

Research Article

Development of Worksheets Based on Guided Inquiry on the Production of Hand Sanitizer from Mahogany Seed Extract (*Swietenia mahagoni*)

Rolina Afriani, Saepudin Rahmatullah, Yulia Sukmawardani*

Department of Chemistry Education UIN Sunan Gunung Djati Bandung, Indonesia

ORCIDSaepudin Rahmatullah: <https://orcid.org/0000-0002-6290-5038>Yulia Sukmawardani: <https://orcid.org/0009-0004-9663-7301>**Abstract.**


This research aimed to develop a worksheet based on guided inquiry on colloidal class learning material. Hand sanitizer is one application of the colloid system. In this study, a hand sanitizer was made using an additional ingredient of mahogany seed extract as an active substance to replace alcohol as an antibacterial. The purpose of this study was to compile and determine the results of a guided inquiry-based worksheet validation test. The research method used was Design-Based Research (DBR). The results of the validation test by expert lecturers were declared valid with an average r-count value of 0.860. The worksheets produced are in accordance with the stages of guided inquiry-based learning and are feasible to be applied to colloid subjects in class XI science with a r-count of 0.83. The hand sanitizer produced was in accordance with SNI 2017 with a pH range of 6-8. This worksheet can later be applied in practical waste management and treatment.

Keywords: worksheet, guided inquiry, hand sanitizer

Corresponding Author: Yulia Sukmawardani; email: yulia.sukmawardani@uinsgd.ac.id

Published: 3 April 2024

Publishing services provided by Knowledge E

 Rolina Afriani et al. This article is distributed under the terms of the [Creative Commons Attribution License](#), which permits unrestricted use and redistribution provided that the original author and source are credited.

Selection and Peer-review under the responsibility of the ICMSCE Conference Committee.

1. INTRODUCTION

Learning in the 21st century is marked by the revolution era 4.0 [1]. In this century, learning does not only rely on knowledge, but requires students to be able to think critically, cooperate, be creative, and have communication skills. These skills are important components that are needed in various fields of life [2], one of which is in the field of chemistry.

Chemistry is the study of the composition of a substance, its structure, properties and changes. Chemistry forms abstract concepts with concrete examples [3]. In studying chemistry students are required to understand and master all the concepts [4]. The scope of material in chemistry is very broad, so many students assume that chemistry

OPEN ACCESS

is difficult to understand [3]. Therefore, to assist students in understanding abstract concepts in chemistry, learning by experiment/practicum in the laboratory is needed [5].

The implementation of the practice is still dominated by only applying what is in the module where several indicators regarding the development of students' scientific skills have not been achieved [6]. Therefore, media is needed to support the implementation of practice in the form of worksheets (LK) [7]. One of the students' scientific skills can be achieved by using guided inquiry-based worksheets [8]. Through guided inquiry worksheets, students participate during the practice, observe each step, analyze the results obtained, and draw conclusions about the practice carried out [9].

Over the last few years, outbreaks of diseases caused by viruses and bacteria that attack Indonesian people have increased significantly [10]. Causing health needs such as masks, soap and hand sanitizers to become items needed by the Indonesian people as a form of prevention. However, the manufacture of hand sanitizers must also be based on SNI standards, manufacture of hand sanitizers from mahogany seed raw materials, in addition to reducing solid waste, of course according to SNI, which has a pH of 4-10. This pH is a pH that is acceptable to the skin.

Most of the hand sanitizers circulating in the community contain high levels of alcohol, if used continuously it will cause irritation. This is the weakness of the hand sanitizer. Therefore, the researcher intends to make a hand sanitizer with natural ingredients as an additional ingredient in the manufacture of hand sanitizer, namely mahogany seeds. Because mahogany seeds contain flavonoid compounds from the isoflavone group [11].

According to Suryani and Agung, the use of worksheets can increase student activity during the learning process [12]. Conducted research on making worksheets for hand sanitizer making. However, the worksheets used were based on the science of writing heuristics. Therefore, researchers will develop worksheets on the manufacture of hand sanitizer based on guided inquiry [13].

