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# Development of Practicum Module for Making Trimyristin Soap Active Ingredients from Nutmeg Seeds (*Myristica fragrans* Houtt)

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**Abstrak:** Research This aims to develop practicum module for making soap with natural active ingredients to improve students' creative thinking skills. Practicum instructions will be applied to natural science and natural product chemistry practicum courses to provide innovations and appropriate technology for science education master students. The development of practicum instructions is a Research and Development (R & D) development with a define, design, develop, and disseminate (4D) model. The samples of this research were chemistry students and Master of Science Education students. The tests carried out were tests of physical properties (organoleptic, pH, and homogeneity) and antimicrobial tests with varying concentrations of trimyristin. Products in the form of practicum module are validated. The results showed that the validity value of the three validators obtained using the Aiken index was V = 0.84, which indicated that the natural science practicum module: the procedure for making trimyristin soap from nutmeg, was very valid and feasible to use. Meanwhile, practicality can be seen from the responses of students and lecturers, who show a positive response with average practicality of all components of 88% of student responses and 89% of lecturer responses. The results of the physical evaluation of trimyristin solid soap (organoleptic, pH, foam stability, and moisture content) produced from this study showed good results because they met several standards for the quality of solid soap SNI 3532-2016. Based on these data, the materials chemistry practicum module: procedures for making trimyristin soap from nutmeg seeds to support meaningful learning that is developed is very valid and very practical to use in the learning process.

**Keywords:** Practicum Instructions; Trimiristin Soap; 4D; Creative Thinking Ability

## Introduction

The Ministry of Education and Culture issued guidelines for compiling an independent learning-free campus curriculum (MBKM) that encourages study programs at each tertiary institution to develop learning in obtaining a broader learning experience and competency development. Students are required to be able to cultivate HOTS abilities (high-order thinking skills) which include 6C competencies (Communication, Collaboration, Critical thinking, Creative thinking, Computational logic, Compassion, and Civic responsibility) (Junaidi et al. 2020). Competence 6C helps students face life's challenges in the 21st century to compete in the industrial era 4.0. 21st-century skills emphasize non-cognitive aspects, which are more focused on building student character in learning and implementation in their lives.

Indonesia is a tropical country. The tropical climate causes microbes to grow and develop rapidly. The community urgently needs the availability of bath soap that can treat various skin health problems and body odor caused by microbes. Antimicrobial soap products currently available on the market generally contain triclocarban, chloroxylenol, and triclosan, which function as antimicrobials. Compound triclosan can make microbes more resistant in long-term use (Arwinda et al., 2013). Apart from being antimicrobial, whitening agent products are in great demand, especially for women. In whitening cosmetics, the active

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chemicals mercury and hydroquinone are used. Both of these chemicals are carcinogenic in long-term use. To overcome the problem of soap with chemical active ingredients, researchers made an innovation to develop a soap product with the natural active ingredient trimyristin compound from the nutmeg Myristica fragrans Houtt.

Trimyristin was isolated from nutmeg essential oil. Nutmeg contains common compounds (30% carbohydrates, 6% protein, 25-40% structural fat) and minerals (potassium, potassium, magnesium, and phosphorus), especially essential oils, which have high economic value. Nutmeg seed oil contains a fairly high yield of the compound trimyristin. Trimyristin activity is antioxidant, anticonvulsant, analgesic, anti-inflammatory, anti-diabetic, anti-bacterial, and anti-fungal. Aside from being an antimicrobial, trimyristin is also used as a whitening agent in beauty products. The properties of antioxidants, antimicrobials, and whitening agents are needed as skin protectors.

This innovative soap product uses olive oil as a soap base. Olive oil is very popular as a natural skin moisturizer. Olive oil can maintain skin elasticity. Natural base ingredients and adding the active compound trimyristin are the advantages of product innovation in this study. People are no longer worried about harmful chemicals when using bath soap. Innovative bath soap is safe for body health.

The innovation of making natural soap encourages the formation of student's creative thinking character. Creative thinking cannot appear by itself but requires practice (Meika, 2017). Innovation research results as outlined in a product and implementation in laboratory learning. Innovation in learning arises from the ability to see natural resources in the area of residence. Environmental conditions determine the form of innovation in learning. Learning that utilizes natural materials in laboratory experiments to produce an innovative product encourages increased creative thinking skills. Students must have creative thinking in the industrial era 4.0. The skill needed to face the industrial revolution era are creative thinking (Astutik & Prahani, 2018). The ability to think creatively is the independence of logically arguing to find solutions to problems (Hanipah, 2018) (Kadir, 2017). Think creatively to produce new innovative products that are safe to meet people's needs.

Based on the description above, this study aims to develop practicum module for science practicum in making soap with the ingredient trimyristin to improve students' creative thinking skills. Practicum instructions are applied to learning Science Practicum students of the Master of the Science Education Postgraduate University of Mataram. Students will better understand the procedure for isolating active compounds from natural materials and innovating in creating a useful product for everyday life. Students are expected to be able to find their innovations from experience in making bath soap with pure active ingredients.

