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Effect of sorbitol in application of edible coating on the quality of potato chips

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Abstract. The goal of this study is to investigate the effect of edible coating material types and concentrations of sorbitol to improve the quality of potato chips produced from Granola. Factors studied were type of material for edible coating that consists of: alginate, CMC, acacia gum, sago starch and the concentration of sorbitol which comprises of: 1%, 2%, and 3 %. This study used a randomized complete block design. The variables observed were chemical properties (moisture content, ash content, and fat content) as well as sensory attribute (color, crispness, and preference). Control is also provided to evaluate the effects of treatments. Based on the obtained data, the treatment of application of edible coating from acacia gum at a concentration of 2 % sorbitol produce potato chips that well accepted by the panelists. By this treatment, potato chips' properties are moisture content 3.20%; ash content 1.57%, and fat content 35.78%. Therefore, sorbitol also plays an important role on determining the quality of potato chips. Further investigation is required to confirm the result by applying this edible coating on other varieties of potato tubers.

1. Introduction

Potato is one of the important food crops in the world. Efforts has been conducted to increase yield and improve the quality in order to fullfil the demand of this tuber [1]. In Indonesia, the cultivated tubers mostly is variety Granola. The implementation of appropriate technology that can improve the quality of a product in the process of processing food product from potato variety Granola is needed to improve the potency of the manufactured product from potato variety Granola. This variety is not appropriate for raw material of processing due to its inherent characteristic [2]. One of the attempts to improve the potency of food product from potato variety Granola is by processing the the tubers into potato chips that have a high level of consumer acceptance and appropriate to the quality standard (SNI 01-4031-1996) that has been established. Edible coating is applied to agricultural commodities and food product as well to protect the quality [3,4].

Potato chips are one of the favourite snack food in the world, they are made of thin slices of potato with a high-fat content. The fat and calorie content in potato chips becomes the main concern for the consumers who have a high level of health awareness [5]. The increase in community awareness towards the importance of staying healthy causes the increased demand from the consumers toward potato chips with low oil content. The decrease of oil absorption in potato chips is one of the solutions that can be done by coating the potato slices with the edible coating before the frying process. The



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edible coating is an edible thin layer and it is coated on the surface of the product. It has a function as the inhibitor toward water vapor, oxygen and mass-transfer in food [3]

A research done by [6], showed that potato chips without dipping it into edible coating solution had a higher average value of fat content than those with a dipping application of edible coating solution. The main polysaccharides that can be used as edible coating are starch and the derivatives, cellulose (MC, CMC, and HPMC) and the derivatives, chitosan, pectin, alginate, and gum [7]. Application of edible coating and vacuum frying for producing food product resulted significance decrease on oil absorption [8].

The increase of edible coating solution quality can be done by adding a plasticizer. Adding plasticizer in producing edible coating solution can improve the quality of solution produced. Sorbitol and glycerol are often used as the plasticizer. The addition of plasticizer contribute on enhance flexibility and peelability of the film and also to overcome the brittleness of the film [7].

Sorbitol that is frequently used as a plasticizer is because of it is environmentally friendly; the abundance on earth, the non-toxic characteristic and it can inhibit the evaporation in the product. Moreover, blend sorbitol and glycerol resulted the intermediate characteristic between only with glycerol or sorbitol. It is due to the molecular weight of the plasticizers. Edible coating can improve the quality of potato chips that using tuber variety Granola as raw material [9]. In this research, different material for making coating and different concentration of plasticizer are applied. This research aimed at finding out the interaction between the edible coating material type and the most appropriate sorbitol concentration to improve the quality of potato chips made from potato variety Granola.

2. Research method

This research was used an experimental method with completely randomized block design as the design of the experiment. The treatment consisted of 2 factors i.e. the edible coating types (A) and the concentration of sorbitol (H). The types of edible coating used in this research were: Alginate (A1), CMC (A2), gum acacia (A3), and sago starch (A4). The concentrations of sorbitol used here were 1 % sorbitol (H1), 2 % sorbitol (H2), 3 % and sorbitol (H3).

