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POTENTIAL OF PUMPKIN FLOUR AS A STABILIZER IN REDUCED-FAT MAYONNAISE

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ABSTRACT

Pumpkin is a local plant that contains antioxidants such as polyphenols and carotenoids. Pumpkin contains pectin which can function as a stabilizer. Full-fat mayonnaise is a semi-solid emulsion product that has a total fat content of 70-80%, while reduced-fat mayonnaise has a fat content of 50-60%. Pumpkin flour can be applied to reduced-fat mayonnaise in terms of physicochemical quality. This research was conducted using a laboratory experimental method and a completely randomized design. The physicochemical qualities of reduced-fat mayonnaise include fiber content, fat content, viscosity, and antioxidant activity. The results of added pumpkin flour have a highly significant effect ($P<0.01$) on fiber content, fat content, viscosity, and antioxidant activity. The physicochemical qualities of reduced-fat mayonnaise with pumpkin flour are as follows 0.90% fiber content, 50.57% fat content, 4443 cP viscosity, and 21.03% antioxidant activity, respectively. It can be conclude that the use of 6% yellow pumpkin flour was the best treatment for reduced-fat mayonnaise. The most types of fatty acids in the best treatment were palmitic, oleic, and linoleic acids.

Key words: Reduced-fat mayonnaise; yellow pumpkin flour; stabilizer

INTRODUCTION

The development of new reduced-fat products is a challenge, as it relates directly to consumer health. Functional food has an advantage in terms of health, namely the presence of nutrients that are beneficial for the health of the body because there are active ingredients in it. The need for functional food increases along with awareness about body health. Functional foods can be developed in the presence of fiber and antioxidants. Functional food development can be carried out on the design, optimization, development of various formulations, and processing techniques (Granato, *et al*., 2020).

Eggs are livestock products that are popular with the community and as a source of animal protein. Egg processing can be done in a traditional or modern way, resulting in various kinds of processed products. Potential eggs can be used for the manufacture of various food products. The potential of eggs is a complete nutritional content, easy to obtain, low prices, and high public consumption. The high protein in the egg after cooking is 91%, the protein quality of chicken eggs is used as a criterion for evaluating other foods (Eddin, *et al*., 2019).

Mayonnaise is a thick sauce made from an oil-in-water emulsion made from egg yolks. This emulsion product has been popular with the public as a complement to food dishes. Currently, the use of mayonnaise has spread widely due to the changing consumption patterns of people who are moving towards modern. The mayonnaise is made by mixing egg yolk which acts as an emulsifier, vegetable oil as the dispersed phase, vinegar as the dispersing phase, and adding other optional ingredients. Modification of mayonnaise processing can be done by making reduced-fat mayonnaise. Reduce the amount of vegetable oil used to make mayonnaise with less fat. Use of less than 70% vegetable oil can be replaced with ingredients that contain low fat so that reduced-fat mayonnaise is formed (Evanuarini, *et al*., 2021). Reduced-fat mayonnaise will experience emulsion instability and reduce consumer acceptance. Added constituent materials as a substitute for the amount of oil can maintain physically, chemically, and sensually the quality of mayonnaise.

Pumpkin is a local plant that contains beneficial nutrients for the body. The tropics and subtropics are places where pumpkin grows. Types of pumpkin circulating in Indonesia are *Cucurbita maxima*, *Cucurbita moschata*, and *Cucurbita pepo*. Pumpkin contains antioxidant compounds, namely carotenoids and polyphenols (Kulczynski, *et al*., 2020).

The beta-carotene content of pumpkin is 9–19.9 mg/100g (Rakcejava, Galoburda, Cude, and Strautniece, 2011). In addition, pumpkin contains pectin which indicates antioxidant activity (Tarkova, *et al*., 2018). Pectin is a compound in food that serves as a stabilizer in food. Pectin can generally be found in fruits that have an array of water-soluble components. Pumpkin can be applied to foodstuffs after undergoing a heating and drying process, namely flour. Stabilizers for reduced-fat mayonnaise can increase emulsion stability and emulsion viscosity.

Added pumpkin flour to food products will improve the emulsion system in mayonnaise, emulsion viscosity, reduce fat, and extend shelf life. Therefore, based on the description above, the authors are interested in researching reduced-fat-based functional foods that is from a

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physicochemical quality standpoint adding pumpkin flour to reduced-fat mayonnaise.

