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The Addition of Avocado Seed Flour in Reduced Fat Mayonnaise as Stabilizer

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This study aims to determine the quality of mayonnaise by adding avocado seed flour as a stabilizer based on pH, viscosity, stability emulsion, emulsion droplets, acidity, and color analysis (L a* b*).
Study Design: This study are an laboratory experimental with a completely randomizeddesign.
Place and Duration of Study: This study are located in Laboratory of Animal Product Technology, Faculty of Animal Science, Universitas of Brawijaya.
Methodology: This research method used was laboratory experimental with a completely randomized design with 4 treatments and 4 replications.
Results: Avocado seed flour is added to the mayonnaise formulation at 0%, 1%, 2% and 3% sensory evaluation of the total ingredients used. The variables measured are pH, viscosity, stability emulsion, emulsion droplets , acidity, color analysis (L a* b*). The results showed that the treatment had a very significant effect (P<0.01) on pH, viscosity, stability emulsion, emulsion droplets, acidity and color analysis (L a* b*). It can be concluded that the best treatment in this study was mayonnaise woth the addition of 1% avocado seed flour.

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Conclusion: This study concluded that the addition of avocado seed flour at 3% can produce mayonnaise with the characteristics of pH, viscosity, emulsion stability, acidity, emulsion droplets, and color analysis.

Keywords: Reduced fat mayonnaise; avocado seed flour; emulsion; stabilizer.

1. INTRODUCTION

Mayonnaise is a product resulting from processed egg in semi-solid form made from mixing vegetable oil, sugar, salt, mustard, vinegar and egg yolk as an emulsifier which will form an emulsion system. Emulsifiying agents are needed to maintain the stability of the emulsion system after rubbing, so that the vegetable oil and other ingredients do not separate. In the process of making mayonnaise, oil ismaterial used with the largest percentage compared to other ingredients because oil is a dispersed medium (Usman et al., 2015). There are three main components that form mayonnaise consisting of acid solution as a dispersing medium, egg yolk as an emulsifier, and vegetable oil which is a dispersed medium [1-3]. The three main ingredients must be balanced so that the mayonnaise produced has good quality in terms of aspects such as texture, viscosity, and emulsion stability [4,5]. Some types of mayonnaise are full fat mayonnaise with fat content ranging from $70-80\%$, reduced fat mayonnaise with fat content ranging from $40-60\%$, low fat mayonnaise with fat content ranging $>30\%$, light mayonnaise, and salad dressing. Reduced fat mayonnaise is made to minimize the fat content in mayonnaise, so as to reduce the risk of degenerative diseases and arterosclerosis. Reduced fat mayonnaise is made by reducing the oil phase and increasing the water phase, the obstacle that occurs in reduced fat mayonnaise products is emulsion instability, so stabilizers are needed [6-8]. The use of stabilizers in mayonnaise will produce reduced fat mayonnaise with the best characteristics [9].

Avocado fruit consumed in Indonesia reaches 461,613 tons and as much as 60,009 tons of avocado seeds only become waste, even though avocado seeds contain starch, which is 80.1% which is quite high (BPS, 2019). Avocado seed waste in Indonesia that accumulates with a fairly high amount of starch can be reduced by using it as an alternative source of starch which is processed into food products such as avocado seed flour. Avocado seeds contain high antioxidants [10,11]. Antioxidants contained in avocado seeds have been proven by research by Segovia, et al. [12] that avocado seeds with a concentration of 0.75% can slow down the oxidation of oil, namely 80%. Avocado seeds can also be used as a source of polysaccharides that play a role in making chitosan edible films. Compounds in starch are able to increase antioxidants.

2. MATERIALS AND METHODS

2.1 Materials

The material used in the research is mayonnaise which is made from egg yolks, vegetable oil and vinegar with the addition avocado seed flour and other ingredients. The ingredients for making spent mayonnaise are spent egg yolks $(20\ \mathrm{g})$, apple vinegar $(5\mathrm{ml})$, sunflower seed oil $(50\mathrm{ml})$, white pepper $(0{,}5\ \mathrm{g})$, salt $(1{,}5\ \mathrm{g})$, sugar $(2\ \mathrm{g})$, mustard $(1\ \mathrm{g})$, and seed flour $(1{,}2$,and $3\ \mathrm{g})$. For analysis ph, viscosity, stability emulsion, emulsion droplet, acidity, analysis color. Erlenmeyer flask, beaker glass, spindle, centrifuge tube, pH meter, nikon eclipse E100 microscope 100x, color reader, distilled water, phenolplatein indicator, $0.1\mathrm{MNaOH}$, buffers 4 and 7.