Based on the results of the above explanation, the development of guided inquiry-based worksheets is appropriate to be applied in learning chemistry on colloidal materials. The objectives of this research are: 1) To describe the appearance of LK products based on guided inquiry on the manufacture of hand sanitizer from mahogany seed extract. 2) Analyzing the results of the guided inquiry-based LK validation test on the manufacture of hand sanitizer from mahogany seed extract. 3) Analyzing the results of the LK feasibility test based on guided inquiry on the manufacture of hand sanitizer from mahogany seed extract.

2. RESEARCH METHOD

This study uses the Design Based Research (DBR) research method [14]. The DBR method is used because in addition to its function to develop, DBR is also to produce products. The product in question is a guided inquiry-based worksheet that can be used in chemistry practicum. The design used in this study using the ADDIE model, including the preparation (Analysis), the design stage (Design), and the development stage (Development), while the implementation stage and the evaluation stage were not carried out.

In the preparation (analysis) stage, it is done by reviewing the literature, defining research problems, and finding suitable solutions for educational problems and then conducting a preliminary study of the product to be developed. At the design stage, collect tools and materials needed for research, as well as design experimental procedures. At the development stage, a preliminary test is carried out based on the procedures that have been designed which are then outlined in the form of guided inquiry-based worksheets, the resulting worksheets are then validated by the validator. The resulting data were analyzed by comparing the results of the feasibility test (r) with the critical value. The worksheet is said to be valid if the value of r -count > 0.3 [15]. The procedure for making hand sanitizer is done by heating CMC-Na and aquades until completely dissolved, then adding other ingredients with the formula as shown in Table 1.

TABLE 1: Hand sanitizer formulation from mahogany seed extract.

Ingredient	Formula 1	Formula 2	Formula 3
CMC-Na	1 g	1 g	1 g
Aquades (mL)	100	100	100
Glycerin	1.5	1.5	1.5
Propylene Glycol (mL)	1	1	1
Mahogany Seed Extract(mL)	5	10	15
Essential Oil (mL)	1	1	1

The hand sanitizer produced is then carried out by organoleptic tests in the form of odor, color and texture/shape tests as well as pH tests using a pH meter and Universal Indicator, to determine whether the hand sanitizer is in accordance with SNI 2017 and is suitable for use.

In this study, data collection techniques were carried out with the LK validation test generated from the questionnaire sheet and the limited LK test on students. The results of the validation test are used as a reference for the feasibility of the resulting LK. The validation questionnaire was filled out by the validator, namely 3 chemistry education

lecturers, while the feasibility test questionnaire was filled out by 15 students of class XI who majored in science at SMAN 1 Sukra.

The data obtained is processed by comparing the feasibility value of r-count with the specified critical value. The critical value is used to determine the validity limit of a tool/media whose value has been set at 0.3. The r-count value is then compared with critical if the r-count value is greater than critical ?? then the instrument is considered valid, and if r-count is less than critical ?? the instrument is said to be invalid [15].

The processing of the questionnaire data obtained from the limited respondents' answers is processed by the following equation :

$$\text{score percentage} = \frac{\sum \text{score obtained}}{\sum \text{score maximum}} \times 100\%$$

3. RESULTS AND DISCUSSIONS

In the following, the results of the research are presented in three parts. The first part is the LK display, the second is the results of the LK validation and the third is the results of the LK feasibility test. The preparation of guided inquiry-based worksheets is based on a framework of thinking. Development of this worksheet is carried out using the Design Based Research (DBR) method which is divided into 3 stages including the preparation stage (Analysis), the design stage (Design), and the development stage (Development). Based on the results of material analysis and journals regarding the manufacture of hand sanitizer from mahogany seed extract, the material taken is colloid in Class XI IPA with the learning objective of applying a colloid system in the form of a gel in the manufacture of hand sanitizer from mahogany seed extract [1]. The results of the journal analysis regarding the manufacture of hand sanitizer from mahogany seed extract show that this experimental material can be applied to colloid subjects in class XI who are majoring in science.

