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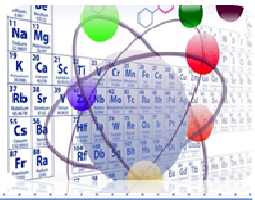

Preparation of Functional Mayonnaise Based on The Ratio of VCO (virgin coconut oil) and Olive oil and The Concentration of Egg Emulsifiers and Soy Milk

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ABSTRACT

This study aims to develop a healthier low-fat mayonnaise formulation by using variations in the ratio of Virgin Coconut Oil (VCO) and olive oil, as well as egg yolk and soy milk concentrations as emulsifiers. In this study, six variations of mayonnaise formulations were tested by measuring pH, fat content, and water content to evaluate the quality and stability of the emulsion. The results showed that the formulation with the combination of VCO and egg yolk produced mayonnaise with the lowest fat content (0.37 g) and good emulsion stability, while the combination of VCO and soy milk produced the highest fat content (0.91 g). pH measurements showed that all formulations were acidic, with the composition of VCO and soy milk having the highest acid content. In addition, formulation variations also affect the water content, where olive oil and egg yolk formulations produce the highest moisture content. Based on these results,VCO formulations with egg yolks are considered a healthier alternative to produce low-fat mayonnaise with optimal stability. This research contributes to the development of healthier food products, especially in the mayonnaise industry.

Keywords: *low-fat mayonnaise, Virgin Coconut Oil, olive oil, emulsifier, egg yolk, soy milk*

1. INTRODUCTION

Mayonnaise is an oil-in-water (o/w) emulsion product that is semi-solid and generally contains a high concentration of oil. Mayonnaise is typically made using vegetable oils and emulsifiers such as egg yolks, which serve to stabilize the mixture by lowering the surface tension between the oil and water.[4] The yolk, due to its lecithin content, acts as a natural emulsifier by binding oil and water, thus preventing phase

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separation. However, the high fat content in traditional mayonnaise is a concern for health-conscious consumers, prompting research to look for alternative ingredients that can reduce fat levels without sacrificing texture and taste.[10] Mayonnaise made from virgin coconut oil has stable properties, the lowest viscosity value is 312 cP with the addition of 0% yolk and the highest is 525 cP with the addition of 9% yolk, the higher the addition of egg yolk, the higher the viscosity.[9]

Virgin Coconut Oil (VCO) has attracted attention in recent years due to its health benefits and functional properties in food products. VCO is rich in medium-chain fatty acids, especially lauric acid, which provides antimicrobial benefits as well as improves product stability.[12] On the other hand, olive oil, which is high in monounsaturated fats, is highly recommended for cardiovascular health, making it an ideal candidate to replace traditional oils in food formulations. Several recent studies have investigated using various oils and emulsifiers to create healthier versions of mayonnaise.[6,12] Clinical research shows that supplementation with MCFA for three months can reduce weight and waist circumference, as well as improve lipid profiles in diabetic patients with obesity.[15]

For example, Harmanto et al. examined the effect of the combination of Red Palm Oil (RPO) and VCO with varying yolk concentrations, which showed that the combination could produce mayonnaise with better nutritional value without sacrificing flavor and stability.[4] While Sarungallo et al. argued that mayonnaise made using an oil-to-water ratio of 35:40 corresponds to the type of oil, with other additives, it can improve the emulsion's stability, viscosity, and level of preference for color, aroma and taste, texture, and overall acceptance of mayonnaise.[11] According to Lee et al. (2024), the use of supercritical CO_2-processed lean soybean flour in plant-based mayonnaise formulations shows improved emulsion stability, viscosity, and better sensory properties after adding the ingredient.[7] In addition, mayonnaise made using olive leaf vinegar (OLV), vegetable oils (a mixture of soybeans and sunflowers), and soy milk in place of egg yolks shows oxidative stability as well as good sensory qualities, with a high content of unsaturated fatty acids (64%) and omega-3 levels (1.7%), which may provide health benefits.[1] Therefore, there are challenges in making healthy mayonnaise, including the substitution of eggs with plant-based ingredients such as soy milk, as well as the use of healthy oils such as VCO and olive oil and offering strategies to optimize the texture, stability, and nutritional content of these products.[8]

Based on previous studies, this study aims to develop low-fat functional mayonnaise by varying the ratio of VCO and olive oil as well as the concentration of egg yolk and soy milk as emulsifiers. This approach is expected to result in healthier alternatives with lower levels of fat and cholesterol while still retaining an acceptable texture and taste. It is hypothesized that using soy milk as an emulsifier would partly contribute to a lighter and less greasy consistency while maintaining the stability provided by the yolk. The chemical reactions thought to occur during the emulsion process involve forming stable oil droplets coated by the emulsifier, preventing coagulation and phase separation. The study will also use pH, fat content, and water analysis to evaluate the quality of mayonnaise, following the methodology used in previous studiess.

