Modification of Mango Extract with Mixture of Chitosan, Glycerine and Tapioca to Produce Edible Film

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Abstract
Edible film by mixture of mango extract with chitosan, glycerol and tapioca has been produced. The homogeneous mixture formed on akrilik metal sheet and dried into oven at temperature of 30^{o}C for 2 days. The result of physical test was tensile strength about 0,2285 Kg F/mm^2 and elongation about 48,9100% and thickness about 0,2480 mm^2 and base on SEM test to film that result the compatible film and showed a smooth and thin surface, FTIR test result the long wave is from 3230 – 3400 cm^{-1} that showed strecth of –OH and – NH groups. The long wave from 1800 – 2200 cm^{-1} is vibration of NH^+ group. This is showing, there is interaction between glycerine, tapioca, chitosan from edible film. The nutrition test results that water degree about 17,1700%, protein degree about 5,500%, carbohydrate degree about 72,220%.
Keywords: modification, mango extract, chitosan, glycerine, tapioca, edible film.

1. Introduction

Edible film is akind of coating and packaging material for any food to extend the shelf life of product, that possible to eat together with food. The use of glutarah aldehide in edible film has a lower water resistance than polietilien glycol Parra, D.F. et al (2004). Water-soluble polysaccharides, such as starch, pectin, alginate, laragenan, chitosan and cellulose derivatives, it is generally known according to the nature in the formation of layers that are specially done the research nowadays. Based on the high diversity of polysaccharides, film-forming properties can broadly be formed (Alves et al, 2011).

Chitosan is a product produced from animal skins crustaceans obtained by deacetylation of chitin. Chitosan is a cationic polysaccharide with a large molecular mass, the ability to form a good film as well as antimicrobial activity (Zhong,O.P., 2008). Chitosan is a copolymer of β- (1,4) -2asetamido D-glucose. Chitosan is capable of forming a coating a semipermeable resistant to atmospheric exchange, delay ripening, and reduce transpiration rate in fruits and foods (Bourtoom, 2008). At the present time, polymers with synthetic materials, biocompatible and very limited biodegrable than natural polymers such as cellulose, chitin, chitosan, and derivatives (Kumar, 2000). In use, the chitosan has been evaluated for a variety of uses in the food, medicine, cosmetics, agriculture and the chemical industry because the properties are non-toxic, biocompatible, adhesive, and easily biodegradable (Abugosch, 2011).

The presence of plasticizer needed to improve the mechanical properties of edible films. Plasticizers that are generally used for edible film is water, glycerol, sorbitol and polyhydroxy compounds with other low molecular weight. Usually glycerol and sorbitol are widely used as a plasticizer for stability and solubility (Cerqueira et al, 2011)). A function of pack in food substance is to prohibit and to decrease damages, protect the food from the dangers of pollution and physical disturbance such as friction, impact and vibration. Besides that packaging serves as a container that has the form that facilitates the storage, transport and distribution. According to Wahyu, M., 2008: edible film defined as layer that can eaten which is placed on or between food components, can give alternative for packaging material which has no impact to enviromental pollution because it uses renewable materials and the price is cheap. Expansion of edible film into food besides give the more better quality of product and extend durability, is also an environmentally friendly packaging material (Bourtoom, T., 2008). Hydrocolloid used in the manufacture of edible film is protein or carbohydrate. Film formed from carbohydrates can be starch, gum (like alginate and pectin), and chemically modified starch. The formation of protein-based films among other can use gelatine, casein, soy protein, whey protein, wheat gluten, and protein maize. Film formed from hydrocolloid is very good as prohibit oxygen transfer, carbon dioxide, and fat and have a good mechanic characteristic, so that very good for use to repair the film structure that are not easily crushed (Wahyu, M., 2008). The purpose of this research is to obtain the modification of manufacture of edible film, characteristic of edible film and add more better of variation of food technology and use the fruits from Indonesian to results the high grade food and the nutrition amount into edible film uses for health.

2. Material and Method

Materials used were mango golek (*Mangifera indica L,)* Famile Anacardiaceae central maket, tapioca Sanghee, glycerineE-Merck, chitosan (Shrimp shell), acetic acid 1% E-Merck , aquadest Chemical Farma. Tools are used is blender Miaco, oven microwave, plastic plate Plat akrilik , Kjeldahl Tools, SEM (Scanning electron microscope) (Jeol, JSM-5410 CV.9.JEOL Ltd, Tokyo Japan). This proccess started with washing of mango afterward, the leather of mango golek peeled and then sliced thin-thin, and next mashed with blender until produce mango extract.

