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Chemistry Concepts in The Process of Making Coconut Oil: A Chemistry Magazine for Senior High School

Rahmawati[1*], Lilik Khaerun Nisa[1], Lalu Rudyat Telly Savalas[1], Fara Dwirani Sofia[1], Syarifa Wahidah Al Idrus[1], Muti'ah[1], Sunniarti Ariani[1], Sya'ban Putra Adiguna[1]

[1] Pendidikan Kimia, Fakultas Keguruan dan Ilmu Pendidikan, Universitas Mataram, Mataram, Indonesia

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Corresponding Author:
Rahmawati
rahmawati_kimia@unram.ac.id

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Abstract: This study aims to identify the chemical concepts contained in the process of making coconut oil, then the results of the identification and documentation are compiled into a chemistry magazine for senior high schools. The process of making coconut oil is done by two methods, namely heating/traditional and fermentation. The preparation of a chemical magazine is carried out using the method according to Borg & Gall which is simplified into five stages, namely preliminary studies, planning, initial product development, field implementation tests, and product finalization. There are several chemical concepts related to the process of making coconut oil, namely macromolecules, mixture separation, boiling point elevation, and colloids. Magazine feasibility testing is done by validating and analyzing student responses. The results showed that the magazine developed was very valid with an average value of V on the components of graphics, content feasibility, presentation feasibility, and magazine language respectively 0.92, 0.91, 0.96, and 0.88. The results of the student response analysis show that the developed magazine is very feasible with an average percentage of 90%.

Keywords: Chemistry concept; Chemistry magazine; Coconut oil

Introduction

Chemistry is a science that studies composition, structure, properties, changes in matter, and the energy that accompanies these changes, and chemistry has characteristics as a science that requires high visual abstraction power (Rachmawati, 2018). Chemistry is still considered a difficult science to learn because most of its material is abstract. Atomic structure, periodic system, chemical bonding, stoichiometry, redox, electrolyte and non-electrolyte solutions, and hydrocarbon compounds are topics for learning chemistry with abstract chemical concepts.

One representative way to visualize the abstractness of chemical material is to apply learning media related to people's habits in everyday life, for example by linking chemical concepts to the process of making coconut oil. Coconut oil is a food that is very important and needed in everyday life. Apart from oil made from palm oil, virgin coconut oil is also often used for cooking. Apart from its distinctive aroma, virgin coconut oil can also be used as medicine (Pramitha & Wibawa, 2021). Making coconut oil is an activity that is commonly found in everyday life throughout Indonesia, especially the people in the Lombok area. Because of its distinctive aroma and taste, the people of Lombok highly favor virgin coconut oil. Based on observations in the Central Lombok area, many residents traditionally made pure coconut oil.

This series of processes for making coconut oil can be related to chemical concepts that can be used as material in chemistry lessons in high school grades X, XI, and XII. The steps for making coconut oil can visualize the abstractness of chemical concepts that can be used as a medium for learning chemistry, starting from the concept of macromolecules in the components of coconut fruit, coconut oil, and the process of making coconut oil by fermentation. In the process of making

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coconut milk there is the concept of separating mixtures, the concept of colliding in coconut milk, and in the heating process there is the concept of boiling point elevation.

Based on a survey conducted at SMAN 2 Gerung, 89.68% of students felt that they still had difficulty learning chemistry. The difficulty for students in studying chemistry is because most of the material in chemistry is abstract in nature, lots of formulas, memorization and calculations so that it is difficult for most students to understand. In addition, the learning media used are still monotonous, namely only in the form of textbooks such as worksheets and textbooks. This too monotonous learning media causes students to quickly get bored when studying chemistry so that students' interest in learning chemistry becomes low which in the end will prevent students from understanding chemical concepts, many students are still unable to distinguish basic chemical concepts, such as atoms, compounds, elements, phases of substances and other basic concepts. Still with the survey results, all students stated that they really liked learning chemistry using interesting learning media and were able to visualize abstract forms of chemical material so that it was easier to understand. From the results of the poll, it showed that as many as 81.43% of students stated that they were very interested in using learning media in the form of chemistry magazines. Besides containing text, magazines also display pictures or photos that can attract students' interest in reading so that teaching and learning activities are not boring.

