Potential Test Development of Dengue Hemorrhagic Fever Medicine from *Jatropha Multifida* Stem Bark as Organic Chemistry Teaching Material

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**Abstract:** *Jatropha multifida* L. is one of the medicinal plants that Bengkulu residents use as a new wound medicine inherited by the ancestors. The purpose of this research is to test *J. multifida* as a medicine of DHF through preclinical trials in mice. Furthermore, this laboratory research was developed as a teaching material, with the ADDIE model. The research started with the phytochemical test of bark extract. 40 mice were divided into eight groups; each of which consisted of 5 mice. The group of P0 mice were given olive oil using gavage, group P1 was given aspirin orally, group P2, P3 and P4 mice were given crude extract of *J. multifida* with consecutive dosage of 0.028 g / kgbw; 0.056 g / kgbw and 0.084 g / kgbw. The groups P5, P6 and P7 were given ethyl acetate extract at the dosage of 0.028 g / kgbw; 0.056 g / kgbw and 0.084 g / kgbw. The steps of the study were started from the phytochemical test. The treatment of each group of mice and the results of treatment after analysis, design, development, implementation, evaluation were then developed as teaching materials. Crude and ethyl acetate extracted from *J. multifida* barks can increase the platelet count of mice suffering from thrombocytopenia. The administration of crude extracts and ethyl acetate extract from *J. multifida* stem barks at the dose of 0.028 g / kgbw; 0.056 g / kgbw and 0.84g / kgbw can increase the platelet count of mice with thrombocytopenia. Particularly in the administration of crude *J. multifida* at a dose of 0.028 g / kgbw can increase the number of platelet up to normal in thrombocytopenic mice. Based on that fact, crude extracts from *J. multifida* barks are highly potential to be used as a medicine to increase number of platelet in DHF patients. Teaching materials developed from this case, the test activity of crude extract and ethyl acetate extract from *J. multifida* stem bark to increase the number of platelets, provide new knowledge for the students and engage them in active learning proven by the response of the students that are in very good categories.

**Keywords:** *Jatropha multifida* L.; Thrombocytes; DHF; Teaching materials; ADDIE.

1. Introduction

Indonesia is known as a country that has a wide variety of extraordinary flora. The community explores its richness to overcome health problems through medicinal plants as an alternative program to meet basic needs in improving health services. It is proved that the use of medicinal plants as alternative medicine in the present is increasing rapidly. However, its usage should be supported by...
modern technology and scientific research. Recent research provides an illustration that medicinal plants can be effective cures because it contains active compounds of secondary metabolites. *Jatropha multifida* L. is one of the medicinal plants that is hereditarily and often used by the Bengkulu Nese to treat new wounds. It is often called *Pinicilin* and *Betadin* plant. The phytochemical screening of *J. multifida* showed the presence of tannins, flavonoids, saponins [1]. This plant has anti-inflammatory and analgesic activities [2], able to glorify blood and heal the wounds from tearing [3]. The extracts from *J. multifida* could be used as antibacterial [4], based on preclinical study, it may increase platelet counts in normal mice [5], usage as local hemostatic is recommended [6], and has potential anti-malarial drugs [7]. Dengue Haemorrhagic Fever (DHF) is a disease caused by by infection of dengue virus (DENV), which is transmitted to human through the bites of *Aedes spp.* mosquito vectors [8]. Doctors always monitor DHF patients’ number of platelets on daily basis because it decreases over time and causes thrombocytopenia. If this happens it causes bleeding on all surfaces of the body tissues. The mechanism of infection and disease progression (pathogenesis) of DHF has so far not been known for certain. Therefore, vaccines and effective drugs to prevent or cure this disease are still being studied until now.

In this study, *J. multifida* was developed through preclinical test of male mice whose the amount of platelet has been decreased to find the potential for stem barks to be used as a drug DHF. The research was further developed as a teaching material, following the ADDIE development model. The development of research-based teaching materials provides students with experience of the development of new research and discoveries. The use of research results as teaching materials can provide real experience for students so that learning will be more contextual and also the research-based for students may provide real conceptual benefits to students while also providing educators with new ways to combine their research and teaching activities [9].

The rest of this paper is organized as follow: Section 2 describes the proposed research method. Section 3 presents the obtained results and following by discussion. Finally Section 4 concludes this work.

