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Production of Biosurfactant from Frangipani Flower Extract (*Plumeria rubra*) as an Eco-friendly Detergent in a Science Learning Project

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Student responses

Abstract

The study aimed to provide experience to students through experimental activities in making liquid detergent to teach substance material and their changes according to the goal of learning outcomes. The research used a type of experimental research in the laboratory. Frangipani flower extract (*Plumeria rubra*) used as research material containing saponins that be used as natural surfactants in the manufacture of liquid detergents. Frangipani flower extraction was carried out by maceration using 96% ethanol solvent. The result of extract was then subjected to a saponin identification test. In this study, it was prepared in 4 different formulations with a comparison of frangipani flower extract of 2 ml (F1), 4 ml (F2), 6 ml (F3), and 8 ml (F4). After that, it was evaluated physically and chemically including organoleptic tests, pH tests, foam stability, and detergency. Questionnaires were given to students to measure the practicum significance, learning motivation, practicum usefulness, and product creation skills. The results of the saponin test on frangipani flower extract showed positive results. And, the results of the chemical physics test were by SNI standards. The most optimum formulation is a liquid detergent with an extract concentration of 4 ml showed an organoleptic test according to SNI standards, a stability test of 85.00%, a pH of 10.30, and detergency showed good results. The result of questioner showed that students responded positively, with an average score in the high category of 78.47%.

INTRODUCTION

Education is a very important factor in human life. With education, it is hoped will equip and build people with knowledge, skills, and creativity (Hadija et al., 2020). Quality education is needed to form the next generation that can compete internationally. Various efforts are being made to improve the quality of education in Indonesia, such as the strengthen effort the elements that support the growth of educational success (Rasmitadila et al., 2021).

The 21st-century education challenge is to maximize the roles and approaches that link the learning process to the needs of the world of work and the need for innovation. Entering the 21st century, the speed of innovation introduction and innovation creation has accelerated that create a gap between the needs of society and the resource education system. A way to close the gap in developing great capability is to focus on student academic success (both theoretical and practical), or known as an outcome-based teaching strategy (Sebayang & Wahyudi, 2016).

Science is one of the subjects that teach from the basic level to the high level. Natural Sciences deals with the study of nature. Systematically, science is not only the mastery of gathering knowledge in the form of facts, concepts, or principles but also the discovery process (Arizal, 2015). When studying science, a lot of material can be taught through the experimental method. One of them discusses the top of its substances and changes through detergent manufacturing activities.

Detergent is a cleaning agent that is commonly used by the public, among the households, industry, hotels, restaurants, and others. The use of detergents not only to help wash activities but also can cause pollution effects on the environment. Detergents containing active ingredients such as ABS (*Alkyl benzene sulfonate*) or LAS (*Linear Alkylbenzene Sulfonate*) surfactants derived from petroleum can hurt the environment and living things because they are difficult for microorganisms to decompose and can pollute the environment (Radiansyah, 2011). Some of the most mpacts include triggering the

eutrophication of water, causing water pollution, various kinds of diseases, and ongoing water crises. Therefore, there is a need for a material to replace the SLS function in liquid detergents with a natural ingredient that does not cause pollution.

Saponin is a glycoside that has an aglycone in the form of sapogenin. Saponins can lower the surface tension of water, resulting in foam forming on the surface of the water after shaking. This property has similarities with surfactants (Nurzaman et al., 2018). The decrease in surface tension is caused by the presence of soap compounds which can break the hydrogen bonds in water. This soap compound has two parts, but are not the same in polarity (Van Dyck et al., 2010). The chemical structure of saponins is a glycoside composed of glycans and aglycones. The glycone part consists of sugar groups such as glucose, fructose, and other types of sugar. The aglycone portion is sapogenin. This amphiphilic nature allows natural ingredients containing saponins to function as surfactants.

Surfactants are ingredients commonly used in soap preparations. A surfactant is a molecule that has both a hydrophilic group and a lipophilic group to unite a mixture, consisting of water and oil. Surfactant molecules have a polar part,likes water (hydrophilic) and a non-polar part, likes oil/fat (lipophilic). The polar portion of the surfactant molecule can be positively, negatively, or neutrally charged (Barson, 2006).

Saponins are found in several plants, for example, frangipani plant (Plumeria sp). Frangipani is also a medicinal plant and is cultivated in gardens in India that usually use as an ornamental tree and perfumery. Frangipani flowers contain saponins and glycosides with acute toxicity studies providing safe results up to a dose of 2000 mg/kg BW without any lethal conditions in test animals. The results showed that the LD50 > 2000 mg/kg BW. 6,7. The phytochemical screening of frangipani leaf extract detected high levels of saponins and had anti-inflammatory and anthelmintic activities. Currently, frangipani plants have been used as raw materials for incense, aromatherapy, cosmetics, and health drinks (Phytochemical, 2014).

The surface tension test was carried out on frangipani extract which had the highest foam. The results of the qualitative saponin test showed that the water extract of frangipani flowers, leaves, and stems had the highest saponin content compared to other solvent extracts. The content of saponins in the water extract of red frangipani leaves, stems, and flowers can reduce surface tension with the best results obtained from the flower parts with a Critical Micelle Concentration (CMC) value of 8.61% (Nurzaman et al., 2018).