Manufacture of edible film

Manufacture of edible film started with dissolving about 2 g tapioca flour into 84 ml of aquadest, the mixture was stirred with *hot plate magnetic stirrer* and heated until temperature of 65 C^0 during 15 minutes until cudle and homogeneous. afterwards, added chitosan 2% (b/v) which dissolved by acetic acid 1%, and next added mango extract about 10 g, and plasticizer of glycerine about 2 g. The solution is reheated at temperature of 65 C^o. And then, restirred until homogeneous and crudle, next poured into the acrylic plate while flattened that fit the mold of edible film and then dried into oven during ± 2 days at temperature of 30 ^oC.

Elasticity and Tensile Strength Methods

Tensile strength (σ) and elasticity (%E) at edible film were determined by the standard method ASTM D638-72. At type IV, the film respectively cutted and conditional at 27^{o}C. Film was put dawn into between two catch with power over tensile speed 100 mm/minute and maximum load 100 kgF. And then the tools was operated. Data result was monitored in monitor. Replication was doing by three times for respectively edible film (Wirjosentono, B. 1996).

Scanning Electron Microscopy (SEM)

A characteristic of film surface was analyzed by SEM tools issued Jeol, JSM-5410 CV.9.JEOL Ltd, Tokyo Japan. Sample was set up at stainless stell stubs with use two set tape, before that respectively of surface was slighted until 5–10 nm and set up into specimen. And the surface of specimen influenced by leaving the intensity of electron signal who collected be based on transfer wave (Stokes, D.J., 2008). SEM analysis is base on investigation and surface analyze with studying morphology properties.

Fourier Transformed Infra Red Spectrofotometry (FTIR)

Pertin Elmer infrared spectrum lies in the wavelength range from 0.78 to 1000 .mu.m or numbers ranging from 12,800 to 10-7instrumentasi spectrum wave infrared radiation is divided into three, namely the near infrared, mid-infrared and far infrared. Edible film cutted fit with mold tools at FT-IR tools, and then clamped placed on a sample, into tool towards the infrared rays. And next, the result will be detected at plate form flow curve of the intensity of the wave numbers, and then the stucture of edible film conformationed with seeing infra red spectrum.

Analysis of Protein

Determining of protein is doing base on desctruction total method, there is with added H_2SO_4 and heated at boiled temperature, based on kjeldahl method. Destructed oxidative complete to H_2O and CO_2 and sulfate salt and $(NH_4)_2SO_4$. Heating continued until the contents in flask to become transparent and solve. Moved quantitative into destilator vapor Kjeldahl tools with added indicator and 2 mL of KOH 1N, then destilated with vapor. The destilate put into a beaker glass that filled with 5 mL of boric acid that has been added with indicator. The destilate is taken as much as 20 – 30 mL. The result of destilation proccess titrated with HCl 0,1N from buret. From the sum of HCl and the titer that used, it can make us known the total N.

Determining Fat Degree

Edible film bacteria cellulose is counted as much as 2 g, put it into a paper. Dehydrated in oven at 80^{o}C as long as one hour. Then put into soxhlet instrument. Extracted with hexane during six hours. The hexane filtrated and the extract dehydrated in oven at 105^{o}C. Count the dry extract until get the constant mass.

Determining Water Degree

Water degree can be counted by gravimetric method. And then weighing the mass of substance until got the constant mass that means the water is steamed.

Determining Ash Degree

Edible film from bacteria cellulose is counted as much as 2 g in the crusible cup that has been count the mass, and dehydrated in oven. Ash proccess done in tanur at maximum temperature is 550^{o}C in 3 hours. Refrigerent in desicatore and count the mass until got constant mass of it.

Determining Carbohydrate

Determining carbohydrate by difference is determining carbohydrate in food rudely, and the result usually showed at composition list of that food (Winarno, 1984).

$$\% \text{ Carbohydrate} = 100\% - \% (\text{protein} + \text{fat} + \text{ash} + \text{water})$$

3. Result and Discussion

Tensile strength is a mechanical properties that connect to chemical properties of film, base on the result of tensile strength, edible film who results from this experiment with comparing 6 g of tapioca, 80 ml of aquadest and 10 g of chitosan, 2 g of glycerine, results tensile strength about 0,2285 KgF/mm2, elasticity about 48,91%, and thickness about 0,248 mm showing at table 1.

Table 1 : The Result of Characterization of Edible Film

No	Parameter	Result
1.	Tensile Strength	0.2285 KgF/mm^2
2	Elasticity	48.9100 %
3	Thickness	0.2480 mm

Base on Jamaludin ((2009), tensile strength and elongation percent is mechanical properties that connect to chemical properties of film. Tensile strength is maximum force that can be resisted by a film until breaking. This parameter is one of mechanical properties that is important from edible film. Tensile strength that is too small indicates that film which it can not be used as packaging, because the characters are less physically strong and easily broken. The measurements of tensile strength of edible film is done using Tensile Strenght & elongation Tester strograph- MI toyoseiki.

