

## **OPTIMIZATION OF REDUCED FAT MAYONNAISE BY USING APPLE PEEL FLOUR AS A STABILIZER**

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Submitted 13 October 2021; Accepted 29 November 2021

### **ABSTRACT**

Reduced fat mayonnaise products have an unstability of the emulsion, so a stabilizer is needed to improve quality of mayonnaise. Apple peel flour can be used as a stabilizer to improve the quality of mayonnaise. The materials used in this study were vegetable oil, egg yolk, vinegar, apple peel flour and other optional ingredients. The research treatment was without the addition of apple peel flour as a control, the use of 1%, 2% and 3% apple peel flour. The objective of this research was to determine the best percentage of apple peel flour as a stabilizer in reduced fat mayonnaise. The research method used is a laboratory experiment method. The design used was a completely randomized design with 4 treatments and 4 replications. Analysis of variance was used to analyze the resulting data, if there was a difference in the effect, it was continued with Duncan's Multiple Range Test. This study resulted that the use of apple peel flour used as a stabilizer resulted gave highly significant difference in reduced fat mayonnaise. The average acidity is 0.66-0.90, the emulsion stability is 96.92-99.18%, the antioxidant activity is 8.37-19.38%, the carbohydrate content is 2.63-5.81% and ash by 1.72-1.92%. It could be concluded that the use of 3% apple peel flour can produce the best quality reduced fat mayonnaise product and is close to the characteristics of full fat mayonnaise.

**Key words:** Apple peel powder; reduced fat mayonnaise; stabilizer

## INTRODUCTION

Manalagi apple peel waste is mostly found in processed apple chips and apple cider factories. Both of these plants can produce 5 tons of waste. Manalagi apple peel waste in Batu Malang City is widely used as ruminant animal feed mixed with other feeds. Apple peel can also be used as a source of pectin which is used as a stabilizer. The stabilizer is used as an emulsion stabilizer which aims to increase the stability of the emulsion and is expected to maintain the stability of the emulsion during storage. Apple peel flour also contains several secondary metabolites that are antioxidative, including alkaloids, phenols, terpenoids, steroids, and flavonoids.

Mayonnaise is a type of oil in water emulsion (o/w). The problem that occurs in full-fat mayonnaise is that it has a high-fat content, therefore various efforts have been made to reduce the fat content but have characteristics similar to full-fat. One effort that can be done is to reduce the dispersed phase and increase the dispersion phase. Reduced-fat mayonnaise uses vegetable oil as the dispersing phase as much as 50% of the total ingredients used. The water phase is used in the form of vinegar and vegetable oil as the oil phase requires a stabilizer. Several studies on the use of stabilizers

include hydrocolloids. One of the materials that can be used as a stabilizer is manalagi apple peel waste.

Manalagi apple peel contains pectin about 40.7% of the fruit weight (Subagyo, and Ahmad. 2010). The proximate content of apple peel is 2.80 g/100g of crude protein, 9.96 g/100g of crude fat, 1.39 g/100g of ash content, 13.95 g/100g, and 59.96 g/100g, contains calcium minerals of 14.89 mg/100g, 0.95 mg/100g zinc, 25.63 mg/100g iron and 1.28 mg/100g manganese (Romelle, et al. 2020). The pectin can increase the formation of mayonnaise emulsion stability, reduce acidity, increase antioxidant activity, increase carbohydrate content and ash content in reduced-fat mayonnaise.

## MATERIALS AND METHODS

This study used laboratory research methods and used a completely randomized design. The treatments used were 4 treatments and 4 replications. The treatments used were without manalagi apple peel flour as a control, the addition of 1% manalagi apple peel flour (P1), 2% manalagi apple peel flour (P2), and 3% manalagi apple peel flour (P3). The reduced-fat mayonnaise formulation can be seen as follows:

**Table 1.** Reduced fat mayonnaise formulation

Ingredient (%)	Control	T1	T2	T3
Canola Oil	70	50	50	50
Eggs yolk	15	15	15	15
Apple peel flour	0	1	2	3
Vinegar	5	5	5	5
Salt	1.5	1.5	1.5	1.5
Sugar	2.5	2.5	2.5	2.5
Mustard	0.5	0.5	0.5	0.5
White Pepper	0.5	0.5	0.5	0.5

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How to cite:

Evanuarini, H., & Susilo, A. (2021). Optimization of Reduced Fat Mayonnaise by Using Apple Peel Flour as a Stabilizer. *Jurnal Ilmu dan Teknologi Hasil Ternak (JITEK)*, 16 (3), 174-180

The preparation of apple peel flour is done by drying the cleaned apple peel in a drying oven at 60 degrees for 46 hours, then the apple peel is mashed and filtered through a 100 mesh sieve. The process of sample mayonnaise is done by mixing the ingredients (sugar, salt, pepper, and mustard) using a hand mixer at 1500 rpm for 1 minute, then adding egg yolks, canola oil and alternating with vinegar, then adding flour apple peel and homogenized until an emulsion is formed (Evanuarini, et al. 2016) with the modification of. The data that has been obtained then perform analysis of variance (ANOVA). If the results are

obtained had a significant or highly significant difference, then continued with Duncan's Multiple Range Test.

## RESULTS AND DISCUSION

### Acidity

Data and analysis of various acidity levels of reduced-fat mayonnaise with the addition of manalagi apple peel flour gave highly significant effect ( $P < 0.01$ ) on the acidity level of mayonnaise. The mean value of reduced-fat mayonnaise acidity with the addition of manalagi apple peel flour can be seen in Table 2.

**Table 2.** The Average Value of Acidity Level of Reduced Fat Mayonnaise

Treatment	Acidity Level
P0	$0.90 \pm 0.02^d$
P1	$0.81 \pm 0.03^c$
P2	$0.72 \pm 0.02^b$
P3	$0.66 \pm 0.03^a$

Note: Different superscripts in the same column show a highly significant difference ( $P < 0.01$ )

Table 2 shows that the acidity of reduced-fat mayonnaise with the addition of apple peel flour with different percentages tends to decrease. The average value of the acidity of mayonnaise is 0.66-0.90. The highest acidity level was found in control mayonnaise (P0) and the lowest acidity level was mayonnaise with the addition of 3% manalagi apple peel flour (P3).

The more addition of apple peel flour to reduced-fat mayonnaise, then the average value of the acidity of the mayonnaise will increase. This is because pectin is a carboxylic group and is acidic (Amelia et al. 2016). Pectin is also a D-galacturonic polymer linked by -1,4 glycosidic bonds which play a role in lowering pH. The use of pectin materials affects the stability of the emulsion (Nguemazong, et al. 2018). The degree of acidity (pH) is used to determine the level of acidity of a material. The acidity in question is the concentration of hydrogen ions ( $H^+$ ) in the water solvent (Dewi, Antarini, and Puryana, 2013). According to

Falah, et al (2020), the pH level of pectin derived from apples is around 2.0-4.0. The acidity of mayonnaise with pectin content results in several 0.7-0.8 (Johary, et al. 2015).

### Emulsion stability

The addition of manalagi apple peel flour gave highly significant effect ( $P < 0.01$ ) on the stability of the mayonnaise emulsion. The average value of the stability of the reduced-fat mayonnaise emulsion with the addition of manalagi apple peel flour can be seen in Table 3.

Emulsion stability in reduced fat mayonnaise with the addition of apple peel flour with different percentages increased. The average value of the stability of the mayonnaise emulsion ranged from 96.92-99.18%. The highest emulsion stability was found in mayonnaise with the addition of 3% apple peel flour (P3) and the lowest emulsion stability was mayonnaise without the addition of apple peel flour.

