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Condro Wibowo, Pepita Haryanti, Renaldy Tamalea, and Rumpoko Wicaksono

The Properties of Edible Film Made of Tapioca, Canna and Arrowroot as Affected by Application of Various Concentration of Plasticizer

Condro Wibowo[a)], Pepita Haryanti[b)], Renaldy Tamalea[c)], and Rumpoko Wicaksono[d)]

Department of Agricultural Technology, Faculty of Agriculture, Jenderal Soedirman University, Jl. Dr. Soeparno 61 Purwokerto, Jawa Tengah 53123, Indonesia.

[a)]Corresponding author: condro.wibowo@unsoed.ac.id
[b)]pita_thpunsoed@yahoo.com
[c)] renaldyraf@gmail.com
[d)]rumpokowicaksono@gmail.com

Abstract. Edible film is thin layers made of edible components, formed to cover the food components or placed between food components that acts as a barrier to mass transfer (eg. moisture, oxygen, lipids, and solutes), and or as a carrier for food ingredients and additional ingredients, and to facilitate food handling. Utilization of starch as raw materials for making edible film has good ability to protect products against oxygen, carbon dioxide, oil, and improve the unity of the product structure. In general, the common edible film used is composed from alginate, sago starch and acacia gum. However, the production of edible films from tubers has not been widely used, although in Indonesia there are many areas that produce tubers such as cassava, canna tuber, and arrowroot tuber. This study aims to evaluate the effects of the treatment between the types of raw materials and the concentration of sorbitol used on the chemical, physical and sensory characteristics of edible films. The experimental design used in this study was a Completely Randomized Design (CRD). The factors studied were the type of raw materials, consisting of B1 = Tapioca, B2 = Canna starch, B3 = Arrowroot starch and sorbitol concentration (S), consisting of: S1 = 1%, S2 = 2%, S3 = 3%. The results showed that edible film with combination treatment using tapioca as raw materials with 2% sorbitol concentration showed better quality compared to other treatments. The results of the analysis showed the value of moisture content of 14.10%, ash content of 0.09%, solubility 53.9%, brightness (L *) 22.63, thickness of 0.14 mm, clarity, not stiff, and preferred by panelists

Keywords: edible film, sorbitol concentration, type of raw materials, quality.

INTRODUCTION

Recently, plastic becomes the environmental problem due to its characteristic regarding the degradation aspect. Packaging that is often found on the market is plastic packaging. The disadvantage of plastic packaging material is that it cannot be decomposed naturally (non-biodegradable) so that it can cause environmental pollution. The impact of using plastic packaging can be minimized by alternative biodegradable packaging materials [1], to be easily degraded naturally by the environment and safe for food. Edible film is one food packaging that is safe to use

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because it is biodegradable, does not cause environmental pollution and can protect food products and is able to prevent product appearance from damage due to environmental influences.

Edible films are organic packaging materials made from hydrocolloid and fat compounds, or a combination of both. Hydrocolloid compounds that can be used are protein and carbohydrates, while fats that can be used are wax, glycerol and fatty acids. Starch as a hydrocolloid compound, is a polymer that is naturally formed in various botanical / vegetable sources such as wheat, corn, potatoes, and tapioca. Starch is a renewable natural resource and widely available and easy to obtain [3].

Utilization of starch as a raw material for making edible film has a good ability to protect products against oxygen, carbon dioxide, oil, and improve the unity of the product structure. As for the weaknesses, like other polysaccharides and hydrocolloids in general, starch has a hydrophilic nature, and if starch is used as a raw material for making edible films it will produce brittle films, high moisture vapor permeability, and less flexibility, so efforts are needed to improve them, one of the way is bay adding plasticizer to make them elastic [4] [5].

Tubes generally contain a fairly high carbohydrate content and starch which can be used to make various kinds of products. There are many ways that can be done and need to be researched, hence innovations and alternative applied technologies are found, so that the edible films that are made using local food raw materials in the form of tubers will have good characteristics and can be used for food products.