2. EXPERIMENTAL

2.1. Chemicals, Equipment and Instrumentation

This research uses an experimental approach by developing a low-fat mayonnaise formulation. The variations carried out in this study were (1) oil comparison (Virgin Coconut Oil/VCO and olive oil) and (2)

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emulsifier concentration (egg yolk and soy milk). The formulation in this study was tested in six variations of combinations between oil and emulsifier. After conducting tests on six variations of combinations, the test was continued by evaluating pH, fat content, and moisture content. The parameters measured in this study are (1) pH to measure acidity, (2) the fat content of mayonnaise using filter paper, and (3) moisture content using the oven method. This research used various tools and materials to create and test low-fat mayonnaise formulations. The materials and tools used in this study can be seen in Table 1. and Table 2.

Table 1. Materials used in the research

No	*Materials*	*Amount*
1	VCO (Virgin Coconut Oil)	180 mL
2	Olive Oil	180 mL
3	Lemon	6 Spoon
4	Soy Milk	120 mL
5	Eggs	4 Pieces
6	Salt	6 Grams

Table 2. Tools used in research

No	*Tools*	*Spesification*
1	Analitical Scale	1 Pieces
2	50 mL Measuring Cup	3 Pieces
3	10 mL Measuring Cup	3 Pieces
4	Mixer	1 Pieces
5	Spoon	2 Pieces
6	Cups	6 Pieces
7	Filter Paper	6 Pieces

2.2. Research Procedure

This research procedure is carried out as it should be in accordance with the stages used in making thisMayones, namely:

A. Virgin Coconut Oil + Egg yolk

1. Make sure the egg is at room temperature.
2. Put one egg, then 2 tablespoons of lemon juice and a pinch of salt into a bowl. Beat the three until well combined using a mixer.
3. Prepare 60ml virgin coconut oil Add little by little while continuing to beat using a mixer for about15 minutes.
4. Keep adding the virgin coconut oil a little at a time until it runs out while continuing to beat until the mixture starts to thicken and takes the shape of mayonnaise.
5. Store the mayonnaise in an airtight container and put it in the refrigerator for about 5 minutes.

B. Virgin coconut oil + soy milk

1. Make sure the soy milk is at room temperature.
2. Put 30ml of soy milk, 2 tablespoons of lemon juice and a pinch of salt in a bowl. Whisk the three

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together until well combined using a mixer.
3. Prepare 60ml virgin coconut oil Add little by little while continuing to beat using a mixer for about15 minutes.
4. Keep adding the virgin coconut oil a little at a time until it runs out while continuing to beat until the mixture starts to thicken and takes the shape of mayonnaise.
5. Store the mayonnaise in an airtight container and refrigerate for about 5 minutes

C. Virgin coconut oil + egg yolk + soy milk

1. Make sure the soy milk and egg are at room temperature.
2. Put 30ml soy milk, one egg, 2 tablespoons lemon juice and salt into a bowl. Beat the four until well combined using a mixer.
3. Prepare 60ml virgin coconut oil Add little by little while continuing to beat using a mixer for about15 minutes.
4. Keep adding the virgin coconut oil a little at a time until it runs out while continuing to beat until the mixture starts to thicken and takes the shape of mayonnaise
5. Store the mayonnaise in an airtight container and put it in the refrigerator for about 5 minutes

D. Olive oil + egg yolk

1. Make sure the egg is at room temperature.
2. Put one egg, 2 tablespoons of lemon juice and a pinch of salt into a bowl. Beat all three until well combined using a mixer.
3. Prepare 60ml of olive oil Add little by little while continuing to beat using a mixer for about 15 minutes.
4. Keep adding olive oil little by little until it runs out while continuing to beat until the mixture startsto thicken and takes the shape of mayonnaise
5. Store the mayonnaise in an airtight container and put it in the refrigerator for about 5 minutes

E. Olive oil + soy milk

1. Make sure the soy milk is at room temperature.
2. Put 30ml of soy milk, 2 tablespoons of lemon juice and a pinch of salt in a bowl. Whisk the three together until well combined using a mixer.
3. Prepare 60ml of olive oil Add little by little while continuing to beat using a mixer for about 15 minutes.
4. Keep adding olive oil little by little until it runs out while continuing to beat until the mixture startsto thicken and takes the shape of mayonnaise.
5. Store the mayonnaise in an airtight container and put it in the refrigerator for about 5 minutes.

