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PLKPD Compilation Based on Research on Characteristics of Epidermis and Epidermis Derivatives of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. Leaves for Students of Class XI SMA/MA

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ABSTRACT

There are limitations to teaching materials used in school sourced from research results. This study aims to look at the characteristics of the epidermis and epidermal derivatives of the leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. as well as to determine the quality of LKPD teaching materials on the material structure and function of plant tissue for class XI students based on the results of the research conducted. The method used for making preparations is the leaf clearing method. The preparations were observed in the laboratory using optilab to see the characteristics of the epidermis and its derivatives. The results of research on the structure of the epidermis and the epidermis derivatives of the leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. developed in the form of Biology LKPD. LKPD arrangement is carried out by the ADD (Analysis, Design, Development) stage. Epidermal structure data analysis and leaf epidermal derivatives were carried out descriptively, product assessment was carried out by 2 experts from biology education. Epidermis leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. has an irregular epidermal cell shape and is spread over the surface, has anisocytic stomata type, glandular and non-glandular types of trichomes, hydatod trichomes and simple needle-shaped hairs found on the edges of the leaves. The average results of the assessment by two Biology education experts get a percentage value of 73.28% with a feasible category to be tested as teaching material for students of class XI SMA / MA.

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Introduction

Active learning is learning that involves students directly in interacting, investigating, solving problems and concluding self-understanding. In this learning, appropriate teaching materials are needed in order to facilitate students' directed and independent learning. Therefore it is necessary to have learning tools that actively develop the abilities of students. Student worksheets (LKPD) are a tool to help and facilitate teaching and learning activities so that effective interactions are formed between students and educators, can increase student activity and learning achievement. The benefits of LKPD are activating students in the learning process, helping to develop concepts, practicing discovering and developing process skills¹. Teaching materials are all materials that are deliberately arranged by humans in a systematic manner that present competencies that will be mastered by students and used during the learning process². Teaching materials function as guidelines for students which provide instructions regarding activities in teaching and learning activities and include substances that must be mastered³.

Based on observations that have been made at SMA Muhammadiyah 7 Yogyakarta in September 2021 by looking at the teaching and learning activities carried out in the class the researcher concludes that in the process of teaching and learning activities students tend to be passive in participating in learning, this is because the teaching materials used are less varied and less interesting. The unavailability of student activity sheets on the material structure and function of plant tissue makes it difficult for students to play an active role in learning because the textbooks and modules do not have many exercises that develop students' skills to solve problems. The weakness of the biology teaching materials used in schools, especially in the material on the structure and function of plant tissues used, is that they only contain material that has not been accompanied by real examples such as pictures sourced from research results. The results of research on the structure of plant epidermis and plant epidermis derivatives can be used as teaching materials by students, examples of local potential are *Capsicum frutescens* L. and *Capsicum chinense* Jacq. which are widely cultivated by people in Indonesia, when learning activities are carried out students do not use teaching materials originating from local potential so that students cannot apply material with direct examples from their surrounding environment, especially on material on the structure and function of plant tissues.

Studies related to the characteristics of the epidermis and its derivatives can be used by students to increase knowledge and insight about the tissues found in plants. One effort to increase student activity is by compiling a teaching material in the form of a Biology LKPD. The anatomical structure of the Solanaceae family plant could be developed to become a learning resource for worksheets on the structure and function of plant tissues for class XI IPA⁴.

LKPD is a collection of sheets containing student activities that allow students to carry out actual activities using the objects and problems being studied. LKPD is defined as printed material in the form of teaching materials with sheets of paper containing summaries, and explanations and implementation of tasks carried out by students related to the basic skills acquired². Student activity sheets serve as concise and effective learning resources for students because LKPD contains exercises and practices that can encourage students to be active in learning activities in accordance with the demands of the 2013 curriculum where students must be active and involved in learning activities and the teacher is only a facilitator. Student activity sheets are structured as enrichment teaching materials equipped with real pictures sourced from the results of research on the epidermis and epidermal derivatives of the leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. the purpose of this study was to determine the quality of Biology LKPD based on research.