Research on the development of chemical magazines has been carried out on the material of hydrocarbon compounds (Yuliyanto & Rohaeti, 2013), basic chemical laws (Pakpahan et al., 2016), and chemical bonds (Gultom et al., 2022). While research on the manufacture of coconut oil has been carried out by several researchers such as research on the manufacture of VCO (Virgin Coconut Oil) by fermentation and enzymatic processes (Dwi Sutanto et al., 2021), processing of virgin coconut oil by the fermentation method using yeast (Muharun & Apriyanto, 2014), making coconut oil enzymatically pure by using various concentration levels of pineapple enzymes in two types of coconut (Prihanani et al., 2017), and making Virgin Coconut Oil (VCO) using traditional methods (Hasibuan et al., 2018).

Research on the development of chemical magazines that explain chemical concepts in the process of making virgin coconut oil has never been reported. In this study the stages of the process of making coconut oil and descriptions of chemical concepts in it will be presented in the form of a chemistry magazine as a supplement to chemistry learning in high school.

Method

Making of coconut oil has been carried out in various ways and methods. Moehady & Hidayatulloh, (2020) made pure coconut oil in a wet way using tempeh yeast, Marlina et al., (2017) developed processed VCO with the addition of table salt, (Silaban et al., 2014) made coconut oil using a combination method of fermentation and enzymatic techniques, Maherawati & Suswanto, (2022) developed the traditional manufacture of coconut oil using the refining method.

This research is divided into several activities: a) coconut oil production using traditional methods and fermentation; b) documentation, producing photographs of the stages during the process of making oil; c) analysis of chemical concepts contained in each stage of the oil production process; d) design a magazine containing photographs and descriptions of chemical concepts in the manufacture of coconut oil (Figure 1).

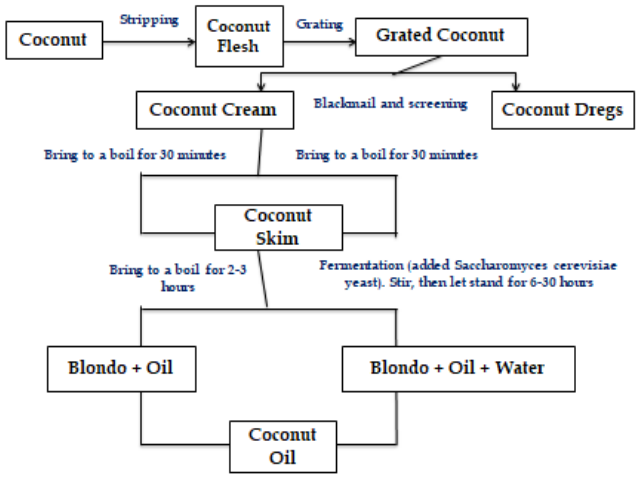

Figure 1. Making Coconut Oil Process

Making Coconut Oil. Making coconut oil is done by 2 methods, namely heating/traditional and fermentation for 6 hours (Andaka & Sentani, 2016). The scheme for making coconut oil can be seen in Figure 1.

Documentation. The process of making coconut oil both traditionally and by fermentation is immortalized in the form of photographs. Starting from selecting the coconut until the oil is obtained. The resulting photographs are used as material for compiling or designing chemistry magazines.

Magazine Design. The initial step at this stage is to identify the chemical concepts contained in making coconut oil. Then the initial design of the magazine is in the form of composing text, sentences, and selecting images to be used as content in the magazine. After the design is complete, the next step is to prepare the initial draft of the magazine according to the design made. The initial draft of the magazine is referred to as prototype 1.

Magazine Eligibility Test. After prototype 1 was formed, the next step was to test the feasibility of the magazine which was carried out in two stages, namely expert validity and student response. The expert validity test stage was carried out by three validators, this stage aims to measure the validity of the chemical magazines that have been made using validity assessment instruments. The product revision results after the validation process are referred to as prototype 2 which is ready to be tested. The next stage was the magazine feasibility test which was conducted on 66 students of grades X, XI, and XII MIPA SMAN 2 Gerung. This stage aims to obtain student responses regarding the chemistry magazine that has been developed to measure the feasibility of the magazine.

