Pakistan Journal of Nutrition 13 (6): 327-330, 2014
ISSN 1680-5194


# Utilization of Milk Processing by Product (Whey) as Based of Edible Film Making with Glycerol Adding as Plasticizer

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**Abstract:** The research on the utilization of milk processing by product (whey) as based edible film making with glycerol adding as plasticizer has been done. Two thousand milliliters of whey is added to ethanol 95% (1:1) and heated to 60°C and then added as much as 1% of the CMC and then treated with the addition of glycerol as much as 2.5% (A), 3% (B), 3.5% (C), 4% (D) and 4.5% (E) in randomized block design with five replications. This research aims to determine the effect of adding glycerol to the characteristics of the edible film. The Variable was observed in this research were the moisture, protein, pH, thickness, viscosity and shelf life of the edible film. Result of the research showed that the higher glycerol plasticizer adding was decreased of moisture and protein content significantly ($p<0.01$) and increased pH, thickness and shelf life of the edible film. The use of glycerol plasticizer as much as 4% is the optimum in producing good edible film.

**Key words:** Whey, edible film, plasticizer, glycerol

## INTRODUCTION

Whey is a by-product of milk processing are rarely used but disposed of as industrial waste, which can cause environmental pollution. For example in the industry of cheese or butter making, by-product out of milk which did not turn out to be a product are quite an amount, so that it can cause problems for the industry as well as for the environment (Rahman *et al*., 1992). Whey still contains all the components of milk except fat and casein, which allows it to be utilized for processing into other products.

Shiddieq (2002) said that in the whey also contained several enzymes, hormones, antibodies, growth factors and nutrients (nutrient transporter). In addition, proteins that are contained in whey could also be used as primary packaging material for food which is environmentally friendly such as Edible Film. According to Hernandez *et al*. (2006) the use of whey protein as a base in edible film-making acts as a barrier in controlling the release of oxygen, aroma and lipids that can affect the quality and shelf life of foodstuff.

According to Krochta *et al*. (1994) Edible Film is one form of packaging made of thin layers which is consumable, which consists of hydrocolloid components, lipids and composer and can be use as a wrapper in sausage, candies and fruits. This thin layer protects the food against evaporation or reaction with other food. According to Embuscado and Huber (2009) Edible Film can replace or enhance the outer layer to prevent loss of water content of foodstuffs, as well as expenditure control is important elements such as $O_2$, $CO_2$ and ethylene. Aside from that Edible film can keep the surface remains sterile and prevent the loss of existing components in foodstuffs. Cutter and Sumner (2002) suggested that the main advantage of the antimicrobial properties of edible film is to protect the microorganism contamination on the surface of the finished product after processing.

According to Ustunol (2009) other functions of the Edible Film is able to inhibit the release of moisture to the outside environment, reduce the absorption of oxygen on the composition of food and protect foods from oxidation. Yoshida and Antunes (2004) adds, the edible films can also extend the shelf life of foods, maintain freshness, avoid growth of microorganisms and to avoid other harmful properties, such as material shrinkage and withering. To produce a good Edible Film, plasticizer-an additive that can prevent cracking during handling and storage processes, so that the elasticity of the resulting edible film can be maintained is often added in the making.

Plasticizer commonly used in the food industry is glycerol, which is a chemical compound which is a simple lipid classes, consisting of fats, fatty esters and glycerol, as well as the fatty acid ester wax (Girindra, 1990). This plasticizer is used to modify mechanical properties of the film. Addition of hydrophilic plasticizer can increase the absorption of water evaporation on the film, in which the solubility in polyhydric alcohol (such as glycerol) can quickly create coating and a good barrier.

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Glycerol as a polysaccharide is a hydrocolloid with a specific molecular weight and soluble in water. These compounds will be absorbed intensively to form hydrogen bonds with water. Due to molecular size and its configuration, this polysaccharide has the ability to thicken and form a gel, as a result of hydrogen bonding reaction between the polymer chains with intermolecular friction (Nieto, 2009). According to Yoshida and Antunes (2004) that Plasticizer molecules can reduce the pressure inter-chain binding protein, increased movement and flexibility filmogenik matrix. The use of glycerol which is a simple lipid classes of chemical compounds is by Syarief *et al*. (2002) is about 3.5-4.0%.