At this stage, the collection of materials that will be presented in a guided inquiry-based worksheet on colloidal chemistry is carried out such as: material text, phenomenon text, pictures, and the stages of guided inquiry worksheet [2]. The materials collected are selected on the basis of suitability to enhance the chemical properties of the material. The purpose of collecting these materials is to facilitate the process of making practice worksheets, so that they can be done properly and correctly. At this stage, the procedure for mahogany seed extract and hand sanitizer was also carried out.

At this stage, a preliminary test was carried out on the manufacture of mahogany seed extract and the manufacture of hand sanitizer from mahogany seed extract based on the tools and materials and procedures obtained from the design stage which will be presented in the form of worksheets [3]. The display of the guided inquiry worksheet consists of 6 stages, including: Orientation (problem identification), formulating problems, formulating hypotheses, collecting data (designing and conducting experiments), testing hypotheses (processing data), making conclusions.

On the first page of the guided inquiry-based worksheet, the student identity format, the purpose of the activity, and instructions for working on the worksheets are given. Then on the next page, the discourse is given as in Figures 1, 2 and 3.

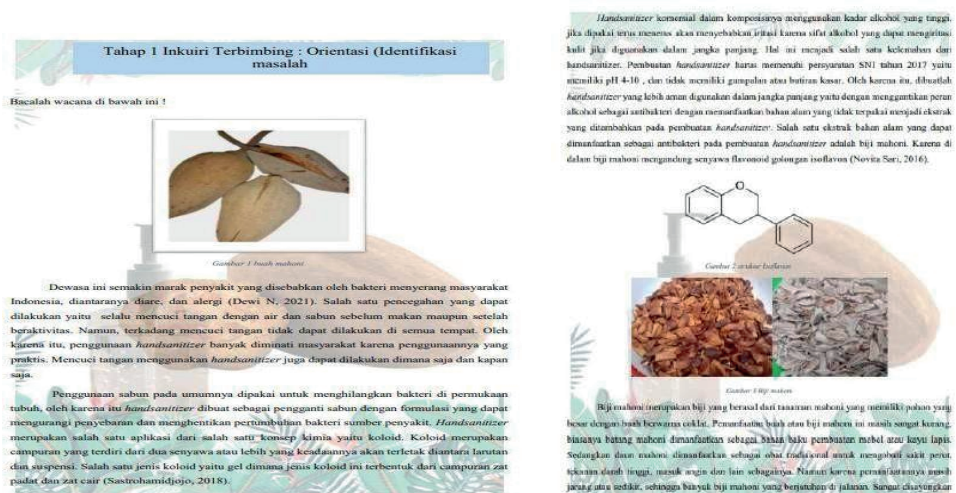


Figure 1: Display of text paragraph 1-4.

The purpose of the first and second paragraphs is to find out that prevention efforts against diseases caused by bacteria can be overcome with the use of soap and the more practical use of hand sanitizer, and to find out that hand sanitizer is one application of the colloid system. The purpose of this paragraph is to find out the dangers of using commercial hand sanitizer if used in the long term, and the use of natural ingredients, namely mahogany seed extract as a substitute for the role of alcohol in the manufacture of hand sanitizer, to find out about the characteristics of the mahogany plant and its functions, and how to make mahogany seed extract.

This paragraph aims to explain how to make hand sanitizer from mahogany seed extract, then questions are presented that direct students to find problems with the discourse presented. The next stage students are given instructions to determine the variables and problem formulation as shown in Figure 3(a). At the stage of formulating a hypothesis, students are given instructions to write a hypothesis based

jika biji mahoni terbuang begitu saja (Koneri, 2016). Untuk dapat memperoleh ekstrak biji mahoni, biji mahoni dihancurkan dan dimacerasi menggunakan pelarut etanol 96% dengan perbandingan 1:10. Kemudian pelarut diuapkan dengan metode evaporasi dan diperoleh ekstrak biji mahoni.