Base on Karina, A. R., (2009) edible film that resulted from the green grass jelly that has 0,07 kgf/mm^2 for tensile strength. It can be seen from the resulting of tensile strength is less from the researcher gets. It is caused the differences of compositions and concentrations will give the effect of the strength of elasticity that has been resulted. From the resulting, it shows that the increasing of concentration from glycerin cause the decreasing of tensile strength of edible film. Glycerin who used in experiment of edible film from the green grass jelly is less than the edible film from the researcher uses. The increasing concentration of glycerin who added cause reduction of intermolecular interaction of protein chains also will increase. So the tensile strength will decrease.

Percent of Elasticity

Elongation percent is a change of maximum length that happens from the sample when it comes elongation or pulled until before the sample is tear (Krochta J.MJ. and Mulder J.C.D., 1997) and (Karina, A.R., 2009). The change of the strength can be seen when the film is tear. Base on the test result that edible film, glycerin, starch and chitosan that have been resulted showing the average of elongation 48,9100%. When edible film with pectin from green grass jelly and starch base on research by Karina, A (2009), has elongation at 13,7 – 19,5%. Wahyu,M, (2008) and Karina, A. R. (2009), said that film from the starch results the matrix with high elasticity. And then, the useful of glycerin as plasticizer on research of edible film from pectin (grass jelly) and starch. Reduction of intermolecular interaction on protein chains happened it because adding of glycerin, the molecule of plasticizer will disturb the strength of starch and decrease the intermolecular interaction and increase the mobility of polymer. And next, it causes the increasing of elongation and decreasing the tensile strength with increasing of concentration from glycerin (Haryadi 2002).

The thickness is important parameter that influence to useful film as packaging and the thickness of edible film that resulted on research is about 0,248 mm, a good enough film for packing due to the high thickness of the film, it still probably contains much water and readily contamined by bacteria and has low durability.

Results Analysis of FTIR of edible film

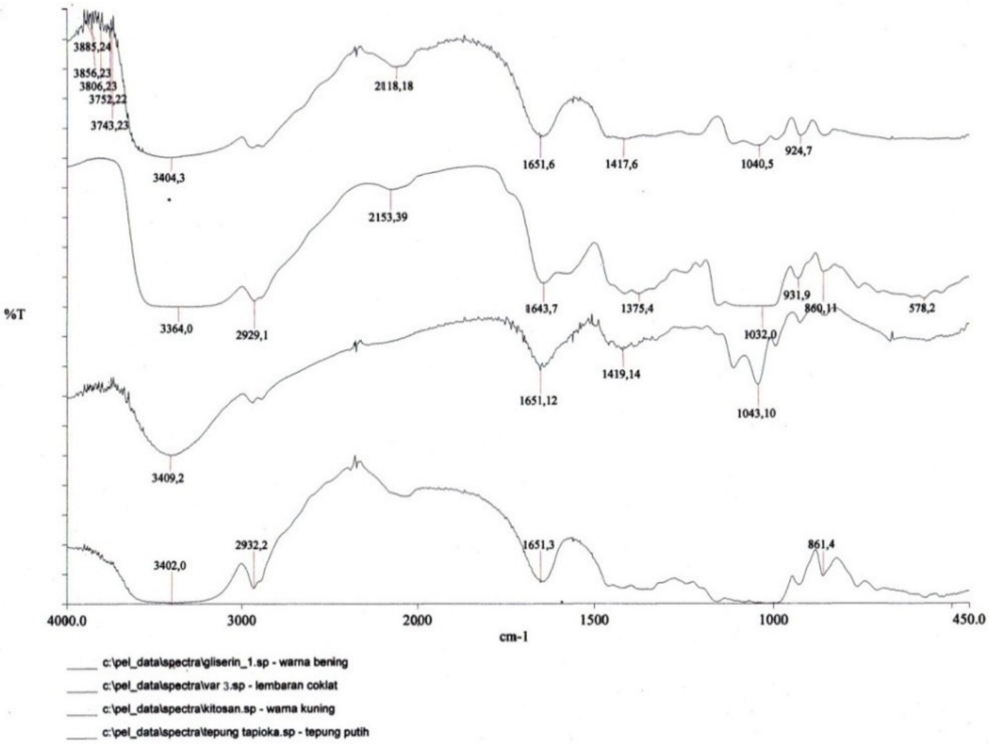


Figure 1 : From the top spectrum represent the,a, glycerine, b, edible film, c,chitosan, and ,d. tapioca flour spectrums.

