Edible Film Characterization from Cassava Starch and Its Organoleptic Properties as Primary Packaging of Snake Fruit Lunkhead

Yeyen Prestyaning Wanita 1,* and Purwaningsih 1
1)Yogyakarta Assessment Institute of Agricultural Technology
Agriculture Ministry
Jl. Stadion Maguwoharjo No. 22, Karangsari, Ngemplak, Sleman. Phone (0274) 884662
Email: yeyen_world@yahoo.com

Abstract
Most of the food packaging material made from plastic, which is difficult to be decomposed. We need food packaging materials environmentally friendly and edible directly with the product. The experiment was conducted in the laboratory of post-harvest, Yogyakarta AIAT in March to October 2012. The purpose of this study was to know the characteristics of edible film made from cassava starch and organoleptic value as primary packaging of snake fruit lunkhead. The experimental design used was completely randomized design with two factors, nine treatments and three replications. The first factor was the percentage of cassava starch used, the second factor was the type of plasticizer used. The results showed that: 1) The range of water content from the ninth edible film treatments were 10-32%. 2) The highest percentage of cassava starch addition, caused the increasing of edible film water vapor transmission rate. 3) The use of sorbitol plasticizers provides the highest water vapor transmission rate. 4) The range of peroxide content from ninth edible film treatment were 1.64 – 7.08 meq/kg. 5) As the primary packaging snake fruit lunkhead, the highest edible film panelist overall preferences was from sorbitol plasticizer and 4% use of cassava starch, ie. 80% of panelists like it, with an average value 3.8 which means they like it.

Keywords: edible film, cassava starch, lunkhead, and packaging

1. INTRODUCTION
Lunkhead fruit is a semi-wet traditional food with about 27% water content, it is made from fresh fruit, glutinous rice flour, sugar, coconut milk and other auxiliary materials (Rukhanah, 2005). Lunkhead can be made from various fruits, one of them is snake fruit. The processing of snake fruit into lunkhead aims to extend the shelf life, add to the economic value of the fruit at harvest time, at which time the availability abundant with the selling price relatively cheap.

In Indonesia, plastic is still the primary packaging materials used in everyday life and industry. Plastic packaging is not environmentally friendly. This is because the raw materials for making plastics are hazardous materials and takes along time to be decomposed (Setyowati et al., 2013). To solve this problem, we need environmentally friendly and a renewable packaging material.

Edible film is a thin layer that serves as a food packaging material or coating, that can also be eaten along with products (Gulibert et al., 1990). Edible films also serves to extend the shelf life of the packaged product, carrier nutritional components of food (vitamins, minerals, antioxidants, antimicrobial, preservatives, colors, and flavors), cost of manufacture is relatively inexpensive, and easy to be overhauled. Raw materials for making edible film is a compound of hydrocolloid and
fats (Fama, 2005). Hydrocolloid compounds such as carbohydrates and protein, while the fatty compounds can be fatty acids. One of carbohydrate type is cassava starch. This starch is a cheap and abundant material, able to form a continuous polymer matrix. It has attracted particular interest because it is able to form edible (Vicentini et al., 1999) and exible, tasteless, odourless, colourless, transparent, non toxic and biologically degradable (Chiumarelli et al., 2014 and Belibi et al., 2014).

Starch granules composed of amyllose and amylopectin. Amylose content affects the properties of gelatinization, retrogradation, swelling energy, starch susceptibility to enzyme, and determine the quality of the product (Peroni et al., 2006 in Hanum, 2010). Cassava starch have 0.20% protein content, 0.15% lipid, 0.21% ash and 19.8% amylose. Guilbert et al., (1990) stated that the stability of the edible film is influenced by amylopectin, whereas amylose effect on compactness. Starch with high amylose content produces flexible and powerful edible film (Thirathumthavorn et al., 2007).

Edible film characteristics be affected by raw material, the type and concentration of plasticizer (Damat, 2008). Plasticizer from the polyhydric alcohols or polyols class ie. glycerin and sorbitol (Pagella et al., 2002). Without plasticizers exhibit poor mechanical strength and become fragile with low water content (Vicentini et al., 2005). Usually, increasing the concentration of plasticizer leads to reduction of mechanical resistance and rigidity and increasing deformability of film, but the behavior depends on the type of plasticizer used (Sobral et al., 2001 and Gontard et al., 1993). The addition of sorbitol increase the value of elongation, fragility edible film decreases, and increased permeability (Prihatiningsih 2000).

This study aims to determine the characteristics of edible film made from cassava starch and organoleptic value as primary packaging from snake fruit lunkhead.

2. MATERIAL AND METHODS

The main raw material of edible film was cassava starch. Cassava starch extracted from cassava tubers. Additional materials used were some kind of plasticizers (sorbitol, beeswax, and glycerol) according to treatment, distilled water, stearic acid, and CMC. The addition of stearic acid serves to reduce the rate of water transmission. Stearic acid is long-chain fatty acids with a number of C atoms as much as 18 units, and hydrophobic (Rodhiquez, 2006).