## MATERIALS AND METHODS

### Materials

**Preparation of whey (Hadiwiyoto, 1983):** Firstly, the milk was segregated from casein (milk protein) by adding two milliliter of acetic acid 0.025 N into one liter of milk dairy cow that have been pasteurized to obtained 40% of whey out of the milk volume and then filtered.

**Edible film making (modified by Syarief *et al*., 2002):**

a: Each treatment group needs as much as 2000 mL of whey is then added ethanol 95% (1:1) and heated 60°C and then added the CMC as much as 1% and stirred for 10 min

b: Then add glycerol according to treatment, that is 2.5% (A), 3% (B), 3.5% (C), 4% (D) and 4.5% (E) and the temperature is maintained at 60°C for 30 min while stirring

c: Film solution is poured on a glass plate mold size 20 x 20 cm, then dried in an oven at a temperature of 50°C for 24 h to later be observed in variable-variables to be measured

d: Above procedure will be done 4 times

**Research method:** This research uses experimental methods using a randomized block design (RBD) that consists of 5 treatments and 4 replications. The treatment is the addition of glycerol as a Plasticizer with 5 concentrations: 2.5% (A), 3% (B), 3.5% (C), 4% (D) and 4.5% (E) into the whey. The variables were measured: moisture content by drying method (Thermogravimetri), protein content by Kjehdahl method, pH with a pH meter, thickness by Vernier Caliper and shelf life by Eber method. The data obtained was processed using analysis of Variance (ANOVA). The differences between the treatment effects followed by Duncan's multiple range test (Steel and Torrie, 1995).

## RESULTS

Protein Content. Protein content of edible films were very significantly ($p<0.01$) influenced by the addition of glycerol plasticizer, where the higher of glycerol addition increased significantly to reduce protein of edible film. Addition 4.5% of glycerol in treatment E produced a protein level were significantly lowest (8.55%) but not difference with treatment D. The protein content of the edible film is the highest in treatment A that added 2.5% of glycerol (11.73%) as shown in Table 1.

Moisture. The moisture of the edible film is very significantly ($p<0.01$) decrease according to increasing the addition of glycerol. The moisture of the edible film lowest in treatment E that added 4.5% of glycerol (2.12%) followed by treatment C, B and A, but not different ($p>0.05$) with the moisture of edible film in treatment D (2.36%) as shown in Table 1.

pH. pH of the edible film is very significantly highest in treatment E which added 4.5% glycerol (6.93), followed by the pH of the edible film on treatment C, B and A but not different ($p>0.05$) with a pH of edible film on treatment D (6.67) that the added glycerol 4% as shown in Table 1. This means that the addition of glycerol will increase the pH of the edible film.

Thickness. A thickness of edible film were very significantly highest (0.54 mm) in treatment E that added 4.5% of glycerol although was not different with pH of edible film on treatments D (0.51 mm) is added 4% of glycerol, while the lowest pH is edible film on treatment A (0.31 mm) which was added 2.5% of thickness glycerol as shown in Table 1.

Shelf Life. The shelf life of edible film is very significantly increased ($p<0.01$) according to the increasing addition of glycerol. The longest of edible film shelf life is 31.50 days on treatment is added glycerol highest (E), followed by the shelf life on treatment D, C, B and a very short on shelf life of edible film treated 2.5% of glycerol that is 18.25 days.

## DISCUSSION

Decreasing levels of edible film protein content along with the higher glycerol adding, because glycerol can reduce the density and the force between molecules along the protein chain, thus reducing the strength of the force between molecules along the protein chain and soften the strength of the film structure. As a result, more and more glycerol is added then the density between molecules along the protein chain to be wane, so the protein content of edible films produced decreases. In accordance with the opinion of Yoshida and Antunes (2004), that the molecule can reduce the pressure plasticizer increased inter-chain protein, increase movement and flexibility phylogenic matrix. In fact protein content of edible films on treatment D didn't different ($p>0.05$) with treatments E indicate that the use of glycerol up to 4% was maximum in reaction to reduce the density and style along the chains of protein molecules during the edible film forming. Consequently, when the level of glycerol adding even higher up to 4.5% the protein content of edible films produced relatively similar.