Pembuatan *hand sanitizer* pada pemanfaatan biji mahoni dapat dilakukan dengan cara melarutkan 1 gram CMC-Na dengan aquades 100 ml di dalam gelas kimia, kemudian dipanaskan diatas pemanas air dan diaduk dengan menggunakan batang pengaduk hingga larut sempurna. Kemudian ditambahkan gliserol 1,5 ml, Propilen glikol 1 ml, ekstrak biji mahoni yang dibedakan volumenya sebanyak 5 ml, 10 ml dan 15 ml, kemudian ditambahkan essential oil sebanyak 1,5 ml sebagai pengharum dengan menggunakan pipet tetes.

Referensi :

Affiah, R. N. (2018). Pengembangan Lembar Kerja Siswa (LKS) Ilmu Pengetahuan Alam Berbasis Metode Percobaan. *Science Activator*, 12(2), 86-96.

Dewi N, A. (2021). Infeksi Bakteri. *Kompas.Com*.

Koneri, R. dkk. (2016). Uji ekstrak biji mahoni (*Swietenia macrophylla*) terhadap larva *Aedes aegypti* vektor penyakit demam berdarah. *Jurnal IKM*, 12, 216.

Novita Sari, S. (2016). *Isolasi Flavonoid Dari Biji Mahoni (Swietenia Macrophylla, King) Dan Uji Aktivitasnya Sebagai Antibakteri*. Yogyakarta: UGM.

Sastrohamidjojo, H. (2018). *Kimia Dasar*. Yogyakarta: UGM PRESS.

Titaley, S., Fatmawati and Lolo, W. A. (2014). Formulasi Dan Uji Efektivitas Sediaan Gel Ekstra Etanol Daun mangrove Api-Api (*Avicennia Marina*) Sebagai antiseptik tangan. *Jurnal Ilmiah Farmasi*, 3(2), 99-106.

Zulfiani, Z. (2017). *Pembelajaran kimia melalui metode eksperimen berbasis lingkungan alam sekitar ditinjau dalam perspektif tsiara*. 189-202. <https://doi.org/http://doi.org/10.15408/tjema.v1i2.1267>

Figure 2: Display discourse paragraph 5.

on a predetermined problem formulation, the appearance of the worksheet at the stage of formulating a hypothesis can be seen in Figure 3(b).



Figure 3: Instruction display formulate the problem (a) and hypotheses (b).

The next stage is collecting data, the LK display at this stage can be seen in Figure 3.

The next stage is testing the hypothesis (processing data), at this stage students are given questions that must be answered according to the results of observational data in the experiment. LK skills at this stage can be seen in Figure ??(a). The last stage of guided inquiry is making conclusions, at this stage students are given instructions to

Tahap 4 Inkuiri Terbimbing : Mengumpulkan data
(merancang dan melakukan percobaan)

Untuk menguji hipotesis yang telah dimajukan, kita perlu menguji dengan melakukan percobaan.
Pembuatan *hand sanitizer* ekstrak biji mahoni

5. a. Tuliskan alat dan bahan yang digunakan dalam pembuatan *hand sanitizer* ekstrak biji mahoni dalam bentuk tabel.

- Siapkan alat dan bahan
- Siapkan 100 ml aquades pembersih
- Tambahkan 1 gram CMC-Na sedikit demi sedikit sampai larut sempurna
- Tambahkan Glycerol sebanyak 1,5 ml
- Tambahkan propilen glikol sebanyak 1 ml
- Tambahkan 5 ml, 10 ml, 15 ml serta ekstrak essent biji mahoni
- Tambahkan 1,5 ml esensial oil
- Aduk hingga homogen
- Simpan ke dalam botol

b. Lengkapi dan lakukan percobaan berikut dengan menggunakan prosedur percobaan dalam bentuk buku saku.