The variables observed in this research were the physical and chemical characteristic and the sensory of product including moisture content, ash content, fat content, the brightness level of chips (chromameter), and sensory evaluation (color, crispness, and the preference) as described by [9]. The data of physical and chemical test were collected from the research finding that was analyzed using analysis of variance (F-test) and if it had a significant impact, Duncan's Multiple Range Test (DMRT) at a significance level of 5% should be conducted afterward. Meanwhile, the non-parametric data of sensory evaluation was analyzed using Kendall's coefficient of concordance. If the result of the analysis showed that there was a difference, the Wilcoxon Signed Rank Test should be conducted afterward. The establishment of treatment combination to produce the best product was done by considering the psycho-chemical variable and sensory variables of product.

3. Result and discussion

3.1 Moisture content

The result of analysis of variance showed that the edible coating material type (A), the sorbitol concentration (H), and the interaction between the edible coating material type and the sorbitol concentration (AxH) used in this research had no significant impact on the moisture content of potato chips. The average value of moisture content in potato chips did not give a significant difference. The reason was likely because of the addition of sorbitol in every edible coating solution treatment. Sorbitol is sugar alcohols category that is hygroscopic so that it absorbs water. Utilization of sorbitol as plasticizer will absorb less water than using glycerol [7]. It could be the high molecular structure resemblance of glucose units to that of sorbitol. The same value of moisture content likely happened because of the frying process of potato chips that was done at similar temperature and duration. The

moisture content of potato chips resulted was around 2.03 % to 3.97%. The maximum moisture content in potato chips product based on SNI 01-4031-1996 is 3%. Therefore, most of treatments produce chips that still higher than this standard.

3.2. Ash content

The influence of the treatment using the interaction between the edible coating type and the variations of sorbitol concentration can be seen in Figure 1.

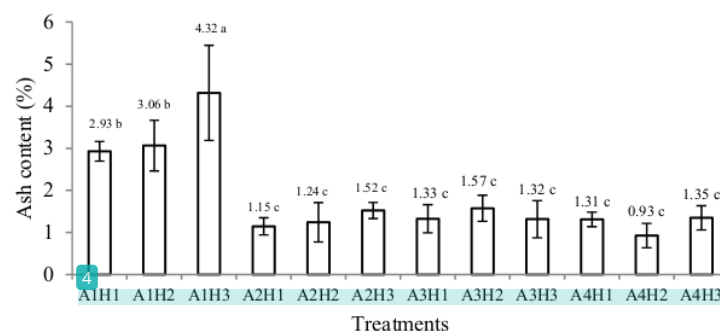


Figure 1. Effect of edible coating and concentration of sorbitol on ash content. The numbers followed by the different letters are significant different at α 5 %. A1 = alginate, A2 = CMC, A3 = acacia gum, A4 = sago starch H1 = Sorbitol 1 %, H2 = Sorbitol 2 %, H3 = Sorbitol 3 %

Figure 1 shows the treatment using the interaction between the edible coating type and sorbitol concentration toward the ash content of potato chips. The highest ash content of potato chips of 4.31% was obtained from the treatment using the interaction between edible coating material types i.e. 5% alginate and the sorbitol concentration i.e. 3% (A1H3). It was because of the treatment in form of the use of edible coating in form of alginate (A1) and the concentration of sorbitol i.e. 3% sorbitol (H3) gave the highest impact on the ash content of potato chips so that the interaction between them (A1H3) also resulted in high ash content in potato chips. The maximum ash content in potato chips product based on SNI 01-4031-1996 is 3%. Consequently, the treatment A1H3 has not fulfilled the SNI standard yet.

The lowest average value of ash content in potato chips was obtained from the treatment using the interaction between the edible coating type in form of sago starch and the addition of 2% sorbitol (A4H2). It was likely because of the influence of ash content contained in sago starch. The maximum value of ash content in sago starch according to SNI 01-3729-1995 was 0.5% and it was categorized low. Low ash content in sago starch caused low ash content in potato chips that was produced.

3.3. Fat content

The result of the analysis of variance showed that the treatment using the interaction between the edible coating type and the sorbitol concentration (AxH) had a significant impact on the fat content in potato chips. The fat content in potato chips was around 35.78% to 48.98%. The influence of the treatment using the interaction between the edible coating type and the variations of sorbitol concentration (AxH) toward the fat content in potato chips can be seen in Figure 2.

