JURNAL KARTIKA KIMIA

J. Kartika Kimia, May 2022, 5, (1), 35-39
Journal homepage: http://jkk.unjani.ac.id/index.php/jkk
P-ISSN: 2655-1322 E-ISSN: 2655-0938

Edible Film Characteristics Moringa Leaves Due to The Effect of Plasticizer (Glycerol) and Moringa Leaf Extract

Yudi Garnida*, Thomas Gozali, and Shanty Nurfirlian
Food Technology Department, Pasundan University, Bandung

*E-mail: yudigarnida@unpas.ac.id

DOI: https://doi.org/10.26874/jkk.v5i1.103

Received: 25 Jan 2022, *Revised*: 4 March 2022, *Accepted*: 11 March 2022, O*nline*: 25 May 2022

Abstract

This study aimed to determine the effect of glycerol and moringa leaf extract on the characteristics of the edible film. The benefit of research is to provide scientific information about the manufacture and characteristics of edible films. The results of the research can improve the quality and economy of Moringa leaves. This research consists of the main research. The preliminary study used a factorial randomized block design (RBD) with a factorial pattern (3x3) with three replications. The responses measured in this study were chemical responses and organoleptic responses. The results showed that the ratio of glycerol and moringa leaf extract affected the characteristics of the edible film.

Keywords: *edible film, glycerol, Moringa leaf extract, plasticizer*

1 Introduction

The edible film is a thin layer made of edible, molded food components that serve as a barrier, both as gas and as water vapor, or as a carrier for food ingredients or additives and improve food handling [1].

According to Bourtoom [2], the edible film is one of the appropriate packaging materials for food products because it can overcome several problems experienced, such as oxidation, moisture migration, reduced aroma and taste, and microbial contamination. The components used for the preparation of edible films can be classified into three categories, namely; (i) Hydrocolloids such as proteins, polysaccharides (cellulose, starch), and pectin derivatives; (ii) lipids such as fatty acids, waxes, and paraffin; (iii) composite. During manufacture, the film materials must be dispersed and dissolved in a solvent such as water, alcohol, a mixture of water and alcohol, or a mixture of other solvents with the addition of plasticizers, anti-microbial agents, color or taste. Edible films that have been made can reliably retain the active substances of a high-value taste and aroma during the cooking and storage process. It is also hoped that the edible film is made does not break down easily, can spread or dissolve quickly to release the active substances contained in it, and when placed in the human body, such as the oral cavity, it will not cause a detrimental taste in the mouth.

Plasticizers are additives added to polymers for added flexibility. Besides increasing its flexibility, plasticizers can reduce the brittleness and durability of the film, especially when stored at low temperatures. Types of plasticizers that are usually used are glycerol, sorbitol, beeswax, glycerin, and acetylated monoglycerine [3].

Glycerol is the most widely used plasticizer in manufacturing edible films because it has stability and compatibility with hydrophilic biopolymer chains [4]. Glycerol as a plasticizer is an important variable that affects the film's mechanical properties due to the plasticizer's effect on the formation of polymer matrices. The use of glycerol as a plasticizer in making edible films is better than sorbitol because it is more flexible and less brittle. Likewise, the mechanical properties and appearance of the edible film with glycerol plasticizer did not change during storage [5]. The role of glycerol in making edible films can increase the flexibility of the film, and the surface of the film is smoother; besides that glycerol can increase the ability of edible films to reduce water vapor transmission rates [6].

The addition of a stabilizer aims to improve the physical properties of the edible film that will be produced. The stabilizers commonly used are

Carboxy Methyl Cellulose (CMC), gelatin, pectin, tapioca, cornstarch, and Arabic gum. CMC is an anionic linear polysaccharide derived from cellulose, used as a viscosity modifier (thickener) to stabilize various food product emulsions. Due to its excellent properties, such as high moisture content and biodegradability, it can absorb water and form moisture and hydrogels in various applications [7].

The presence of antioxidants in edible films aims to improve texture which can increase stability and maintain the nutrition of food products by protecting products from rancidity and oxidation [8]. One of the highest sources of antioxidants is found in plants. In this study, Moringa leaves will be used. Moringa leaves are widely used as food because they contain high nutritional value and are considered a supplement for protein, calcium, and fiber and contain phytochemicals, glucosinolates and isothiocyanates with many health functions such as anti-hypertension, anti-cancer and anti-microbial properties [9]. Moringa leaves are also one of the plant sources with a lot of vitamins A, B, C, D, E and K, as well as essential minerals such as calcium (1,839.10 - 2,743.38 mg/100 g), copper, iron, potassium, and zinc, and has natural antioxidants such as Vitamin A, Vitamin C, Vitamin E, Vitamin K, Vitamin B (Choline), Vitamin B1 (Thiamin), Vitamin B2 (Riboflavin), Vitamin B3 (Niacin), Vitamin B6 [10].

This study aimed to determine the effect of the concentration of plasticizer (glycerol) used and the concentration of moringa leaf extract on the characteristics of Moringa leaf edible film. This research is expected to obtain benefits such as: (1) the edible film produced can be one of the diversities of food products and (2) help optimize the use of Moringa leaves for the food industry.

