Effectiveness of Edible Film impregnated by Vegetable Waste Filtrate on Dodol

R Smeets-Rittichai¹, I Agustina² and T Budiati³*

¹. Lamex Food BV, Koopmanslaan 31-04, 7005 BK Doetinchem, Netherlands
². Food Industrial Technology Department, Politeknik Negeri Jember, Mastrip PO Box 164 Jember 68101, Indonesia
³. Food Engineering Department, Politeknik Negeri Jember, Mastrip PO Box 164 Jember 68101, Indonesia

*Email : titik.budiati@polije.ac.id

Abstract. Dodol is one of the semi-wet products (Intermediate Moisture Foods) made from a mixture of sugar and lipid so it is easily to be oxidized and become rancid. By using edible film with antioxidant the rancidity can be reduced. Vegetable waste (eggplant peel and chinese cabbage root) were composed by bioactive compound as natural antioxidant which can be incorporated with edible film. The results showed that the addition of vegetable filtrate on edible film had a significant effects on its antioxidant activity. The antioxidant activity of BHT, eggplant peel filtrate and chinese cabbage filtrate were 12.17%, 11.72% and 8.53%, respectively. Edible film impregnated by eggplant peel filtrate was effective as natural antioxidant in dodol

1. Introduction

Semi-wet food or known as Intermediate Moisture Foods is a food that has a water content that is not too low, namely the moisture content range of 10-25% dry basis with an aw content below 0.9. Dodol is one semi-wet product that has a moisture content of 10-15% wet base with an aw value on the material of 0.7-0.9 [1]. As a semi-wet food product, dodol is a type of food that contains a mixture of carbohydrates, fats, proteins and other components that undergo chemical changes. The mixture of some of these components can affect the shelf life of dodol, that is, dodol is susceptible to damage such as rancidity due to oxidation reactions of the mass transfer of products to the environment which also triggers the growth of microorganisms. One way to reduce the damage caused by this oxidation reaction is through the packaging and administration of antioxidants.

Currently, there are many types and forms of packaging design, but most come from plastic-based packaging in which plastic has properties that cannot be deciphered biologically and are not environmentally friendly. So that other alternative packaging that is biodegradable is chosen, namely edible film. Edible film is a thin layer that can be eaten and can be a barrier (transfer) mass transfer (humidity, oxygen and transfer of solutes) to the food itself or between food and the environment. This thin layer stands alone as a "stand-alone sheet" on the product [2]. Although edible film cannot completely replace plastic packaging, it has a few more points in its application due to its biodegradable nature. Edible film as an edible primary packaging (edibility) also provides additional functions which are not possessed by plastic packaging, such as: being a passive barrier between...
heterogeneous components in food or providing individual protection for each small pieces or parts of food ingredients. Besides acting as a passive barrier, edible film also has many other applications such as: controlling loss of active food composition, immobilization of enzymes, encapsulation of microorganisms (as antimicrobials) and protecting food from the formation and modification of the atmosphere. And with the addition of certain components in edible film, it can add its functional value to an antimicrobial and antioxidant edible film.

Some antioxidants which include synthetic and natural antioxidants are added to the gelatin film to produce active films in the presence of antioxidant activity [3]. At present the use of synthetic antioxidants has begun to be restricted because synthetic antioxidants such as BHT (Buthylated Hydroxy Toluene) can poison animal experiments and are carcinogenic, for this reason natural plants receive much attention as a safe source of antioxidants [4]. According to Pratt and Hudson [5], most sources of antioxidants come from plants and generally are phenolic compounds that are spread throughout all parts of the plant both, wood seeds, leaves, roots, fruit, flowers and pollen.

Many studies has been done on the effect of adding antioxidants to the functional properties of edible films and coatings from different biopolymers. Antioxidant agents from natural sources such as plant extracts [6] and other components with antioxidant activity that have been extensively studied either individually or combined to replace synthetic antioxidants such as BHA or BHT. According to Sayuti and Yenrina [7], the working principle of antioxidants is as an inhibitor of auto-oxidation in the oxidation process, which in its mechanism of action is influenced by several factors, one of which is light. The aim of this study was to determine the effect of natural antioxidant obtained from vegetable waste (eggplant peel and chinese cabbage root) incorporated into edible film on the rancidity of dodol.