Natural ingredients with a high saponin content should replace the surfactant function with a lower level of irritation and are eco-friendly in cleansing preparations. Several studies have been conducted on frangipani plants, which show that these plants contain phytochemical saponins that can cause foam qualitatively.

Learning about substances and their changes is learning to recognize all forms of matter around us, including substances and materials contained in natural ingredients that can be used in the manufacture of detergents. Some materials are substances that are very important in life, while others are substances that are very dangerous to live in, such as polluting the environment. Learning through literature studies and field observations will assist students in understanding the various phenomena of substances and their changes which are taught in the science subject in class X of the Health Cluster of Vocational Schools (Indang Retno et al., 2022).

It will build students' logical thinking (minds on) in utilizing these substances. Aiming to reflect students' understanding of substances and their changes, hands-on activities can be carried out, namely making liquid detergents with natural ingredients. The aspects of the Science and the learning outcomes are in table 1.

Based on background, the article tries to provide experience to students through experimental activities in making detergent with simple methods in teaching substance, material, and its changes according to the goal of learning outcomes.

This study describes the manufacture of an eco-friendly detergent made from frangipani flowers as an alternative material that is safe and eco-friendly in terms of the concentration of frangipani flower extract given and tests including organoleptic tests, detergency, foam stability, and pH value.

Table 1. Aspects of Science and Learning Outcomes in class X of the Health Cluster of Vocational Schools

IPAS Aspect	**Description**
Substances and Changes	This aspect includes the types and properties of substances that are distinguished chemically and physically, the characteristics of changes in substances physically, chemically, and biologically, as well as the elements of mixed compounds.
Element	**Learning Outcomes**
Explain phenomena scientifically	Students can explain the phenomena that occur in the surrounding environment, seen from the substance and its changes
Design and evaluate scientific investigations	Students can determine and follow appropriate procedures for conducting science investigations, explain appropriate methods of investigation of a scientific question, and are expected to be able to identify deficiencies or errors in the design of scientific experiments
Translate data and evidence scientifically	Students can translate data and evidence from various sources to build an argument and can defend it with scientific explanations. Students are expected to be able to identify the correct conclusions drawn from result tables, graphs, or other data sources.

RESEARCH METHOD

This research was conducted from October to November 2022. The frangipani flower *Plumeria rubra* came from the area around the house. Sampling was selected through purposive sampling, which is a sampling carried out with a specific purpose and without comparison with samples from other regions (Ningrum et al., 2016). The flower samples selected were flowers that had a pink and white color and a yellow color in the center as presented in figure 1. The population and sample instruments were taken from several random frangipani flowers from the same tree.

Figure 1. Frangipani Flowers as a Sample

The research method used an experimental type of research in the laboratory to formulate a liquid detergent soap containing frangipani flower extract at a concentration of 2 ml (F1), 4 ml (F2), 6 ml (F3), and 8 ml (F4). Preparations were evaluated by tests, including organoleptic tests (shape, fragrance, color), pH test, foam stability test, and detergency. The variables were the Independent Variable (X), namely the concentration of frangipani flower extract, and the Dependent Variable (Y), namely eco-friendly detergents.

Research Materials

Frangipani flower, 96% Ethanol, Aquadest, coconut oil, 25% KOH, CMC, BHT, stearic acid, and perfume.

Research Tools

Oven, Blender, Sieve, Analytical Balance, Hot Magnetic Stirrer, Watch Glass, Stir Bar, Spatula, Dropper Pipette, Measuring Cup, Dark Bottle/Jar, Aluminum Foil, Filter Paper, Beaker Glass, Funnel, Erlenmeyer, pH Meter, Test Tube, and Test Tube Rack.

Production of frangipani floral extract.

Frangipani flowers are washed and removed from the petals, drained until not watery. Then, it dried in the oven at 45^{o}C for 6 hours. The dried frangipani flowers continued to cutting in a blender until smooth, then filtered through a sieve to get frangipani flower powder of the same size. Frangipani flower extraction was carried out by maceration of 10 grams of dried frangipani flower.Simplicia powder soaked in 50 mL of 96% ethanol for 7 x 24 hours into a dark bottle with occasional shaking for 24 hours at room temperature. After that, it carries out the filtration process to separate the precipitate and filtrate. The precipitate/powder dregs were macerated again with 50 ml of absolute ethanol for 3 x 24 hours. Then separate the filtrate and precipitate with filter paper.

Saponin Test

Up to 2 ml of frangipani flower extract was put into a test tube, then distilled water was added until the sample was immersed. The sample was boiled for 2 to 3 minutes. Then it cooled and shaken vigorously. Positive results are indicated by the formation of stable foam (Marlinda et al., 2012).

Liquid Detergent Formulation

The liquid detergent formula is adapted from the formula (Yuliyanti et al., 2019) with modifications as presented in table 2. The process of making the liquid detergent is performed by mixing the constituent ingredients at a temperature of 50ºC - 60ºC until it is homogenous. The liquid detergent product is then characterized.