Method

The research was carried out in two stages: the exploratory research stage was carried out by observing the location and presence of *Capsicum frutescens* L. and *Capsicum chinense* Jacq., then sampling was carried out by taking the 4th leaf from the shoots of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. using the leaf clearing method, namely the leaves that have been taken are cut into rectangles with a side of 1 cm and put into a flakon bottle containing chloralhydrate and then heated over a Bunsen until the pieces become transparent, the parts of the leaves taken are the ends, edges and middle of the leaves. The second stage is the preparation of LKPD according to the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) but only up to the Development stage. LKPD development model put forward by Rayanto Y⁵.

Place and time of research

The research was conducted at Muhammadiyah 7 Yogyakarta High School in September 2021, in the Salam alley V Pringgolayan garden, Banguntapan, Bantul Yogyakarta, and the Ahmad Dahlan University Integrated Laboratory in February-April 2022.

Data collection technique

Data collection techniques used are observation and questionnaires. Observations were carried out by looking at the needs of students for enrichment teaching materials, especially Biology LKPD, questionnaires were used to see the feasibility of LKPD as Biology teaching materials given to material and media expert lecturers. The questionnaire used is a Likert scale. Questionnaire is a data collection technique by providing a set of written questions given to respondents⁶.

Tools and materials

The tools used in this study included cameras, brushes, scissors, flakon bottles, binocular microscopes, slide glasses, cover slips, optilab which had the Image Raster 3.0 application installed, pipette drops, bunsen, wooden clamps, stationery, laptops that had been installed. installed the Canva application. The materials used in this study included the leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. chloralhydrate solution, distilled water, label paper, spiritus, and matches, 100 gr HVS paper, and cover paper, books supporting material and documentation of research results.

Research procedure

Work procedures in this study, namely:

- a. Exploratory research procedures
 - 1) Leaf measurement, leaves are taken on the 4th leaf from the top of the plant and the length and width of the leaf are measured.
 - 2) Making samples, the leaves that have been measured are then made into rectangular pieces by cutting the part that has the leaf veins on it the ends, edges and middle of the leaves using scissors each with a width of 1 cm.
 - 3) Leaf preparation, The leaf pieces are then put into a flakon bottle and given chloralhydrate and aquadest with a ratio of 5:2 (5 gr chloralhydrate : 2 ml aquadest). A flakon bottle containing chopped leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. heated for about 2 minutes over a Bunsen flame until the leaves turn transparent. After the leaves look transparent, they are then stored in a flakon bottle containing chloralhydrate.
 - 4) Observation of preparations was carried out using optilab at a magnification of 100x and 400x over a certain area to see the epidermal tissue of stomata and trichomes.

b. Preparation of LKPD

Teaching materials prepared based on research results in the form of LKPD Analysis of the potential of teaching materials refers to Suhardi's book with reference to the ADDIE model (Analysis, Design, Development, Implementation, Evaluation)⁷ proposed by Rayanto & Sugiyanti, which is limited to the stage development because research only extends to the development of teaching materials not to implementation and evaluation of students⁵. The stages of preparing the LKPD are:

- 1) Analysis Phase
 - a) Analysis of student needs
 - b) Material analysis
 - c) Analysis of potential research results
- 2) Design Stage
 - a) The design phase carried out is as follows:
 - b) Prepare tools and materials used to compile LKPD
 - c) Formulate indicators of achievement of learning outcomes in accordance with KD 3.3 and 4.3 c) Search and collect material to be included in LKPD
 - d) Prepare Biology LKPD based on the components contained in the LKPD including: Title, identity, indicators, core competencies and basic competencies, learning objectives, materials, work instructions, activities, and bibliography.
 - e) Designing a Biology Worksheet with the Canva application
- 3) Development Stage

Teaching material products that have been compiled and then printed and then assessed appropriateness teaching materials by material and media expert validators. The LKPD assessment uses a Likert scale, the assessment instrument uses a grid based on aspects of the textbook assessment by BSNP, the aspects that are assessed are aspects of content feasibility, presentation aspects, linguistic and graphic aspects.