2. Proposed Method

Research and Development (R & D) is intended to produce a product and test the effectiveness of the resulting product. The product of this research is organic chemistry teaching materials that are developed from laboratory research.

2.1. Laboratory Research

2.1.1. Extraction of *J. multifida* L. stem bark sample was done by maceration.

Samples taken from Bengkulu City, washed, cut into small pieces, then aired (not dried by direct sunlight). A total of 6000 g of *J. multifida* L. stem bark is macerated with 18 liters of 96% technical ethanol in a 10 liters cup, then stored in a place protected from sunlight for 10 days, stirred once a day. The result of maceration is separated using filter paper. The obtained filtrate was then concentrated using a rotary evaporator. Most crude extracts obtained were used for pre-clinical trials in mice, others fractionated with n-hexane, and ethyl acetate (1: 1 solvent ratio) and ethyl acetate. The ethyl acetate extract was concentrated by using a rotary evaporator to be preclinical tested for mice.

2.1.2. Phytochemical test, conducted to determine the content of secondary metabolite compound of *J. multifida* stem barks [10,11]

2.1.3. Test activity of *J. multifida* L. stem bark on mice (*M. musculus*)

a. The male mice were kept in a cage with 12 hours lighting (06.00-18.00). During maintenance, the average minimum room temperature was 23.6°C to 26°C, and humidity 80.6%. Mice used are 7-12 weeks old with the average weight of 30-40 g.
b. Activity test were conducted on male mice. A total of 40 mice with 30-40 g weight were divided into 8 group treatments (P0-P7). Each group treatment consisted of 5 mice. P0 as a control group, P1 as treatment group was given aspirin, P2-P4 as treatment groups were given crude *J. multifida* extract and P5-P7 as treatment group were given ethyl acetate extract (see Table 1). Treatment of each group (P0-P7) used the gavage method. It is done orally using a gavage device directly into the stomach. Aspirin administration then performed until the mice experienced thrombocytopenia, then treated with crude extract and ethyl acetate extract.

Table 1. Sample treatment of mice with gavage method

| Group treatment | Repetition | Aspirin (mg/kgbw) | Crude extract (g/kgbw) | Extract etil acetat (g/kgbw) |
|-----------------|------------|-------------------|------------------------|-----------------------------|
| Control (P0)    | 5          | 0                 | 0                      | 0                           |
| Aspirin (P1)    | 5          | 84                | 0                      | 0                           |
| Treatment 1 (P2)| 5          | 84                | 0.028                  | 0                           |
| Treatment 2 (P3)| 5          | 84                | 0.056                  | 0                           |
| Treatment 3 (P4)| 5          | 84                | 0.084                  | 0                           |
| Treatment 4 (P5)| 5          | 84                | 0                      | 0.028                       |
| Treatment 5 (P6)| 5          | 84                | 0                      | 0.056                       |
| Treatment 6 (P7)| 5          | 84                | 0                      | 0.084                       |

Platelet counts were calculated after mice had thrombocytopenia due to aspirin administration. The calculation of platelets was done by taking blood through the tail of mice blood is placed on a hemocytometer to calculate the platelet count.

2.2. Development of teaching materials

This research and development was done to produce teaching materials that is the learning materials of organic chemistry which was intended for the students of Chemical Education Study Program of Bengkulu University. The research began with data collection through of field observations conducted together with students to search for medicinal plants used by the people of Bengkulu. The observation results were followed by laboratory research to prove preclinical (see sub-section 2.1). The results of this laboratory study were further developed as teaching materials using the ADDIE model, through the stages of analysis, design, development, implementation, and evaluation [12].

a. Stage analysis is a survey activity on semester learning plan (RPS), courses learning outcomes (CPMK) and lesson learning outcomes (Sub-CPMK) which are in accordance with the learning objectives to be achieved. Also conducted observations on the implementation of learning in the classroom as well as interviews of lecturers and students.

b. The design stage is to design teaching materials products according to the results of the analysis of the learning objectives that have been formulated, designing teaching materials ranging from the format, framework, and the design of teaching materials. Teaching material is the result of laboratory research to test the potential for *J. multifida* stem bark as a medicine DHF.

c. Development stage is a validation of teaching material that has been designed, validation is done by judgment expert, ie educational experts and material experts. Validation is done to improve the product of teaching materials that have been developed. A product worthy of use if the validate declares that the product is eligible to use.

d. Implementation stage is a step to apply the teaching materials in class. In this implementation distributed questionnaires to know the student response to the learning process as well as to the developed teaching materials.