Data Analysis. Expert validity analysis result is measured using the Aiken's V formula which is formulated at Equation 1 and Table 1 (Retnawati, 2016).
Aiken's V formula (Formula 1) :

$$V = \frac{\sum s}{n\,(c-1)} \quad (1)$$

Information:
V = expert agreement index
S = expert score minus lowest score
n = number of expert
h = highest validity score

Table 1. Aiken's V index category

Index Range	Category
V ≤ 0.4	Less valid
0.4 < V ≤ 0.8	Valid
0.8 < V ≤ 1	Very valid

Student response questionnaires were analyzed using descriptive methods to determine the feasibility level of the developed chemistry magazine. The formula used in analyzing the data is shown at Equation 2 and Table 2.

Formula of the student response:

$$P = \frac{f}{N}\, x\, 100\% \quad (2)$$

Information:
P = final score
f = acquisition score
N = maximum score

Table 2. Eligibility criteria range

Percentage (%)	Eligibility Category
< 21	Very unworthy
21 - 40	Unworthy
41 - 60	Decent enough
61 - 80	Worthy
81 -100	Very worthy

Result and Discussion

This study discusses the development of the magazine, while the layout of the magazine begins with the magazine cover page which is equipped with the title, magazine header, serial number, and pictures related to the process of making coconut oil. The magazine cover page can be seen in Figure 2.

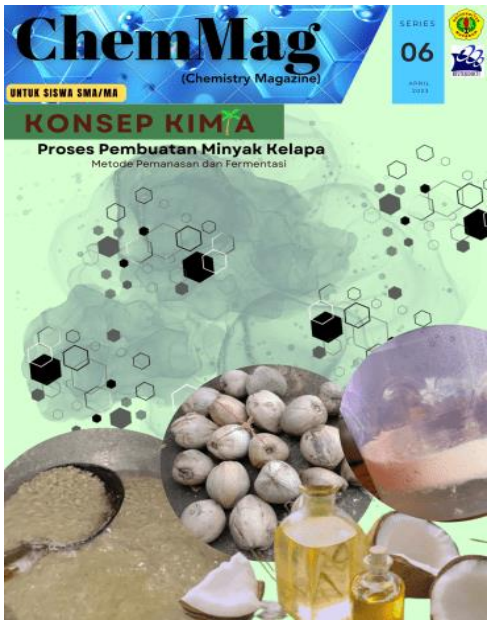

Figure 2. Magazine's cover

The next page is the introductory page of the magazine which contains the editor's greetings, the editorial team, and a table of contents. This page can be seen in Figure 3.

Figure 3. Editorial page

The next introductory page contains an explanation of the njeleng/nyeleng tradition and ethnoscience learning in the chemistry education

study program. Furthermore, as an introduction there is an explanation of the production of coconut oil as well as a general explanation of the coconut plant which is then followed by a schematic of the process of making coconut oil. The introductory page can be seen in Figure 4.

Figure 4. Introductary Page

Most of the processes for making coconut oil involve chemical concepts, starting with the components of the coconut fruit itself. For example in coconut shell and fiber which contain cellulose, lignin, and hemicellulose. Cellulose itself is included in carbohydrates, namely class XII material regarding macromolecules. Water and coconut meat contain protein, fat, carbohydrates and various vitamins which are also classified as macromolecular materials. An explanation of the components of coconut fruit and its relation to chemical concepts can be found on pages 6-17 of the chemistry magazine. An example can be seen in Figure 5.

In the process of making coconut milk, from the grating process to the separation of the coconut milk from the dregs, there is a chemical concept, namely the separation of mixtures which is the subject matter for class X. The grating process is the initial stage of the extraction process, which aims to reduce the particle size to facilitate the extraction of coconut milk (Afrizal et al., 2020; Gagliardi et al., 2022; Patel et al., 2019). Extracted coconut milk is an oil-in-water emulsion (Hartayanie et al., 2014; Sidik et al., 2013). The shredding process in the magazine can be found on page 18, which can be seen in Figure 6.