1. Menyajikan alat dan bahan.
2. Menandai label pada gelas kimia sesuai konsentrasi
3. Membuat *hand sanitizer* sesuai prosedur
4. Melakukan uji organoleptik dengan menguji bau, bentuk dan warna.
5. Melakukan uji tingkat keasaman dengan menggunakan pH meter / indikator universal
6. Melakukan uji homogenitas

c. Tuliskan hasil pengamatan terhadap percobaan yang telah dilakukan dalam bentuk tabel data pengamatan

Berlakuan	Pengamatan sebelum percobaan	Pengamatan setelah percobaan

6. Jawablah pertanyaan berikut.

1. Bagaimana bentuk *hand sanitizer* yang dihasilkan?
2. Bagaimana warna *hand sanitizer* yang dihasilkan?
3. Bagaimana bau *hand sanitizer* yang dihasilkan?
4. Bagaimana kehomogenan dari *hand sanitizer* yang dihasilkan?
5. Tuliskan hasil pH yang didapat dari berbagai konsentrasi biji mahoni dalam bentuk tabel!

Konsentrasi Ekstrak	pH

7. Apakah *hand sanitizer* yang dihasilkan sesuai dengan standar SNI ? Berikan alasannya !

Figure 4: Display of data collection instructions.

make conclusions from the results of the experiment. The display at this stage can be seen in Figure ??(b).

The project-based worksheets that have been prepared are then validated by three expert lecturers to ensure that the worksheets developed are categorized as valid or not. The results of the validation test from the three validators can be seen in Table 2.

There are several changes to the worksheets that have been validated including consistency in the use of the term “hand sanitizer” and the writing is adjusted based on the EYD, in the discourse text the procedure for making mahogany seed extract is added as student knowledge, in the last paragraph of the discourse text it should be made into a procedure sentence for making hand sanitizer , as well as improvement of the score range on the LK grid. Based on the data in Table 2, the guided inquiry-based worksheets in the manufacture of hand sanitizers have an average r-count value of 0.860 which is categorized as valid, because it has an r-count 0.30. This shows that the developed LK has met the requirements of a good LK.

After being validated and categorized as a valid worksheet, the next stage is a limited test to 15 class students XI IPA at SMAN 1 SUKRA. The data on the results of filling out guided inquiry-based worksheets on the manufacture of hand sanitizers are presented in Table 3.

The average result of student answers in doing guided inquiry-based worksheets is 95.2% which is categorized as very good. To determine the feasibility of the worksheets

TABLE 2: Guided inquiry worksheet validation test results.

No	Question	rcount	critical	Note:
1	The sentences used in inquiry-based worksheets for making mahogany seed extract hand sanitizer are easy to understand	0.833	0.3	Valid
2	The discourse on the use of mahogany seeds given in the hand sanitizer for making mahogany seed extract can help students answer the questions presented in the student worksheet.	0.833	0.3	Valid
3	The questions given to the worksheets help students in exploring the use of mahogany seeds in the manufacture of hand sanitizer.	0.916	0.3	Valid
4	The questions used in the LK are in accordance with the stages of the guided inquiry-based LK model.	0.833	0.3	Valid
5	LK leads to the ability to think, explain, create and analyze.	0.833	0.3	Valid
6	The picture in the LK is quite clear.	0.916	0.3	Valid
7	The concept of matter is related to everyday life.	0.833	0.3	Valid
8	The stages of inquiry learning in worksheets are arranged in a coherent manner	0.916	0.3	Valid
9	The procedure for making hand sanitizer is easy	0.833	0.3	Valid
Average		0.860	0.3	Valid

TABLE 3: Presentation of student worksheets.

No	Guided Inquiry Worksheet Stages	Maximum score	Average score Obtained	Percentage (%)	Interpretation
1	Problem orientation	3	2.6	86.67	Very good
2	Formulate the problem	6	6	100	Very good
3	Making a hypothesis	3	2.6	86.67	Very good
4	Collecting data and conducting experiments)	29	28.4	97.93	Very good
5	Testing Hypotheses	6	6	100	Very good
6	Making conclusions	3	3	100	Very good

that have been made, students are given a questionnaire containing several statements. The results of the student worksheet feasibility test can be seen in Table 4.