2. Material and method

2.1 Material
Vegetable waste (eggplant peel and chinese cabbage root) was crushed in mortar and mixed with 10% water. It was filtered by using whatmann filter and kept in dark bottle at room temperature. Butylated hydroxytoluene (BHT) was used as synthetic antioxidant. Dodol was purchased from local market which is produced at first day.

2.2 Preparation of edible film with antioxidant
Alginate-based edible films were prepared by modification of the method used by Pavlath et al. [8]. Sodium alginate (1 g) was dissolved into 100 mL of distilled water and rotary shaking was done concurrently. As the alginate film was brittle, 0.4 mL of glycerol was added into the edible film solution. Vegetable filtrate or BHT was incorporated into the edible film solution at 30 % v/v of edible film forming solution. The solutions were cast onto 12 - 16 cm of polyacrylic plates followed by air drying at room temperature 24 h in UV laminar floor. The dry films obtained were peeled off and stored for evaluation.

2.3 Antioxidant Activity (DPPH Method) [8] with modifications
About 3.94 mg DPPH 2, 2-diphenyl-1-picrylhydrazyl was dissolved in methanol to reach 100 ml. Three milliliter DPPH solution was put it in a test tube and mixed with 300 µL of the sample solution. It was homogenized with vortex and incubated at room temperature in dark conditions for 30 minutes. Measuring the absorbance of DPPH absorption at a wavelength of 517 nm. Calculating antioxidant activity as the formula:

\[
\%\text{Inhibit} = 1 - \frac{\text{absorbance of sample}}{\text{absorbance of control}} \times 100
\]

Note:
- Control absorbance: DPPH radical absorption of 0.1 mM at maximum wavelength (517 nm)
- Sample absorbance: absorbance of samples at maximum wavelength (517 nm).
2.4 Peroxide Numbers [9].
About 5 grams of sample was mixed with 30 chloroform glacial acetic acid and homogenized. It was added by 5 ml of saturated KI solution and left for 1 minute. About 30 ml of aquadest and 1 ml of starch indicator were added in the sample and homogenized. Titration was carried out by using 0.1 N thiosulfic acid until color was changed into a lighter color. Blank was done by using the solution without sample.

\[ \text{Peroxide Number} = \frac{(S - B) \times N \text{ thiosulfate} \times 1000}{\text{berat sampel (gr)}} \]

Note:
S = sample titration volume
B = volume of blank titration

3. Result and Discussion

3.1 Antioxidant activity
Antioxidant activity (AA) or Scavenging Activity is done by DPPH method with antioxidant activity expressed as percent inhibition (% inhibition). DPPH is a compound that has proton free radicals that have maximum absorbance at a wavelength of 517 nm. The proton radical scavenging action is known as one mechanism to measure antioxidant activity [10]. Antioxidant compound is an inhibitor that is used to inhibit auto-oxidation. This compound plays a role in neutralizing free radicals [11]. In food antioxidants are components that can delay, slow down or prevent damage to food due to oxidation. However, antioxidants only act as inhibitors of oxidation reactions, not to repair food ingredients that have been oxidized [12]. There were significant differences between the two treatment factors on the antioxidant activity of edible films. Edible films with the addition of natural antioxidants from purple eggplant peel filtrate and edible films with the addition of synthetic antioxidant BHT have higher antioxidant activity than edible films with the addition of natural antioxidants from mustard filtrate and edible films without the addition of antioxidants (control).

