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### **Application of Edible Whey Protein Film Containing $\alpha$ -Tocopherol and Ascorbyl Palmitate in Coating of Peanuts in Indonesia**

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#### **Abstract**

Lipid oxidation of unsaturated fatty acids is the main reason of the shelf life and quality reduction especially in many functional food ingredients containing highly oxidative compounds, like in peanut. Lipid oxidation can be reduced by packaging systems which limit oxygen permeation. This can be achieved by the use of high oxygen barrier packaging films or edible coating. Physical properties of whey protein isolate (WPI) coating solution incorporating ascorbic palmitate and  $\alpha$ -tocopherol and the antioxidant activity of dried WPI coating against lipid oxidation in roasted peanuts can be used for edible coating. The methodology of this paper is taken from research library. The Ascorbyl Palmitate and  $\alpha$ -Tocopherol were mixed into a 10% (w/w) WPI solution containing 6.7% glycerol using a high-speed homogenizer. Ethanol as a solvent is mixed for dissolving Ascorbyl Palmitate and  $\alpha$ -Tocopherol into the WPI solution. After peanuts were coated with WPI solutions, color changes of peanuts were measured during 16 weeks of storage at 25°C, and the oxidation of peanuts was determined by hexanal analysis using solid-phase micro-extraction samplers and GC-MS. Regardless of the presence of antioxidant in coating layer, the formation of hexanal from the oxidation of peanut lipids was reduced by WPI coatings, which indicates WPI coatings protected the peanuts from oxygen permeation and oxidation. The results of this paper can be applied in Indonesia especially to increase the added value of peanuts.

**Keywords:** edible coating; lipid oxidation; oxidation; peanut; whey protein

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## Introduction

Indonesia is famous as an agriculture country which product so many kind of natural resources. One of agriculture product from Indonesia is peanut. This crop is produced spreadly in almost area of Indonesia country. The center of peanut planting in Indonesia include East Java province, Center Java Province, Yogyakarta, West Java Province and South Sulawesi. Base on survey from International Finance Corporation (IFC), to fulfill the raising of peanut demand from snack industry Indonesia has to increase the import number of peanut in last three year. In 2008, the import number of peanut reach about ten quintillion or almost be equal as US \$100 million. (Khafid S, 2009)

Peanut also known as *groundnut*, and *goober*. Peanut is commonly used as snack, cooking spices, and many others. The processing methode and manufacture of peanut kernel will influence the price and quality of that peanut. Peanut as food material contain high nutrition that is fat (40-50%), protein (27%), carbohydrate, and vitamin (A, B, C, D, E, and K). Beside that, peanut also contain mineral (Ca, Cl, Fe, Mg, P, K and S)

In high fat-food or fried food, peanut or roasted peanut, the lipid oxidation of unsaturated fatty acids is the main reason of the shelf life and quality reduction. This oxidation process can be retarded by the addition of antioxidants, which delay onset or slow the reaction kinetics of oxidation. Tocopherols are naturally occuring antioxidant components. Tocopherols act synergistically as antioxidants with other reducing or chelating agents such as ascorbic acid, citric acid, and ethylenediaminetetraacetic acid. Fatty acid ester of ascorbic acid (for example, ascorbyl palmitate) is lipid soluble and can provide a direct antioxidative effect in lipid. Ascorbyl palmitate act synergistically with  $\alpha$ -tocopherols as an antioxidant in oils or fats (Krochta J.M., Han J.H., Hwang H.M., Min S., 2008).

Edible coatings are used in foods to minimize the migration of components within the food system or between the food and its surrounding environment (Maria and Krochta 2002). For example, such coatings prevent the diffusion of water, fats and/or oxygen into, out of, or within the food system. Edible coating can be applied for peanut which has characteristic susceptible with rancidity because of unsaturated lipid oxidation. Coating of peanut use base material from whey protein that can be got from extraction of milk protein. Whey protein-based edible coatings effectively reduced lipid oxidation during the storage of frozen King Salmon (Stuchell and Krochta 1995), dry roasted peanuts (Mate and Krochta 1996; Lee and Krochta 2002), and walnuts (Mate and Krochta 1997). This edible coating for roasted peanut is done as an effort to increase added value that can be used in various industry in Indonesia and increase the export number of fickle peanut and decrease Indonesia's dependence in import of peanut.

## Materials and Methods

Edible films and coatings are protective barriers while also being an edible portion of the packaged of coated food. Because of the barrier function of edible films and coatings, the coated food may not require high-barrier packaging system.

Whey protein isolate (WPI) is nearly of protein (more than 90%). The width range of protein concentration in these products depends of the membrane used and the pretreatment prior to

membrane separation (Maria and Krochta 2002). It was dissolved in day ionize water at 10 % w/w 1 %.

Components of Edible Films and Coating can be divided into three categories : hydrocolloids, lipids, and composites. Suitable Hydrocolloids include proteins, cellulose derivatives, alginates, pectins, starches, and othe polysaccharides (Donhowe and Fennema 1993). Protein that is used in edible coating of this peanut is whey protein, and for pollysaccharide use pectin or LMP. Another component, glycerol, has function as a plasticizer in coating. Plasticizer is define as non-volatile substance that has high boiled point. This component was added to another compound to change physic and mechanic character of that compound. In general, plasticizer is used to increase the permeability of coating against gas, vapor, and soluble substances. Glycerol is hydrofilic molecule, has small size and can be inserted easily between protein chain and form hydrogen bond with amide. When glycerol make a bundle with protein, the bond inter-protein will be lost.