Figure 5. Chemical concepts at the stages of making coconut oil.

Figure 6. Grating Procces

The next page contains the squeeze and filter process which is the process of separating a mixture of extraction and filtration methods. The explanation is on pages 19 and 20, can be seen in Figure 7.

Figure 7. Extraction Procces

After the filtering process, coconut milk is formed. Coconut milk is a colloid type of oil-in-water emulsion which is a class XI chemical. An explanation of coconut milk and related chemical concepts can be found on pages 22-23 of the magazine, which can be seen in Figure 8.

Figure 8. Coconut milk and related chemistry concept

After the coconut milk is formed, the next step is to make coconut oil using two methods, namely heating and fermentation. In the heating process there is the concept of an increase in the boiling point because the heated coconut milk still contains 54% water and 35% fat, resulting in an increase in the boiling point of water because there is a fat content in coconut milk which has a higher boiling point than water so that the evaporation of water from the surface becomes difficult (density of oil is lower than water). In addition, there is also the concept of extraction, namely the process of extracting oil from coconut milk. Explanations in the magazine are on pages 24-25, can be seen in Figure 9.

Figure 9. Boiling process and related chemistry concept

The fermentation process method contains macromolecular material because this method requires the help of enzymes (proteins) in the manufacture of coconut oil (Asmoro et al., 2018). The explanation can be found on pages 26-27 in the magazine, which can be seen in Figure 10.

After the process of heating and fermentation, coconut oil and blondo are formed. Coconut oil and blondo produced from the heating process are different from the fermented coconut oil, both in terms of color and benefits, but the general chemical concept is the same. Blondo produced from heating and fermentation processes is a protein that has undergone denaturation so that it is included in the concept of macromolecules. An explanation of blondo and related chemical concepts can be found on page 28 of the magazine, which can be seen in Figure 11.

Figure 10. Fermentation process and related chemistry concept

Figure 11. The Blondo and related chemistry concept

Blondo is used as a seasoning for Gudeg Jogja (Haerani, 2010), as a basic ingredient in soap making (Amalia et al., 2021), as an additional ingredient in cake making (Ramadhani et al., 2021).

As with blondo, coconut oil is also included in macromolecular material because coconut oil is generally composed of triglyceride compounds which contain various fatty acids. An explanation of coconut oil and its chemical concepts can be found on pages 29-31, which can be seen in Figure 12.

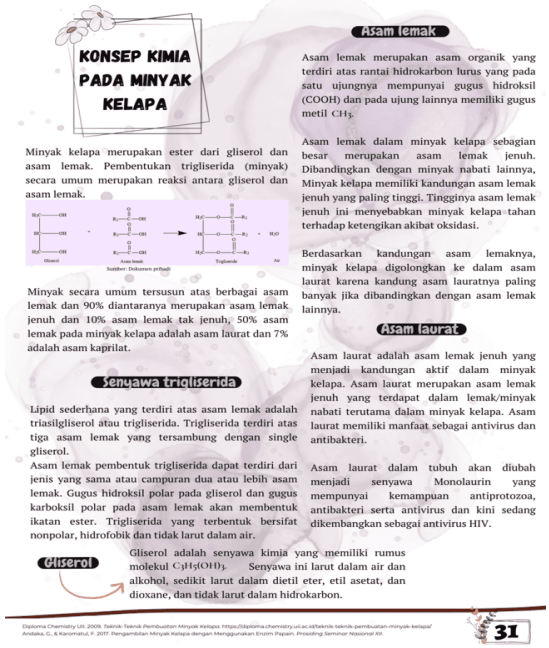

Figure 12. Coconut oil and related chemistry concept.