The objectives of this study is to evaluate the effects of treatment interactions between the types of raw materials and the concentration of sorbitol used on the chemical, physical and sensory characteristics of edible films.

RESEARCH METHODS

The materials used in this study were arrowroot starch, tapioca, canna starch, sorbitol, and aquades. Making edible film is done by raw material weighing as much as 2.5 grams, then mixed with 50 ml of distilled moisture stirred slowly while heated at a temperature of 70-80°C. During stirring, sorbitol is added slowly then stirred until homogeneous for 10 minutes. After that, 50 ml of the edible film solution was poured into a 10x20 cm mold while leveling the surface, then dried in a cabinet dryer for 4 hours at a temperature of 50-60 °C. Next, the edible film is cooled first, then released from the mold slowly.

The experimental design used in this study was a Completely Randomized Design (CRD) which was arranged factorial with 3 replications for each treatment. The treatment tried in this study consisted of two factors. Type of raw material (B), consisting of: B1 = Tapioca, B2 = Canna starch, B3 = Arrowroot starch and sorbitol concentration (S), consisting of: S1 = 1%, S2 = 2%, S3 = 3%.

The variables observed in this study consisted of chemical variables, physical variables and sensory variables. Chemical variables include moisture content. Physical variables include solubility test, thickness test, and color test. Sensory variables include stiffness, clarity, and preference. Data on chemical and physical variables obtained were analyzed using the F Test at the level of $\alpha = 5\%$, if the results of the analysis had a significant effect, it would be followed by the Duncan Multiple Range Test (DMRT). Sensory variable data were analyzed using the Kruskal Wallis test.

RESULTS AND DISCUSSION

Moisture content

The results of the data analysis showed that moisture content increased with increasing concentration of plasticizer added. The results of the analysis showed that the highest moisture content in the treatment of 3% sorbitol concentration was 17.21%, while the lowest moisture content in the treatment of sorbitol concentration of 1% was 14.98%. The moisture content of edible film is influenced by the concentration of plasticizer added. These results are in line with the statement [6] which states that the treatment of increased plasticizer concentration indicates that the moisture content value is increasing. This is because the plasticizer is the simplest glyceride compound with hydroxyl which is hydrophilic and hygroscopic. Increasing the concentration of plasticizers can contribute to the moisture content of edible film because of the ability of plasticizers to hold moisture. The results of data analysis showed that the treatment combination had a significant effect on the moisture content of edible film. The average value of the moisture content of the treatment combination edible is presented in Figure 1.

The results showed that edible films produced with a concentration of sorbitol above 1% in all materials had higher average moisture content than those using 1% sorbitol concentrations. It is assumed that the high concentration of sorbitol has higher moisture content.

Edible film moisture content produced in this study ranged from 13.9% to 17.87%. The edible film moisture content produced in this study is almost suitable even lower than that reported by [7] [8], using carrageenan as a base which is 19.28%. Therefore edible film produced if it is applied as a primary packaging for intermediate moisture food, the best edible film is edible film which has the lowest moisture content.

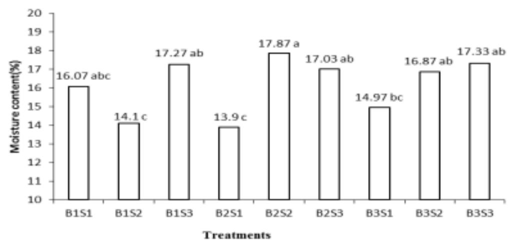

FIGURE 1. Moisture conten of edible films
The numbers followed by the different letters are significant different
B1= Tapioca, B2= Canna starch, B3= Arrowroot starch. S1 = Sorbitol 1%, S2 = Sorbitol 2%, S3 = Sorbitol 3%.

Thickness

The results of data analysis showed that the concentration of sorbitol had a significant effect on the thickness of the edible film produced. The average value of edible film based on sorbitol concentration is shown in Figure 2.