Table 2. Liquid detergent formula for frangipani flower extract

Bahan	F I	F II	F III	F IV
Frangipani flower ethanol extract	2 mL	4 ml	6 ml	8 ml
Coconut oil	15 ml	15 ml	15 ml	15 ml
KOH 25%	9.5ml	9.5ml	9.5ml	9.5ml
CMC	1.5 g	1.5 g	1.5 g	1.5 g
Stearic acid	3.6 g	3.6 g	3.6 g	3.6 g
BHT	0.5 g	0.5 g	0.5 g	0.5 g
Perfume	2 ml	2 ml	2 ml	2 ml
Aquades	65 ml	65 ml	65 ml	65 ml

Source: Mela Yulianti, et al (2019) with modifications

Production of Detergent Formulas

Put 15 ml of coconut oil into a beaker glass and add 9.5 ml of 25% KOH little by little, while continuing to heat it at 50ºC until it forms a paste soap. Then add 15 mL of distilled water to the paste, soap, and CMC which has been developed in 15 mL of hot distilled water, and stir until homogeneous. The next step is to add 3.6 grams of stearic acid and 0.5 grams of BHT, and stir until homogeneous. Add 2 ml of frangipani flower extract, then stir until homogeneous, and add 2 ml of perfume. Lastly, it add 35 ml of distilled water to the liquid detergent and stir until homogeneous**.** After everything is homogeneous, the liquid detergent is put into a prepared sterile bottle. The liquid detergent is used as a preparation for formula 1. Steps are repeated for formulations of liquid detergents 2, 3, and 4 (table 2).

Evaluation of Liquid Soap Preparations

Evaluation of liquid soap preparations was under the requirements of the Indonesian National Standard (SNI) 06-4085-1996 with several additional tests, including preparation organoleptic tests, measurement of preparation pH, foam stability, and detergency tests.

Organoleptic Test

The appearance test was carried out by looking directly at the color, shape, and smell of the liquid soap formed (Depkes RI, 1995). According to SNI, the ideal liquid soap standard is having a liquid form, as well as a distinctive smell and color (SNI, 1996).

pH test

5 grams of the preparation to be examined is diluted with water up to 50 mL. The pH meter electrode is immersed in the solution to be examined. The pH is recorded according to the numbers printed on the pH meter. The pH test is important to see a detergent effect when contact with the skin or becomes waste. According to SNI (06-0475-1996), the standard pH value for liquid detergents is allowed between 8-11 (SNI, 1996).

Foam Stability Test

To evaluate the stability of the resulting foam is carried out by taking 5 grams of liquid soap preparation, which is put into a test tube, and then adding 10 ml of water. After that, it shakes for 30 seconds and measure the foam height in the first and fifth minutes. Foam stability is formulated as follows:

$$Foam\ Stability\ = \frac{H}{Ho} x\ 100\%$$

Where, Ho is the initial foam height measurement and H is the foam height measurement after 5 minutes.

Detergency Power

Detergent power is used to assess the effectiveness of the foam in cleaning dirt adhering to the fabric. The detergency test is carried out by looking at the test results for fabrics, both with and without rinsing.

Student's Response

The questionnaire method is used to carry out data collection techniques. The questionnaire is closed-ended questions consisting of 20 questions for which an answer has already been given. Respondents can select the statement that seems most consistent with the fact in question. There are four options for each statement item's response: Strongly Agree, Agree, Disagree, and Strongly Disagree. The answers range from positive to negative. A Likert scale was used to analyze student responses. Table 3 present the response questionnaire rating scale.

Percentage of each instrument item numbers obtained by the formula:

$$\frac{Total\ Score\ of\ Respondents'\ Answers}{ideal\ scores} X100\%$$

Ideal score = maximum score x number of respondents

Table 3. The rating scale for the student response questionnaire

Positive Question		Negative Question	
Strongly Agree	= 4	Strongly Agree	= 1
Agree	= 3	Agree	= 2
Disagree	= 2	Disagree	= 3
Strongly Disagree	= 1	Strongly Disagree	= 4

The percentage of student response categories are: First, 80% to 100% is categorized as Very High. Second, 60% to 80% is categorized as High. Third, 40% to 60% is categorized as Enough. And, 20% to 40% is categorized as Low (Riduwan, 2016)

The questions are divided into 4 categories including (1) practicum significance, (2) learning motivation, (3) practicum usefulness, and (4) product creation skills. (Kurnia & Daningsih, 2021)

RESULT AND DISCUSSION

Identification of saponin compounds in a frangipani flower extract

Saponins contain steroid and triterpenoid groups which function as nonpolar groups and glycosylic groups which act as polar groups. Compounds that have polar and non-polar groups will be surface active. So, when shaken with water, saponins can form micelles, and the nonpolar groups will face inward while the polar groups will face out (Yuliyanti et al., 2019). The results of the saponin test for frangipani flower extract are presented in figure 2.

The results showed that a frangipani flower extract contains saponin compounds which are characterized by the formation of stable foam with a height of 0.7 cm for 2 minutes.