e. Evaluation phase is the improvement on teaching materials product that has been developed after the implementation process, the improvement can also be done on the learning process.
Instruments used in this study include a validation sheet of educational experts and material experts as well as a student response questionnaire. The validation sheet is intended to look at the feasibility of the instructional materials and obtain expert input on aspects of the content presented, language, presentation, and graffiti. Questionnaire student responses conducted on field tests is intended to know the response from 20 students that learn to use teaching materials developed. The data analysis was solved using the Intracorelation class coefficient (ICC) in equation (1).

\[
ICC = \frac{RK_b - RK_e}{RK_b + (p-1)RK_e}
\]  

Where ICC = Intracorelation class coefficient, \(RK_e\) = Average squared error, \(RK_b\) = Average squares of grains, and \(P\) = Panelists.

3. Results and Discussion

This section presents obtained results and following by discussion.

3.1. Result

Research development was done to produce teaching materials of organic chemistry courses based on local potency. The teaching materials were intended for students of Chemical Education Study Program of Bengkulu University. Development of teaching materials began with laboratory research on the test of mice to determine the potential for *J. multifida* stem barks used as a medicine of DHF. The results of laboratory research include phytochemical tests and preclinical test. The results of the phytochemical test are presented in Table 2, and the preclinical test results of the mice are presented in Figure 1.

| Sample               | Flavonoid | Saponin | Tanin | Steroid | Terpenoid | Alkaloid |
|----------------------|-----------|---------|-------|---------|-----------|----------|
| Crude extract        | √         | √       | √     | -       | -         | √        |
| Extract ethanol      | √√√       | √       | √     | -       | -         | √        |
| Extract ethyl acetate| √√         | √       | √     | -       | -         | √        |
| Extract n-heksana    | -         | √       | -     | -       | -         | -        |

Note: (√) = strong, (√√√) = very strong

*Figure 1.* Number of mice platelets in each treatment
Where, P0 = Sesame oil; P1 = Aspirin; P2 = Aspirin+crude J. multifida extract at 0.028 g / kg bw; P3 = Aspirin+crude J. multifida extract at 0.056 g / kg bw; P4 = Aspirin+crude J. multifida extract at 0.084 g / kg bw; P5 = Aspirin+ethyl acetate J. multifida extract doses 0.028 g / kgbw; P6 = Aspirin+ethyl acetate J. multifida extract doses 0.056 g / kgbw; P7 = Aspirin+ethyl acetate J. multifida extract doses 0.084 g / kgbw

The results of further laboratory study were developed as teaching materials using the ADDIE model. The results of the panelist test of the feasibility of the developed teaching materials are presented in Table 3. The quality teaching materials according to panelists test is presented in Table 4. The items used for the evaluation of learning are also validated by panelists whose results are presented in Table 5, and the result of student responses are presented in Table 6.

**Table 3. Validation of teaching materials by panelists**

| SV  | JK  | Db | Variance | ICC(r11) |
|-----|-----|----|----------|----------|
| Evaluator | 0.1404 | 2 | 0.0702 | 0.7566  |
| Item   | 7.9298 | 18 | 0.4405 |          |
| Error  | 3.8596 | 36 | 0.1072 |          |
| Total  | 11.9298 | 56 |        |          |

Criteria: ICC ≥ 0.7: can be trusted, and ICC ≤ 0.7: not be trusted

**Table 4. Quality teaching materials**

| No | Component           | Criteria          | Not good | Enough | Good | Very good |
|----|---------------------|-------------------|----------|--------|------|-----------|
| 1  | Eligibility of content | 6 < x ≤ 11 | 12 < x ≤ 17 | 18 < x ≤ 23 | 24 < x = 27.6 ≤ 30 |
| 2  | Language            | 4 < x ≤ 7       | 8 < x ≤ 11 | 12 < x ≤ 15 | 16 < x = 19.0 ≤ 20 |
| 3  | Presentation        | 5 < x ≤ 9       | 10 < x ≤ 14 | 15 < x ≤ 19 | 20 < x = 23.3 ≤ 25 |
| 4  | Graffiti            | 4 < x ≤ 7       | 8 < x ≤ 11 | 12 < x ≤ 15 | 16 < x = 18.3 ≤ 20 |