## Method

*Research Design*

This research is a Research and Development (R&D) research, namely in the form of research procedures carried out by creating a particular product and testing the effectiveness of the product (Sugiyono, 2010). The development model used in this research is the 4D model, which stands for Define, Design, Development, and Dissemination, developed by Thiagrajan in 1974. The 4D model chosen in this study includes the 4D model arranged in a systematic sequence of activities, a unique 4D model developed to develop learning models and not learning designs. The 4D model has been widely used in research on developing learning models (Syahrir, 2015).

*Research Variables*

This study has two types of variables: the independent variable and the dependent variable. The independent variable is a variable that influences or causes the dependent variable to arise. In contrast, the dependent variable is a variable that is affected or becomes a result because of the independent variable (Sugiyono, 2017). The independent variable in this study is the practical instructions for making soap with natural active ingredients, while the dependent variable is the ability to think creatively.

*Stages of development*

Development is carried out in 4 stages: the define, the design, the developing stage, and the dissemination.

- *Defining stage (Define)*

Steps taken are in the form of defining and limiting the scope and limitations of the development of this practicum module.

- *The design stage (Design)*

Aims to design the developed module by selecting the initial appearance design and the format of the contents of the practicum instructions.

- *Development stage (Develop)*

At the development stage, theoretical considerations from experts and practitioners regarding the validity of research instruments include practicum module validation sheets and student response questionnaires.

*Expert Validity and Reliability*

Four expert validators with assessment instruments carried out the validity test of the developed product. Data from expert validation results were analyzed to

determine the validity level of the product developed using Aiken's V formula (Adawiyah, 2019). The level of validity is determined based on the following table.

**Table 1.** Validity Score Criteria

| Interval | Category |
|---|---|
| 0 - 0.20 | Very Invalid |
| 0.21 - 0.40 | Invalid |
| 0.41 - 0.60 | Less |
| 0.80 | Valid Enough |
| 0.81 - 1.00 | Very Valid |

Next, a reliability test was carried out to measure agreement between validators and analyzed using a percentage agreement. The validation results of learning tool validation are reliable if the percentage agreement is ≥ 0.75 or 75% (Nasrah, 2017). The product developed is said to be suitable for use in learning if the results of the analysis meet the valid and reliable categories.

*Practicality Test*

Practicum module for ethnoscience that are already valid and reliable are tested for practicality. The practicality of using a Likert scale with alternative answers, namely strongly disagree (SD), disagree (D), entirely agree (EA), agree (A), and strongly agree (SA). The results of the practicality test are determined based on the criteria in Table 2 (Hendryadi, 2017).

**Table 2.** Table of palatalization criteria

| Interval | Criteria |
|---|---|
| 80% < x ≤ 100% | Very practical |
| 60% < x ≤ 80% | Practical |
| 40% < x ≤ 60% | Practical enough |
| 20% < x ≤ 40% | Less practical |
| 0% < x ≤ 20% | No practical |

*Feasibility* Test

Limited scale distribution produces trimyristin compounds and antimicrobial natural soap products. The product obtained as a basis for stating the guidelines developed can be widely disseminated to students.

*Dissemination Stage (Disseminate)*

The dissemination stage is the final stage in the development process. Products resulting from the development are distributed on a limited scale, using students from the Science Education Masters Study Program. Students are guided through making soap from the natural active ingredient trimyristin. The feasibility and feasibility tests of the product being developed were carried out in the final stage of making antimicrobial soap.