![Figure 1. Antioxidant activity of edible film impregnated by antioxidant](image)

Edible films with the addition of synthetic antioxidants have higher antioxidant activity compared to edible films with the addition of natural antioxidants, seen from the average delta value of antioxidant activity between variables from day 0 to day 3, day 3 to day 6 and 6th day to 9th day. From the average delta (d) value, it is obtained that edible film with the addition of synthetic antioxidant BHT has the highest antioxidant activity compared to edible film with the addition natural antioxidant from purple eggplant and chinese cabbage eggplant peel filtrate. This is because the
antioxidant activity of edible films with purple eggplant peel filtrate is only determined from the filtrate where antioxidant compounds can only dissolve in non-polar solvents such as beta carotene and vitamin C. Vitamin C is soluble in water and plays an important role as an antidote to extracellular free radicals. While other compounds, such as the polyphenol group in purple eggplant, may not soluble in non-polar solvents because the polyphenol group is soluble in ethanol (polar solvents) [13]. Edible film with the addition of natural antioxidants from Chinese cabbage filtrate has the lowest antioxidant activity even lower than the edible film control, in addition to being less than the maximum extraction factor, this is also due to several factors that influence the antioxidant activity of all ingredients such as: antioxidant concentration, temperature, media pH, chemical structure and position in the molecule [10]. Research from Miyake and Takyuki [14] shows similar results, that the antioxidant activity of natural antioxidants is not as strong as the antioxidant activity of BHT.

Compounds that play a role in antioxidant activity in purple eggplants are alkaloid and flavonoid compounds [13]. Purple eggplant peel is known to contain flavonoid compounds with anthocyanin content, namely high nasunin in the vegetable peel. Delphinidin and its derivatives are the largest group of anthocyanins found in eggplant peel. Anthocyanins are the largest group of water-soluble pigments in the plant kingdom. In addition, chlorogenic acid which is a type of phenolic acid is also commonly found in the peel and fruit of purple eggplant [15]. While in Chinese cabbage, which plays a role in antioxidant activity is the natural pigment of flavonoids, which are pale yellow to pale white pigments which are phenolic compounds. Phenolic compounds, especially flavonoid compounds, are known to have antioxidant properties that act as anti-cancer and antimicrobial [16, 17].

3.2 Rancidity

Rancidity test is one of the important parameters to determine the quality and shelf life of dodol. Peroxide number is one of the rancid tests determined based on the amount of iodine free of fat or oil after adding KI. The material fat is reacted with KI in acetic acid and chloroform (2:1) solvents then the iodine formed is determined by titration using Na2SO4 [18]. There is significant differences between the two factors in edible film on dodol peroxide numbers. This shows that edible film with purple eggplant peel is the most effective in slowing the rancid dodol during storage. When viewed from the treatment of the addition of antioxidants, it appears that the dodol packed with edible film of the type natural antioxidants have lower peroxide numbers compared to dodol packed with edible films with synthetic antioxidant types, and the increase in peroxide numbers is also slower (smaller delta values). The presence of antioxidants in edible film can slow rancidity in dodol. Antioxidants greatly affect the process of rancidity because it will affect to the speed of the oxidation process [18]. Based on the edible film with antioxidant activity test parameters, the results of the peroxide number test of the four dodol samples packaged with various types of edible films give results that are not directly proportional. From the edible film antioxidant activity test, it was found that the highest antioxidant activity was showed by edible film with the addition of BHT, while the lowest peroxide number was showed by dodol packed with edible film with the addition of purple eggplant peel filtrate. This could happen because of the influence of the thickness of the edible film, the thick edible film will be more resistant to the influence of environmental conditions. According to Robertson [19], in general thick films (thick films) are more resistant than thin films (think films). The thickness of the film is limited by the film's stiffness and affects to flavor and aroma of some foods. McHugh et al. [20] also mentioned that increasing film thickness will provide increased resistance to mass transfer. Figure 2 showed that peroxide number of dodol increases during storage. The higher the peroxide number of a material indicates the higher degree of rancidity (fig. 2).
Figure 2. Rancidity of dodol coated by edible film impregnated by antioxidant

4 Conclusion
The results showed that the addition of vegetable filtrate on edible film had a significant influence on its antioxidant activity. The antioxidant activity of BHT, eggplant peel filtrate and Chinese cabbage filtrate were 12.17%, 11.72% and 8.53%, respectively. Edible film impregnated by eggplant peel filtrate was effective as natural antioxidant in dodol.

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