The Impact of Pumpkin Seed Flour Addition on Low Fat Mayonnaise Production

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Abstract. Low fat mayonnaise (LFM) is an emulsion product with low emulsion stability, so that a stabilizer in the form of pumpkin seed flour (PSF) is needed to stabilize the emulsion. The aim of this study was to determine the best percentage of PSF to improve the quality of LFM. The material used is canola oil, egg yolk as a emulsifier, PSF, vinegar, and other constituent materials. The method used is laboratory experimental using a Completely Randomized Design (CRD) and data analyzed using ANOVA with 4 treatments and 5 replications. If different result were obtained between treatments, Duncan's Mutiple Range Test (DMRT) was continued. The treatment of PSF in LFM is without addition (T0), 1% (T1), 3% (T2), and 5% (T3) addition of PSF. The result of the addition of PSF showed that the moisture content decreased, while pH, viscosity, and emulsion stability increased, and sensory evaluation including color, taste, texture, and aroma were preferred by panelists. It can be concluded that the best LFM with the addition of PSF as much as 5% based on physical properties and sensory evaluation.

1 Introduction

Mayonnaise is one of the product that made from eggs also a product of oil in water (o/w) emulsion. Some of mayonnaise research that has been done is mayonnaise with apple peel flour added as a stabilizer [1], mayonnaise with additions of avocado seed flour as a stabilizer [2], and mayonnaise with additions of pumpkin flour as a stabilizer [3]. O/W emulsion is a type of emulsion in which oil is the dispersed phase and water is the dispersing phase. Storage of mayonnaise to maintain good quality after opening can be placed in a low temperature place such as a refrigerator. If storage is done properly, the shelf life of mayonnaise will last for several weeks. Mayonnaise is divided into several variants ranging from full fat mayonnaise, salad dressing, reduced fat mayonnaise, light mayonnaise, and low fat mayonnaise (LFM).

LFM is one of the variants mayonnaise that has lowest fat content among other mayonnaise. The weaknesses that can affect the flavor and texture of LFM is emulsion stability. The amount of oil to meet the low fat content causes the emulsion stability of the resulting mayonnaise to be poor, which can cause the quality of the product to decrease. Therefore, it is necessary to use stabilizer in the process of making mayonnaise.

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Stabilizer is an ingridient that is used with the aim of maintaining texture and also preventing phase separation in emulsions. One of the material used as a stabilizer is pumpkin seed flour (PSF). Per 100 g of PSF contain 559 Kkal energy, 30.23 g protein, 49.04 g lipid, 10.71 g carbohydrate, and 7.81 mg zink [4]. Carbohydrates containdes in PSF can be used as a stabilizer to help emulsify processed foods.

Pumpkin seed flour is interesting to be used as a stabilizer because it comes from waste but still has a lot of nutritional content. In addition, pumpkin seed flour is considered more economical and environmentally friendly when compared to other synthetic stabilizers. Not many studies have evaluated the use of PSF as a stabilizer on the physical properties of LFM and consumer acceptance of the product. The purpose of this study was to determine the best percentage of pumpkin seed flour to improve the quality of LFM. This study will be a new research to develop LFM products with the use of PSF stabilizer.

2 Material and methods

2.1 Material

Material that used for making LFM is canola oil, vinegar, egg yolk, PSF, mustard, sugar, salt, and pepper. Canola oil used is only about 30% of the total ingridients because LFM has lowest fat from vegetable oil. Fresh egg yolk 20%, water 40%, apple cider vinegar 5%, mustard 0.5%, sugar 3%, salt 1%, and pepper 0.5%. The process of making mayonnaise start with mixer all the ingridients except canola oil, apple cider vinegar, and water. Three ingridients that not mixer yet added little by little in turn.

The stabilizer added when making LFM is PSF. The process of making PSF start with roasting the pumpkin seed during 6 hour in 80ºC temperature. After that grilling the roasted pumpkin seed until 100 mesh and the stabilizer is ready to use.

Moisture content was analyzed using the oven method [5]. pH was analyzed using pH meter [5]. Viscosity was analyzed using viscometer [5]. Stability emulsion was analyzed centrifuge [6]. Sensory evaluation analysis was done by 5 semi-trained panlists with hedonic scales scoring method [7].

2.2 Methods

Methods that used in this research is experimental laboratory using a Completely Randomized Design (CRD) and data analyzed using ANOVA with 4 treatments and 5 replications. If different result were obtained between treatments, Duncan's Mutiple Range Test (DMRT) was continued. The treatment of PSF in LFM is as follows :

T0 : without addition
T1 : with addition of 1% PSF
T2 : with addition of 3% PSF
T3 : with addition of 5% PSF

3 Result and discussions

3.1 Moisture content

The moisture content will affect the shelf life of a product. The higher the amount moisture content, the shorter the shelf life of the product. The average value moisture content of LFM with PSF added shown in Table 1.