F. Olive oil + egg yolk + soy milk

1. Make sure the soy milk and egg are at room temperature.
2. Put 30ml soy milk, one egg, 2 tablespoons lemon juice and salt into a bowl. Beat the four until

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well combined using a mixer.

3. Prepare 60ml of olive oil Add little by little while continuing to beat using a mixer for about 15 minutes.
4. Keep adding the olive oil little by little until it runs out while continuing to beat until the mixture starts to thicken and takes the shape of mayonnaise.
5. Store the mayonnaise in an airtight container and put it in the refrigerator for about 5 minutes

3. RESULTS AND DISCUSSION

3.1. Analysis of Characterization Results

The results of this study showed that the variation of mayonnaise formulation with oil-based ingredients (Virgin Coconut Oil and olive oil), as well as the type of emulsifier (egg yolk and soy milk), significantly affected the physicochemical characteristics of mayonnaise, including acidity level (pH), fat content and moisture content. Formulations with VCO and egg yolks produce mayonnaise that has low fat content and stable emulsions, the combination of VCO and soy milk produces mayonnaise that has the lowest fat content and stable emulsions, and the combination of VCO and soy milk produces the highest fat content. This difference in results shows that emulsifiers have a role in forming stable emulsions. This is also following research conducted by Fransisca et al. (2023) that emulsifiers have an important role in maintaining the stability of mayonnaise formulations with egg emulsifiers to produce stable mayonnaise and a typical sour taste of mayonnaise with a pH of 4.31-5.20 (Fransisca et al., 2023). In addition, the moisture content was also tested, where the formulation between olive oil and egg yolk had the highest moisture content. This showed that the ingredient affected the texture and stability of the mayonnaise.

Analysis pH

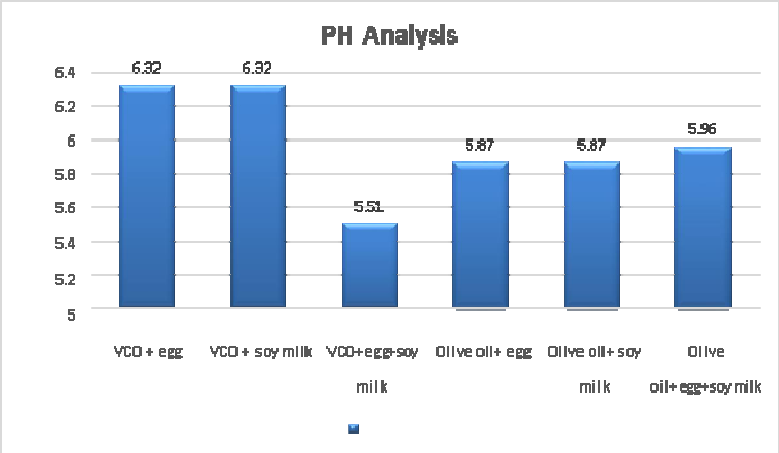

Figure 1. Results of pH Analysis of Mayonnaise Mixes Contained Acid

In the PH analysis measurement, it was evident that all six mayonnaise mixes contained acid. This can be seen in the graph, the highest acid content is in the composition of virgin coconut oil emulsifying eggs and virgin coconut oil emulsifying soy milk. The lowest acid content is in the composition of VCO + eggs +

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soy milk, which, if mixed with these two emulsifiers, will produce mayonnaise products with low acid content.

Fat Content

In measuring fat content, filter paper is used with an original weight of 0.55g. Then, after a few minutes, the paper absorbed all the fat in the 6 types of mayonnaise mixture that had been made. Based on graph, the highest fat content is obtained in the composition of a mixtureof virgin coconut oil and soy milk mayonnaise, which is 0.91 g of fat content. The lowest fat content result is virgin coconut oil and eggs 0.37g, which is good for consumption.