Data analysis technique

1. Analysis of the results of the research based on the structure of the epidermis and epidermal derivatives descriptively, research data on the structure of the epidermis and epidermal derivatives of the leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. The results obtained were then analyzed descriptively to describe, analyze and interpret the epidermal cell type, stomata type, and trichome type found in the leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq.
2. Product validation by experts
The quality of the research results that have been made in the form of teaching materials in the form of worksheets is tested.

Table 1. Percentage of Book Quality Criteria

Criteria Interpretati	Evaluation
Sanot worth it	0% - 25%
Not feasible	26% - 50%
Worthy	51% - 75%
Saworth it	76% - 100%

Source : Riduwan⁸

Results and Discussion

Exploration Research Results

The results of this exploratory study focused on the morphology and anatomy of the leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. After observing the morphology, the two leaves have almost the same leaf shape, namely oval shape, tapered tip, curved base shape and pinnate leaf reinforcement. The differences are in the size, edges, and shape of the leaf surface where *Capsicum frutescens* L. leaves have smaller leaf sizes with flat edges and smooth leaf surfaces. *Capsicum chinense* leaves jacq. has larger leaf sizes with wavy leaf edges and wrinkled leaf surfaces. According to Faizah, chili plants are elongated oval in shape and have tapered ends and have pinnate leaf bones⁹. Chili seeds are yellowish, arranged in groups and has a flat round shape. The following is an image of the leaf morphology of *Capsicum frutescens* L. and *Capsicum chinense* Jacq.

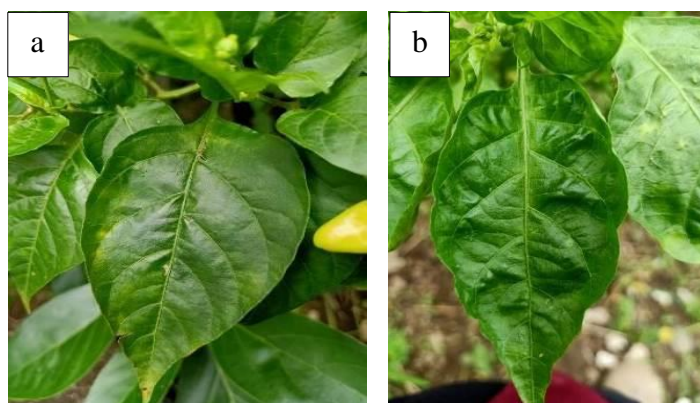


Figure 1. a. Leaf Morphology of *Capsicum frutescens* L. b. Leaf Morphology of *Capsicum chinense* Jacq.

Epidermal tissue comes from the Greek word "epi" which means on the skin, the epidermis is the outermost layer of cells in the primary plant organs such as stems, roots, leaves, seeds, flowers and fruit. Epidermal tissue is the layer that covers the surface of leaves, stems, roots, fruits and seeds¹⁰. Observations were made on two leaf surfaces, namely adaxial and abaxial, the surface facing up is called the adaxial surface (upper epidermis) and the one facing downward is called the abaxial surface (lower epidermis). Leaf epidermal cell shape of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. Both adaxial and abaxial surfaces have the same irregular cell shape with grooved cell walls, but on the leaves of *Capsicum frutescens* L. the indentation of the epidermal cells is deeper than the indentation of cells in *Capsicum chinense* Jacq. According to Sundari's research the presence of sunlight does not affect the morphology of epidermal cells and also does not affect the number of indentations in the cells¹¹. The location of the epidermal cells is very tight with the epidermis spreading on the surface. Cell size epidermis is inversely proportional to the number of cells If the size of the epidermal cells of a species is smaller, the number of epidermal cells will be more and if the cell size is larger, the number of cells will be smaller¹². The following is a picture of the shape of the epidermal cells in the leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq leaves:

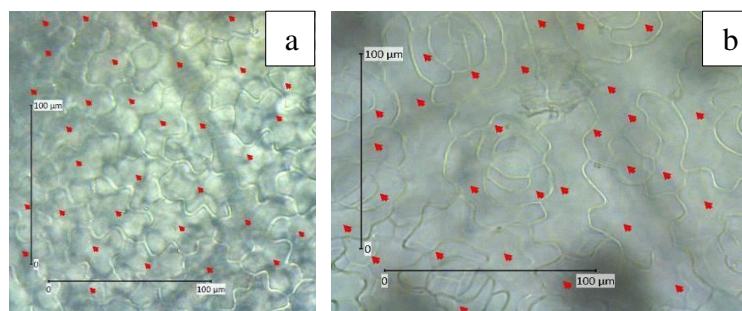


Figure 2. a. Leaf Epidermis Cell Shape of *Capsicum frutescens* L. b. Cell Shape Epidermis Leaves of *Capsicum chinense* Jacq. 400x magnification.

The epidermis on leaves has a modified cell shape, according to its function the epidermis can undergo modifications to develop into the form of stomata and trichomes¹³. Stomata comes from the word stoma which means porus or hole, each of which is bounded by guard cells. There are two types of cover cells, namely cover cells in the form of epidermal cells that have undergone changes in function and shape and cover cells that regulate the size of the hole. on stomata. Based on the results of research on leaf stomata of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. belonging to the anisocytic type of stomata where there are 3-4 irregular neighboring cells with different sizes and shapes from the shape of the kidney guard cells, this is in line with research conducted by Fauziah, that anisocytic stomata types were found in *Capsicum* leaf samples *frutescens*¹⁴. The following is a picture of the shape of the stomata on both leaves:

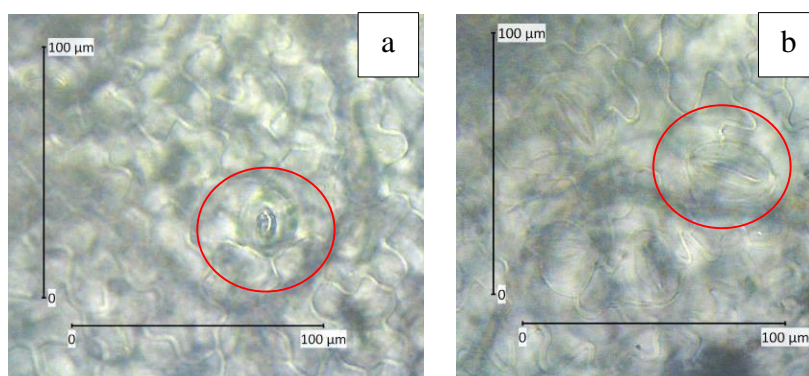


Figure 3. a. Stomata shape of *Capsicum frutescens* L. b. Leaf stomata shape *Capsicum chinense* Jacq. at 400x magnification.

Trichomes are one of the epidermal derivatives in the form of hairs which have functions such as protecting plants from predators, controlling water loss and temperature as well as solar heat. Trichomes are grouped into two glandular trichomes (having glands) and non-glandular trichomes (without glands), leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. The types of trichomes that are found on adaxial and abaxial surfaces are glandular, namely Hydatodes, while on the edges are simple hairs (non-glandular). Based on the results of previous research conducted by Dewi, et al, found several types of trichomes in the Solanaceae family with 7 plant species, one of which was (*Capsicum frustecens* L.) which was of the non-glandular type with simple hairs with hooked ends and in *Capsicum annum* it was non-glandular and glandular in the form of simple hairs with hooked ends and was found hydatodes¹⁵. Hydatodes have the characteristic of having many xylem vessels, each hydatode will form a pore structure in the leaf epidermis and function as a gland that secretes guttation water in the leaves as well as absorbing nutrients and minerals from the xylem tissue to the cells found in the leaves¹⁶. In general, the Solanaceae shows that the

tissues that make up the roots, stems, and leaves of plants are relatively the same⁴. The following is a picture of the trichomes found on both leaves:

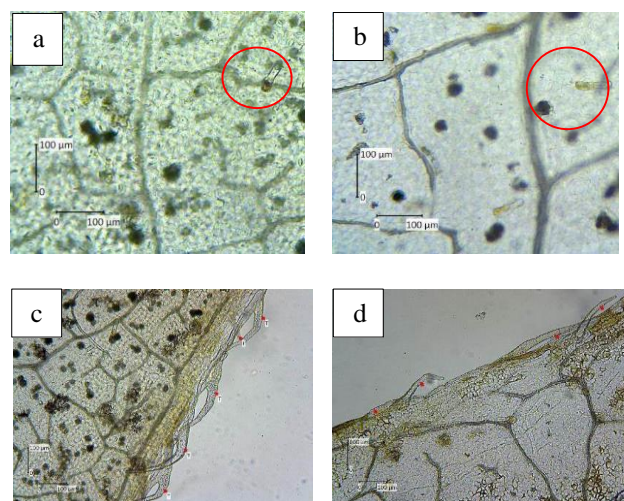


Figure 4. a. Shape of the middle trichome of *Capsicum frutescens* L. b. leaf. Middle trichome form *Capsicum chinense* leaves Jacq. c. Leaf margin trichomes of *Capsicum frutescens* L. d. Trichome shape of *Capsicum chinense* leaf edge Jacq. at 100x magnification.

Educational Research Results

The teaching materials developed are in the form of Biology Student Activity Sheets (LKPD) in the subject of structure and function of plant tissues which are intended for class XI SMA/MA students. LKPD is prepared using the ADDIE development model (Analysis, Design, Development, Implementation, Evaluation) which is limited to the Development stage. LKPD can be interpreted as teaching materials that can direct students in the learning process which contains subject matter and practice questions that can guide students to learn practically¹⁷.

PLKPD preparation begins with the analysis stage. The analysis carried out is an analysis of the needs of students, material analysis and analysis of potential research results as learning resources. Analysis of the needs of students can be seen from the existence of problems in learning activities in class when PLP 2 activities were carried out at SMA Muhammadiyah 7 Yogyakarta. Learning activity blum uses student activity sheets as a means to practice skills and solve problems. Material analysis is carried out by collecting material and compiling activities and then adjusting them to the competencies and indicators to be achieved namely in Basic Competency 3.3 and 4.3 in Biology class XI SMA subject on the structure and function of plant tissue. The absence of activity sheets for students motivated researchers to develop an activity sheet sourced from local potential. The analysis carried out next is an analysis of the potential of research results as a source of learning referring to Suhardi⁷. Munajah and Susilo put forward that before teaching materials are compiled, the results of the research must first be reviewed for procedures to see their feasibility as a source of learning and then issue as teaching material¹⁸. According to Suhardi analysis of research, results as teaching materials there are six main points, namely the clarity of the potential availability of the problem object raised, suitability with learning objectives, material objectives and their designation, guidelines for exploration and acquisition to be achieved⁷.

The next stage is the Design stage, at this stage the things that are done include formulating achievement indicators that are in accordance with KI KD, compiling LKPD that sequentially according to the LKPD components (Title, identity, indicators, core competencies and basic competencies, learning objectives, materials, work instructions, activities/exercise

questions and bibliography). The material presented in the Biology Worksheet is the structure of the epidermis, stomata and trichomes found in the leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. Design activities also include selecting fonts that are easy to read, cover designs that are attractive and appropriate to the content, colors used, illustrations and font sizes used. Then the completed LKPD products are printed on HVS paper 100 gr A4 size.