Figure 2. Saponins detection test, foam test

These results are consistent with research results which show the red frangipani flower extract containing saponins that have the property of reducing surface tension with a CMC value at a concentration of 8.61%. Cambodian red contains several types of secondary metabolites such as flavonoids, alkaloids, terpenoids, steroids, polyphenols, and saponins (Husni & Helwati, 2013; Nurzaman et al., 2018). Saponins of white frangipani flowers (Plumeria acuminate) have antifungal activity (Sari & Sumadewi, 2021).

Evaluation of Physical Properties of Frangipani Flower Extract Liquid Detergent.

Evaluation of the physical properties of the frangipani flower extract liquid detergent formula was an organoleptic test, pH value test, Foam Stability Tes, and Detergent Power according to the Indonesian National Standard (SNI) in table 6.

Organoleptic Test

Organoleptic test aimed to determine the physical appearance of liquid detergent preparations by looking at the shape, smell, and color. The more addition of frangipani flower extract, the color of the liquid detergent changes from white to slightly yellowish (cream). And, the preparation is in the form of a homogeneous liquid with a distinctive scent of strawberry aromatherapy perfume with the difference in color variations due to differences in the concentration of frangipani flower extract added.

It is through the rules of SNI, that a good organoleptic test is to produce a homogeneous liquid with a distinct smell and color. Table 4 shows the results of the organoleptic test on frangipani flower extract liquid detergent.

Table 4. Results of organoleptic tests for liquid detergent preparations

Sample	Shape	Color	Smell
F1	Viscous liquid	white	Khas
F2	Viscous liquid	cream	Khas
F3	Viscous liquid	cream	Khas
F 4	Viscous liquid	cream	Khas

Information :
F1: Formula 1 with a 2 ml extract concentration
F2: Formula 2 with a 4 ml extract concentration
F3: Formula 3 with a 6 ml extract concentration
F4: Formula 4 with a 4 ml extract concentration

PH test

PH is an important parameter in the manufacture of detergent because the pH value

determines the feasibility of the detergent to be used. The value of the soap solution depends on the type of fat, for example, soap made from coconut oil has a pH in the range of 8-11, such as, soap made from coconut oil has a pH between 9 -10. According to SNI (06-0475-1996), the standard pH value for liquid detergents is allowed between 8-11 (SNI, 1996).

The results showed that the pH of various liquid detergent formulas for frangipani flower extract, ranged from 9.50 – 10.56 (table 5).

Table 5. Results of testing the pH of liquid detergent preparations

Sample	Extract Concentration	pH
F1	2 ml	10.56
F2	4 ml	10.30
F3	6 ml	9.76
F4	8 ml	9.50

Information :
F1: Formula 1 with a 2 ml extract concentration
F2: Formula 2 with a 4 ml extract concentration
F3: Formula 3 with a 6 ml extract concentration
F4: Formula 4 with a 4 ml extract concentration

The resulting pH is alkaline. This pH value has entered the range stipulated by SNI. Based on the results obtained in the pH test, it is known that the increasing concentration of frangipani flower extract, the lower the pH, as shown in Figure 3, indicates that the saponin extract is acidic. The pH value of the soap is affected by the alkaline content, the pH value increases with increasing acidity. In addition, a decrease in pH also occurs over time.

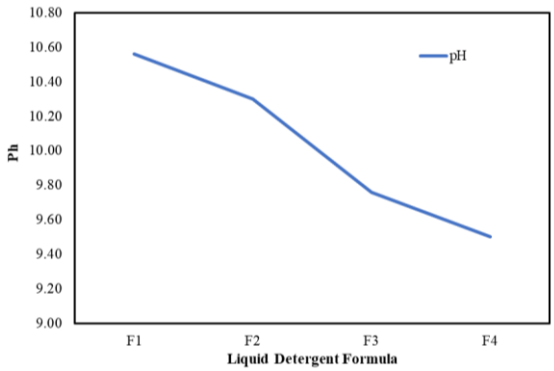

Figure 3. The pH value of various frangipani flower extracts liquid detergent formulas.

Information :
F1: Formula 1 with a 2 ml extract concentration
F2: Formula 2 with a 4 ml extract concentration
F3: Formula 3 with a 6 ml extract concentration
F4: Formula 4 with a 4 ml extract concentration

Foam Stability Test

The foam stability test can be used to find out how long the resulting foam can be stable. This observation was carried out in a test tube with a shaking process for 30 seconds (figure 4).