Plasticizer used to raise the level of elasticity from the polymers produced, by reducing the degree of hydrogen bonding and increase the distance between the molecules of the polymer (Harris, 2000).

CMC serves as a stabilizer, produce edible film with a good textured and prevent retrogradation (Prihatiningsih, 2000).

The making process of cassava starch flow diagram of as follows:

![Figure 1. Process flow diagram for cassava starch](image-url)
The manufacturing process of edible film flow diagram of as follows:

The plasticizer additional according to treatment, 1.5% (w / v) stearic acid, and 1% (w / v) CMC

EF3G = edible film made from cassava starch 3%, with 15% glycerol plasticizer.
EF3S = edible film made from cassava starch 3%, with 2% sorbitol plasticizer.
EF4L = edible film made from cassava starch 3%, with 0.3% beeswax plasticizer.
EF4S = edible film made from cassava starch 4%, with 15% glycerol plasticizer.
EF4G = edible film made from cassava starch 4%, with 2% sorbitol plasticizer.
EF5L = edible film made from cassava starch 5%, with 0.3% beeswax plasticizer.
EF5S = edible film made from cassava starch 5%, with 2% sorbitol plasticizer.
EF5G = edible film made from cassava starch 5%, with 0.3% beeswax plasticizer.

Edible films were then used as primary packaging snake fruit lunkhead. To determine consumer acceptance of snake fruit lunkhead that has been coated by edible film, the organoleptic test conducted with preferences method (hedonic scale). Hedonic scale was made with five levels of preferences (1-5), ie. 1 = strongly dislike, 2 = dislike, 3 = somewhat like, 4 = like, and 5 = very like. Test carried out on color, odor, texture, and overall preferences against nine treatments (Resurreccion, 1998). Test conducted on 25 random panelists.

The parameters observed and measured in this study were the water content (AOAC, 1990), the water vapor transmission rate, solubility, peroxide value, and organoleptic value.

The data were processed statistically with Duncan test (95% confidence level) (Steel et al., 1995).

3. RESULT AND DISCUSSION

3.1 Water Contents

The processing of edible film made from starch basically uses the principle of gelatinization. Gelatinization process occurs due to the addition of water and cooking. This process led to amylose starch bonding close to each other due to hydrogen bond. The drying process results in shrinkage due to loss of water, so that the gel will form a stable film (Careda et al., 2000). According to Sarmento (1997), starch gelatinization begins at 60.5°C. In the process of cooling to 50 ° C will increase the viscosity, there may be a small retrogradation, and the possibility of a small crystallization. The water content of edible film produced by treatment with the addition...
of cassava starch and plasticizer types was presented in Figure 3.

![Figure 3. The water content of edible film produced from nine treatments](image)

From Figure 3, it appears that: edible film from glycerol plasticizer provide the highest moisture content and elasticity, in comparison with sorbitol and beeswax. Edible film with the addition of sorbitol and beeswax, possess less elastic and rigid, if used as a wrapper will be broken easily.

### 3.2 Water vapor transmission rate

Water vapor transmission rate are amount of water vapor losted per unit time divided by the area of the film. Water vapor transmission rate are water vapor permeability through a unit area of the material flat surface with a certain thickness, as a result of a difference in vapor pressure unit between two surfaces at a certain temperature and humidity conditions. Therefore, it is one of the functions of edible film are to resist migration of water vapor; the water vapor permeability should be as low as possible (Gontard, 1993). Edible films with a basis of polysaccharides (starch cassava) have low water vapor permeability and permeability to oxygen. This is due a polymer having a large hydrogen bonds. According Careda et al., (2000), 3% of cassava starch concentration of non-modified produce small pores, which may be caused by small bubbles of dissolved air when heating. Small pores resulting edible film of cassava starch has a low transmission rate to water vapor and gases (Santoso et al., 2004). Water vapor transmission rate of edible film, with the addition of hydrocolloids, such as carbohydrates will produce a powerful film because it is a good barrier against the transfer of O2, CO2, and lipids.

![Figure 4. Transmission rate of nine treatments of edible film-making.](image)

Figure 4. Shows that the more starch is added, the rate of transmission is also getting bigger, except the addition of glycerol. Edible films with sorbitol, has a water vapor permeability value higher than glycerol and beeswax.

This is because the sorbitol has a particle size larger than glycerol and beeswax, cause enlargement of the free volume between the polymer chains, which facilitate the water molecules transfer (Donhowe et al., 1993 and McHugh et al., 1994). Glycerol and beeswax with a smaller molecular size would enter more into the film amorphous network, thus slowing down the transfer of water in the film.

### 3.3 Solubility

Solubility or percent solubility edible film are a dry weight percent of the film dissolved after immersion in water for 24 hours (Gontard, 1993). The solubility of the film is an important factor in determining biodegradabilitas when used as packaging films. There are films that the desired level of high solubility or vice versa depending on the type of product packaged (Nurjanah, 2004). This product requires edible film with low
solubility. The lower solubility, result the melted more quickly.