After the design stage has been carried out, the next step is the Development stage. At this stage what is being done is to develop research products to be assessed by Biology education experts. Before the product is assessed, the assessment instrument is first made, the assessment instrument used is a questionnaire instrument in the form of a Likert scale. The aspects assessed are in accordance with the assessment based on the BSNP, namely content feasibility aspects, presentation aspects, linguistic aspects and graphical aspects. The results of the Biology LKPD research were assessed by two biology education experts, namely material experts and media experts. The following is an assessment chart from material experts:

Table 2. Results of Material Expert Assessment

No	Assessment	Percentage (%)	Category
1.	Content	85%	Saremember
2.	Language	87.5%	Eligible Very
3.	Pedish	81.25%	Eligible Very
4.	Graphics	81.25%	Eligible Very
	Average	83.75%	Saworth it

Table 3. Appraiser Result Media Expert

No	Assessment	Percentage (%)	Category
1.	Content	70%	Worth
2.	Language	68.75%	Worth
3.	Pedish	56.25%	Worth
4.	Graphics	56.25%	Worth
	Average	62.81%	Worth

Table 4. Recapitulation of Quality Assessment LKPD Biology By Experts

No	Validators	Pevalue (%)	Information
1.	Material	83.75%	Saworth it
2.	Media	62.81%	Worthy
3.	Average	73.28%	Worthy

Based on the recapitulation of the two experts get a value of 73.28% it shows that the Biology LKPD on the material structure and function of plant tissue is feasible to be tested with revision. The actions taken by the researcher after getting the results of the assessment were improving teaching materials based on suggestions and input from expert lecturers. The LKPD contains material on plant structure. The characteristics of this LKPD contain material developed from the results of research on the epidermis and leaf epidermis derivatives of *Capsicum frutescens* L. and *Capsicum chinense* Jacq., featuring images of the epidermis, stoma and trichomes. In this LKPD, apart from the material, there are also activities that students can do to observe epidermal tissue and its derivatives. Here are some pictures of Biology LKPD products after revision:

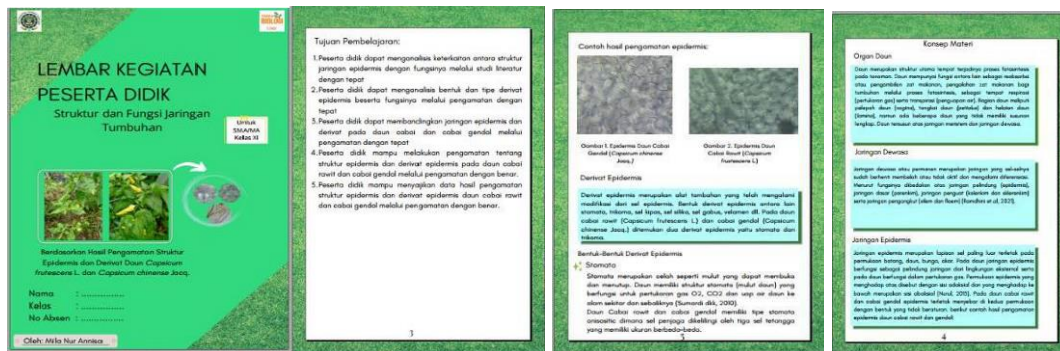


Figure 5. Some parts of the resulting LKPD

Conclusion

Characteristics of the epidermis found in the leaves of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. is having an irregular epidermal cell shape with indented cell walls, and is located spread over the surface. The type of stomata is anisocytic and has glandular and non-glandular trichome types, glandular trichomes in the form of hydatodes are found in the middle of the leaves and non-glandular in the form of simple hairs resembling needles which are found on the edges of the leaves. LKPD teaching materials based on the results of research on the structure of the epidermis and leaf epidermis derivatives of *Capsicum frutescens* L. and *Capsicum chinense* Jacq. declared feasible with an average percentage of the assessment of the two lecturers is 73.28%.

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