MATERIALS AND METHODS

Materials

Make mayonnaise using the following ingredients canola flower oil, egg yolk, mustard, vinegar, salt, sugar, and pumpkin flour. Pumpkins (*Cucurbita moschata Duschenes*) has a yellow color with medium fruit size were obtained from the Pudjon District Market, Malang City. Materials for testing ether solutions, H_2SO_4 1,25%, NaOH 1,25%, K_2SO_4, and equates for testing fiber content, sulfuric acid for testing fat content, while DPPH and methanol solutions for antioxidant activity.

Pumpkin Flour preparation

Pumpkin flour was processed using a drying method based on Wahyono, *et al*. (2018) with modifications. Fresh pumpkin was peeled, cut, then dried at 60°C for 48 h using an oven. The dried pumpkin was mashed using a dry mill. The pumpkin that has been mashed will be filtered using a sieve with a size of 80 mesh.

Mayonnaise preparation

The procedure for making mayonnaise is based on Evanuarini, *et al*. (2016) with modifications. The ingredients for mayonnaise such as salt, sugar, mustard, and white pepper powder are added to a bowl and mixed for 1 min at 1500 rpm with a hand mixer. Add the egg yolk, then the vegetable oil little by little, and alternate with vinegar for 10 min until an emulsion system is formed. Next, add pumpkin flour and stir for 1 min. Mayonnaise is put in a film pot and stored.

Methods

The study method used was a laboratory test with 4 treatments and 4 replications in a completely randomized design. The treatment of adding pumpkin flour was 2, 4, and 6%, and control without pumpkin flour addition.

Fiber Content

Crude fiber testing uses the acid-alkali digestion method (Savitri and Suwita, 2017). The sample was weighed 2g (a) and extracted using ether. It was put into an Erlenmeyer and 220 ml of 0.225N H_2SO_4 was added. Filtered with filter paper, the residue left is washed with distilled water. Wash the residue on filter paper with 200 ml of boiling 0.313 N NaOH. The filter paper (b) was weighed and the residue was filtered, then washed using 15 ml of 10% K_2SO_4, followed by washing with boiling distilled water, then 15 ml of 95% ethanol. The filter paper and residue were dried in an oven at 60°C, cooled in a desiccator to constant, and weighed (c).

$$\text{Crude fiber (\%)} = (c-b)/a \times 100\%$$

a = sample weight
b = weight of empty filter paper (initial)
c = weight of filter paper with residue (final)

Fat Content

The sample was put into a Babcock bottle and mixed using sulfuric acid. Centrifuged at a temperature of 55 – 65°C until the fat rises to the neck of the bottle.

Viscosity measurement

Testing using a viscometer (AOAC, 2005). Samples were prepared and put into a beaker glass. The spindle is mounted on the arm and inserted into the sample. Press the on button and the viscosity value is recorded.

Antioxidant Activity

A sample solution and a comparison solution were made. 1 ml of each solution was taken, put into a test tube, and 0.004% DPPH solution was added. Let stand at room temperature for 30 min. The wavelength

used is 517 nm for the absorbance of the solution with a methanol blank was measured using an ultraviolet spectrophotometer. Free radical scavenging is calculated by the following formula

$$\% \text{ immersion} = \frac{\text{DPPH absorbance } x \text{ sample absorbance plus DPPH}}{\text{DPPH absorbance}} \; x \; 100\%$$

Fatty Acid Profile

Tests based on Lin, *et al*. (1999). Samples were homogenized using methanol and chloroform. It was centrifuged and continued to remove the methanol and water layers by aspiration. Filtered the bottom layer using a Buchner. Extracted and obtained fatty acid methyl ester. Analyzed using gas chromatography.

Statistical analysis

ANOVA was used to analyze the data and followed by Duncan's Test (DMRT) to determine the significant difference.

RESULTS AND DISCUSSION

Fiber Content

The ANOVA results show that added pumpkin flour in different proportions has a highly significant effect (P<0.01) on the fiber content of reduced-fat mayonnaise. Table 1 shows an average value of fiber increase in reduced-fat mayonnaise due to added pumpkin flour.

The average fiber content in reduced-fat mayonnaise with added pumpkin flour ranged from 0.00 - 0.90%. Added pumpkin flour increased the fiber content of reduced-fat mayonnaise. The highest fiber content was at P3 which was 0.90% and the lowest was at P1 which was 0.00%. The increase in the fiber content of reduced-fat mayonnaise was caused by the fiber content in pumpkin flour.