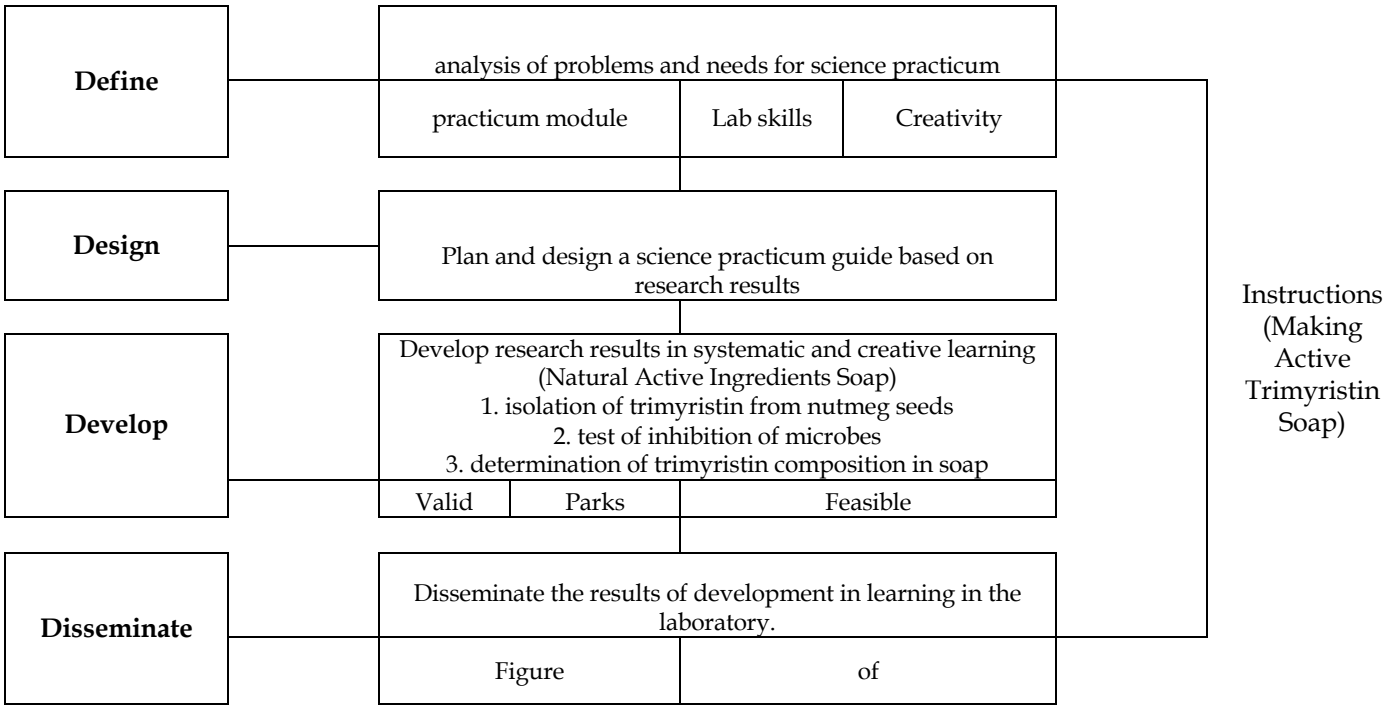



**Figure 1.** Developing Instructions for Science Practicum

*Implementation Test*

The implementation test is conducted to determine the percentage of implementation of practicum activities using the guidelines for the development of antimicrobial soap. The test is a questionnaire containing the observer's perception of making antimicrobial soap in the laboratory.

*Testing the Effectiveness*

Limited Scale Deployment was carried out in learning activities in the laboratory. Laboratory activities are focused on the process of making soap with natural antimicrobial ingredients. The test was carried out as a student's creative thinking ability test. The tests carried out are pretest before learning and posttest to see the increase in ability. The test results are used to determine the effectiveness of product development, namely, increasing the ability to think creatively about the learning carried out.

Furthermore, inferential analysis was carried out with several tests. To find out the level of effectiveness of practicum instructions can be seen through the results of the pretest and posttest, which are then analyzed using N-gain and the T-test (Rachmawati, 2020).

**Table 3.** Criteria for the Category of Creative Thinking Ability

| Score Interval | Classification |
|---|---|
| 81.25% < x ≤100% | Very good |
| 62.50% < T ≤ 81.25% | Good |
| 43.75% < T ≤ 62.50% | Poor |
| 25% < T ≤ 43.75% | Not Good |

**Table 4**. Criteria for N-Gain

| N-gain | Criteria |
|---|---|
| 0.7 ≤ N-gain ≤ 1 | High |
| 0.3 < N-gain ≤ 0.7 | Moderate |
| N-gain < 0.3 | Low |

## Result and Discussion

This research is research on developing a practicum module for a natural product chemistry course on procedures for making trimyristin soap from nutmeg seeds to support meaningful learning. This module is intended for students of the Chemistry Education study program, Faculty of Teacher Training and Education, University of Mataram, at least in semester 6, who are or have programmed natural product chemistry courses. This study aims to produce natural product chemistry practicum modules that meet valid and practical criteria, which are tested through validity and practicality tests using 4D models through the stages of define, design, develop, and dissemination.

*Stage Define*

At the define stage, three steps will be carried out, namely initial and final analysis, material analysis, and task analysis which aims to define and limit the scope of the development of this module. The final initial analysis step aims to analyze the preparation for the development of a natural product chemistry practicum module regarding the procedure for making trimyristin soap from nutmeg seeds. This analysis was carried out by analyzing the Semester Learning Design (RPS) and several journals regarding the isolation of trimyristin from nutmeg seeds and the procedure for making trimyristin soap.

Based on an analysis of the Semester Learning Design (RPS), the final ability or competency expected in the natural product chemistry course is that students can analyze the structure, nature, origin, and biosynthesis of secondary metabolites or active ingredient compounds, and can isolate natural product compounds and presented the results of isolation of secondary metabolites or active ingredient compounds. The material for study in natural product chemistry courses includes metabolite compounds such as terpenoids, steroids, polyphenols, flavonoids, alkaloids, and several useful natural compounds as well as the isolation of secondary metabolites. The indicators to be achieved in the study material for the isolation of secondary metabolites or active ingredients are: 1) make a simple proposal on the isolation of secondary metabolites or active ingredients from a plant species, 2) present a proposal for the isolation of secondary metabolites or active ingredients, 3 ) implementing isolation proposals for secondary metabolites or active ingredient compounds that the lecturer has approved, 4) compiling reports and presenting the results of practicum implementation.