Note: x is the scores of tested materials

**Table 5. Validation of the item by the expert**

| SV  | JK  | db | Variance | ICC(r11) |
|-----|-----|----|----------|----------|
| Evaluator | 0.1 | 2  | 0.05     | 0.7420   |
| Item   | 6.2667 | 19 | 0.3298   |          |
| Error  | 3.2333 | 38 | 0.0851   |          |
| Total  | 9.6  | 59 |          |          |

Criteria: ICC ≥ 0.7: can be trusted, and ICC ≤ 0.7: not be trusted

**Table 6. Criteria for assessment of student responses**

| No | Component       | Criteria          | Not good | Enough | Not good | Very good |
|----|-----------------|-------------------|----------|--------|----------|-----------|
| 1  | Learning Activities | 20 < x ≤ 34 | 35 < x ≤ 49 | 50 < x ≤ 64 | 65 < x = 70.6 ≤ 80 |
| 2  | Teaching materials | 20 < x ≤ 34 | 35 < x ≤ 49 | 50 < x ≤ 64 | 65 < x = 74.6 ≤ 80 |

Where x is the scores of student responses
3.2. Discussion

Test the activity of J. multifida stem bark as DHF medicine

Research on potential development of J. multifida as a medicine DHF started from preparing samples of J. multifida stem barks, followed by phytochemical test and activity test on mice. Phytochemical tests were intended to determine the secondary metabolite content from J. multifida stem barks. The results of phytochemical test of crude extract and ethanol extract, ethyl acetate extract and n-hexane extract of J. multifida bark are presented in Table 2. Secondary metabolite, consists of flavonoids, saponins, tannins and alkaloids, is a responsible compound in the activity of J. multifida stem barks extract.

The preparation of crude extract and ethyl acetate extract for the purpose of the activity test was carried out by airming J. multifida stem bark in a room without direct sunlight exposure. This was intended to reduce water content, stop enzymatic reactions and prevent the growth of fungi [13]. The dried J. multifida stem barks were further mashed to a powdered form and then macerated with 96% ethanol for 7-10 days while stirring periodically. Maseration is the process of solvent penetrating the cell wall and into the cell cavity. secondary metabolite compound contained in the cell cavity due to differences in concentration of solutions inside and outside the cell. In this case, secondary metabolites in the cells will be pushed out. This process was repeated so that there is a balance of concentration between the existing solution outside and inside the cell. At the end of the maceration process, filtrate was separated by filtering using filter paper, the obtained filtrate is evaporated using a rotary evaporator.

In order to know the activity of J. multifida stem barks extract from the number of platelets in this research was used male mice as test animals (body weight of mice average 30-35 g, age 7-12 weeks). Mice were used as test animal because the blood component of mice has similarities with the human blood component. The intended components are red blood cells, blood plasma, white blood cells and thrombocytes. In this study, the mice used were selected male sex, because male mice did not have estrus cycles (such as menstrual cycle in humans), where the hormone during the estrous cycle of female mice can affect the amount of blood.

In this research the number of platelets in mice was deliberately lowered by aspirin in order for mice to become thrombocytopenia (ie the number of platelets below the normal amount), it is intended to condition this study similar to real cases of DHF patients which generally always decrease the number of platelets even up thrombocytopenia and bleeding occurs to every tissue in the body. Treatment for group P0 (control) is gavage of sesame oil to mice, this is meant to know the number of normal platelets. Treatment for group P1, mice were given aspirin so that the platelet counts fell to below normal condition. Treatment for group P2, P3, and P4, mice were given aspirin, then were also gavaged with stem bark of J. multifida, followed by phytochemical test and activity test on mice.

The results of the activity test for the number of platelets obtained by the calculation data as shown in Figure 1. Based on Figure 1, control group P (0), the mice are given orally with sesame oil, the measured platelet count is \(234 \times 10^3 / \text{mm}^3\), this is the information of normal thrombocyte count on mice. The group (P1), to the mice administered orally with aspirin at a dose of 84 mg / kg, for two days, aspirin administration resulted in platelets in mice falling, in which case the mice had thrombocytopenia after aspirin administration. Thrombocytopenia is a condition when the number of platelets in the blood circulation is below normal, if there is bleeding when in a state of thrombocytopenia then bleeding becomes difficult to stop, because the blood is difficult to clot. A common cause of thrombocytopenia is a failure of platelet production by the spinal cord. It is generally caused by drug toxicity or viral infection, can also be caused by increased platelet destruction due to infection and drug induction. The cases of thrombocytopenia caused by the virus occur to people with DHF and typhoid. Thrombocytopenia cases are still categorized as mild if the platelet count is between 100,000-150,000 / \text{mm}^3, and if platelet counts are less than 60,000 / \text{mm}^3 it is
likely that spontaneous bleeding may occur because platelet function is impaired or a disorder of coagulation. If the platelet count is less than 10,000 \( \times \) \( \text{mm}^3 \) there will be more severe hemorrhage.