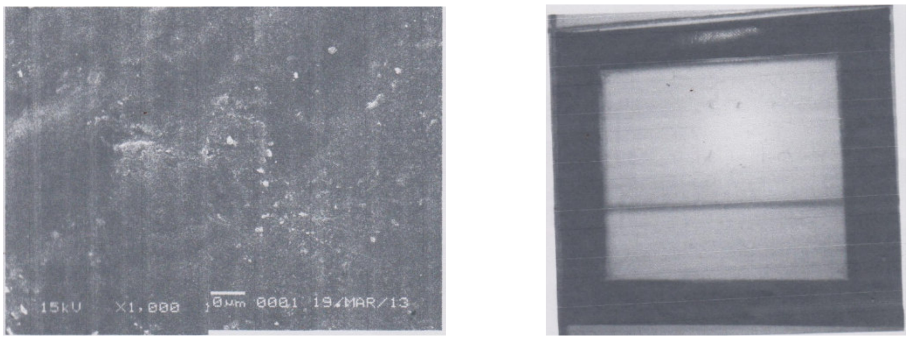
The result using FT-IR shows the –OH and –NH group lays in wavelength of 3230-3400 cm^{-1}, while the wavelength of 1800-2200 cm^{-1} is the vibration of $–NH^{+}$ where there is a possibility of interaction between the mixture of the film contained mango extract, tapioca and glycerin, chitosan. FT-IR spectroscopy was done to characterize group spectrum interaction microstructurally between chitosan, tapioca, and glycerin. In the tapioca flour used in this research shows there are strain of –NH/ –OH group in 3400-3440 cm^{-1} wavelength, –CH group in 2915-2940 cm^{-1} wavelength, C=O group in 1650-1680 cm^{-1} wavelength in the formation of group –CH in 800-870 cm^{-1} wavelength describe the whole tapioca flour.

As for chitosan used in the research, the FT-IR results there are strains of –NH group at 3400-3440 cm^{-1} wavelength, the strain of amida C=O group is at 1610-1655 cm^{-1} wavelength in the formation of –OH group at 1390-1420 cm^{-1} wavelength, the strains of C-OH group is at 1010-1075 cm^{-1} wavelength in the formation of –CH group at 860-900 cm^{-1} wavelength describe the whole structure of chitosan. Meanwhile for glycerin used in this research, FT-IR describe its whole structure as there are strain of –NH group at 3400-3440 cm^{-1} wavelength, the strain of intermolecule C=O group at 1650-1680 cm^{-1} wavelength in the formation of –OH group at 1395-1440 cm^{-1} wavelength.

For edible film with optimum mechanic test, the FT-IR analysis shows there are strain of –NH and –OH group at 3230-3400 cm^{-1} wavelength, and $–NH^{+}$ group vibration at 1800-2200 cm^{-1} wavelength. This is a prove the presence of interaction between tapioca flour, chitosan, and edible film within the edible film.

SEM Analysis

The picture below shows the result of structure test for the edible film made using SEM to determine the morfology and structural change from one material such as fracture, curvature. SEM result shows the surface structureof the film in Picture. It shows the surface structure of the film is smoother, slippery, has intense pores, flat film surface, and there are no bubbles in the 1000 X zoom in.



(a) (b)

Figure 2 : SEM result of edible film made by mango extract, tapioca, glycerine, and chitosan 1000 X (a) and Edible film compositions made by mango extract 10 g, tapioca 8 g, glycerine 2 g, and chitosan 2 % (b).

Table 2. Nutrition result of Edible Film

No.	Parameter	Result (%)
1.	Water Content	17.1700.
2	Protein Content	5.500.
3	Carbohydrate Content	72.220.
4	Fat	1,55
5	Fiber	2,56

As seen in table 2, edible film contains 17.1700 % of water, 5.500 % of protein, 72.220 % of carbohydrate. Due to it contains almost 15 % of water, microorganisme is easily growing up in the film and so the reducing the durability of the film, meanwhile the 5.500 % of protein is almost equal as milk. Probablly the N content from the chitosan adds the value of protein.

Conclusions

The composition of edible film produced from this research has the good mechanic properties, and meet the requirement of film especially for thickness, tensile strength, flexibility, and nutrition contents, yet has bad water content. Sufficient protein and carbohydrate content will enhance the value of film produced. Modification between the mixture of a good film and the possibility of interaction between –OH group in tapioca, glycerine, and N from chitosan can be invisible as IR spectrum, while SEM shows the film is compatible, intense, slipery film surface, flat, and no bubbles.

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