Glandular peltate trichomes type I and II are composed of basal cells, short stalk cells, and 1-2 secretory cells covered by a thick cuticle. Has a reddish brown color. Glandular peltate trichomes were also found with long stems. Has a yellowish color. Non-glandular trichomes are shaped like needles composed of basal cells, and 2 cells make up the trichomes. The tip of the trichome is more pointed to form like the tip of a needle. Has a pink color. Non-glandular trichomes with associated ends are composed of basal cells, and 3 cells make up the trichomes. At the ends it bends to form a hook, precisely in the 2nd cell. It has a pointed tip, and is pink in color. The trichomes found in the pagoda flower plant (*Clerodendrum japonicum*) only found 1 type of non-glandular trichome and 2 forms of trichomes, namely, non-glandular trichomes shaped like needles composed of basal cells, and 4 trichome cells. The cells that make up the trichomes look wider, with the tip of the trichomes being pointed. The color of the trichomes is reddish brown. Needle trichomes have also been previously found in salvia merah (Salvia splendens), buakchao grass (*Anisomeles indica*), and undel-undel grass (*Hyptis rhomboides*). Trichomes with associated ends are composed of basal cells, and 3 cells make up the trichomes. It has a pointed end that bends to the right. The color of the trichomes is reddish brown. Trichomes with associated ends are also found in kemangi (*Ocimum sanctum*), undel-undel grass (*Hyptis rhomboides*), and buakchao grass (*Ansiomeles indica*).

The results of this study entitled "Identification of Leaf Trichomes in Several Plants of the Lamiaceae Family and Their Contribution to High School Biology Learning" have the potential as enrichment for students who have mastered basic competencies in high school biology material for class XI KD. 3.3 Analyzing the relationship between cell structure in plant tissues and organ functions in plants and KD. 4.3 Presenting data from observations of the structure of tissues and organs in plants. The enrichment activity was carried out by developing a booklet containing descriptions and pictures related to the characteristics of the trichomes. The presentation of

pictures of trichomes in the form of booklets aims to make students better understand the structure of microscopic trichomes. This is in accordance with previous research which stated that the representation of plant tissue structures in the form of images can help students understand the structure of microscopic plant tissues (Ermayanti, 2017; Ermayanti et. al., 2017; Ermayanti et. al., 2018).

## CONCLUSION

Types of glandular trichomes found in plants *Ocimum sanctum*, *Penorema canescens*, *Salvia splendens*, *Lavandula angustifolia, Hyptis rhomboides*, and *Anisomeles indica*. Meanwhile, non-glandular trichomes were found in *Ocimum sanctum, Penorema canescens*, *Salvia splendens, Hyptis rhomboides*, *Anisomeles indica*, and *Clerodendrum japonicum* plants. The number of cell arrangement of trichomes found in seven plants of the Lamiaceae family, namely, 12 multicellular trichomes found in the seven plants and 2 unicellular trichomes which were only found in *Peronema canescens* and *Hyptis rhomboides* plants. The forms of trichomes found in seven Lamiaceae plants are glandular peltate trichomes type I, II, long-stemmed peltate type I, type IV peltate, type I capitate, type II capitate, type V capitate, oval-headed capitate, glandular trichomes with warty ends. Non-glandular trichomes are needle-shaped, non-glandular trichomes with hooked ends, simple non-glandular trichomes are thorn-like (unicellular), simple non-glandular trichomes are thorn-like (multicellular), and non-glandular trichomes are three-branched.

Type I glandular peltate trichomes are found in plants *Ocimum sanctum*, *Salvia splendens*, *Hyptis rhomboides*, and *Anisomeles indica*. Type II glandular peltate trichomes are found in *Ocimum sanctum*, *Salvia splendens*, *Hyptis rhomboides*, and *Anisomeles indica* plants. Long-stemmed type I glandular trichomes are only found in *Anisomeles indica* plants. Type IV glandular peltate trichomes are only found in the *Ocimum sanctum* plant. Type I glandular capitate trichomes are found in plants *Ocimum sanctum*, *Salvia splendens*, and *Anisomeles indica*. Type II glandular capitate trichomes are found in plants *Ocimum sanctum*, *Penorema canescens, Salvia splendens*, and *Anisomeles indica*. Type V glandular capitate trichomes are only found in the *Lavandula angustifolia* plant. The glandular capitate trichomes are oval-headed, only found in the *Ocimum sanctum* plant. Glandular trichomes with warty ends, found only in the *Salvia Splendens* plant. Non-glandular, needle-like trichomes are found in *Salvia splendens*, *Hyptis rhomboides*, *Anisomeles indica*, and *Clerodendrum japonicum*. Non-glandular form of trichomes with linked ends, found in plants *Ocimum sanctum*, *Hyptis rhomboides, Anisomeles indica*, and *Clerodendrum japonicum*. The form of non-glandular trichomes is shaped like a thorn which is found to be multicellular and some are multicellular. Non-glandular trichomes are thorn-like, multicellular, found in the plant *Penorema canescens*. Meanwhile, non-glandular trichomes are unicellular thorns found in *Penorema canescens* and *Salvia splendens* plants. Three-branched form of non-glandular trichomes, found only in the plant *Salvia splendens*. The average size of the longest trichomes found in *Lavandula angustifolia* is 89.5 microns. Then *Clerodendrum japonicum*, *Anisomeles indica*, *Hyptis rhomboides*, *Ocimum sanctum*, *Salvia splendens*, and those with the shortest average size of trichomes in *Peronema canescens* plants, namely, 8.7 microns.

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