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The Quality of Edible Film by Using Glycerol as Plastisizer

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Abstract: The aim of this research is to find out the effect of interaction and giving; *Carboxymethyl cellulose* (CMC) and Glycerol toward water quality, pH, density and solubility time at the making of Edible Film Whey Milk. Materials used in this research are 5400 ml whey, 108 gram CMC and 324 ml glycerol. Method used in this research is experimental method using the 3 x 3 factorial pattern of group random design with repeated 3 as the group. The first factor (A) is by giving CMC into whey that consists of A_1 = 0.5%, A_2 = 1.0% and A_3 = 1.5% whereas the second factor (B) is by giving glycerol into whey that consists of B_1 = 2.5%, B_2 = 3.0% and B_3 = 3.5%. In this research, the changing of water quality, pH, density and solubility time from the resulted Edible Film Whey Milk is point to be monitored closely. The result of this research shows that the interaction of CMC and Glycerol gives effect to density but has no effect to water quality, pH and solubility time. The addition of CMC really affects Edible Film Whey Milk's water quality, density and solubility time. The addition of glycerol affects water quality, density and pH of Edible Film Whey Milk. The best result in the making of Edible Film Whey Milk is at the giving of 1.0% CMC (A_2) and 3.0% glycerol (B_2).

Key words: Edible film whey milk, packing, carboxymethyl cellulose, glycerol

INTRODUCTION

Milk can be processed to become a more credible product that has longer storage time and higher price than usual one. Whey as one of the next milk products is rarely used by people unlike yoghurt and cheese. In fact, whey still has some nutritious values tough in small scale. According to Soeparno (1996) whey still has some nutritious value like water 93.2%, protein 0.8%, fat 0.6%, lactose 4.7% and Abu (dust) 0.5%. It implies that whey still can be used for something good so it can increase the economic value of whey.

Edible film is thin layer formed at the surface level of water or between food components that can prevent loss of product quality. It acts as the barrier that controls the transferring and taking process of vapors and oxygen.

Stabilizer and plasticizer are additional ingredients that should be added in the making process of edible film whey milk. Stabilizer is an additional material of food that its use is limited. Generally, stabilizer is used to stabilize the food and make them becoming more concentrate or viscous. Stabilizers that often use are Carboxymethyl Cellulose (CMC), gelatin and karagenan. Instead of stabilizer, plasticizer is also used in the making of edible film. The addition of plasticizer is useful to handle disadvantage characters of film like; fragile, easy to break and less elastic. Plasticizer that often uses to handle such problems is glycerol. The previous explanation inspires the writer to conduct a research entitle "The Effect of Giving Carboxymethyl Cellulose and Glycerol toward Water Quality, pH, Density and Solubility Time at The Making of Edible Film Whey Milk by Using Whey as The Basic Ingredient".

This research is aimed at finding out the effect of interaction of using Carboxymethyl Cellulose (CMC) and Glycerol toward water quality, pH, density and solubility time at the making of edible film that uses whey as the basis ingredient. This research can be used as a guideline in determining the accurate giving of CMC and glycerol to produce an elastic and uneasy to break edible film whey milk. Hypothesis of this research is that there is interaction between CMC and glycerol toward the quality of edible film whey milk and toward the water quality, pH, density and solubility time of this film.

Review of related literature: According to Krochta *et al.* (1994) whey protein can be used to make transparent, elastic and distasteful film so it can be used to make an eatable package (edible film).

Krochta *et al.* (1994) also said that edible film components can be divided into three categories; hydrocolloid, lipid and composite. Hydrocolloid like protein, pectin and patty can be used in controlling the migration of evaporation. Lipid is used as barrier if evaporation happens. The examples of lipid are wax, glycerol and fatty acid. Whereas composite is one of component categories that exists between hydrocolloid and lipid components.

Winarno (1997) said that the generative result of cellulose known as Carboxymethyl Cellulose (CMC) is often used in food industry to create good texture, such as in producing ice cream. According to Syarief *et al.* (2002) Carboxymethyl cellulose often used in making edible film is 1.0%. Glycerol also known as glycerin has $C_3H_8O_3$ as empirical formula. Plasticizer is material that

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can change the dimension structure of object, generate the strings of chain among protein, fill empty spaces in product and uneasy to vaporize quoted by Yoshida and Antunes (2004) from Banker (1966). Syarief *et al.* (2002) also said that glycerol used in making edible film is about 3.5-4%.