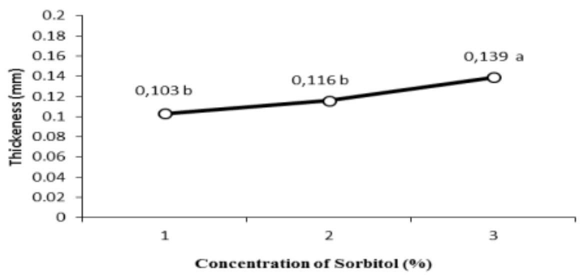

FIGURE 2. Thickness of edible films
The numbers followed by the different letters are significant different

The Thickness increased with the increasing of plasticizer concentration. The results of the analysis showed that the highest thickness was in the treatment of 3% sorbitol concentration, of 0.139 mm, while the lowest thickness in the treatment of 1% sorbitol concentration was 0.103 mm. The thickness of edible film is influenced by the concentration of plasticizer added. The addition of the plasticizer concentration will increase the composing polymer of the film matrix along with the increase in the total dissolved solids in the film solution, thus increasing the film thickness. The difference types of plasticizer and the concentration will influence several properties of the edible films, include: density, thickness, and solubility [5].

Color

The results of the data analysis show that there is a significant influence between the raw materials used to the color of edible film. At brightness (L *) the raw material of arrowroot starch has brighter results than canna starch and tapioca, while colors (a *) and (b *) in tapioca raw materials have significant differences with canna and arrowroot starch raw materials. The average brightness value (L *) of edible film based on the type of raw material is presented in Figure 3.

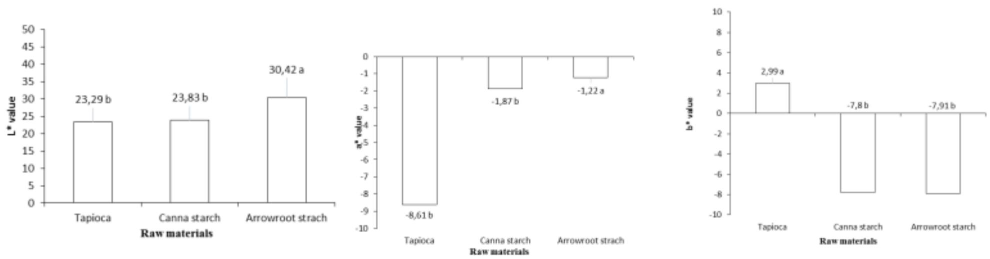

FIGURE 3. Color properties of edible films
The numbers followed by the different letters are significant different

The highest brightness level analysis results were on arrowroot starch material with L * = 30.42, while the brightness level in tapioca was L * = 23.29 which was not significantly different from canna starch material L * = 23.83. The brightness of edible film will affect the application of edible film as packaging material for food products. The color of edible film in the packaging of fruits and vegetables is more preferred with high brightness to transparency [9]. The brightness of the edible film produced is influenced by differences in the degree of whiteness from each starch. The results of this study indicate that edible film made from raw arrowroot starch is significantly different from the ingredients of canna starch and tapioca, because arrowroot starch has a large degree of whiteness compared to canna starch. Compared to arrowroot starch, canna starch is darker because of the formation of brown color when making starch, especially when the tubers are grated due to oxidation of polyphenol compounds by polyphenolase enzymes which are naturally found in canna tuber. The value of a * for all types of material indicates green because the a * value is negative with tapioca having a * lower value. The value of b * for tapioca indicates yellow because the value of b * is positive, while the arrowroot starch and canna indicate blue because the value of b * is negative.

Solubility

The average value of solubility of edible film based on the type of raw material is presented in Figure 4.