2.2 Methods

This research used laboratory research methods with a Completely Randomized Design experimental method with 4 treatments and 4 replications.

2.3 Data Analysis

The collected data are tabulated using Microsoft Excel 2013 and Further analysis using ANOVA methods. Duncan Multiple Range Test (DMRT) are use when there a significant or every significant effect of data.

2.4 Mayonnaise Production

The first step is to weigh and prepare the ingredients used, such as egg yolks, sunflower seed oil, apple vinegar, salt, sugar mustard and

white pepper. The ingredients that are ready are mixed tohether into the container provided using a mixer at a speed of 1500rpm for about 1 minute. Next, add sunflower oil little by little and alternately with vinegar. For the control treatment, avocado seed flour was not added. For treatments P1, P2 and P3, avocado seed flour was added according to the percentage of 1%, 2%, 3%. then homogenized with a mixer until an emulsion is formed and stored at room temperature until it reaches stability

2.5 Quality of Mayonnaise

2.5.1 pH

pH is determined with a pH meter by calibrating the pH meter using buffer solutions 4 and 7 , a sample of 1 gram is prepared, added with 10ml of distilled water, the sample is homogenized with distilled water for approximately 5 minutes, transfer the sample into a measuring cup and then obtain the pH value listed on the scale pH meter.

2.5.2 Viscosity

Viscosity is determined using a viscometer that is preheated to a temperature of 75 . Then a sample is taken in a glass beaker and the temperature is measured. dipped spindle no. 6 into the sample until the limit mark on the dipped spindle. Then enter the spindle code and set the rotation speed to 5rpm, press start to start the test and stop to end it. A scale reading is carried out which will be indicated by the tool in centipoise (CP) units.

2.5.3 Stability emulsion

Emulsion stability is determined using the stability rating method. Prepare 10 g of sample then put it in a centrifuge tube, then centrifuge the sample for around 15-20 minutes, then measure the volume of the separated oil. Emulsifying power can be calculated using the formula for separate oil to sample volume.

$$\frac{\text{Sampel mayonnaise} - \text{Sinyak terpisah}}{\text{Sampel mayonnaise}} \times 100\%$$

2.5.4 Emulsion droplets

Emulsion droplets were determined with a Nikon Eclipse E100 microscope with 100 - 400x magnification by smearing a small amount of mayonnaise on a glass object and observing microscopically. then look for the smallest to largest globules and measure the diameters of the largest and smallest globules.

2.5.5 Acidity

Acidity is determined using the titration method. 2 g of mayonnaise sample was weighed and put into a 500ml Erlenmeyer flask, diluted with 200ml of distilled water, added 2-3 drops of phenolplatein indicator, then titrated with 0.1MNaOH solution until it turned pink. Sample titration can be calculated using the formula

$$\text{Total Asam } \% = \frac{\text{mlNaOHxNNaOHxBMXFP}}{\text{mg sampel}} \times 100\%$$

2.5.6 Color analysis

Color is determined using a color reader. Before analyzing samples with a color reader, the color reader must be calibrated using a black and white plate. Prepare a mayonnaise sample in a clear container, turn on the color reader and adjust the reader button. The color value can be seen on the screen in 3 types of colors, namely reddish, yellow and light.

3. RESULTS AND DISCUSSION

3.1 pH

The results of analysis of variance showed that the addition of avocado seed flour with different proportions had a very significant effect ($P < 0.01$) on the pH of reduced fat mayonnaise. Table 1 shows the increase in pH of reduced fat mayonnaise with the addition of avocado seed flour. The average pH value of mayonnaise with the addition of avocado seed flour ranged from 3.57-3.93. The addition of avocado seed flour can increase the pH of reduced fat mayonnaise. The highest pH was obtained in the P3 treatment which was 3.93 , while the lowest pH was obtained in the PO treatment which was 3.57. This increase in pH is caused by the addition of avocado seed flour to reduced fat mayonnaise.