MATERIALS AND METHODS

Materials used in this research are 5400 ml whey that comes from FH (Frisian Holland) cow milk at the Padang district; West Padang area; precisely Ujung Gurun, Carboxymethyl cellulose and glycerol.

Method used in this research is experimental method using the 3 x 3 factorial pattern of group random design with repeated 3 as the group. The first factor (A) is by giving CMC into whey that consists of A_1 = 0.5%, A_2 = 1.0% and A_3 = 1.5% whereas the second factor (B) is by giving glycerol into whey that consists of B_1 = 2.5%, B_2 = 3.0% and B_3 = 3.5%.

RESULTS AND DISCUSSION

Water quality: The result of edible film whey milk research in every treatment for the average of water quality can be seen in Table 1.

The result of various analysis shows that the giving of CMC obviously affects ($p>0.01$) the water quality of produced edible film whey milk, whereas by adding more glycerol create real effect ($p<0.05$) toward the water quality of edible film whey milk. Meanwhile at the addition of both materials, there is no obvious interaction ($p>0.05$) between the addition of CMC and glycerol toward water quality of edible film whey milk. It means that the giving of Carboxymethyl cellulose and glycerol at the same time do not affect the protein quality of edible film.

The decrease of edible film whey milk's water quality is equal to the higher giving of CMC. It is caused by the characteristic of CMC that can capture and tie water. The higher the giving of CMC the more water tied by CMC in the framer solution of edible film whey milk. It causes the smaller amount of measured water quality in edible film whey milk solution that can be seen through research's result. By adding more CMC specifically in amount 1.5% (A_3) can cause lower water quality results that are 1.99. It is similar to Krochta's *et al.* (1994) opinion who said that Carboxymethyl cellulose has several characteristics that able to tie water and act as stabilizer in the form of polysaccharide that will form viscous or gelatinous soluble.

The tendency of decreasing edible film whey milk's water quality is also equal to the addition of glycerol. It is caused by the hydrophilic characteristic of glycerol that makes glycerol able to tie water. The higher the addition of glycerol will decrease the water quality measured in edible film whey milk soluble. It can be seen on the result of research that at the addition of B_3 (3.5%) as the highest glycerol concentration will produce the lowest water quality, 3.7%. It is similar to what has been stated by Gontard and Guilbert (1992) that glycerol has hydrophilic characteristic so it is easy to absorb water. It is also supported by Nurwantoro and Djarijah (1997) that glycerol has characteristic to be able capturing and tying water so that it can decrease food Aw.

Table 1: The result of edible film whey milk research for the average of water quality

Factor A (CMC)	Factor B (Glycerol) B_1 (2.5%)	B_2 (3.0%)	B_3 (3.5%)	Average
A_1 (0.5%)	5.07	4.51	4.27	4.62^{A}
A_2 (1.0%)	3.63	3.41	3.46	3.50^{B}
A_3 (1.5%)	2.36	2.13	1.48	1.99^{C}
Average	3.68^{a}	3.35^{aA}	3.07^{A}	

Superscripts with different capital letters show very real different result ($p<0.01$) and letters show real different result ($p<0.05$)

Table 2: The result of edible film whey milk research for the average of pH

Factor A (CMC)	Factor B (Glycerol) B_1 (2.5%)	B_2 (3.0%)	B_3 (3.5%)	Average
A_1 (0.5%)	5.85	5.92	5.90	5.89
A_2 (1.0%)	6.04	6.08	6.14	6.09
A_3 (1.5%)	6.24	6.24	6.32	6.27
Average	6.04^{A}	6.08^{B}	6.12^{C}	

Superscripts in columns and rows with different capital letters show very real different result ($p>0.01$)

pH: The result of edible film whey milk research in every treatment for the average of pH can be seen in Table 2.

The result of various analysis shows that the giving of CMC does not affect ($p>0.05$) the pH of edible film whey milk. At the addition of glycerol, it shows that glycerol can give obvious effect toward edible film whey milk by increasing the amount of glycerol concentration ($p<0.01$), but there is no obvious interaction ($p>0.05$) between the giving of CMC and glycerol toward pH of edible film whey milk. It means that the giving of Carboxymethyl cellulose and glycerol do not affect one of another toward the pH of edible film whey milk.