**Table 3.** The Average Stability Value of Reduced Fat Mayonnaise Emulsion

Treatment	Emulsion stability (%)
P0	96.92 ± 0.11 <sup>a</sup>
P1	97.18 ± 0.04 <sup>b</sup>
P2	98.82 ± 0.10 <sup>c</sup>
P3	99.18 ± 0.04 <sup>d</sup>

Note: Different superscripts in the same column show highly significant difference (P<0.01)

With the more addition of apple peel flour to reduced-fat mayonnaise, the average value of the stability of the mayonnaise emulsion will increase. This is due to the nature of pectin in apple peel flour can form a gel and increase the viscosity of the mayonnaise emulsion.

The nature of pectin can form a gel when combined with water and acid (Amelia, et al. 2016). Emulsion stability is an important parameter to determine durability during storage and mayonnaise using pea pod powder produces 99.86% emulsion stability (Rudra, et al. 2020). Mutiah (2002) explained that the stability of the emulsion is influenced by the balance of the proportion between protein and water. If

the amount of protein is not proportional to the amount of water, it can cause water to separate because the protein is not able to bind high amounts of water so that it will cause low emulsion stability. Vegan mayonnaise using durian gum seeds resulted in emulsion stability of 80.34% (Cornelia, et al. 2015).

#### Antioxidant activity

The addition of manalagi apple peel flour gave highly significant effect (P<0.01) on the antioxidant activity of mayonnaise. The average value of the antioxidant activity of reduced-fat mayonnaise with the addition of manalagi apple peel flour can be seen in Table 4.

**Table 4.** Average Value of Antioxidant Activity of Reduced Fat Mayonnaise

Treatment	Antioxidant activity (%)
P0	8.70 ± 0.56 <sup>a</sup>
P1	13.09 ± 0.32 <sup>b</sup>
P2	16.59 ± 0.42 <sup>c</sup>
P3	19.38 ± 0.24 <sup>d</sup>

Note: Different superscripts in the same column show a very significant difference (P<0.01)

The antioxidant activity of reduced-fat mayonnaise with the addition of apple peel flour with different percentages increased. The average antioxidant activity of mayonnaise was 8.70-19.38%. The highest antioxidant activity was found in mayonnaise with the addition of 3% apple peel flour (P3) and the lowest antioxidant activity was control mayonnaise.

The higher the addition of manalagi apple peel flour in reduced-fat mayonnaise, the average value of the antioxidant activity of mayonnaise will increase. This is because manalagi apple peel flour contains 55.77% of antioxidants (based on preliminary research). The IC<sub>50</sub> value (50% inhibitor

concentration) is a concentration that can absorb 50% of DPPH free radicals, so the smaller the IC<sub>50</sub> value, the greater the antioxidant. Compounds that can be said to be very strong antioxidants have IC<sub>50</sub> values of less than 50 ppm, strong IC<sub>50</sub> of 50-100 ppm, moderate IC<sub>50</sub> of 100-200 ppm, and weak IC<sub>50</sub> of more than 200 ppm. Apple peel flour also contains several secondary metabolites that are antioxidative, including alkaloids, phenols, terpenoids, steroids, and flavonoids. Materials containing vitamin E can also increase antioxidant activity (Johary, et al. 2015). Types of antioxidant content in apple peels are procyanidin, catechin, epicatechin,

chlorogenic acid, phloridzin, and quercetin conjugates (Gunathilake and Considine, 2018). Components such as flavonoids, terpenoids, and phenolics can significantly affect antioxidants (Gomes, et al. 2016).

**Carbohydrate Level**

The addition of manalagi apple peel flour gave a highly significant effect ( $P < 0.01$ ) on the carbohydrate content of mayonnaise. The average value of reduced-fat mayonnaise carbohydrate content with

the addition of manalagi apple peel flour can be seen in Table 5.

Table 5 showed that the carbohydrate content of reduced-fat mayonnaise with the addition of apple peel flour with different percentages increased. The average value of the carbohydrate content of mayonnaise is 2.63-5.81%. The highest carbohydrate content was found in mayonnaise with the addition of 3% apple peel flour (P3) and the lowest carbohydrate content was mayonnaise without treatment.