The pH of a food can increase or decrease depending on the acids naturally contained in the food (Wahab, Ashar, and Maryana 2021). Avocado seeds contain amylum acid, capric acid, myristic acid, palmitic acid, stearic acid, oleic acid, linoleic acid and linolenic acid, while the reddish colored seed coat contains cellulose (Rastini, Minah, Puspita and Berliana 2017).

3.2 Viscosity

The results of the analysis of variance showed that the addition of avocado seed flour in different proportions had a very significant effect ($P < 0.01$) on the viscosity of reduced fat

mayonnaise. Table 1 shows the increase in viscosity of reduced fat mayonnaise with the addition of avocado seed flour. The average viscosity value for reduced fat mayonnaise with the addition of avocado seed flour ranges from 2963-3299 cP. Adding avocado seed flour can increase the viscosity of reduced fat mayonnaise. The highest viscosity was obtained in treatment P3 at 3299 cP, while the lowest viscosity was obtained at treatment P0 at 2963 cP . This increase in viscosity is caused by the addition of avocado seed flour to reduced fat mayonnaise.

The viscosity value is influenced by component ingredients such as oil or the addition of avocado seed flour so that the mayonnaise obtained will be thick. Factors that influence viscosity are the use of egg yolk as an emulsifier, vinegar as a dispersing medium, oil as a dispersing medium, and stabilizer (Kovalcuks, et al 2016). Viscosity occurs because the number of fat particles dispersed in the liquid phase is greater than the amount of the liquid phase. The higher the dispersed phase, the higher the emulsion viscosity (Sonlay, Sipahelut, and Armadianto, 2020).

3.3 Stability Emulsion

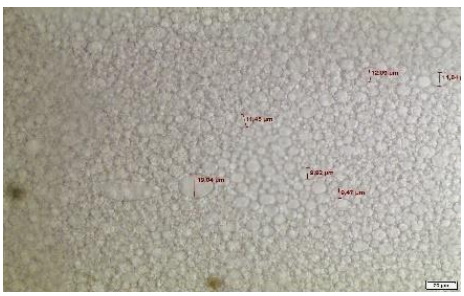
The results of the analysis of variance showed that the addition of avocado seed flour in different proportions had a very significant effect ($P < 0{,}01$) on the stability emulsion of reduced fat mayonnaise. Table 1 shows the increase in stability emulsion of reduved fat mayonnaise with the addition of avocado seed flour. The average stability emulsion value of reduced fat mayonnaise with the addition of avocado seed flour ranges from 97.238-94.129. The highest stability emulsion was obtained in the P0 treatment at 97.238, while the lowest stability emulsion was obtained in the P3 treatment at 94.129 . Stability emulsion can be influenced by many factors such as oil content and ratio, particle size, storage conditions, two-phase density differences, including high and low temperatures, the amount and effectiveness of emulsifiers. The shelf life of emulsions is also influenced by the stability of the emulsion. Stability emulsion can also be one of the important characteristics that have a major influence on the quality of the product when marketed. The use of vegetable oils with higher concentrations can improve emulsion stability (Dikho and Herly, 2019).

Eggs contain lecithin which plays a role in emulsion stability [13]. The higher the lecithin content in the eggs used, the better the emulsion stability (Rusalim, 2017). The high water phase in mayonnaise can reduce stability emulsion because avocado seed flour has a high water content. Evanuarini et al. [1] stated that if the water phase using less flour and kefir can increase stability emulsion. The addition of kefir exceeding 30% willincrease the water phase so that it can reduce stability emulsion. Mutiah (2002) stated that the use of higher oil can increase stability emulsion. Stability emulsion is influenced by the balance of proportion between protein and water.