Administration of aspirin in mice orally for 2 days, followed by crude \textit{J. multifida} stem barks extract at 0.028 g / kg bw in group P2; 0.056 g / kg bw in group P3 and 0.084 g / kg bw in group P4 measured platelets in 236.4 \( \times \) \( 10^3 / \text{mm}^3 \); 258.8 \( \times \) \( 10^3 / \text{mm}^3 \) and 237.2 \( \times \) \( 10^3 / \text{mm}^3 \) respectively. If the treatment of P2, P3 and P4 is compared with treatment P1, then the provision of crude \textit{J. multifida} stem barks extract from mice can increase the number of thrombocyte on mice with thrombocytopenia. Even the administration of crude \textit{J. multifida} stem barks extract from a dose of 0.028 g / kg bw may increase platelet counts in mice with thrombocytopenia until platelets rise to the nearest normal platelet count (P0). This shows that crude \textit{J. multifida} stem bark extract has potential to be used as an increase in platelet count in DHF patients. The treatment of P5, P6 and P7 groups of aspirin administration in mice was continued by giving ethyl acetate \textit{J. multifida} stem barks extract from consecutive dose 0.028 g/kgbw; 0.056 g/kgbw and doses 0.084 g/kgbw, platelet count in mice was respectively 104.8 \( \times \) \( 10^3 / \text{mm}^3 \); 126 \( \times \) \( 10^3 / \text{mm}^3 \) and 209 \( \times \) \( 10^3 / \text{mm}^3 \). If the treatment of P5, P6 and P7 is compared with the treatment group P1, the ethyl extract from \textit{J. multifida} stem barks extract is also able to increase the number of thrombocyte mice with thrombocytopenia.

The result of calculation of platelet counts in crude treatment of P2 extract (P3 and P4) when comparing with treatment of ethyl acetate extracts P5, P6 and P7. Crude extract of \textit{J. multifida} bark has a greater ability than the ability of ethyl acetate extract from increasing the number of mice platelets. Secondary metabolite compounds contained in crude extracts from \textit{J. multifida} stem bark after extracted with ethanol, the polar secondary metabolite compounds will be interested in the ethanol fraction, and when extracted with n-hexane the secondary non-polar metabolite compounds will be attracted in the fraction n-hexane, while when extracted with ethyl acetate the semi-polar secondary metabolite compounds will be attracted to the ethyl acetate fraction. It can be understood that the activity of crude extract from increasing the number of platelets in mice will be greater than with ethyl acetate extract, this is because the secondary metabolite compounds contained in the ethyl acetate extract have been reduced due to partially extracted in ethanol and n-heksan. It is also possible that secondary metabolite compounds present in crude extracts work as synergistically in increasing platelet counts as compared to secondary metabolites contained in the ethyl acetate fraction.

3.3 Development of teaching materials

The teaching materials in this research were developed from the results of laboratory research on the potential for \textit{J. multifida} stem bark as a medicine DHF through test of increased of platelet counts in mice. The results of this laboratory study are further developed as teaching materials using the ADDIE model with the sequence of steps analysis, design, development, implementation, and evaluation.

The results of the analysis of RPS, CPMK, Sub-CPMK, and also observations on the implementation of learning in the classroom as well as interviews of lecturers and students, obtained the description that on the learning of organic chemistry in Chemical Education Studies Program University of Bengkulu, then the students need to be given, new knowledge and research skills. The new knowledge in this research is the development of \textit{J. multifida} plant which is known by the students only as newly wound medicine, developed to be used as medicine of DHF. To the students also need to be plied with research skills on secondary metabolit. Based on the analysis, students need to be given supplementary teaching materials on the subject of bioassay of secondary metabolite compounds. Supplementary teaching materials are designed on the basis of competence mapping results developed, in which case the student may (1) describe the secondary metabolite compounds contained in a medicinal plant that grows around the student's area. In this case the secondary metabolite compound contained in the \textit{J.multifida} L, (2) describes the preclinical method of stem bark \textit{J.multifida} L to determine the potential for DHF medicine through platelet tests for mice. Teaching materials consists of three materials in one learning activity, namely secondary metabolite compounds (active compounds), isolation of active compounds, and bioassay test of active compounds. Systematic teaching materials consist of title,
table of contents, list of drawings, table list, introduction, prerequisites, learning objectives, ability checks, learning activities, summary, evaluation and bibliography.