The last page is the closing page which contains a crossword game related to the material described in the contents of the magazine. The crossword page can be seen in Figure 13 is a game puzzle (Hidayah & Nurtjahyani, 2017)

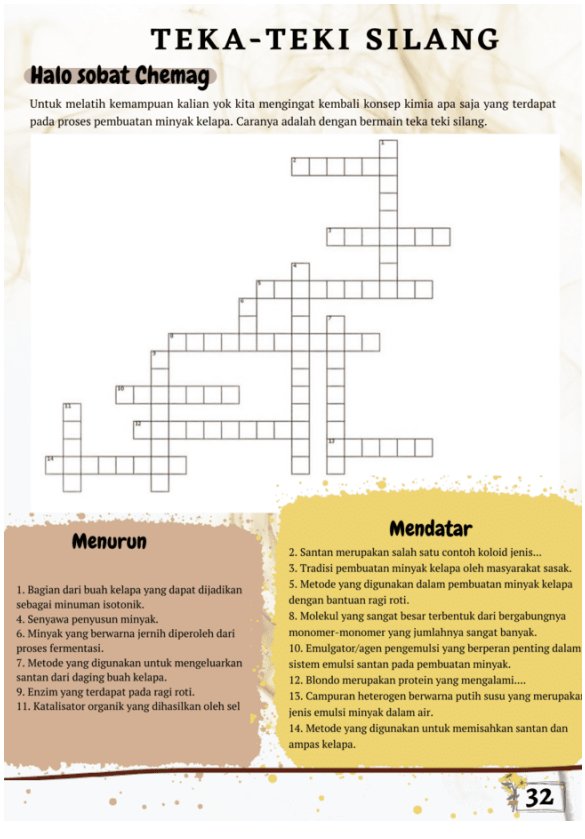

Figure 13. Crossword puzzle game

After the preparation of the magazine has been completed, the next step is the magazine's feasibility test. The results of the feasibility test were carried out in two stages, namely the expert validity test (Andani et al., 2021) which was carried out by three validators, namely two validators who were lecturers in chemistry education and one validator who was a chemistry teacher. Validasi dilakukan dengan menggunakan instrument untuk menvalidasi media (Pribowo, 2018)

The graph of the expert validity test results can be seen in Figure 14.

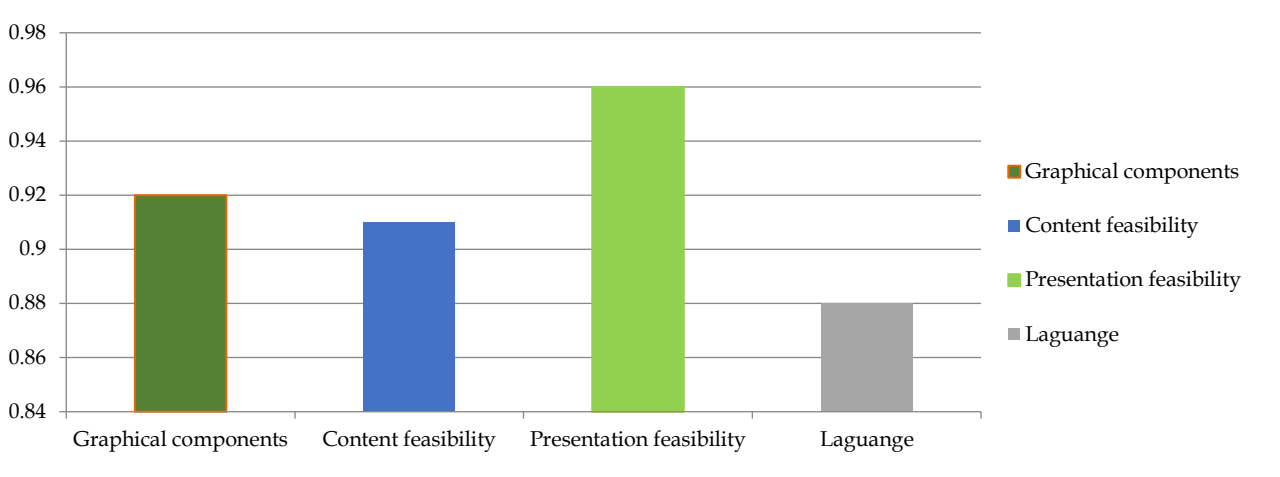

Figure 14. Graph of the validity result of chemistry magazine

The results of the magazine validation test (Alsyabri, 2021) for graphical components, content feasibility, presentation feasibility, and magazine language respectively were 0.92, 0.91, 0.96, and 0.88, all of which were included in the very valid category.