The result of analysis at a significance level of 5% showed that the interaction between the edible coating type and the concentration of sorbitol had a significant impact on the fat content of potato chips. The highest average value of the fat content of 48.98% was obtained from the treatment of sago starch by adding the concentration of sorbitol i.e. 3% sorbitol (A4H3). It likely happened because the

molecule of plasticizer inhibited the cohesiveness of starch, decreased the intermolecular interaction, and increased the mobility of polymers. This result is accordance with previous research [10].

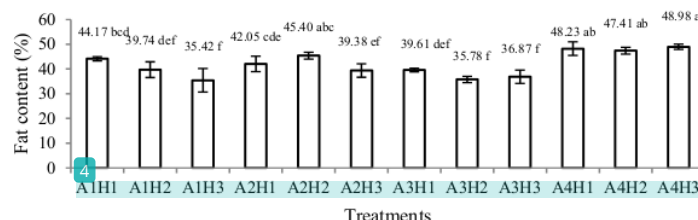


Figure 2. Effect of edible coating and concentration of sorbitol on fat content
The numbers followed by the different letters are significant different at 5 %.
A1 = alginate, A2 = CMC, A3 = acacia gum, A4 = sago starch, H1 = Sorbitol 1 %, H2 = Sorbitol 2 %, H3 = Sorbitol 3 %

The lowest average value of fat content was obtained from the treatment using the interaction between the edible coating type in form of alginate by adding 3% sorbitol (A1H3). It happened because the treatment of alginate as the edible coating (A1) and the addition of 3% sorbitol (H3) resulted in low-fat content in potato chips. Hence, the interaction between both of them (A1H3) also resulted in relatively low-fat content. This effect is also reported by the previous research [6].

3.4. Brightness level

The influence of the treatment using the interaction between edible coating type and the variations of sorbitol concentration toward the brightness level in potato chips can be seen in Figure 3.

Figure 3 shows the influence of the interaction between edible coating type and the concentration of sorbitol toward the brightness level in potato chips. The average value of brightness level was around 50.61 to 55.27. The highest brightness level in potato chips of 55.27 was obtained from the treatment using the interaction between gum acacia as the edible coating and the addition of 2% sorbitol (A3H2). However, the use of edible coating material gave a contribution to the highest average value of brightness level that was obtained from the treatment using CMC as the edible coating i.e. around 53.46 to 53.49.

The high brightness level in potato chips by using CMC (A2) as the edible coating happened because the use of CMC resulted in a thicker coating layer. In addition, the addition of sorbitol in edible coating solution also caused a thicker coating layer [11]. The thick coating layer inhibited the Maillard reaction because it prevented to direct contact between potato slices surface and hot oil.

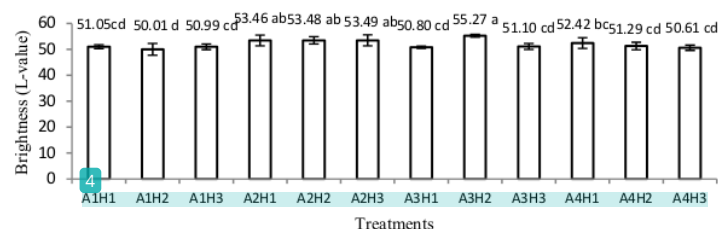


Figure 3. Effect of edible coating and concentration of sorbitol on brightness level
The numbers followed by the different letters are significant different at 5 %.
A1 = alginate, A2 = CMC, A3 = acacia gum, A4 = sago starch, H1 = Sorbitol 1 %, H2 = Sorbitol 2 %, H3 = Sorbitol 3 %

3.5. Sensory variable

3.5.1. Color. The influence of treatment combination between the edible coating type and the sorbitol concentration toward the color of potato chips can be seen in Figure 4. The assessment by panelist toward the color parameter in potato chips resulted in some scores around 2.32 (brownish-yellow) to 3.15 (yellow). The best assessment by the panelist was obtained from the addition of edible coating in form of gum acacia with 2% sorbitol into edible coating solution (A3H2). The use of edible coating material gave the highest average score for color by using CMC (A2) as the edible coating. This was influenced by the brightness level of potato chips product. The potato chips product that had a high brightness level had a tendency to get a high score from the panelist.