Based on the analysis of journals regarding the isolation of trimyristin from nutmeg and journals for making trimyristin soap, several journals were used as references, one of which was the journal by Torry (2014), "Utilization of Trimyristin as Nutmeg Fat in Bath Soap." Then the researcher made a work scheme consisting of the main and modified work schemes. The working scheme obtained from the literature is modified by replacing the extraction method with chloroform solvent with the reflux method with ethanol solvent. The trimyristin isolation method was modified in the hope of providing good isolation results in terms of yield and health aspects. The modified method of making soap starts with the replacement of the use of several ingredients and the addition of citronella oil. With this modification method, trimyristin can still be produced with high yields and is safe to be used as an additional active ingredient in soap-making procedures. So that good practicum modules and better soap products are produced.

After preparing the modified work scheme, the researchers conducted experiments in the laboratory regarding the isolation of trimyristin compounds and the manufacture of trimyristin soap. Based on the experiments' results, the trimyristin compound obtained was in the form of white crystals with a weight of 6.92 grams, a yield value of 34.6%, and a molecular weight of 723.18 g/mol. The yield of the isolated trimyristin compound using the modified work scheme is greater than that of the isolated trimyristin compound using the

main work scheme. Procedure for making trimyristin soap using coconut, olive, and citronella oil. The trimyristin powder obtained by the researchers was then identified using a TLC plate that reacted with iodine vapor to produce one brown spot. These results indicate that the trimyristin compound obtained is pure. The results of the Thin Layer Chromatography (TLC) of trimyristin can be seen in Figure 1.

The isolated trimyristin is then used to make trimyristin soap using NaOH, coconut oil, olive oil, trimyristin, and citronella oil. Based on the research results, it is known that the trimyristin soap that is formed has ingredients including lauric acid and myristic acid, which function to harden, clean, produce foam and provide soft properties. Palmitic acid and stearic acid stabilize foam, and oleic acid and linoleic acid function to moisturize. In addition, trimyristin can function as an anti-bacterial, anti-fungal, and bleach (whitening agent). The addition of citronella soap functions as an aromatherapy fragrance. Furthermore, an organoleptic test was carried out to observe the shape, color, and smell of trimyristin solid soap preparations. Organoleptic test results can be seen in Table 5.

**Table 5.** Observation Results of Organoleptic Test

| Characteristics | Test Results | |
|---|---|---|
| | **A** | **B** |
| Odor | The characteristic odor of citronella oil | The characteristic odor of citronella oil |
| Form | Solid, slightly soft on the surface | Yellow |
| Solid Color | White | yellowish |
| Surface Texture | Smooth | Smooth |

Notes:
A. trimyristin soap stored for two weeks
B. trimyristin soap stored for four weeks

Then carry out a material analysis which aims to identify natural chemical substances regarding the isolation of trimyristin from nutmeg seeds and the procedure for making trimyristin soap. At this stage, it examines natural product chemistry regarding the isolation of trimyristin from nutmeg and the procedure for making trimyristin soap, both procedurally and theoretically, which contains several chemical concepts that students already have from natural material chemistry courses and other subjects. The material presented in the module refers to the practicum objectives. Namely, students can understand how to isolate the active ingredients, especially the trimyristin compound from nutmeg seeds, and use it as an active ingredient in soap making. These materials were obtained from several natural product chemistry books and journals regarding the isolation of active ingredient compounds, which explain the process of isolating active compound compounds and their bioactivity.

Task analysis aims to identify the main tasks students carry out. At this stage, the Student Task Plan (RTM) is analyzed. The task analysis consists of an analysis of the skills students must have and additional skills related to the material to be developed in the teaching materials, in this case, the natural product chemistry practicum module: procedure for making trimyristin soap from nutmeg seeds.

The results of the analysis of the task analysis on the Student Assignment Design (RTM) contained in the task descriptions in the form of isolating secondary metabolite compounds or active ingredient compounds carried out by students in a project-based group consisting of making a simple proposal on the isolation of trimyristin from nutmeg and its use as an active ingredient in soap-making procedures in the practicum module which can be varied according to students' ideas or ideas, presenting the proposals that have been made, implementing the trimyristin isolation proposals that have been approved by the lecturer and compiled a report and presented the results of the practicum implementation. So that the output of the task produced is in the form of a group assignment made in the form of a simple proposal regarding the isolation of trimyristin as an active ingredient compound that can be used in soap-making procedures, which are then implemented in the laboratory as well as making a practical report on trimyristin isolation from nutmeg and procedures for making trimyristin soap.

Based on the results of material analysis of journals regarding the isolation of trimyristin from nutmeg and the procedure for making trimyristin soap, the researchers created a series of work schemes for isolating anacardic acid compounds consisting of the main work scheme and the modified work scheme. Based on the results of laboratory experiments that have been carried out using a modified work scheme, quite a lot of trimyristin extract was obtained. So that the modification method can be used as a reference for doing a module for chemical practicum of natural materials, the procedure for making trimyristin soap from nutmeg seeds has been developed.