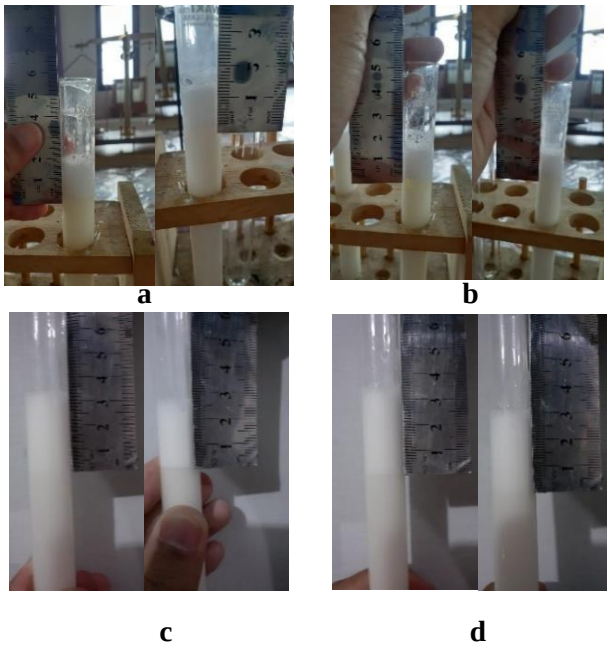

Figure 4. Detergent foam formation. Foam test results on detergents with different concentrations of frangipani flower extract a. 2 ml b. 4 ml c. 6 ml d. 8 ml

A foam is considered stable if it has a stability score of approximately 60–70 after forming for 5 minutes (Yulyanti et al, 2019). Table 6 shows the results of the foam stability test within 5 minutes.

Table 6. Foam stability test within 5 minutes

Sample	Initial Height (cm)	Final Height (cm)	Foam Stability (%)
F 1	1.9	1.5	78.95
F 2	2	1.7	85.00
F 3	3.6	3	83.33
F 4	3.2	2.6	81.25

Information :
F1: Formula 1 with a 2 ml extract concentration
F2: Formula 2 with a 4 ml extract concentration
F3: Formula 3 with a 6 ml extract concentration
F4: Formula 4 with a 4 ml extract concentration

The data shows that F2 has the highest stability value of 85.00% and F3 at 83.33%. And, the lowest is F1 at 78.95% which is still in the stable category. Foaming is affected by the presence of surfactants and active substances present in the formulation. The surfactant will form a layer with the adsorbed molecules on the surface of the layer. The polar part

of the surfactant will be on the outside of the layer and interact with water, while the non-polar part of this surfactant will interact with trapped air. However, the stability of the foam is poor if the resulting foam is thermodynamically unstable and easily broken or lost. Foam that is easily lost is caused by coalescence and thinning of the film layer due to the velocity of the flows (drainage) (Rozi, 2013).

Detergency Test

The detergency test is used to assess the effectiveness of the foam in cleaning dirt adhering to the fabric. The detergency test was carried out in 2 ways, namely the detergency test with rinsing and without rinsing. The mechanism for removing dirt by detergents is by lowering the surface tension to form an emulsion, and binding the dirt in suspension so that the dirt is removed. In soap, the COO, the group is a polar part that dissolves in water (hydrophilic), while the R group which is a long carbon chain C12-C18 is a part that is non-polar and insoluble in water (hydrophobic) but this group dissolves in water and non-polar solvents such as oil (Febrianti, 2013).

In the study, the cloth had been given soil as an impurity was tested with 4 detergent formulas that had been made to test the results. Then, it showed that all detergent preparations that had been made had fairly good detergency because they showed the ability to remove dirt properly and did not leave the other colors on the fabric. Detergency power of the cloth with 2 treatments, namely without rinsing and with rinsing. The result of detergency test is presented in figure 5.

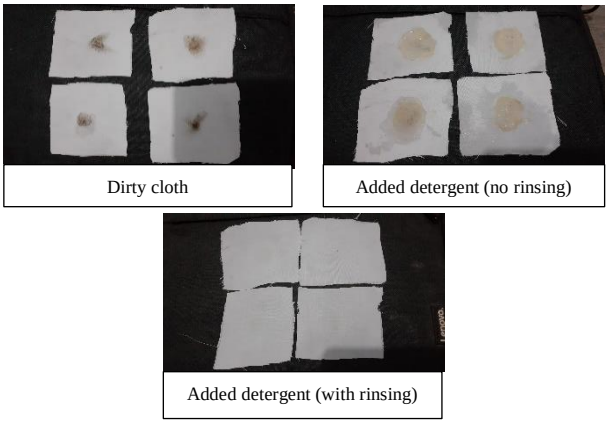

Figure 5. The results of the detergency test

In the detergent test without rinsing, the test

In the test by rinsing with water the color of the cloth becomes whiter and cleaner.And, the remaining dissolving dirt can be removed. Based on research, formulas 2 and 3 show good detergency. The value of both is almost the same when it comes to the stability of the foam, which has a value of 85.00% and 83.33%. The more stable the foam that is formed, the faster the surfactant will lift dirt because contact with dirt will be more optimal. Formulas 1 and 4 when rinsing the stains are not completely removed so the marks remain.