Teaching materials that have been designed are further developed for validation, validation is performed to gain recognition or endorsement of the feasibility of teaching materials for use. Validation is done by 3 experts ie experts in education, language and material. A product is found eligible to be used if the validator declares that the product is eligible for use. Validation results from the expert validator then tested the similarity and level of trust, to see whether the three validators provide values that are not much different. If the three validators provide not too different (same variant) then the test result is acceptable and feasible to be tested in the field. The results of the validator test, calculated using the ICC equation (1), the results of ICC calculations of teaching materials can be seen Table 3. ICC calculation results obtained ICC results $\geq 0.7$ this indicates that the test can be trusted, so the teaching material is said to be feasible to use. Panelist test is also used to determine the criteria of teaching materials on each component that is the feasibility of content, language, dish and graffiti. The results of panelist test for the criteria of instructional materials can be seen in Table 4. The criteria of assessment of teaching materials on each component in the category is very good. The items used for the evaluation of learning are also done panelist validation, panelist test results are presented in table 5. The result of the validation of the item by the panelist with the calculation of ICC obtained value of 0.7420. Therefore, ICC calculation result of validation of item about $\geq 0.7$ then result of panelist test for validation of item can be trusted.

Validated teaching material is then implemented in the classroom to find out the student's response. Response from students that want to know was the response to learning activities using teaching materials that have been developed and the student's response to the teaching materials itself that include the design of teaching materials, legibility, ease of understanding, and the depth of teaching materials. Data collection technique is done by giving a questionnaire, while the questionnaire grid student response to teaching materials used is: teaching materials can help students in mastering the subject matter; teaching materials can enhance the student's active role in the learning process; teaching materials can inspire students to be more creative in understanding material according to experience; teaching materials can motivate students to learn more about materials; benefits from teaching materials; teaching materials provide ease of use for students.

In the implementation of learning to use teaching materials can be observed that students actively follow the learning, it is shown by the student’s record things they consider important to understand, ask questions, answer questions, explore the content of teaching materials and students are actively involved in drawing conclusions at the end of each meeting. Based on the questionnaire analysis obtained a score of 70.6 for the learning process components and a score of 74.6 for the component of teaching materials used in the learning. The results of the analysis revealed that the two assessment components are included in the excellent category, see Table 5.

Evaluations were performed to refine the product developed after the product was implemented. Improvement to teaching materials is done at the request for the panelist, based on the validation results are known that the teaching materials developed, already meet the criteria of good teaching materials, teaching materials are also in accordance with the standards of competence, components are prepared to follow the systematics of writing and material presented is coherent and level the depth of the material is appropriate to apply to the students. Improvements were also made on the basis of input from students as users of teaching materials.

4. Conclusion and Recommendations

The *J. multifida* plant so far by the community Bengkuku used as a new wound medicine, in this study *J. multifida* developed as a medicine DHF through stem barks to test. Crude extracts and ethyl acetate extract from *J. multifida* stem barks at dose 0.028 g / kgbw; 0.056 g / kgbw and 0.84g / kgbw may increase the platelet count of mice with trombocytopenia. Particularly in the administration of crude *J. multifida* stem barks extract from a dose of 0.028 g / kgbw the platelet count in mice with trombocytopenia increases until the platelet count is near normal. Thus, crude *J. multifida* stem barks
to extract has good potential to be developed as a medicine to increase platelet count in DHF patients. Teaching material developed from laboratory research, in this study on the topic of crude extract activity test and ethyl acetate extract from *J. multifida* stem bark to increase platelet counts, in this case provide new knowledge for students. The presence of new knowledge in teaching materials that is studied by the students make the activeness of students in learning to be active is evidenced by the response to students that are in very good category. Clinical testing of potential *J. multifida* stem barks should be established as a base of the development of DHF medicine. Laboratory-based teaching materials should be developed in the learning to equip students with new knowledge.

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