Based on the analysis above, using the reflux extraction method, the designed practicum module aims to isolate trimyristin compounds from nutmeg seeds. The materials are presented from several natural product chemistry books, journals, and articles regarding the isolation of active compounds. The theoretical material consists of the meaning and purpose of isolation, equipment, materials for isolating active compounds, and compound extraction, which consists of extraction, solvent polarity, and solvent selection. These factors influence the extraction and identification of compounds. In addition, an explanation was given about the characteristics of the nutmeg plant and the trimyristin compounds that would be isolated from the

nutmeg seeds. As for the procedural material, an explanation was given regarding the extraction process using the reflux method and the purification of compounds using the recrystallization method and identification of compounds using thin-layer chromatography.

*Stage Design*

At the design stage, a product chemistry practicum module was produced regarding the procedure for making trimyristin soap from nutmeg seeds. The design stage aims to design practicum modules that are developed by considering the results of the definitions. The activities to be carried out are divided into two stages, namely:

a. Determining the Module Format

The selection of the module format is based on the initial and final analysis and material analysis at the define stage, which consists of the following:

1) Practicum Title

The practicum title developed consists of only one "Module Natural Product Chemistry Practicum: Procedure for Making Trimyristin Soap from Nutmeg Seeds." In the final analysis stage, the researcher has carried out practicum module on isolating trimyristin from nutmeg using the reflux method and making trimyristin soap.

2) Practicum Objectives

Practicum objectives in the practicum module are made by adjusting the initial analysis results at the define stage, namely, so that students can understand how to isolate trimyristin compounds from nutmeg seeds and the procedure for making trimyristin soap.

3) Practical Material

Practicum material given and explained in the practicum module is obtained from reference books and several journals related to the isolation of trimyristin from nutmeg and the manufacture of trimyristin soap which can broaden students' knowledge before doing a practicum.

4) Tools and Materials

The tools and materials contained in the module are adjusted to the availability of tools and materials in the laboratory. Tools and materials in the module can make it easier for students to carry out practicum properly. The tools used in this practicum have been introduced in the initial chapter of the module on Introduction to Laboratories. The main ingredients used in this lab are nutmeg, coconut oil, and citronella oil.

5) Implementation Procedure

The practicum implementation procedure is explained in more detail. It uses standard and unambiguous sentences and a work scheme to illustrate the stages in carrying out practicum activities. The practicum implementation procedure developed consists of extraction (reflux), purification of compounds, and manufacture of trimyristin soap.

6) Observation Results of Practicum

In the developed practicum module, a table of observations has been provided to write down the results obtained after carrying out practicum, both practicum modules for lecturers and students. However, in the practicum module for lecturers, the researcher fills the observation results table directly. In contrast, in the practicum module for students, the observation results table is filled in groups by students following the modification work scheme that has been done and the results obtained.

7) Discussion of the Practicum

The Practicum associated with supporting theory the practicum.

8) Practical Conclusion

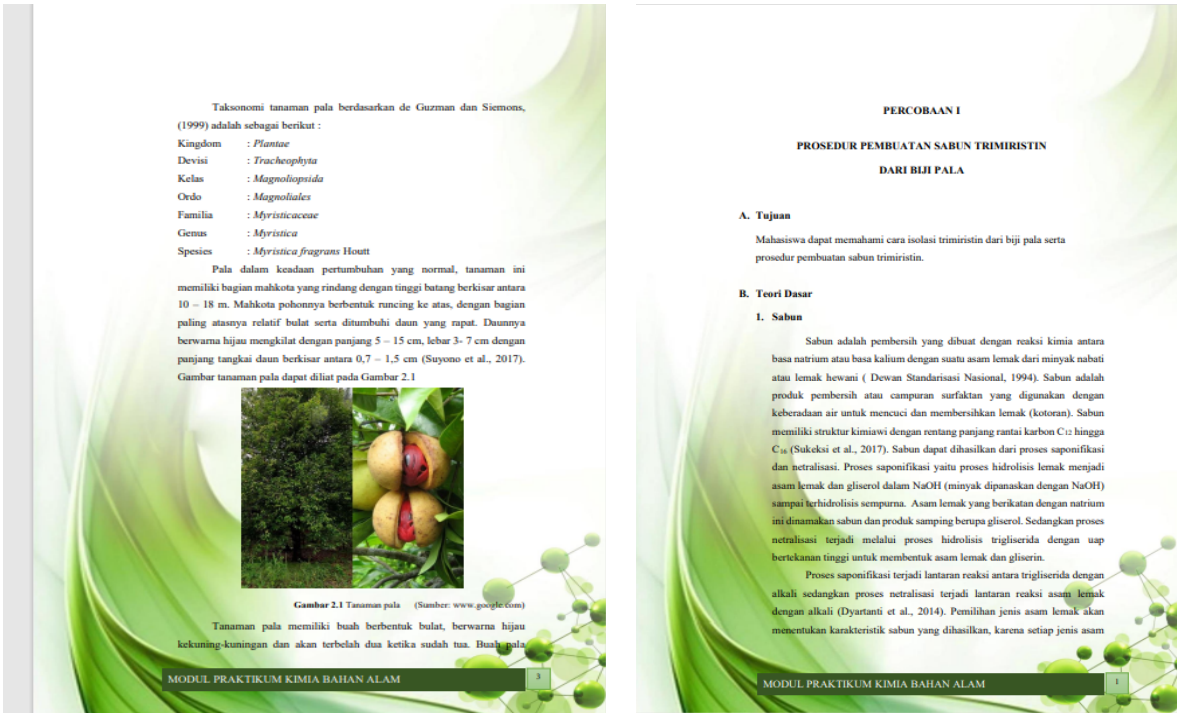
The conclusions contained in the practicum module contain important things that are the object of study in carrying out a practicum activity.