Figure 5. Solubility edible film produced by 9 treatments of edible film making

In Figure 5. Solubility values were influenced by the percentage of cassava starch used and the type of plasticizer.

The smaller percentage starch used, the solubility values have higher tendencies, while the type of plasticizer, glycerol gives the average value highest solubility than others. This is similar with the Bourtoom (2007).

3.4 Peroxide

The use of fatty compounds in the produce of edible film, allowing these materials undergo rancidity process due to increased peroxide. The existence of the heating process causing fatty compounds exposed to air and water vapor, which causes the oxidized fatty compounds.

High peroxide number in food product causes rancid faster, because of the oxidation process. The maximum peroxide number on food product containing fat is 10 meq/kg (Anonim, 2014).

Figure 6. Numbers peroxide produced from edible film (meq/kg)

The ninth edible film has a peroxide number below 10 meq / kg, making it safe to consume. The highest peroxide number produced by beeswax plasticizer. While glycerol and sorbitol were relatively lower. This is because beeswax produces the most brittle edible film. Thus ability to inhibit the rate of gas and water vapor is smaller than edible film produced by glycerol and sorbitol. This leads to a higher peroxide numbers.

3.5 Organoleptic Test Result

Organoleptic test used to determine preferences and consumer acceptance of lunkhead that was wrapped with edible film. Observations conducted in sensory, stating liked or disliked, and accept or not on the physical properties of the product. Organoleptic test results presented in Table 1.

Table 1. Preferences value of organoleptic test results from snake fruit ‘lunkhead’ were wrapped with edible film

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Color</th>
<th>Texture</th>
<th>Odor</th>
<th>Overall preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>3% Cassave starch + glicerol</td>
<td>3,1a</td>
<td>2,4a</td>
<td>3,7a</td>
<td>3,1a</td>
</tr>
<tr>
<td>4% Cassave starch + glicerol</td>
<td>3,0a</td>
<td>2,5a</td>
<td>3,7a</td>
<td>3,1a</td>
</tr>
<tr>
<td>5% Cassave starch + glicerol</td>
<td>3,2a</td>
<td>2,6a</td>
<td>3,7a</td>
<td>3,2a</td>
</tr>
<tr>
<td>3% Cassave starch + sorbitol</td>
<td>3,8c</td>
<td>3,4b</td>
<td>3,4a</td>
<td>3,6ab</td>
</tr>
<tr>
<td>Starch + Plasticizer</td>
<td>Odor Preference (%)</td>
<td>Texture Preference (%)</td>
<td>Overall Acceptance Rate (%)</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------</td>
<td>------------------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td>3% Cassave starch + sorbitol</td>
<td>45</td>
<td>20</td>
<td>75</td>
<td>45</td>
</tr>
<tr>
<td>4% Cassave starch + sorbitol</td>
<td>45</td>
<td>25</td>
<td>70</td>
<td>40</td>
</tr>
<tr>
<td>5% Cassave starch + sorbitol</td>
<td>50</td>
<td>35</td>
<td>80</td>
<td>45</td>
</tr>
<tr>
<td>3% Cassave starch + beeswax</td>
<td>80</td>
<td>70</td>
<td>50</td>
<td>65</td>
</tr>
<tr>
<td>4% Cassave starch + beeswax</td>
<td>85</td>
<td>65</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>5% Cassave starch + beeswax</td>
<td>85</td>
<td>65</td>
<td>60</td>
<td>85</td>
</tr>
<tr>
<td>3% Cassave starch + glycerol</td>
<td>55</td>
<td>75</td>
<td>60</td>
<td>55</td>
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<tr>
<td>4% Cassave starch + glycerol</td>
<td>55</td>
<td>75</td>
<td>60</td>
<td>55</td>
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<tr>
<td>5% Cassave starch + glycerol</td>
<td>50</td>
<td>65</td>
<td>55</td>
<td>55</td>
</tr>
</tbody>
</table>

The above table shows that the percentage of panelists acceptance rate in accordance with the value of panelist preferences.

3.5.4 Overall preferences

To determine consumer acceptance as a whole, the assessment of overall satisfaction. The result was a noticeable difference between lunkhead wrapped in edible film from glycerol, sorbitol and beeswax plasticizer.

4. CONCLUSIONS

The average of edible film water content produced from the ninth treatments were 16.71%. The higher starch addition causes the water vapor transmission rate increases. The use of sorbitol plasticizer provides the highest water vapor transmission rate. Peroxide produced by ninth treatments edible film manufacture under safe levels for consumption (10 meq/kg). Edible films made from cassava starch with sorbitol, glycerol and beeswax plasticizer can be used as primary packaging lunkhead snake fruit. The highest panelist overall preferences at sorbitol plasticizer and 4% of cassava starch treatment ie. 80% of...
panelists liked and average value of preferences was 3.8 which means they like it.

5. REFERENCES


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