Based on Table 4 the average value of r-count is 0.83 which is categorized as valid. This shows that the guided inquiry-based worksheets on the manufacture of

hand sanitizer from mahogany seed extract are suitable to be used as learning media for colloid material for class XI. Based on the results of the feasibility test, LK can be said to help in colloidal learning, the resulting product is in the form of a hand sanitizer in the form of a gel and is a product that is closely related to daily life where everyone always carries a hand sanitizer in this pandemic era as a prevention effort. The average value of r-count obtained is 0.83 which is categorized as valid. Therefore, inquiry-based worksheets on the manufacture of hand sanitizer from mahogany seed extract are appropriate to be used as learning media in colloid subjects.

TABLE 4: Worksheet feasibility test results.

No	Question	Rcount	Critical	Note
1	The sentences used in inquiry-based worksheets for making mahogany seed extract hand sanitizer are easy to understand	0.85	0.3	Valid
2	The discourse on the use of mahogany seeds given in the hand sanitizer for making mahogany seed extract can help students answer the questions presented in the student worksheet.	0.9	0.3	Valid
3	The questions given to the worksheets help students in exploring the use of mahogany seeds in the manufacture of hand sanitizer.	0.8	0.3	Valid
4	The questions used in the LK are in accordance with the stages of the guided inquiry-based LK model.	0.85	0.3	Valid
5	LK leads to the ability to think, explain, create and analyze.	0.8	0.3	Valid
6	The picture in the LK is quite clear.	0.95	0.3	Valid
7	The concept of matter is related to everyday life.	0.75	0.3	Valid
8	The stages of inquiry learning in worksheets are arranged in a coherent manner	0.85	0.3	Valid
9	The procedure for making hand sanitizer is easy	0.8	0.3	Valid
Average		0.83	0.3	Valid

This research has succeeded in making a hand sanitizer from mahogany seed extract in the form of a gel that has a pH in accordance with SNI 2017. The bitter taste in mahogany seeds comes from the flavonoid content in it, this bitter taste can be reduced by soaking using whitening for one week, soaking using whitening does not eliminate the value of the substance content in mahogany, as is the case with research conducted by FMIPA UNY students who majored in physics, namely the use of mahogany seeds as chips [5]. Flavonoids contained in natural ingredients can be consumed by humans in relatively small amounts [6]. This is a new innovation in utilizing underutilized natural materials into useful products, and safe if used in the long term. The optimal hand

sanitizer formula in the experiment was based on organoleptic tests and the pH value of the volume variation of the added extract (5 ml, 10 ml, 15 ml), the optimal hand sanitizer formulation was the formulation added 10 ml of mahogany seed extract, this formulation resulted in a neutral pH, namely (6-7.5) gives better results because it is suitable for skin pH 7 [14]. The results of the hand sanitizer obtained from the three variations of the added extract have a pH value of 6-8 in accordance with the 2017 SNI.

The worksheets that have been made have not been able to assist students in analyzing the antibacterial activity in the hand sanitizer produced, because the worksheet does not contain procedures for analyzing antibacterial activity. The preliminary test was only carried out until the pH test and organoleptic tests were carried out in the form of color, smell, and shape of the hand sanitizer produced. So that researchers do not have an overview of the antibacterial activity test procedure against the hand sanitizer produced. Based on research conducted [14] stated that the chemical compounds in mahogany seed extract are bioactive containing flavonoids, alkaloids, saponins, steroids and terpenoids, which have antibacterial activity [15].

4. CONCLUSION

Guided inquiry-based worksheets on the manufacture of hand sanitizer from mahogany seed extract consist of 6 stages including: 1) Orientation (Identification of problems); 2) Formulate the problem; 3) formulate hypotheses; 4) collecting data (designing and conducting experiments); 5) test the hypothesis (process the data); 6) Making conclusions. In the worksheet, a discourse is presented as additional information for students who can direct students to carry out experiments.

Guided inquiry-based worksheets on the manufacture of hand sanitizer from mahogany seed extract were declared valid based on the average value of r-count obtained at 0.86. This shows that the value of r-count is 0.30 so that the LK is declared valid. The LK feasibility test was carried out on 15 students of class XI IPA at SMAN 1 Sukra which were divided into 5 groups, getting the average presentation value of the results of filling out the worksheets of 95.2%. While the results of the feasibility test on students obtained an average value of r-count of 0.83 which was declared valid. This shows that guided inquiry-based worksheets in making hand sanitizer from mahogany seed extract are categorized as very suitable to be used as learning media in colloid subjects.