b. Preparing the Initial Design of the Module

The initial design is the module design that is made before the trial is carried out. All modules produced at this stage are called prototype 1. At this stage, the researcher compiled and made a practicum module which consisted of the module cover and module content. The practicum module cover on the front contains the title of the development module, the research institution, and the author's name. The images contained in the module are images related to the practicum and are found on the front of the practicum module, while the symbol of the institution is located at the top left of the module. The back cover adjusts to the appearance of the front cover.

As for the contents of the practicum module, it is designed to guide students to understand the material theoretically and procedurally. The contents of the practicum module are also adjusted to the indicators of meaningful learning to be achieved, so studying the module's contents is expected to support meaningful learning. The practicum module is equipped with questions related to the isolation of trimyristin from nutmeg and the process of making trimyristin soap so that students can construct their understanding after studying the practicum module developed by the researcher. The contents of the natural product chemistry practicum module regarding the procedure

for making trimyristin soap from nutmeg seeds can be seen in Figure 2.


Taksonomi tanaman pala berdasarkan de Guzman dan Siemons, (1999) adalah sebagai berikut :

Kingdom : *Plantae*
Devisi : *Tracheophyta*
Kelas : *Magnoliopsida*
Ordo : *Magnoliales*
Familia : *Myristicaceae*
Genus : *Myristica*
Spesies : *Myristica fragrans* Houtt

Pala dalam keadaan pertumbuhan yang normal, tanaman ini memiliki bagian mahkota yang rindang dengan tinggi batang berkisar antara 10 – 18 m. Mahkota pohonnya berbentuk runcing ke atas, dengan bagian paling atasnya relatif bulat serta ditumbuhi daun yang rapat. Daunnya berwarna hijau mengkilat dengan panjang 5 – 15 cm, lebar 3- 7 cm dengan panjang tangkai daun berkisar antara 0,7 – 1,5 cm (Suyono et al., 2017). Gambar tanaman pala dapat diliat pada Gambar 2.1

**Gambar 2.1** Tanaman pala (Sumber: www.google.com)

Tanaman pala memiliki buah berbentuk bulat, berwarna hijau kekuning-kuningan dan akan terbelah dua ketika sudah tua. Buah pala

MODUL PRAKTIKUM KIMIA BAHAN ALAM 3

**PERCOBAAN I**

**PROSEDUR PEMBUATAN SABUN TRIMIRISTIN DARI BIJI PALA**

**A. Tujuan**

Mahasiswa dapat memahami cara isolasi trimiristin dari biji pala serta prosedur pembuatan sabun trimiristin.

**B. Teori Dasar**

**1. Sabun**

Sabun adalah pembersih yang dibuat dengan reaksi kimia antara basa natrium atau basa kalium dengan suatu asam lemak dari minyak nabati atau lemak hewani ( Dewan Standarisasi Nasional, 1994). Sabun adalah produk pembersih atau campuran surfaktan yang digunakan dengan keberadaan air untuk mencuci dan membersihkan lemak (kotoran). Sabun memiliki struktur kimiawi dengan rentang panjang rantai karbon $C_{12}$ hingga $C_{16}$ (Sukeksi et al., 2017). Sabun dapat dihasilkan dari proses saponifikasi dan netralisasi. Proses saponifikasi yaitu proses hidrolisis lemak menjadi asam lemak dan gliserol dalam NaOH (minyak dipanaskan dengan NaOH) sampai terhidrolisis sempurna. Asam lemak yang berikatan dengan natrium ini dinamakan sabun dan produk samping berupa gliserol. Sedangkan proses netralisasi terjadi melalui proses hidrolisis trigliserida dengan uap bertekanan tinggi untuk membentuk asam lemak dan gliserin.