Edible coating in roasted peanut is made of hydrocoloid that has good tenacity against gas (O<sub>2</sub> and CO<sub>2</sub>) and fat, increase physic endurance, but endurance against vapour is very low. Pectin and plasticizer (glycerol) will increase water absorption so the structure will be expand and change the film. This coating use  $\alpha$ -tocophaerol and ascorbyl palmitathe act synergistically as antioxidants to prevent lipid oxidation and scavanges single oxygen reduce oksygen and carbon-centered radical.

### Methods

The methods were taken from the Research of J.H Han, H.M. Hwang and J.M. Krochta in the Jurnal of Food Science 2008.

### Whey protein coating solution

WPI that are saved in refrigerator, mix with deionize water at 10 % w/w concentration. After homogenized, tambahkan Low Metoxi Pectins (LMP) 1 %. After dissolved, gliserol was edited in the WPI solution at the ratio of 60/40 of WPI per GLY as plasticizer. Selanjutnya, this solution was heated in 90 degree celcius circulatary water bath during 30 minutes in the denaturation of WPI. Then, this solution was cooled in an ice bath and the antioxidant can be fortificate.

### Incorporation of antioxidants

The Ascorbyl Palmitate and  $\alpha$ -Tocopherol were mixed into a 10% (w/w) WPI solution containing 6.7% glycerol using a high-speed homogenizer. Ethanol as a solvent is mixed for dissolving Ascorbyl Palmitate and  $\alpha$ -Tocopherol into the WPI solution.

Fortification of antioxidant into WPI film forming solution can be practice into 2 ways. First way, 10 ml antioxidant or ethanol liquid was vacuumed in an aspirator to evaporated ethanol and to get the homogenous dry mixture of AP and tocopherol. Then, this mixture was edited with WPI film forming solution (200 gram) and blended using high-speed homogenizer for five minutes at 20000 rpm in an ice bath.

Second way, 200 gram cf WPI film-forming solution was edited drop-wise into dissolved antioxidant in 10 ml ethanol with high-speed homogenization at 20000 rpm in the ice bath. The antioxidant-incorporated WPI solution was degassed, using pump.

### Peanut coating

The method for coating peanut used dip application. Dip application method lends itself to food products that require several application of coating materials or require a uniform coating

on an irregular surface. After dipping, excess coating material is allowed to drain from the product, and it is then dried or allowed to solidify (Krochta 2008). Dip application use process that can be expanded for industry scale. The advantages of this method is if we want to arrange the material thickness bigger than before, we can make and arrange the viscosity of coating solution easily. The weakness of this method is the presence of waste deposit in solution.

Unsalted roasted peanut were immersed into 5% soluble lecithin solution. To increase the surface energy and the wettability of the peanuts, we had to dried it for five minutes at room temperature. Then, the peanuts were coated with WPI solution by dipping it in 10% heat-denatured WPI film-forming solution with antioxidant. After 30 minutes drying of the coated peanuts at room temperature, the peanuts were coated at second time with the corresponding WPI solutions. Then, the coated peanuts were stored in incubator at 25°C for 16 weeks. The air inside the incubator was flushed once everyday.

## Results and Discussion

The result were also taken from the Research of J.H Han, H.M. Hwang and J.M. Krochta in the Jurnal of Food Science 2008.

### Turbidity and viscosity of coating solutions containing antioxidant

The turbidity of WPI solutions increased linearly as the incorporated AP concentration increased if AP concentration was above 0,25%. Compared to the turbidity of tocopherol-WPI, which was increased by increasing tocopherol concentration from 0%-1% linearly, the turbidity of AP-WPI solution had a lag concentration range below 0,25% showing a curve linear profile. Increase in tocopherol concentration produced more o/w emulsions in water-based WPI solution, which increased solution turbidity. The dissolved AP did not affect affect the turbidity.

### Color changes of the peanuts

The peanuts coated by P1 (first way) had lower *a* and *b* values than other treatments due to the artificial colorant in the WPI solution. The color measurement to determine the oxidation of fruit and vegetables after sour whey coating is an efficient method. Therefore, the color determination method for oxidation evaluation may be applicable with large variation depending on the nature of commodities. There was some significant differences in the color of the peanut surface during storage, however, it is impossible to figure out any tendency of color change such as increasing or decreasing patterns of color components with storage time and progress of oxidation.

### Hexanal and hexanoic acid analysis

Linoleic acid of peanut oil is oxidized and produces hexanal. This hexanal is further oxidized to hexanoic acid. Using pure hexanal and hexanoic acid the GC-MS system was pretested. During storage, the peanuts were oxidized and the hexanal was produced from all treatments. The oxidation level was significantly changes between treatments and within storage time. Uncoated peanut showed significantly increased hexanal peak areas than others. The WPI coated peanut had smaller hexanal peak areas compared the control sample (uncoated peanut).

## Conclusion

WPI solutions containing an antioxidant mixture of  $\alpha$ -tocopherol and ascorbyl palmitate formed emulsions. The effect of addition antioxidant were increased the turbidity and viscosity

of WPI solutions. This formula was used as a coating material for peanuts, and the coated peanuts were oxidized slower than uncoated peanuts. Using dip application and the testing methods in this paper, coating of peanut with  $\alpha$ -Tocopherol and Ascorbyl Palmitate can be applied at industrial production in Indonesia. But, it still needs more research to make the quality better.

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