Added pumpkin flour to reduced-fat mayonnaise can increase the fiber content. This is because the amount of crude fiber in pumpkin flour is 5.83%. The crude fiber content of fresh pumpkins is 0.56% (El Khatib and Mariam, 2015). In addition, pumpkin contains carotenoids, namely beta carotene and pectin (Amin, *et al*., 2019). The fiber content in full-fat mayonnaise was not detected because there was no addition of pumpkin flour and the source of fiber was only in mustard, while the use of mustard was only 1%.

Table 1. Average Effect of Pumpkin Flour on the Physicochemical Quality of Reduced-Fat Mayonnaise

Treatments	Fiber Content (%)	Fat Content (%)	Viscosity (cP)	Antioxidant Activity (%)
P0	0,00±0,00^{a}	71,23±0,43^{d}	3985±55,08^{a}	7,56±0,56^{a}
P1	0,30±0,06^{b}	52,42±0,16^{c}	4175±34,16^{b}	15,38±0,37^{b}
P2	0,66±0,08^{c}	51,61±0,34^{b}	4370±25,82^{c}	18,02±0,87^{c}
P3	0,90±0,06^{d}	50,57±0,26^{a}	4443±17,08^{c}	21,03±0,38^{d}

Description: ^{a,b,c,d} Superscripts differences appear in the same column show very significant effect

Fat Content

The ANOVA results show that added pumpkin flour in different proportions has a highly significant effect (P<0.01) on the fat content of reduced-fat mayonnaise. Table 1 shows an average value of fat content of reduced-fat mayonnaise due to added pumpkin flour.

The average value of fat content in reduced-fat mayonnaise with added pumpkin flour ranged from 50.57 to 71.23%. Added pumpkin flour and a

decrease in the use of vegetable oil volume were able to reduce the fat content of reduced-fat mayonnaise. The highest fat content was at P0 that was 71.23% and the lowest was at P3 that was 50.57%. The decrease in fat content was caused by a decrease in the volume of use of vegetable oil and added low-fat pumpkin flour.

The fat content of reduced-fat mayonnaise is influenced by the egg yolk used as an emulsifier. Increasing the use of egg yolks or emulsifiers can affect the amount of fat content (Rusalim, *et al*., 2017). Egg yolk lecithin will bind fat by hydrophobic groups and increase fat content (Fitryaningtyas and Widyaningsih, 2015). Pumpkin flour, which is high in carbohydrates, can bind and absorb fat, resulting in a decrease in the amount of fat in reduced-fat mayonnaise. The fat content of mayonnaise is influenced by the use of vegetable oils, emulsifiers, and the treatment given (Evanuarini, *et al*., 2021).

Viscosity

The ANOVA results show that added pumpkin flour in different proportions has a highly significant effect (P<0.01) on the viscosity of reduced-fat mayonnaise. Table 1 shows an average value of viscosity increase in reduced-fat mayonnaise with added pumpkin flour. The average value of viscosity in reduced-fat mayonnaise with added pumpkin flour ranged from 3985 – 4443 cP. Added pumpkin flour can increase the viscosity of reduced-fat mayonnaise. The highest viscosity at P3 treatment was 4443 cP and the lowest at P0 was 3985 cP. The increase in viscosity was caused by added pumpkin flour in reduced-fat mayonnaise.

The reduced-fat mayonnaise viscosity was influenced by added pumpkin flour given. The carbohydrate content in pumpkin flour affects the resulting viscosity. Factors that affect viscosity are the use of egg yolk as an emulsifier, vinegar as a dispersing medium, oil as a dispersed medium, and stabilizer (Kovalcuks, *et al*., 2016). The amount of vegetable oil used affects the viscosity of the emulsion system (Usman, *et al*., 2015). The use of vegetable oils with different types resulted in differences in viscosity ranging from 3700 – 5513 cP (Lioe *et al*., 2018).

Antioxidant Activity

The ANOVA results show that added pumpkin flour in different proportions has a highly significant effect (P<0.01) on antioxidant activity. Table 1 shows an average value of the resulting antioxidant activity increase in reduced-fat mayonnaise with added pumpkin flour.

The average value of antioxidant activity on reduced-fat mayonnaise with added pumpkin flour ranged from 7.56 to 21.03%. Added pumpkin flour increased the antioxidant activity of reduced-fat mayonnaise. The highest antioxidant activity at P3 is 21.03% and the lowest at P0 is 7.56%. The increase in antioxidant activity in reduced-fat mayonnaise was caused by added pumpkin flour.