Proses saponifikasi terjadi lantaran reaksi antara trigliserida dengan alkali sedangkan proses netralisasi terjadi lantaran reaksi asam lemak dengan alkali (Dyartanti et al., 2014). Pemilihan jenis asam lemak akan menentukan karakteristik sabun yang dihasilkan, karena setiap jenis asam

MODUL PRAKTIKUM KIMIA BAHAN ALAM 1

Figure 2. Natural Materials Chemistry Practicum Module About the Procedure for Making Trimyristin Soap from Nutmeg Seeds

The design stage is the second step which is carried out based on the results of the identification and analysis of the definition. In general, the design of the module framework to be developed is carried out at this stage. At this stage, the preparation of the module begins with cover design, and the preparation of the module components, namely: (1) preface, table of contents, practicum rules and introduction to the chemical laboratory, (2) practicum process, containing practicum titles, practicum objectives, related material with practicum, work procedures, results of observations, data processing, questions and discussion of practicum. After designing the practicum module, the results obtained from the design stages are prototype module 1.

*Stage Development*

This stage aims to produce a new module (prototype which has been revised based on validators (experts) so that it can be considered valid and practical to be used in learning activities. The research instruments used were expert validation sheets and student and lecturer response questionnaires.

The practicum module validation sheet determines the validity level of the practicum module being developed. The practicum module validation format consists of graphical aspects, presentation, content feasibility, and language with four categories: very good, good, good enough, and not good enough. Meanwhile, student and lecturer response questionnaires were used to determine the practicality level of the practicum module being developed. There are four response selection criteria, namely strongly agree, agree, disagree, and disagree, in the questionnaire format for student and lecturer responses to the material chemistry practicum module: the procedure for making trimyristin soap from nutmeg contains questions that students and lecturers respond to. Student and lecturer response sheets for practicum modules can be seen in table 8.

Teaching materials developed in this case, practicum modules are highly quality if they meet several criteria: 1) validity and 2) practicality. The initial product module (prototype 1) produced at the design stage is then tested for validity to obtain input and suggestions that will be used to build a better module and can be used as a practicum medium. The validity test uses an instrument in the form of an expert validation sheet containing graphical, presentation, content feasibility, and linguistic components. A good instrument must meet two important requirements: validity and reliability. During the process of developing this practicum module, there are several notes from the validator that must be considered, including the spacing between texts that is still inconsistent, the need to provide further reading sources about the material, the background color being too contrasting, there are still

some errors in writing words and the use of conjunctions and sentence formulations on the module should be more communicative.

Analysis The analysis used in determining the level of validity of the module is the Aiken index, where it is obtained that the three validators provide a valid assessment of the module and can be used after making a few revisions. After validating the practicum module, the results were obtained from the development stage, namely prototype 2. Furthermore, prototype two was tested on test subjects, namely chemistry education lecturers and students for the 2017/2018 academic year (8th-semester students) who had programmed the Natural Materials Chemistry course and lecturer in the Natural Materials Chemistry course, Chemistry Education study program, FKIP, University of Mataram.

The trial was conducted on a limited scale on 25 chemistry education study program students and three chemistry education lecturers at the University of Mataram. At this stage, trials were carried out to obtain student and lecturer responses to the developed practicum modules. The student and lecturer response questionnaire used consisted of 22 statement items, in which ten statements were for the module attractiveness component, seven statements were for the module's ease of use component, two statements were for the module implementation time component, and three statements were for the module benefits component. After analyzing the student and lecturer response questionnaires, the results showed a good response to the practicum module that had been developed. In order to obtain the prototype practicum module 3, based on the results of the validity test and practicality test, a natural product chemistry practicum module was obtained: the procedure for making trimyristin soap from nutmeg seeds which can support meaningful learning with valid and practical categories and can be used in the learning process.

*Analysis of Validation Results and Reliability*

1. Analysis of Validation Results

The validation of the natural product chemistry practicum module on the procedure for making trimyristin soap to support meaningful learning that has been developed was carried out by three validators. The validator's assessment contains a review and notes on points that must be corrected. The results of this validation will determine the validity of the practicum module being developed.

Aspects assessed in the practicum module validation broadly include (1) graphical aspects, (2) presentation aspects, (3) content feasibility aspects, and (4) linguistic aspects. Based on the Aiken index, the results of the module validation analysis for each aspect can be seen in Table 6.

**Table 6**. The results of the module validation analysis for each aspect

| No | Assessment Aspect | V |
|---|---|---|
| 1 | Graphic | 0.95 |
| 2 | Presentation | 0, 78 |
| 3 | Content Eligibility | 0.80 |
| 4 | Linguistics | 0.86 |

Based on Table 4.1, the results of the practicum module validation analysis for graphical aspects V = 0.95 are classified as very valid categories, presentation aspects V = 0.78 are classified as valid categories, content feasibility aspects are V = 0.80 belonging to the valid category, linguistic aspects V = 0.86 belonging to the very valid category. So based on the data above, an average value of V for all aspects is obtained, namely V = 0.84, which means that the natural product chemistry practicum module on the procedure for making trimyristin soap from nutmeg seeds to support meaningful learning is very valid.

2. Analysis of Reliability Results

The reliability of the practicum module was determined using the percentage of agreement equation. The R-value is determined for each aspect. The results of the reliability analysis of the module in each aspect can be seen in Table 7.