The increase of edible film whey milk pH is equal to the addition of glycerol until 3.5% (B_3) because glycerol has some alkaline OH clusters. Glycerol can donate many more OH clusters by increasing the addition of glycerol to edible film whey milk therefore solution becomes more alkalis. It can be seen on the result of research that at the highest addition of glycerol, B_3 (3.5%) gives the highest pH value of edible film whey milk, 6.32. The same statement also stated by Lehninger (1982) "solution that has pH value bigger than 7 (pH>7) is alkaline because its OH^- concentration is bigger than H^+ concentration." Furthermore Girindra (1990) also revealed that glycerol has hydroxyl clusters (OH).

Table 3: The result of edible film whey milk research for the average of density (mm)

Factor	Factor B (Glycerol)			
A (CMC)	B_1 (2.5%)	B_2 (3.0%)	B_3 (3.5%)	Average
A_1 (0.5%)	0.44^{Aa}	0.46^{Aa}	0.48^{Ba}	0.46
A_2 (1.0%)	0.48^{Ab}	0.50^{Bb}	0.53^{Cb}	0.50
A_3 (1.5%)	0.50^{Ac}	0.54^{Bc}	0.59^{Cc}	0.54
Average	0.42	0.52	0.51	

Superscripts with capital letters on rows and letters on columns show very real different result ($p<0.01$)

Table 4: The result of edible film whey milk research for the average of solubility time

Factor	Factor B (Glycerol)			
A (CMC)	B_1 (2.5%)	B_2 (3.0%)	B_3 (3.5%)	Average
A_1 (0.5%)	1.27	1.23	1.28	1.26^{A}
A_2 (1.0%)	3.22	3.24	3.26	3.24^{a}
A_3 (1.5%)	2.62	2.44	2.53	2.53^{a}
Average	2.37	2.30	2.54	

Superscripts with different capital letters show very real different result ($p<0.01$) and letters show real different result ($p<0.05$)

Density: The result of edible film whey milk research in every treatment for the average of density can be seen in Table 3.

The result of various analysis shows that the addition of glycerol and CMC obviously has interaction ($p<0.01$) toward the density of edible film whey milk. It means that there is togetherness effect between both of these treatments toward the density of edible film whey milk.

The increase of edible film whey milk's density is possibly caused by the increase of total solid that is equal to the decrease of water quality in edible film whey milk solution. The same thing also stated by Buckle *et al*. (1987) "water quality has important role in determining texture of a product." Purnomo (1995) also proposed similar statement that food water quality has main role to decide the characteristics of material texture.

Solubility time: The result of edible film whey milk research in every treatment for the average of solubility time can be seen in Table 4.

The result of various analysis shows that the giving of 1.5% CMC (A_3) does not affect ($p>0.05$) toward the giving of 1.0% CMC (A_2), but the addition of 0.5% CMC (A_1) gives real effect ($p<0.01$) toward the other treatment. The giving of glycerol has no real effect ($p>0.05$) toward edible film whey milk's solubility. At this solubility, there is also no real interaction ($p>0.05$) between the giving of CMC and glycerol toward the solubility of edible film whey milk It means that the giving of CMC and glycerol do not affect one of another toward the solubility of edible film whey milk.

The increase of edible film whey milk's solubility time is equal to the addition of CMC. Since CMC acts as stabilizer, the more the CMC given the more stable the edible film whey milk's components (water, fat, protein) that interacts in soluble. Therefore it takes much time in dispersing those reactions to be soluble in water. That the increase of using CMC until 1.0% will slow down the solubility time of edible film whey milk can be seen through research's result. The similar opinion also proposed by Winarno *et al*. (1980) stated that CMC is food material that can stabilize food and make it becomes more concentrate or viscous. CMC also can be mixed with water to produce certain viscosity or gelatin.

There is no real differentiation of edible film whey milk's solubility time among treatment A_2 (1.0%) and treatment A_3 (1.5%) caused by giving 1.0% CMC (A_1) has been maximal to stabilize edible film whey milk's components. The use of higher CMC concentration until 1.5% (A_3) in making edible film whey milk produces relatively stable solubility time so there is no real differentiation.

Conclusion and suggestion: There is interaction between Carboxymethyl cellulose and glycerol toward the density of edible film whey milk, but there is no interaction between both of them toward the water quality, pH and solubility time of edible film whey milk. The giving of CMC will affect the water quality, density and solubility time of edible film whey milk meanwhile the addition of glycerol will affect the water quality, pH and density of edible film whey milk. The giving of 1.0% Carboxymethyl cellulose and 3.0% glycerol is the best result in the making process of edible film.

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