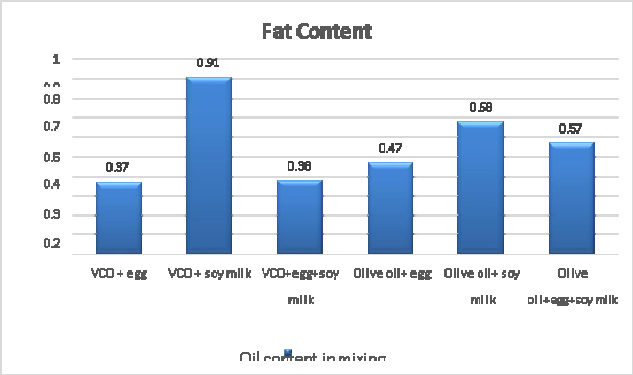

Figure 2. Results of Fat Content of Mayonnaise Mixes Contained Acid

Water Content

Measurement of water content is done using the oven method. where when mayonnaise is placed on a heat-resistant cup weighing 20.63 g. then put into the oven, the results obtained mayonnaise which has the highest water content is in the composition of olive oil with egg emulsifier and soy milk. Mayonnaise has the lowest water content and is composed of virgin coconut oil-emulsifying eggs.This measurement is obtained by subtracting the weight of the mayonnaise cup before entering the oven and after leaving the oven. Then, the water vapor in the mayonnaise will shrink. Based on the graph, the highest water content is obtained in the composition of a mixture of olive oil, egg, and soy milk, which is 0.15 g of water content. The lowest water content result is virgin coconut oil and eggs 0.02 g.

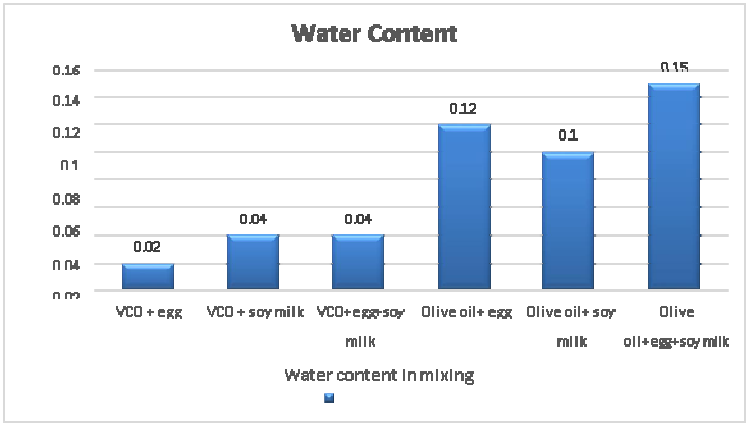

Figure 3. Results of Water Content of Mayonnaise Mixes Contained Acid

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Based on previous research, VCO, which contains the fatty acid Medium Chain Triglycerides (MCTs), can affect the viscosity and pH of mayonnaise, as well as affect the texture and color of mayonnaise. These results show the importance of comparing the oils used, which will affect the sensory properties of mayonnaise, such as taste, texture, and preference level.[5] Mayonnaise formulated with varying concentrations of 5%, 10%, and 15% indicates that the viscosity and pH of mayonnaise increase with adding oil. In addition, it can also improve the physical and textured properties of mayonnaise by providing additional benefits in terms of emulsion stability and nutritional content.[14] In addition, the results of the study by Flamminii et al. (2020) showed that mayonnaise with OLE (Mayo + Alg/Pec) charged microparticles was effective in improving its physical properties both in terms of the degree of dispersion of oil droplets and the lubricating properties of the emulsion; however, the highest viscosity, which in turn was reflected by the lowest spreading power, led to different sensory perceptions concerning the control sample and Mayo + OLE.[2] Furthermore, according to Wang et al. (2022) that thickeners can improve the apparent viscosity, emulsion stability, and thermal stability of substituted mayonnaise while improving their hardness and adhesion. In addition, substituted egg yolks can delay the lipid oxidation of mayonnaise and improve the oxidative stability of SOB-substituted mayonnaise during storage, compared to whole egg yolk mayonnaise.[13]

The success of mayonnaise formulation relies heavily on selecting the correct and appropriate emulsifier and careful processing to achieve stability between mayonnaise's physical, textural, and sensory qualities. The addition of functional ingredients such as soy milk to the formulation can increase the nutritional value of mayonnaise and provide health benefits. The use of oils with fatty acid composition, emulsifiers, and the addition of the right functional ingredients can produce stable, delicious, and healthier mayonnaise.

4. CONCLUSION

Based on the research results, it can be concluded that using a combination of olive oil and palm oil as a base for mayonnaise gives quite good results. Olive oil provides a milder taste and distinctivearoma, while palm oil increases the viscosity and stability of the emulsion. The optimal comparison between these two oils must be investigated further to obtain the desired mayonnaise characteristics. Using egg yolks and soy milk as emulsifiers in making mayonnaise gives varying results. Egg yolk produces a more stable emulsion but has a high cholesterol content. Soy milk, as a vegetable alternative, can reduce cholesterol content but requires formula optimization to achieve the desired viscosity. Combining the two could be an interesting option to obtain mayonnaise with a better nutritional profile. The mayonnaise produced from this formulation has different characteristics depending on the oil ratio and type of emulsifier. In general, the resulting mayonnaise has a soft texture and a distinctive taste.

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