**Table 7.** The results of the reliability analysis of the module in each aspect

| No. | Assessment aspect | R |
|---|---|---|
| 1 | Graphical component | 0.97 |
| 2 | Presentation component | 0.94 |
| 3 | Content feasibility component | 0.98 |
| 4 | Language component | 0.85 |

Based on Table 7, the results of reliability calculations using a percentage of agreement on each component, namely, the graphical component, the presentation component, the content feasibility component, and the linguistic component, obtained the R-value respectively, namely 0.97; 0.94, 0.98, and 0.85. Because an instrument can be said to be good if it has an understanding index R greater than 0.75 to 1, it can be concluded that the natural product chemistry practicum module: procedures for making trimyristin soap from nutmeg seeds to support meaningful learning is reliable.

Based on the validation and reliability results carried out on the module, taking into account the suggestions from the validator, a natural product chemistry practicum module is obtained: procedures for making trimyristin soap from nutmeg seeds to support meaningful learning in the form of prototype 2. Furthermore, researchers conducted limited trial activities on chemistry education study program students at the Faculty of Teacher Training and Education, University of Mataram.

*Analysis of Limited Trial Results*

Limited trials at this stage were carried out after the validated validation of the natural product chemistry practicum module on the procedure for making trimyristin soap from nutmeg seeds to support meaningful learning. The limited trial was carried out by 25 respondents, namely chemistry education study program students for the 2018/2019 academic year and three lecturers from the Chemistry Education Study Program, Faculty of Teacher Training and Education, University of Mataram. The results of student and lecturer responses to the practicum module developed at this stage were obtained. Student and lecturer responses consist of four assessment components, namely the attractiveness of the module, the ease of use of the module, the implementation time of the module, and the benefits of the module.

*Student Response*

The modules that the validators have validated are then tested on students. This trial aims to collect student responses or responses related to the practicum module that has been developed. The practicum module trial was carried out by 25 respondents from the chemistry education study program students for the 2021/2022 academic year class of 2018, Faculty of Teacher Training and Education, University of Mataram, who have taught Natural Materials Chemistry courses. Based on the practicality index of student responses to the practicum module on all aspects of the assessment.

The assessment results of respondents 1-25 use the practicality index on the aspects of module attractiveness, ease of use of modules, module implementation time, and benefits. The practicum module obtained an average practicality of 88% which indicates that the natural product chemistry practicum module on the procedure for making trimyristin soap from seeds to support meaningful learning that has been developed is included in the very practical category because it has a practicality percentage in the range of $80\% < x \leq 100\%$.

*Lecturer Responses Lecturer*

Responses to this practicum module were analyzed quantitatively based on the answers given in the lecturer's response questionnaire to the practicum module. The results of the lecturer's response to the natural product chemistry practicum module: the procedure for making trimyristin soap from nutmeg to support meaningful learning can be seen in Table 8. Based on the data, it was obtained that the average practicality of the modules tested on three lecturers was 89%, indicating that the practicum module for natural product chemistry: procedures for making trimyristin soap from nutmeg seeds to supports meaningful learning that has been developed is included in the very practical category because it has a practicality percentage in the range $80\% < x \leq 100\%$.

**Table 8.** The results of the lecturer's response to the practicum module

| No | Assessment Aspect | Score Lecturer Respondents | | |
|---|---|---|---|---|
| | | I | II | III |
| 1 | The attractiveness of the module | 34 | 37 | 38 |
| 2 | Ease of use of the module | 22 | 26 | 27 |
| 3 | Time to implement the module | 7 | 7 | 6 |
| 4 | Benefits of the module | 10 | 11 | 11 |
| Total score | | 73 | 81 | 82 |
| Practicality (%) | | 82 | 92 | 93 |
| Average practicality (%) | | | | 89 |

Based on the results of an analysis of the student and lecturer response questionnaires and making improvements to the module, a natural product chemistry practicum module was obtained: procedure for making trimyristin soap from nutmeg seeds to support meaningful learning in the form of a prototype practicum module prototype.

## Conclusion

Based on the results of the research and development that has been carried out, the following conclusions are obtained the results of analysis of the validation sheet of the practicum module for natural product chemistry: procedures for making soap trimyristin from nutmeg seeds show an average V value of 0.84 with a very valid category so that it can be used for learning activities. The analysis of student and lecturer responses using a response questionnaire for all aspects obtained an average practicality index with a percentage of 88% for students and 89% for lecturers, both of which are included in the very practical category so that it can be used for learning activities. The results of isolating the trimyristin compound from nutmeg seeds obtained a yield of 6.92 grams with a yield value of 34.6%. These results show that the yield obtained using the modified work scheme is greater than the yield of trimyristin isolated using the main work scheme. The resulting trimyristin solid soap product is included in the good category. Based on the test results (Organoleptic, pH, Foam stability, Moisture content), trimyristin soap has met several standards for the quality of SNI 3532-2016 solid soap.

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