3.4 Emulsion Droplets

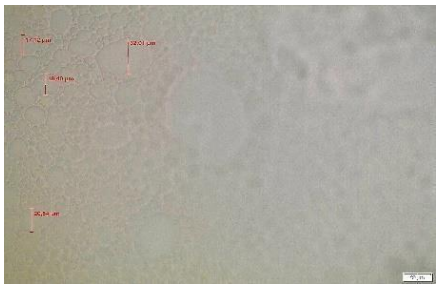
Microscopic observation of reduced fat mayonnaise emulsion droplets was carried out using an Olympus Bx 40 Microscope. The different percentage of avocado seed flour addition will produce different emulsion droplets. Droplet emulsion of reduced fat mayonnaise is presented in Fig. 1.

P0 = Without the addition of avocado seed flour



P1 = Addition of avocado seed flour 1%

P2= Addition of avocado seed flour 2%



P3= Addition of avocado seed flour 3%

Fig. 1. Emulsion droplet of reduced fat mayonnaise with the addition of avocado seed flour at $100x$ magnification

The emulsion droplet image above shows if there are empty spaces and differences in size due to different oil concentrations and the addition of avocado seed flour. P0 emulsion droplets (control) the size of fat globules that are seen are small and arranged very tightly, P1 emulsion droplets (1%) the size of fat globules that are seen are uniform, P2 emulsion droplets (2%) and P3 (3%) the size of fat globules that are seen tend to be small and arranged very tightly. P2 (2%) and P3 (3%) the size of fat globules that are seen tend to be tenuous and not uniform. Based on the figure above, the diameter of each treatment is $\mathrm{P0} = 16.32\text{-}22.55\ \mu\mathrm{m}, \mathrm{P1} = 9.47 - 19.04\mu\mathrm{m}, \mathrm{P2} = 8.18 - 14.08\mu\mathrm{m}, \mathrm{P3} = 3.03 - 32.01$. The observation of emulsion droplets in mayonnaise aims to determine the size of droplets with different percentages of avocado seed flour usage, starting from the smallest to the highest scale.

The oil in water emulsion system is formed from a continuous phase of solution in which there are dispersed oil droplets. The results of emulsion droplet analysis using avocado seed flour in reduced fat mayonnaise showed different globule sizes in each treatment. The percentage of avocado seed flour has an effect on droplet size, the more avocado seed flourincreases, the larger, non-uniform droplets will be and there are many spaces.According to Biradar, et al. [14], stable emulsion products are characterized by smaller droplet size. The smaller the droplet size of the emulsion, the droplet configuration of the dispersed phase in the dispersing medium will be more uniform.

3.5 Acidity

The results of the analysis of variance showed that the addition of avocado seed flour with different proportions had a very significant effect ($P < 0.01$) on the acidity of low-fat mayonnaise. Table 1 shows the increase in acidity of reduced fat mayonnaise with the addition of avocado seed flour. The average value of reduced fat mayonnaise acidity decreased with the addition of avocado seed flour ranging from 0.38-0.18. The results of the analysis of variance showed that the addition of avocado seed flour with different proportions had a very significant effect $(P < 0.01)$ on the acidity of reduced fat mayonnaise. The highest acidity was obtained in the P0 treatment at 0.38 , while the lowest acidity was obtained in the P3 treatment at 0.18 . This shows that the higher the proportion of avocado seed flour substitution, the lower the acidity of reduced fat mayonnaise. Avocado seeds contain amylum, palmitic acid, stearic acid, oleic acid, linolenic acid, hemicellulose 34.15% and lignin 15.25% , while the reddish colored seed coat contains cellulose 16.36% (Zulhida and Tambunan, 2013).

Acidity and pH value have inversely proportional values. Acidity measures all total dissociated and undissociated acids, while pH only measures total dissociated acids [15]. The acidity test or TAT in making mayonnaise is used to measure all the total acids present in it. In Evanuarini and Susilo [16], the addition of apple peel flour to reduced fat mayonnaise will increase the acidity of mayonnaise, with a total acid of 0.90 0.66%.