**Table 5.** The Average Value of Carbohydrate Content of Reduced Fat Mayonnaise

Treatment	Carbohydrate Content (%)
P0	2.63 ± 0.13 <sup>a</sup>
P1	4.16 ± 0.64 <sup>b</sup>
P2	5.02 ± 0.31 <sup>c</sup>
P3	5.81 ± 0.07 <sup>c</sup>

Note: Different superscripts in the same column show highly significant difference ( $P < 0.01$ )

Table 5 shows that the more apple peel flour is added to reduced-fat mayonnaise, the higher the average value of the carbohydrate content of mayonnaise will be. This is because of the carbohydrates in apple peel flour, one of which is pectin. Pectin is a galacturonic acid polymer that contains polysaccharide acid and can bind water so that it is a thickener (Nadir, et al. 2019).

The stability of the emulsion in mayonnaise can be improved with carbohydrates, the function of carbohydrates as thickeners (Safitri, Evanuarini, and Thohari 2019). The sugars in mayonnaise can bind to pectin to form strong hydrogen bonds and become a complex polysaccharide network (Shin, et al. 2002). The higher carbohydrate content is also caused by the higher acidity in mayonnaise. This is because the more hydrogen ions that can hydrolyze protopectin into pectin, can increase the yield, which also means the carbohydrate content will also increase (Nadir, et al. 20219). According to Fernandes and Myriam (2017) in the study of low-fat

mayonnaise, carbohydrates increased influenced by the level of concentration of chia mucilage as a substitute for oil. According to Araujo, et al. (2014) the increase in carbohydrates is influenced by the dissolved material and the stability of the emulsion formed in mayonnaise.

**Ash Level**

Data and analysis of variance in ash content of reduced-fat mayonnaise with the addition of manalagi apple peel flour gave highly significant effect ( $P < 0.01$ ) on the ash content of mayonnaise. The average value of reduced-fat mayonnaise ash content with the addition of manalagi apple peel flour can be seen in Table 6.

Table 5 showed that the carbohydrate content of reduced-fat mayonnaise with the addition of apple peel flour with different percentages increased. The average value of the carbohydrate content of mayonnaise is 2.63-5.81%. The highest carbohydrate content was found in mayonnaise with the addition of 3% apple peel flour (P3) and the lowest carbohydrate content was mayonnaise without treatment.

**Table 6.** Average Value of Ash Content of Reduced Fat Mayonnaise

Treatment	Ash Content (%)
P0	1.72 ± 0.03 <sup>a</sup>
P1	1.78 ± 0.05 <sup>b</sup>
P2	1.88 ± 0.04 <sup>c</sup>
P3	1.92 ± 0.03 <sup>d</sup>

Note: Different superscripts in the same column show highly significant difference ( $P < 0.01$ )

Table 6 shows that the ash content of reduced-fat mayonnaise with the addition of apple peel flour with different percentages increased. The average value of the ash content of mayonnaise is 1.72-1.92%. The highest ash content was found in mayonnaise with the addition of 3% apple peel flour (P3) and the lowest ash content was mayonnaise without treatment.

Table 6 shows that the more apple peel flour is added to reduced-fat mayonnaise, the higher the ash content of mayonnaise will be. This is because apple peel flour also has an ash content. Based on preliminary research, the ash content in apple peel flour is 4.54%. Ash is the residue of burning organic matter to produce inorganic materials (Nuh, et al. 2017). According to Romelle, et al (2020) explained that the ash content in 100 g of dried apple peels includes 14.89 mg calcium, 0.95 mg zinc, 25.63 mg iron, and 1.28 mg manganese. The more apple peel flour added to the mayonnaise, the higher the ash content was because the calcium, zinc, iron, and manganese content in the mayonnaise also increased. The ash content in apple skin is about 0.06-0.35% (Falah, et al. 2020). It is very possible that the ash content of mayonnaise also increased significantly.

### CONCLUSION

It can be concluded that the use of apple peel flour as much as 3% resulted in the best-reduced fat mayonnaise with an acidity of 0.66, emulsion stability of 99.18%, the antioxidant activity of 19.38%, the carbohydrate content of 5.81%, and ash content. by 1.92%, and close to the characteristics of full-fat mayonnaise.

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