Table 1. Average value of moisture content

Treatment	Moisture Content (%) ± SD
T_0	23.27 ± 0.48^c
T_1	22.57 ± 0.30^b
T_2	22.25 ± 0.35^b
T_3	20.45 ± 0.30^a

Note : $^{a, b, c}$ Different letters in the column indicate highly significant difference ($P<0.01$).

Based on the Table 1, the higher percentage of PSF added, the lower moisture content value of LFM. This is due to PSF as a stabilizer can bind the water contained in LFM. Some of the nutrients contained in PSF have the ability to absorb water. Some of them are polysaccharides, protein, and fiber [8].

Amino acid proteins in PSF have polar and non-polar groups, the structure of the polar group of PSF allows the binding of water which forms hydrogen bonds and provides a gel-like structure. Fibers contained in PSF such as hemicellulose, lignin, and pectin can absorb and retain water contained in LFM. These fibers can bind free water. The lower the moisture content, the higher the viscosity and the more stable the emulsion effect. The value of moisture content higher than previous research but still within normal range. Vegan mayonnaise with soy flour added as an emulsifier replacer result moisture content value by 7.41% [9]. Reduced fat mayonnaise with watermelon rind flour added result moisture content value around 15.34-19.28% [7].

3.2 pH

pH analysis is an analysis conducted to determine the acidity or basicity of a product. The analysis was carried out using pH meter. The average value pH of LFM with PSF added shown in Table 2.

Table 2. Average value of pH

Treatment	pH (%) ± SD
T_0	4.60 ± 0.02^a
T_1	4.75 ± 0.04^b
T_2	4.82 ± 0.03^c
T_3	4.90 ± 0.03^d

Note : $^{a, b, c, d}$ Different letters in the column indicate highly significant difference ($P<0.01$).

Based on the Table 2, the higher percentage of PSF added, the higher pH value of LFM. This is due to PSF has pH value around 6.31-6.91 [10]. In addition, the protein in PSF can provide a buffering effect so that it can withstand pH changes when a small amount of acid is added. In addition, the fiber contained also balances the pH changes that occur due to acidic ingredients such as vinegar in the manufacture of LFM.

The value of pH still within normal range if compared with past research. Reduced fat mayonnaise with watermelon rind flour added result pH value around 4.89-5.03 [7]. Mayonnaise with different flour such as apple flour, nectarine flour, pear flour, and peach flour result pH value 4.00, 4.35, 3.50-4.00, and 5.47 [11].

3.3 Viscosity

The viscosity is the analysis to measure the viscosity of a product. The viscosity influenced by the amount of water added. The average value viscosity of LFM with PSF added shown in Table 3.

Table 3. Average value of viscosity

Treatment	Viscosity (cP) ± SD
T_0	3229 ± 206.71^{a}
T_1	3930 ± 156.20^{b}
T_2	4156 ± 185.28^{bc}
T_3	4416 ± 127.79^{c}

Note : $^{a, b, c}$ Different letters in the column indicate highly significant difference ($P<0.01$).

Based on the Table 3, the higher percentage of PSF added, the higher viscosity value of LFM. This can be happen cause by pectin in carbohydrate can form a gel and make viscosity increase [12]. In addition, gel formation that occurs due to the water absorbing fiber content can increase viscosity. It is this gel that results in higher viscosity despite the low fat content of the LFM. The higher the viscosity, the lower the moisture content. Viscosity value still within normal range. Previous research states that mayonnaise with avocado seed flour added as a stabilizer result viscosity value around 2963-3299 cP [2]. Another research states that mayonnaise with addition of apple peel flour result viscosity value around 3010-3965 cP [13].

3.4 Emulsion stability

The emulsion stability is a parameter that serves to measure the extent to which the mayonnaise emulsion is stable over time. The average value emulsion stability of LFM with PSF added shown in Table 4.

Table 4. Average value of emulsion stability

Treatment	Emulsion Stability (%) ± SD
T_0	94.79 ± 0.20^{a}
T_1	94.98 ± 0.11^{a}
T_2	95.12 ± 0.13^{a}
T_3	95.85 ± 0.22^{b}

Note : $^{a, b}$ Different letters in the column indicate highly significant difference ($P<0.01$).