3.6 Color Analysis

The results of the analysis of variance showed that the addition of avocado seed flour with different proportions in Table 1 had a very significant effect ($P < 0.01$) on the brightness (L), redness (a^*), and yellowness (b^*) of reduced fat mayonnaise. The L color test aims to determine the lightness or brightness of the product, then the a^* color test to determine the

Table 1. Physical, chemical and biological properties of experimental soil (0-20" " cm)

	Treatments			
Variable	**P_0 ± SD**	**P_1 ± SD**	**P_2 ± SD**	**P_3 ± SD**
pH	3.57 ± 0.09[a]	3.80 ± 0.04[b]	3.88 ± 0.06[b]	3.93 ± 0.04[b]
Viscosity	2.963 ± 0.07[a]	3.188 ± 0.09[b]	3.420 ± 0.14[c]	3.299 ± 0.10[c]
Stability emulsion	97.238 ± 0.62[a]	95.510 ± 0.68[ab]	94.827 ± 0.18[bc]	94.129 ± 0.32[c]
Acidity	0.38 ± 0.04[a]	0.29 ± 0.03[a]	0.24 ± 0.03[b]	0.18 ± 0.03[c]
Lightness (L)	89.72 ± 1.60[a]	83.08 ± 1.92[b]	75.02 ± 1.76[c]	63.47 ± 1.68[d]
Redness (a^*)	0.85 ± 0.28[a]	2.53 ± 0.55[b]	5.36 ± 1.06[c]	1.06 ± 0.64[d]
Yellowness (b^*)	59.45 ± 2.03[a]	54.14 ± 2.56[a]	47.43 ± 2.32[b]	34.27 ± 1.28[b]

a,b,c,d shows a very significant effect

redness or redness, and the b^* color test to determine the yellowness or yellowishness of the product. The brightness value of color L in reduced fat mayonnaise ranges from 89.7263.47. The lowest value was obtained from the P3 treatment, namely with the addition of avocado seed flour with a color brightness L of 63.47 while the highest average value was obtained from the P0 treatment without the addition of avocado seed flour at 89.72. The decrease in L value is due to the addition of avocado seed flour so that it affects brightness. The brighter the color brightness is caused by the higher the L value. The increase in L color is thought to be due to the use of yellow egg yolks. The lowest value of color L is 63.47 which indicates that the level of brightness in the reduced fat mayonnaise product shows the level of brightness in the product towards dark brownish on the addition of avocado seed flour. The smaller the value of lightness produced, the lower the color brightness (Bintoro and Nurwanto, 2020).

The value of color brightness a^* in reduced fat mayonnaise ranged from 0.85-1.06. The lowest value was obtained from the P0 treatment, namely without the addition of avocado seed flour with a* color brightness of 0.85 while the highest average value was obtained from the P1 treatment with the addition of 1% avocado seed flour at 2.53 . The increase in a* value is due to the addition of avocado seed flour so that it affects the redness. This showsthat all a* color results have a positive value, so they tend to be more towards red. This is because avocado seed flour has a light brown color. The physical characteristics of avocado seeds that have become flour are brown in color and do not have a distinctive aroma (Lady Violita, et.al., 2021).

The yellowness value of b^* color in reduced fat mayonnaise ranged from 89.72-63.47. The lowest value was obtained from the P3 treatment, namely with the addition of avocado seed flour with a yellowish color b* of 63.47 while the highest average value was obtained from the P0 treatment without the addition of avocado seed flour at 89.72 . The decrease in b^* value is due to the addition of avocado seed flour which affects the yellowish color. The b^* color value shows a yellow color, the decrease in yellow b^* color is due to the addition of avocado seed flour which has a brown color. The more the addition of avocado seed flour, the lower the yellow color b* will be. Making reduced fat mayonnaise that produces yellow color is in egg yolk (Evanuarini, Nurliyani, Indratiningsih, and Hastuti, 2017).

Each figure should have a caption. The caption should be concise and typed separately, not on the figure area. Figures should be self-explanatory. Information presented in the figure should not be repeated in the table. All symbols and abbreviations used in the illustrations should be defined clearly. Figure legends should be given below the figures. A sample figure is given in Fig. 1.

4. CONCLUSION

Avocado seed flour has the potential to be used as a stabilizer in making reduced fat mayonnaise. The addition of tomato paste according to the percentage of 3 g can affect mayonnaise production with the characteristics of pH, viscosity, emulsion stability, acidity, emulsion droplets, and color analysis.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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