Table 7. Results of physical and chemical evaluation of frangipani flower extract liquid detergent

No.	Formulas	Test Parameters			
		Organoleptic	pH	Foam Stability (%)	Detergent Power
1	F1	Viscous liquid, White, strawberry aroma	10.56	78.95	Still, stains remain
2	F2	Viscous liquid, Cream, strawberry aroma	10.30	85.00	Clean
3	F3	Viscous liquid, Cream, strawberry aroma	9.76	83.33	Clean
4	F4	Viscous liquid, Cream, strawberry aroma	9.50	81.25	Still, stains remain
5.	SNI	Homogeneous liquid has a characteristic color and scent	8 - 11	60 -70	Clean

Information :
F1: Formula 1 with a 2 ml extract concentration
F2: Formula 2 with a 4 ml extract concentration
F3: Formula 3 with a 6 ml extract concentration
F4: Formula 4 with a 4 ml extract concentration

Students' response to the production of biosurfactant from frangipani flower extract as an eco-friendly detergent

A total of 27 students filled out a questionnaire after completing the practicum. The students' response questionnaire consisted of 4 sub-variables which were developed into 20 modified questions.

Based on the analysis of the students' response questionnaire results about the practice of creating biosurfactants from frangipani flower extracts as eco-friendly detergents received an overall average

percentage of 78.47% with the high category. This shows that the practicum has fulfilled 4 sub-variables, the significance of the practicum, learning motivation, practicum usefulness, and product creation skills (table 8).

Table 8. Data from Questionnaire Analysis Results of Students' Responses to Practicum Making Biosurfactant from Frangipani Flower Extract (*Plumeria rubra*) as an Eco-Friendly Detergent.

	Sub Variable	Percentage of student response	Category
1	Practicum significance	79.07%	High
2	Learning Motivation	84.94%	Very High
3	Practicum usefulness	81.36%	Very High
4	Product creation skills	68.52%	High
	Average	78.47%	High

The first sub-variable is a response questionnaire about the practicum's significance. Response students in this sub-variable are included in the high category of 79.07%. This indicates that the practicum for making biosurfactants from frangipani flower extract as an eco-friendly detergent that has been carried out by students makes it easy to understand the substance of the material and their changes, and provides a deeper meaning of the learning. Students' responses statement about the practicum's significance are presented in figure 6). Direct experience through practicum methods has an impact on increased student learning activity and led to an increase in students' process skills. Then, it leads to student understanding of a material or concept that can last a relatively long time (Nopri Jumarni, Tri Jalmo, 2013). Students can achieve learning success by doing and experiencing for themselves what they have learned through experimental methods that allow for the application of a variety of science process skills and the development of a scientific attitude that supports the process of knowledge acquisition (scientific product) in students (Subiantoro, 2010).

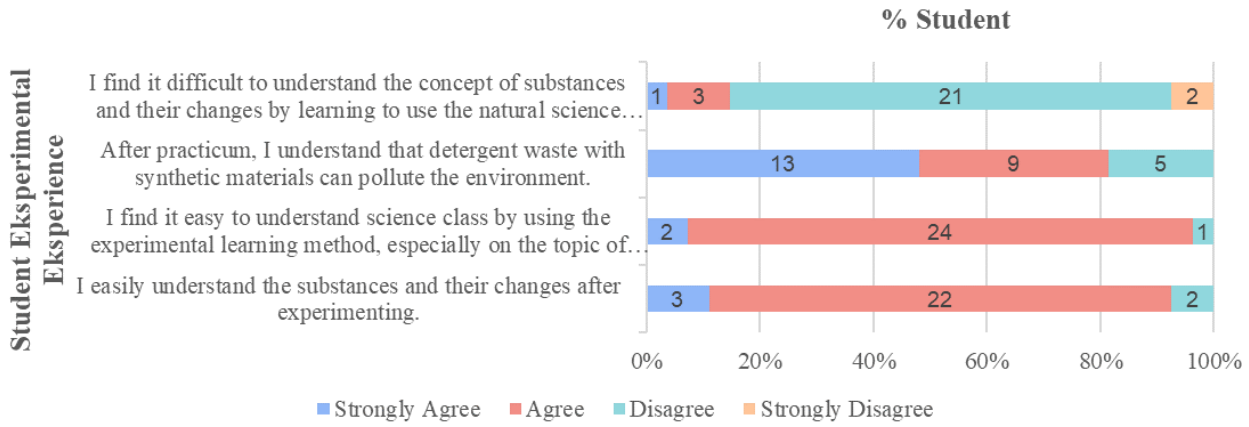

Figure 6. Student responses about the significance of practicum

The second sub-variable measures responses about learning motivation. The average response of students in this sub-variable is 84.94% (table 8) and included in the very high category. This shows that the practice of making biosurfactants from frangipani flower extract as an eco-friendly detergent can inspire and motivate students to continue learning and discover concepts that can be applied in everyday life. One of them is eco-friendly detergent from frangipani flower extract as an application of the topic of substance and their changes. Overall, motivation is a psychosocial driver of students who create learning activities. Motivation to learn is a form of encouragement from within students that encourages students to be involved in a period of activity aiming to achieve changes in behavior as a result of cognitive, affective, and psychomotor abilities from relevant learning experiences. Students manifest themselves in the form of active involvement in learning (Bahriah & Abadi, 2016). Students' responses statement about learning motivation is presented in figure 7.