2 Research Method

Research Materials and Tools

The materials used in stage one, preparation of Moringa leaf extract, are Moringa leaves and aquadest. The materials used in the second stage are making edible films such as Moringa leaf extract, glycerol, CMC, gelatin and aquadest. The chemicals used to p Moringa leaf edible film are aquadest, glycerol ($C_3H_8O_3$), CMC, and gelatin. The tools used in stage one are scales, volume containers, and filters. The tools used in stage two are analysis scales, measuring cups, measuring flasks, bowls, hot plates, magnetic stirrers, and printing plates.

Treatment Design

The factors to be tested in this study were the concentration of glycerol (A) and the concentration of Moringa leaf extract (B) in making the edible film, with three levels of treatment, namely:

a) Factor 1, namely the concentration of glycerol (A):
   a_1 = glycerol 1%
   a_2 = glycerol 3%
   a_3 = glycerol 5%
b) Factor 2, namely the concentration of Moringa leaf extract (B):
   b_1 = moringa leaf extract 2%
   b_2 = moringa leaf extract 4%
   b_3 = moringa leaf extract 6%

Experimental design

The experimental design used in this study was a randomized block design (RBD) with a 3x3 factorial design with three replications.

Response Design

a) Chemical Response
   The chemical responses analyzed on the edible film were water content analysis (gravimetric method based on SNI 01-2891-1992) and water vapor permeability (gravimetric method based on ASTM E96 / 96 M-16).
b) Organoleptic Response
   The organoleptic response carried out was a study of the texture, appearance, and color attributes using the hedonic quality test.

3 Result and Discussion

Research Result Chemical Response

Table 1. Water Content (Moisture Content)

Moringa Leaf Extract Concentration (B) (%)	Water content average (%)
2 (b_1)	18.13 b
4 (b_2)	15.04 b
6 (b_3)	7.66 a

The data in the table shows that the higher the concentration of Moringa leaf extract used, the lower the water content produced. That is because the higher the concentration of the extract will increase the number of dissolved solids so that the viscosity of the film will increase, more water is bound to the material, and free water will evaporate with heating. Likewise, glycerol functions as an absorber of water, forming crystals, and can increase the viscosity of the solution.

The greater the polymer that makes up the film matrix, the lower the amount of water left in the film network, and the increasing viscosity will affect the increase in the thickness of the edible film so that the water will decrease [11].

The addition of Moringa leaf extract increases the attractive force between gelatinized CMC molecules. The total solids of both dissolved and undissolved in the suspension will increase, which causes the amount of free water bound to polysaccharide compounds to decrease so that the water content is lower. According to Tubari [12], the stronger the adhesive structure formed will cause the amount of water bound to the polysaccharide bonds to decrease so that the water content of the edible film tends to decrease.

Water Vapor Transmission Rate (WVTR)

The analysis results follow Mchugh and Krochta [1], statement that edible film with glycerol plasticizer has a low moisture permeability or resistance value. As well as, the addition of excess glycerol plasticizer can cause a decrease in hydrogen bonding which causes an increase in film permeability resulting in water displacement. Likewise, the presence of Moringa leaf extracts in a higher concentration it made lowers the water vapor that passes through the edible film. That is because glycerol molecules and Moringa leaf extract at specific concentrations can absorb large amounts of water vapor or block water vapor, resulting in an edible film with a low WVTR value.

Organoleptic Response

Based on Table 2, the analysis results show that the glycerol concentration factor affects the texture attributes of Moringa leaf edible film. The increasing concentration of glycerol (A) showed an effect on all concentrations of Moringa leaf extract (B), marked by a different significance level in each treatment. Whereas the treatment of Moringa leaf extract (B) and the increase in the concentration of glycerol (A) showed no effect indicated by a significant level that was not different, the b_3 treatment showed an effect marked by different levels.

Table 2. Texture Attribute

Glycerol Concentration (A) (%)	*Moringa Leaf Extract Concentration (B)*		
	2% (b_1)	*4% (b_2)*	*6% (b_3)*
1 (a_1)	*4,00 A b*	*4,09 A b*	*3,74 A a*
3 (a_2)	*4,83 B b*	*4,37 B a*	*4,37 B a*
5 (a_3)	*4,76 B b*	*4,27 B a*	*4,74 C b*

Note: Lowercase letters read horizontally, and uppercase letters read vertically

Table 3. Appearance Attribute

Glycerol Concentration (A) (%)	*Moringa Leaf Extract Concentration (B)*		
	2% (b_1)	*4% (b_2)*	*6% (b_3)*
1 (a_1)	*2,64A a*	*2,91A b*	*2,68A a*
3 (a_2)	*4,72A b*	*4,78A b*	*4,33A b*
5 (a_3)	*4,61A a*	*4,56A a*	*4,82B a*

Note: Lowercase letters read horizontally, and uppercase letters read vertically

Based on Table 3, the analysis results that the increase of glycerol concentration (A) to the concentration of Moringa leaf extract (B) affects the appearance attribute of the Moringa leaf extract edible film. However, treatment a3 shows no effect on the appearance attribute marked by a significant level that is not different. At the same time, the concentration of Moringa leaf extract (B) on glycerol concentration (A) shows no effect on the appearance attribute, which is marked by a significant level that is not different. However, the b_3 treatment affects the appearance attribute marked with a different level. When the glycerol concentration increases, the resulting value is even higher. The 1% glycerol concentration treatment has the lowest value, while the 5% glycerol concentration treatment has the highest value indicating that the 5% glycerol concentration treatment is the most accepted by consumers. Higher glycerol concentration gives a more elastic appearance to the edible film so that consumers accept it.