The content of beta carotene in pumpkin flour causes antioxidant activity. The antioxidant activity of pumpkin flour is 60.96%. Fresh pumpkin has carotenoid and polyphenol components, thus affecting the antioxidant activity produced (Kulczynski, *et al*., 2020). Phospholipids in egg yolk affect antioxidants and mayonnaise emulsion stability (Gorji, *et al*., 2016). The antioxidant activity of mayonnaise affects the oil phase and oxidation stability (Romeo, *et al*., 2021). The formation of an emulsion system that has antioxidant activity will extend the shelf life of mayonnaise (Bakota, *et al*., 2015).

Fatty Acid Profile

Fatty acids are a group of volatile compounds such as aldehydes and ketones derived from chemical reactions, namely enzymatic and fat oxidation. The components of volatile compounds contained in fatty acids are composed of alcohol, aldehyde, and ketone output based on fatty acid reactions (Lazo, *et al*., 2017). Fatty acids are divided into saturated fatty

acids, monounsaturated fatty acids, and polyunsaturated fatty acids. It is distinguished based on several factors such as chemical structure.

Table 2. Composition of Fatty Acid Profile on the Best Treatment of Reduced-fat Mayonnaise with The Addition of Pumpkin Flour

No.	Types of Fatty Acids	Total Fatty Acid (%)
1.	Myristic Acid	0.0588
2.	Stearic Acid	2.3724
3.	Heptadecanoic Acid	0.0374
4.	Palmitic Acid	5.5311
5.	Heneicosanoic Acid	0.0287
6.	c-Oleic Acid*	34.0760
7.	Palmitoleic Acid*	0.3722
8.	c-Linoleic Acid**	11.9456
9.	Eicosapentaenoic Acid**	0.0966
10.	Arachidonic Acid**	0.5445
11.	Eicosadienoic Acid**	0.0661
12.	Linoleic Acid**	0.4134
13.	Docosahexaenoic Acid**	0.0548
14.	DHA**	0.0548
15.	EPA**	0.0966

Description: *) Monounsaturated fatty acids, **) Polyunsaturated fatty acids

The fatty acid content in the best treatment of reduced-fat mayonnaise can be seen in Table 2. The test results showed that palmitic acid was the saturated fatty acid with the highest amount. Palmitic acid is produced by synthesis carried out by other fatty acids, amino acids, and carbohydrates (Carta, *et al*., 2017). Palmitic acid in reduced-fat mayonnaise is influenced by the carbohydrate content in pumpkin flour which is added so that it affects the synthesis process carried out by fatty acids. The most abundant unsaturated fatty acids are oleic acid and linoleic acid.

This is due to the use of canola flower oil which contains oleic and linoleic acids which are the two main fatty acids, and oleic acid is the main ingredient in various vegetable oils. The main fatty acids found in canola flower oil are oleic and linoleic (Rahpeyma and Sayed, 2020). The high amount of unsaturated fatty acids causes reduced-fat mayonnaise products to be easily oxidized which will affect the shelf life of the product. The reaction of unsaturated fatty acids that bind to oxygen will produce a fat oxidation reaction that causes rancidity (Ayu, *et al*., 2020).

DISCUSSION

Full-fat mayonnaise is a food product that has a fat content of up to 70%. Meanwhile, reduced-fat mayonnaise is the result of a modified full-fat mayonnaise product that is reduced in fat content. The quality of mayonnaise can be seen from the fat content, viscosity, antioxidant activity, and fatty acid profile. The composition of mayonnaise in general is vegetable oil, egg yolks, and vinegar. Reducing the amount of vegetable oil used and adding pumpkin flour to reduced-fat mayonnaise needs to be tested on the fat content produced. Vegetable oil is a liquid material, so if there is a change in the volume used it will affect the viscosity produced by mayonnaise. The fatty acid profile shows the amount of saturated and unsaturated fatty acids in mayonnaise. The amount of fatty acids indicates the

antioxidant activity of mayonnaise. The amount of vegetable oil used by 50% with the addition of pumpkin flour can reduce fat content, increase viscosity, and the resulting fat content indicates the amount of fatty acids contained and fatty acids indicate antioxidant activity in mayonnaise.

CONCLUSION

As a result of research, reduced-fat mayonnaise with added pumpkin flour as much as 6% can improve the physicochemical quality of mayonnaise. The highest fatty acid composition in the best treatment was palmitic acid, oleic acid, and linoleic acid.

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