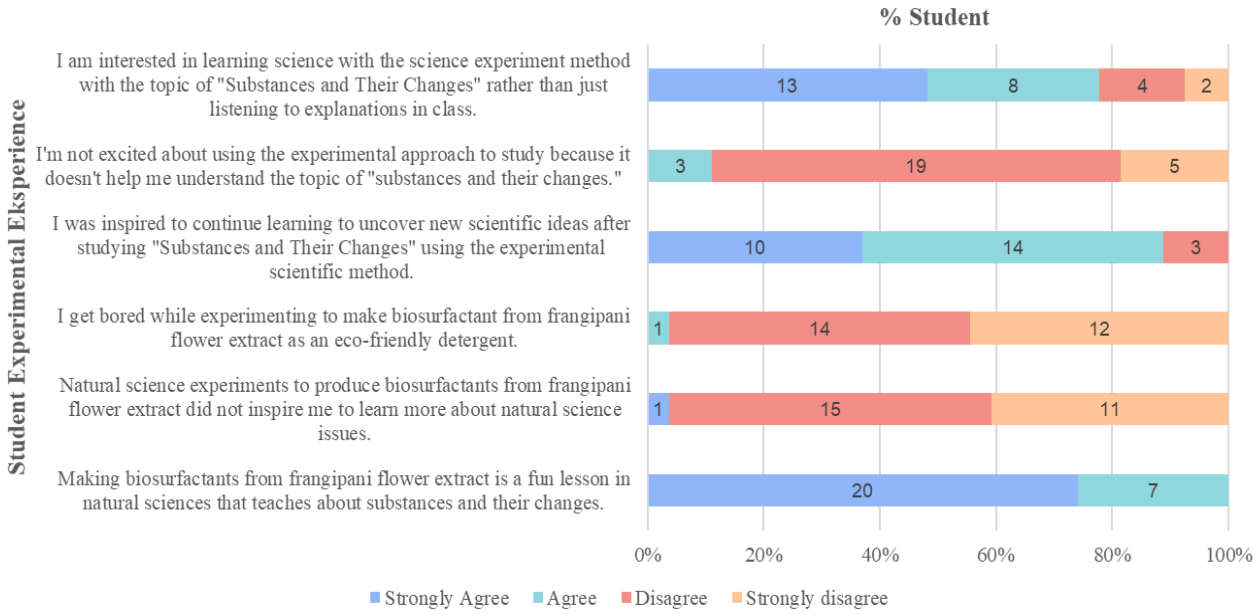

Figure 7. Student responses about the learning motivation

The third sub-variable analyzes the opinions of the students on the usefulness of the practicum. This sub-average variable's percentage is 81.36%, which comes into the very high category. This indicates that the advantages of using frangipani flower extracts to create eco-friendly detergents are obvious, particularly in reducing detergent waste that can contaminate the environment. In addition, by using the scientific method, students are more concerned about the environment. When used it properly, media may make learning activities much easier and more engaging for students, and increasing their desire to understand what they are studying (Primasari et al., 2015). Students' responses statement about the usefulness of practicum is presented in figure 8.