Based on the Table 3, the higher percentage of PSF added, the higher emulsion stability value of LFM. The hydrophilic nature of PSF can also improve the emulsion stability of LFM product. This can happen because the protein and polysaccharide content of PSF can absorb water [14]. Proteins in PSF are amphiphilic which can form a protective layer thus preventing coalescence. The increased viscosity due to fiber content also helps to increase emulsion stability because with high viscosity the mobility of water molecules will be lower and make the emulsion remain stable during storage. The value of emulsion stability higher than previous research. Reduced fat mayonnaise with addition of avocado seed flour result emulsion stability around 94.12-97.23% [2]. Vegan mayonnaise with soy flour as emulsifier replacer result emulsion stability around 93-97% [9].

3.5 Sensory evaluation

The hedonic scale categories for sensory evaluation assessment are as follows : 1 (strongly dislike), 2 (dislike), 3 (moderate), 4 (like), and 5 (strongly like). The 5 panelists involved were selected based on their experience and ability to evaluate food products. The selected panelists had insight into low-fat products compared to the regular version. The average value sensory evaluation of LFM with PSF added shown in Table 5.

Table 5. Average value of sensory evaluation

Treatment	**Texture (%) ± SD**	**Taste (%) ± SD**	**Aroma (%) ± SD**	**Color (%) ± SD**
T_0	3.60 ± 0.96[a]	3.64 ± 0.49[a]	3.76 ± 0.60[a]	3.84 ± 0.75[a]
T_1	3.56 ± 0.96[a]	3.64 ± 0.65[a]	3.64 ± 0.78[a]	3.92 ± 0.49[a]
T_2	3.84 ± 0.75[a]	3.88 ± 0.67[b]	3.88 ± 0.76[a]	4.12 ± 0.78[a]
T_3	4.28 ± 0.89[b]	4.12 ± 0.78[c]	4.04 ± 0.89[b]	4.44 ± 0.71[b]

Note : [a, b, c] Different letters in the column indicate highly significant difference (P<0.01).

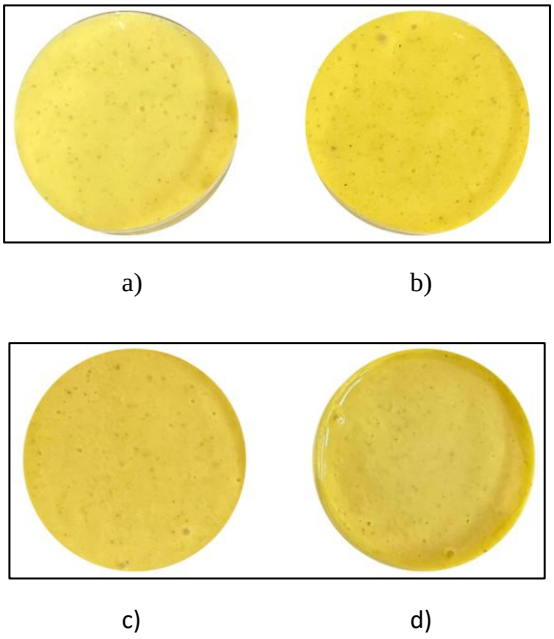

Fig. 1. LFM: a) T0, b) T1, c) T2, and d) T3

Based on the Table 5, LFM with 5% PSF addition has the highest color acceptance score. This is because PSF contains chlorophyll components that can produce an attractive green color. Several types of carotenoids such as lutein and zeaxanthin are yellow color producers owned by PSF [15]. The color difference of LFM for each treatment can be seen in Figure

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1. Based on the Table 5, LFM with 5% pumpkin seed flour addition has the highest taste acceptance score. This is because the taste of LFM with 5% PSF addition produces a good taste where the taste of LFM becomes more savory. The combination of ingridients used in making mayonnaise will produce a combination od flavors between sweet, salty, and spicy so that the taste becomes more complex [16].

Based on the Table 5 also, LFM with 5% PSF addition has the highest texture acceptance score. This can be happen because the texture of LFM with 5% PSF addition produces a good texture where the texture is thick and not too watery. This is comparable to previous research which states that a good mayonnaise making process will produced a semi-solid mayonnaise texture [17]. Based on the Table 5, LFM with 5% PSF addition has the highest atoma acceptance score. This can be happen because the oil used as a raw material for making mayonnaise can contributes as a flavor agent [4].

4 Conclusion

Mayonnaise is an o/w emulsion with many variants including LFM. However, the low oil content of LFM causes emulsion stability and product quality to decrease. Therefore, stabilizers are needed, one of which is PSF. In this study, concluded that PSF can be used as a stabilizer. The polysaccharide, protein, and fiber nutrients contained in PSF can bind water, resulting in the best moisture content. The best pH value, emulsion stability, viscosity, and sensory evaluation are also found in LFM with the addition of 5% PSF. Further research is needed to evaluate PSF as a stabilizer in various low-fat food products.

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