Table 1: Influence of glycerol adding on milk processing by product (Whey) as plasticizer on edible film characteristic

| Variable | A | B | C | D | E |
|---|---|---|---|---|---|
| Protein (%) | 11.73[a] | 10.48[b] | 10.00[b] | 8.70[c] | 8.55[c] |
| Moisture (%) | 5.07[a] | 4.83[b] | 3.63[c] | 2.36[d] | 2.12[d] |
| pH | 5.03[a] | 6.36[b] | 6.28[b] | 6.67[c] | 6.93[c] |
| Thickness (mm) | 0.31[a] | 0.34[a] | 0.42[b] | 0.51[c] | 0.52[c] |
| Shelf Life (hari) | 18.25[a] | 24.75[b] | 25.25[b] | 27.00[c] | 31.50[d] |

[a-d]Mean within colomn with different superscript letter are significantly different at p<0.01

The reduced of the edible film moisture along with the increase of glycerol adding because glycerol has a hydrophilic character that is able to bind the water in the material, so that the moisture of the material is reduced. As shown in Table 1. the highest of glycerol adding in treatment E, the lowest of edible film moisture. In accordance with the Gontard and Gilbert (1992) statement that glycerol is hydrophilic which means that it easily absorbs water. Similar with Nurwantoro and Congress (1997) that its hydrophilic character so glycerol can decrease the $a_w$ of food. Unlike the irrelevant moisture content of edible film between treatments D and E indicate that the use of glycerol up to 4% was maximum in reaction to bind the water in the materials during the edible film forming. Consequently, when the level of glycerol adding even higher up to 4.5%, the water binding capacity not increases more or relatively the same acts, so the moisture content of the edible film which is produced relatively has not too many changes.

Increasing levels of edible film pH along with the higher glycerol adding, because glycerol have a several of OH cluster that alkali characters so that to increase the material pH. As a result, more and more glycerol is added then more and more the OH supplied in to edible film. Consequently the solution in edible film to be alkali that followed by edible film increasing. As shown in Table 1. The highest of glycerol adding in treatment E (4.5%), the highest of edible film pH by 6.93 respectively. Similar to the research of Girindra (1990), glycerol have a couple of OH hydroxyl group, whereas the solution that $OH^-$ group content more than $H^+$ cause the solution to be alkali and the pH is more than 7.

There were no significant differences between edible film at treatment D and E indicated that the use of glycerol up to 4% was maximum in reaction to supply a OH on the edible film making so that the solution in edible film to be alkali. Consequently, when the level of glycerol adding even higher up to 4.5%, there are unchanged of alkalis solution so the pH of the edible film which is produced relatively has not too many changes.

Increasing the thickness of edible film along with the higher glycerol adding, because glycerol has a hydrophilic character that is able to bind the water in the material, so that the water content of the material is reduced and the moisture of edible film is low. Decreasing moisture in material is followed by increasing its total solid. That means is the total solid to be increase that indicated by increasing edible film thickness. It is indicated that moisture of material determine a texture of material. This research is corresponding to Purnomo (1995) that moisture of food is main role on texture characteristics of food. As a result, more and more glycerol is added then the water binding in edible film to be higher is followed by decreasing of edible film moisture. Consequently, the texture of edible film was increased and its thickness to be increase too. The edible film thickness in this research is consistent with Mawarwati *et al*. (2001) report that edible film thickness based on wheat germ among 0.384 to 0.541 mm.

Increasing the shelf life of edible film along with the higher glycerol adding, because glycerol has a hydrophilic character which able to bind the water in the material, so the water binding is higher cause edible film moisture is low. As stated by Gontard and Guilbert (1992) that glycerol has a hydrophilic character which is so easy to absorb hydrophilic water. So the higher glycerol adding, the higher the hydrophilic character to bind the water and then the moisture of edible film to be lower. Decreasing the moisture of edible film will influence a growth of microorganism over stored, where the growth of microorganism that destroyed a material was inhibited caused of the lackness of water that needed by microorganism. The consequently is the shelf life of edible film to be longer. Similar to statement of Frazier and Westhoff (2002) who stated that in microorganism growth need a water. When related to moisture of edible film in this research has shown that the shelf life is influenced by water content. The higher glycerol adding up to 4.5% in treatment E, the moisture of edible film is lowest (2.12%) and its shelf life is longest up to 31.5 days respectively.

**Conclusion:** The increase of glycerol adding as plasticizer on milk processing by product (whey) was significantly decreased moisture, protein and increased pH, thickness and shelf life of edible film. The adding of glycerol as much as 4% is the optimum to produce edible film.

## ACKNOWLEDGEMENT

The author are very grateful for the financial support of Fundamental fund, Directorate General of Higher Education, Ministry of National Educational, Republic of Indonesia (No.126.b/H.16/PL/HB-PID/IV/2009).

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