Furthermore, the feasibility test is in the form of student responses to the developed chemistry magazine. The fit test for the magazine was carried out on 66 students of grades X, XI, and XII MIPA SMAN 2 Gerung. The graph of the results of the magazine's due diligence can be seen in Figure 15.

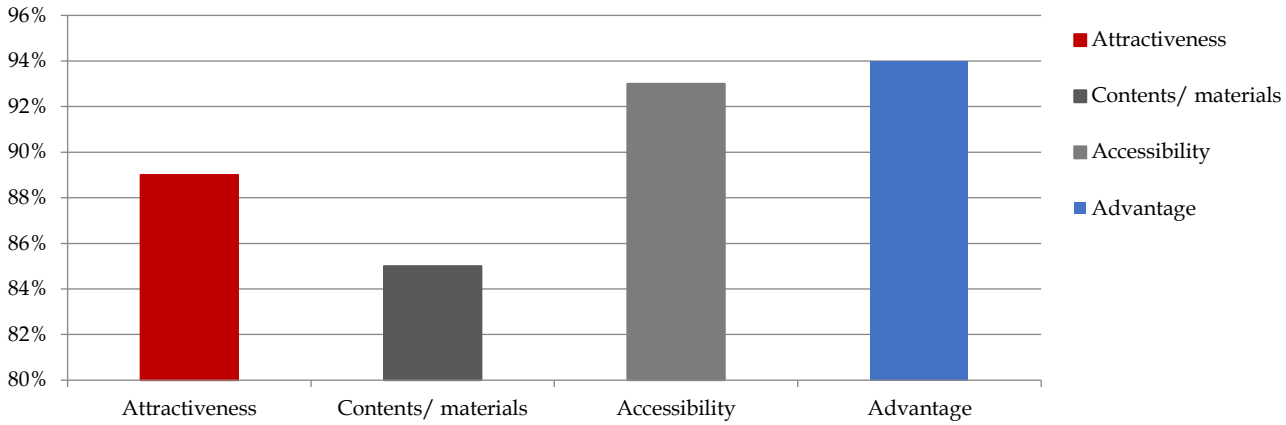

Figure 15. Graph of the results of the analysis of responses to chemistry magazines

Based on Figure 15 student responses to chemistry magazines with chemical concept content in the process of making coconut oil developed based on a range of eligibility criteria obtained the percentage of attractiveness of the magazine, the contents/material of the magazine, the ease of use of the magazine, and the benefits of the magazine respectively, namely 89%, 85% , 93%, and 94%. So that the results of the feasibility test of the chemical magazine that has been developed based on these

four components have an average of 90% which is classified in the very feasible category.

Student responses to interactive learning media generally get good grades with a percentage reaching 90% (Kartini & Putra, 2020).

Like the results of research by (Fitria et al., 2017; Maulidta & Sukartiningsih, 2018) that the results of the practicality test on learning media obtained a value of more than 80%. This means that the feasibility level of the developed chemistry magazine is very worth it to use.

Conclusion

Based on the results of the research that has been done, it can be concluded that: Chemical concepts related to the process of making coconut oil are macromolecules, separation of mixtures, boiling point elevation, and colloids; The validation results obtained an average V value of 0.92, indicating that chemistry magazines are in the very valid category; The results of the analysis of student responses, the average percentage is 90%, which means that chemistry magazines are included in the very appropriate category to be used as reading material for learning.

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Author Contributions

Conceptualization and methodology, R. Rahmawati.; software, Sya'ban Putra Adiguna.; validation, Fara Dwirani Sofia., Syarifa Wahidah Al Idrus. and Sunniarti Ariani.; formal analysis, Lilik Khaerun Nisa, Muti'ah.

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Conflicts of Interest

I declare that no conflicts interest in this research.

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