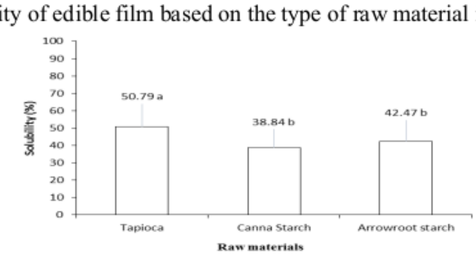

FIGURE 4. Solubility properties of edible films
The numbers followed by the different letters are significant different

The results of the analysis showed that solubility increased with the increasing plasticizer concentration. The analysis results showed the highest solubility obtained in the treatment of 3% sorbitol concentration, amounted to 53.90%, while the lowest solubility in the treatment of sorbitol concentration of 1%, amounted to 30.86%. The higher the value of solubility, the lower the ability of edible film to have moisture resistance. The low solubility value of edible film is very well used as packaging material. The solubility of edible film is influenced by the concentration of plasticizer added. The type and concentration of plasticizers will affect the solubility of starch-based films [5]. The more plasticizers are used, the more solubility will increase. Similarly, the use of hydrophilic plasticizers will also increase their solubility in moisture.

The results of the solubility analysis also showed that there was a significant influence between the raw materials used for the solubility of edible film. The highest solubility was obtained from tapioca raw materials of 50.79%, and the solubility of tapioca raw materials had significant differences compared to arrowroot starch and canna starch.

Sensory properties

Clarity

Clarity in the edible film is the same as transparent. Clarity also describes the quality of edible films, good edible film is edible film that has a high degree of clarity or transparency. The higher the clarity value of edible film, the better and preferred edible film is. The results of the clarity data analysis can be seen in Figure 5.

The results of analysis from 20 panelists showed that there was a significant effect on the clarity of edible film. Based on the results of the analysis of the value of clarity, the clarity value of edible films ranged from not clear (2) to clear (4), in treatment B1 with all sorbitol concentrations showed no apparent difference with clear values, but compared to B2 and B3 shows a difference. In conclusion, these results indicate that tapioca starch has a high degree of clarity compared to canna starch and arrowroot starch. Therefore, the use of edible film with high degree of clarity is appropriate to improve the quality of products [10].

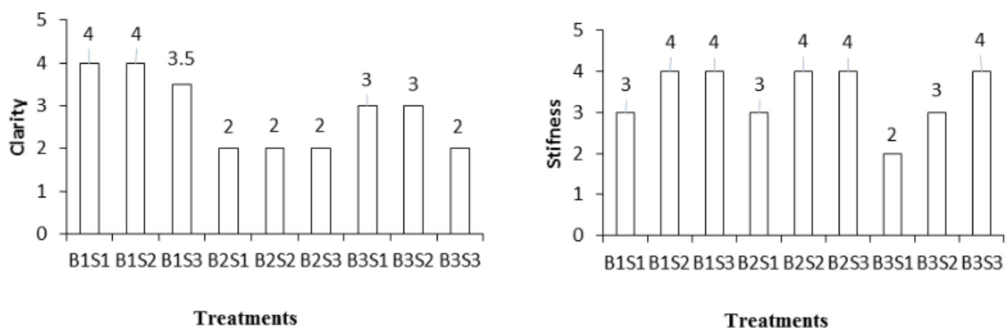

FIGURE 5. Clarity and stiffness of edible films
B1= Tapioca, B2= Canna starch, B3= Arrowroot starch. S1 = Sorbitol 1%, S2 = Sorbitol 2%, S3 = Sorbitol 3%.

Level of stiffness

The level of stiffness in edible film influences the characteristics of edible film produced, the stiffer edible film is, the more difficult it is to remove edible films from edible film mold and difficult to form. The results of the analysis of the level of stiffness can be seen in Figure 5. According to the results of the analysis with 20 panelists, it was shown that there was a significant effect on the edible film texture. The highest score is edible film with a level of texture that is not stiff, while the lowest is edible film that has a very stiff texture. The value of the level of stiffness in the edible film ranges from rigid (2) to not rigid (4). The treatment of edible films B1S2, B1S3, B2S2 B2S3, and B3S3 has a non-rigid texture, while the B3S1 treatment has a stiff texture. This is presumed by the influence of the concentration of sorbitol where the treatment using high sorbitol concentration / the higher the addition of sorbitol concentration will reduce the level of stiffness in the edible film, so that the edible film produced is better. Plasticizer applied plays important role on determining the level of stiffness of edible film

Preference

Preference is the panelist's assessment from clarity and texture. Preference is influenced by consumer subjectivity. Preference will influence whether a product can be accepted by consumers or not. The results of analysis of preference values showed a significant difference from several treatments. The results of the analysis can be seen in Figure 6.