For educators, the practical worksheet for making hand sanitizer from mahogany seed extract can be applied to the colloid making practice as an alternative to learning on colloid material. For students and other researchers, it is recommended to apply this worksheet to students. Because this research is only up to the development stage, it is recommended to carry out the implementation and evaluation stages.

References

- [1] Chabeli M, Nolte A, Ndawo G. Authentic learning: A concept analysis. *Glob J Health Sci.* 2021;13(4):12.
- [2] Yudha SF. Validity of student worksheet based on guided inquiry learning model assisted by digital practicum tool. *Journal of Physics: Conference Series.* 2019. 12058
- [3] Diawati C, Liliyasi A, Setiabudi A, Buchari. Setiabudi, and Buchari, "Using project-based learning to design, build, and test student-made photometer by measuring the unknown concentration of colored substances.," *J Chem Educ.* 2018;95(3):468–75.
- [4] Ernawati I. "Uji kelayakan media pembelajaran interaktif pada mata pelajaran administrasi server.," *Elinvo Electronics, Informatics, and Vocational Education.* 2017;2(2):204–210. <https://doi.org/10.21831/elinvo.v2i2.17315>.
- [5] Muthoharoh S. Pengaruh konsentrasi natrium bikarbonat dan rasio kacang tanah dengan air terhadap sifat fisikokimia susu kacang tanah. 2021.
- [6] McCullough ML, Peterson JJ, Patel R, Jacques PF, Shah R, Dwyer JT. Flavonoid intake and cardiovascular disease mortality in a prospective cohort of US adults. *Am J Clin Nutr.* 2012 Feb;95(2):454–64.
- [7] Ismail I. *Formulasi Kosmetik (Produk Perawatan Kulit dan Rambut).* Alauddin University Press. Makassar; 2013.
- [8] Koneri R, Pontoring HH. Uji ekstrak biji mahoni (*Swietenia macrophylla*) terhadap larva aedes aegypti vektor penyakit demam berdarah. *Media Kesehatan Masyarakat Indonesia The Indonesian Journal of Public Health.* 2016;12(4):216–23.
- [9] Dewi AP, Fauzana A. Uji aktivitas antibakteri ekstrak etanol biji mahoni (*Swietenia mahagoni*) terhadap *Shigella dysenteriae* [*Journal Of Pharmacy and Science*]. *JOPS.* 2017;1(1):15–21.
- [10] Djalante R, Lassa J, Setiamarga D, Sudjatma A, Indrawan M, Haryanto B, et al. Review and analysis of current responses to COVID-19 in Indonesia: Period of January to March 2020. *Prog Disaster Sci.* 2020 Apr;6:100091.

- [11] Novitasari L, Agustina PA, Sukesti R, Nazri MF, Handhika J. Fisika, etnosains, dan kearifan lokal dalam pembelajaran sains. Prosiding SNPF. Seminar Nasional Pendidikan Fisika; 2017. pp. 81–8.
- [12] Hobri H, Septiawati I, Prihandoko AC. High-order thinking skill in contextual teaching and learning of mathematics based on lesson study for learning community. Repository Universitas Jember; 2018.
- [13] Arikunto S. Prosedur Penelitian: Suatu Pendekatan Praktik. Jakarta: Rineka Cipta; 2010.
- [14] Robiatun RR, Pangondian A, Paramitha R, Rani Z, Gultom ED. Formulation and evaluation of hand sanitizer gel from clove flower extract (*Eugenia aromatica* L.). International Journal of Science, Technology & Management. 2022;3(2):484–91.
- [15] Dubale S, Kebebe D, Zeynudin A, Abdissa N, Suleman S. Phytochemical screening and antimicrobial activity evaluation of selected medicinal plants in Ethiopia. J Exp Pharmacol. 2023 Feb;15:51–62.