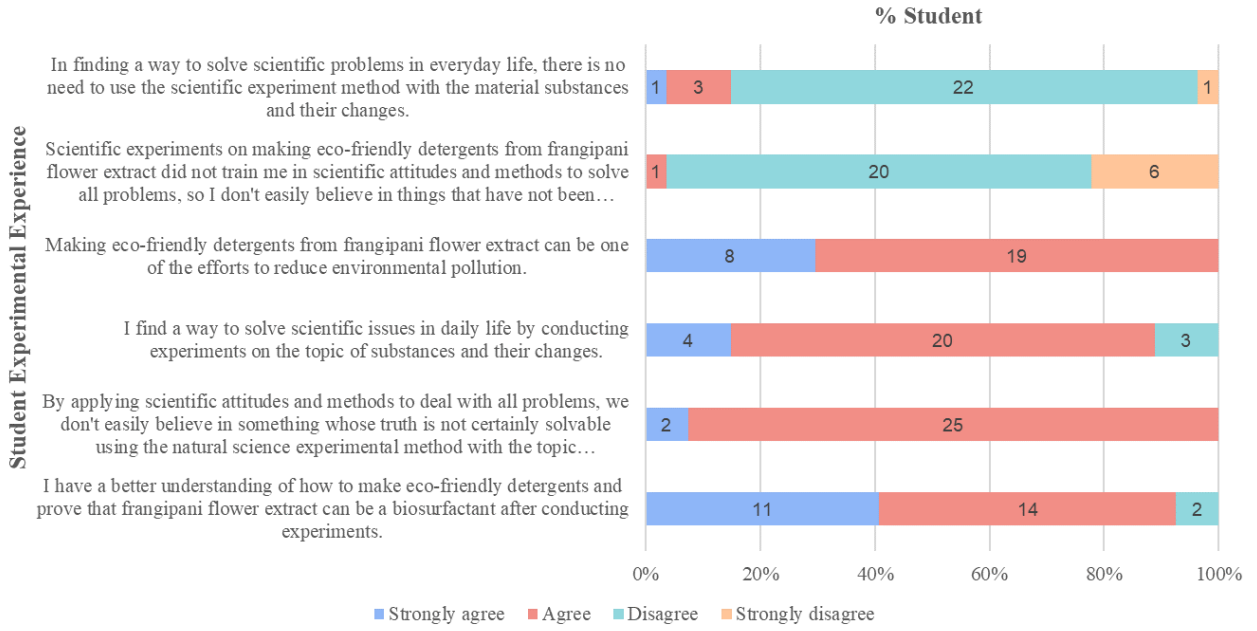

Figure 8. Student responses about practicum usefulness

The fourth sub-variable measures students' opinions on product creation skills. The average percentage is 68.52% in the high category. It implies that a practicum involving the creation of eco-friendly detergent using frangipani flower extract can improve students' abilities to create green products from natural ingredients. One value of the practicum is that, it enables students to make fresh conclusions from their experiments and gives students the chance to improve their experimental

skills and creativity, as well as their inspiration and motivation to learn science subjects, especially in the topic of substances and their changes (Zahara et al., 2017). Students' responses statement about product creation skills is presented in figure 8

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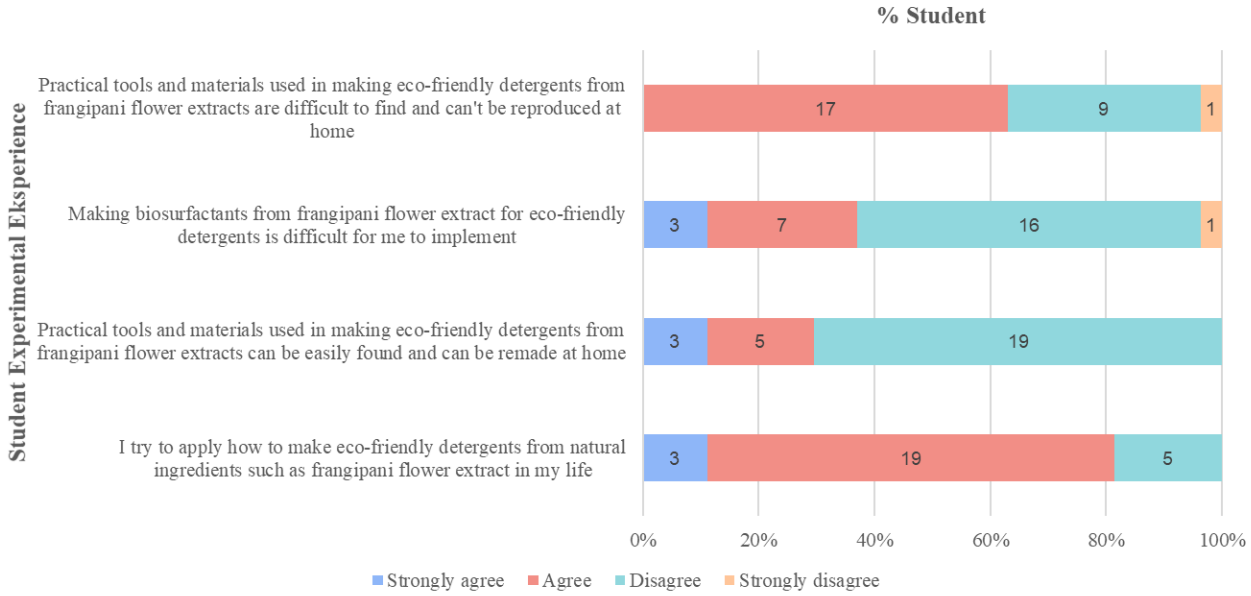

Figure 9. Student responses about product creation skills

Overall, the student's response to the practicum of production of biosurfactant from Frangipani flower extracts as an eco-friendly detergent is in the high category. This shows that the practice gets a very good response from students. This is illustrated by the student's response to each question in the sub-variable indicates that practicum is very well applied to the topic of substances and their changes. Besides that, experience in making biosurfactants from Frangipani flower extracts as an eco-friendly detergent can make students more concerned about the environment and its surroundings.

CONCLUSION

Based on finding and discussion, it concluded that frangipani flower extract contains saponins. It has function as surfactants where the chemical content contained in frangipani flowers is more eco-friendly as it is easily biodegradable and is also expected to increase the effectiveness of detergent cleaning power by removing dirt. This can provide the potential for natural ingredients to be developed into detergents. The most optimum composition of frangipani flower extract is at a concentration of 4 ml. Whereas, in the organoleptic test, the formula has a liquid texture and is slightly viscous, homogeneous, yellowish white (cream) in color, and has a distinctive odor. The pH test shows the number 9.50, the foam stability test is 85.00 % and the detergency test shows the maximum removal of dirt and meet THE SNI standards.

The practice of making biosurfactants from frangipani flower extract (plumeria rubra) as an environmentally friendly detergent was well received by students as seen from the students' response questionnaire scores with an average of 78.47% in the high category.

It is hoped that practicum can be applied and used as one of the learning methods on the topic of substances and their changes in science learning. In addition, it is hoped that the manufacture of environmentally friendly detergents will not be limited to the use of natural materials such as frangipani flowers.And, the better materials for the environment can be found.

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