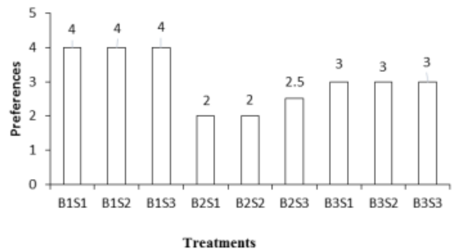

FIGURE 6. Preferences of edible films
B1= Tapioca, B2= Canna starch, B3= Arrowroot starch. S1 = Sorbitol 1%, S2 = Sorbitol 2%, S3 = Sorbitol 3%.

Based on Figure 6, it can be seen that the value of preference for edible films ranged from dislike (2) to likes (4). Panelists prefer edible film made from tapioca raw materials with all concentrations of sorbitol, then followed by raw materials of arrowroot starch and the lowest is canna starch. It is suspected that panelists prefer edible films that have high clarity, and in accordance with the results of the clarity analysis where the clarity of edible film is very influential on consumer preferences. In addition, the application of edible film or edible coating made of tapioca is potential on fresh or processed product [12].

CONCLUSION

Based on the result, tapioca could be used as raw material for edible film that has better properties than those made of canna starch and arrowroot starch. Moreover, edible film that made of tapioca with 2% sorbitol concentration shows better quality compared to other treatments, with a moisture content value of 14.10%, 0.09% ash content, 53.9% solubility, brightness level (L *) 22.63, thickness 0.14 mm, clarity and color are good, not rigid, and preferred by panelists.

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REFERENCES

1. Henrique, C. M. *J. Food Sci.* 74: 184-189 (2007).
2. Fama, L. *LWT* 38: 631-639 (2005).
3. Misir, J., F. H. Brishti and M. M. Hoque. *Am J Food Sci Tech* 2(3):93-97 (2014).
4. Myllarinen, P. *Carbohydr Polym* 50 (4): 355-361 (2002).
5. Sanyang, M.L., S.M. Sapuan, M. Jawaid, M.R. Ishak and J. Sahari. "Effect of glycerol and sorbitol plasticizers on physical and thermal properties of sugar palm starch based films", in Recent Advances in Environment, Ecosystems and Development, Conference paper pp. 157-162 (2015).

6. Rangel-Marrón M. “Optimization of the moisture content, thickness, water solubility and water vapor permeability of sodium alginate edible films”, in Proceeding of Recent Advances in Chemical Engineering, Biochemistry and Computational Chemistry France (2013).
7. Martins J.T., M.A. Cherquiera, A.I. Bourbon, A.C. Pinheiro, B.W.S. Souza and A.A. Vicente. *Food Hydrocolloids* 29(2): 280-289 (2012).
8. Kammani P. and J.W. Rhim. *Int J Biol Macromol* 68: 258-266 (2014).
9. Syarifuddin. *Jurnal Pangan dan Agroindustri.* 3 (4):1538-1547 (2015).
10. Suput, D.Z., V. L. Lazić, S. Z. Popović, N.M. Hromis. *Food and Feed Research* 42 (1): 11-22 (2015).
11. Thomazine, M., R.A. Carvalho, P.J.A. Sobral, *J Food Sci* 70(3): 172-176 (2005).
12. Wibowo, C., Erminawati and R. Wicaksono. *Int J on Adv Sci Eng Inf T* 8 (15): 2099-2015 (2018).

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