According to Garnida [13], glycerol can increase the adsorption of polar molecules such as water and act as a plasticizer, and its concentration can increase the flexibility of the film.

Table 5. Color Attribute

Glycerol Concentration (A) (%)	*Moringa Leaf Extract Concentration (B)*		
	2% (b_1)	*4% (b_2)*	*6% (b_3)*
1 (a_1)	*4,53B c*	*3,79B b*	*3,02A a*
3 (a_2)	*4,08A c*	*3,49B b*	*2,83A a*
5 (a_3)	*4,57B c*	*2,77A a*	*3,19B b*

Note: Lowercase letters read horizontally, and uppercase letters read vertically

Based on Table 5, it can be seen that the increase in the glycerol concentration (A) to the concentration of Moringa leaf extract (B), affects the color attribute marked with different significance levels. As well as, the increasing concentration of Moringa leaf extract (B) to the glycerol concentration (A) shows that there is an influence on the color attribute, which is marked with a different significance level and a smaller value. The increase in glycerol concentration decreased the preference level at 4% Moringa leaf extract concentration. However, there was an increase in panelists' preference level at 6% Moringa leaf concentration with increasing glycerol concentration. It can be concluded that consumers accept the 2% concentration of Moringa leaf extract because it has the highest average yield.

4 Conclusion

The glycerol concentration affects the texture attributes, appearance attributes, and color attributes. However, does not affect the moisture content and WVTR value. The concentration of Moringa leaf extract affects moisture content, appearance attributes, and color attributes. However, it does not affect the WVTR value and texture attributes. The interaction between the glycerol concentration and the concentration of Moringa leaf extract affects the texture attributes, appearance attributes, and color attributes of the edible film of Moringa leaf extract. Nevertheless, it does not affect the moisture content and WVTR value of the Moringa leaf extract edible film.

References

[1] Krochta JM. Control of mass transfer in foods with edible coatings and films. *Adv Food Eng*. 1992. :517–38.

[2] Bourtoom T. Edible Films and Coatings: Characteristics and Properties. *Int Food Res J*. 2008. 15(3):237–48.

[3] Kester JJ, Fennema O. Resistance of lipid films to water vapor transmission. *J Am Oil Chem Soc*. 1989. 66:1139–46.

[4] Embuscado ME, Huber KC. Edible Films and Coatings for Food Application [Internet]. New York; 2009. springer.com

[5] Osés J, Fernández-Pan I, Mendoza M, Maté JI. Stability of the mechanical properties of edible films based on whey protein isolate during storage at different relative humidity. *Food Hydrocoll*. 2009. 23(1):125–31.

[6] Fatnasari A, Nocianitri KA, Suparthana IP. Pengaruh Konsentrasi Gliserol Terhadap Karakteristik Edible Film Pati Ubi Jalar (Ipomoea batatas L.). *Media Ilm Teknol Pangan*. 2018. 5(1):27–35.

[7] Tongdeesoontorn W, Mauer LJ, Wongruong S, Rachtanapun P. Water vapour permeability and sorption isotherms of cassava starch based films blended with gelatin and carboxymethyl cellulose. *Asian J Food Agro-Industry*. 2009. 2(4):501–14.

[8] Manuhara GJ, Kawiji K, Estiningtyas HR. Aplikasi Edible Film Maizena dengan Penambahan Ekstrak Jahe Sebagai Antioksidan Alami pada Coating Sosis Sapi. *J Teknol Has Pertan*. 2009. 2(2):50–8.

[9] Evivie SE, Ebabhamiegbebho PA, Imaren JO, Igene JO. Evaluating the Organoleptic Properties of Soy Meatballs (BEEF) with varying Levels of Moringa oleifera Leaves Powder. *J Appl Sci Environ Manag*. 2015. 19(4):649–56.

[10] Bey H. All Things Moringa [Internet]. 2010. www.allthingsmoringa.com

[11] Putri IR. Pengaruh Konsentrasi Ekstrak Teh Hijau dan Teknik Pembuatan Edible Film Terhadap Kadar Air, Aktivitas Air, dan Kelarutannya [Internet]. Universitas Jember; 2014. http://repository.unej.ac.id/handle/123456789/2206

[12] Tubari WA. Karakterisasi Fisikokimia Edible Film Berantioksidan Dari Tepung Porang Dengan Penambahan Sari Wortel [Internet]. Universitas Brawijaya; 2009. http://repository.ub.ac.id/id/eprint/148108

[13] Garnida Y. Edible Coating dan Aplikasinya pada Produk Pangan. Bandung: Penerbit Manggu; 2020.