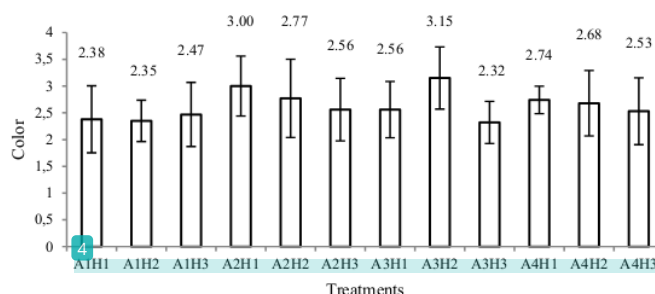


Figure 4. Effect of edible coating and concentration of sorbitol on color
A1 = alginate, A2 = CMC, A3 = acacia gum, A4 = sago starch, H1 = Sorbitol 1 %, H2 = Sorbitol 2 %, H3 = Sorbitol 3 %, 1= Dark brown, 2= light brown, 3= yellow, 4= light yellow

3.5.2. Crispness. The result showed a significantly different value on the panelist's assessment toward the crispness of potato chips. The influence of treatment combination between edible coating type and the sorbitol concentration toward the crispness of potato chips can be seen in Figure 5.

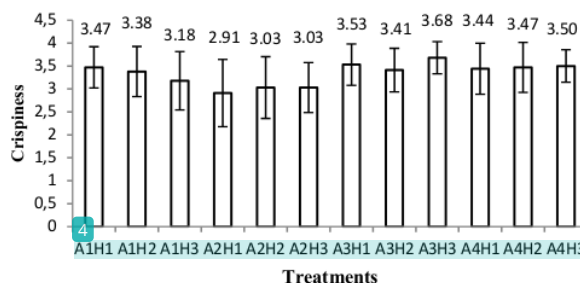


Figure 5. Effect of edible coating and concentration of sorbitol on crispiness
A1 = alginate, A2 = CMC, A3 = acacia gum, A4 = sago starch, H1 = Sorbitol 1 %, H2 = Sorbitol 2 %, H3 = Sorbitol 3 %, 1= not crispy, 2= slightly crispy, 3= crispy, 4= cery crispy

The crispness test toward potato chips resulted in a range score of 2.91 (crispy) to 3.68 (very crispy). The highest average score of crispness of 3.68 was obtained from the use of edible coating i.e. gum Acacia type by adding 3% sorbitol. Meanwhile, the treatment using the interaction resulted in the lowest average score of crispness and it was obtained from the interaction between the edible coating in form of CMC and the addition of 1% sorbitol (A2H1). It likely happened because the edible coating using CMC was thicker so that it inhibited the evaporation when the process of frying.

3.5.3. Preference. The result showed that the treatment combination between the edible coating type (A) and the variations of sorbitol concentration (H) gave no significant impact on the panelist's assessment toward the preference in potato chips that had been produced. The preference toward potato chips was because of the color i.e. yellow to brownish-yellow, crispy texture, and potato flavor that was tasted in potato chips product. The preference toward a product is affected by some factors i.e. color, taste, and the attractive appearance, and containing good nutrient. The score in the panelist's assessment toward the preference level of potato chips was from 2.62 to 3.15. It means that the preference level given by the panelist is "like".

4. Conclusion

The combination of treatment between the edible coating types and the variations of sorbitol concentration gives a different effect on the content of ash, fat, brightness level and sensory properties of potato chips.

The treatment using the interaction between the edible coating types gum acacia and the addition of sorbitol concentration of 2% shows a better result than other treatments. The treatment results in potato chips with a moisture content of 3.29 %, an ash content of 1.57 %, fat content of 35.78 %, a brightness level of 55.27, yellow color, crispy texture, and preferred by the panelists (for preference parameter). Further research is required to improve the quality of chips in order to conform to the SNI.

5. Acknowledgment

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