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Effect of Edible Coating on Quality of Chips from Potato Variety Granola

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Abstract— Nowadays, the consumption of processed potato tend to increase in Indonesia. In order to provide sufficient supply throughout the year, import is conducted. It occurs due to the wide variety cultivated in Indonesia is Granola that reaches about 90 % of the total area. Due to its inherent characteristic, the tuber is appropriate for table potato and not for processing one. Therefore, an alternative treatment is required for using variety Granola for processing purpose. An alternative is processed Granola tuber into flour and used it as raw material for processed food. This research aims to evaluate the properties' of potato chips that resulted from various combinations of other flours and application of the edible coating. For the comparison, edible coatings were also applied during chips' processing from fresh tubers. Tuber variety Granola was obtained from the potato farmers in Dieng plateau, one of a central potato producer in Indonesia. Tuber was powdered and used as raw material for chips combined with other flours include wheat, rice, and maize flour. In addition, the edible coating was introduced before frying on potato slices. Starch-based edible coating was applied in this research. Quality of potato chips observed was: content of moisture, ash and fat, and sensory properties including crispiness, color, flavor and overall acceptance. The result shows that through mixing with other flours, potato flour from variety Granola can be utilized as raw material for potato chips. Application of edible coating significantly improves the quality of chips by minimizing oil absorption during frying. Chips produced in the present research are accepted by the panellist. However, any effort is still required in order chips' quality meets the criteria of Indonesian National Standard (SNI).

Keywords— potato; chips; flour; tuber; Granola; quality chips.

I. INTRODUCTION

Potato is one of important horticultural commodities in Indonesia. Demand for potato tubers tends to increase during the last decade [1]. The tubers can be consumed in fresh form or as processed foods, such as French fries, potato chips, and other dehydrated products. Granola is the dominant variety grown in Indonesia. It is estimated 90% of the total potato cultivation in Indonesia [2]. The productivity of Granola potatoes in Indonesia is higher than other potato varieties due to its resistance to potato diseases and short growing season [3]. Characteristic of potato tuber variety Granola is not appropriate for processing due to low dry matter content, susceptible to blackspot and after cooking blackening [4].

Currently, in Indonesia, the need for potatoes for processing is high due to more demand [1], but the production of potatoes is mostly Granola varieties so that the need of processing tubers is supplied by importing from various countries. In order to minimize the dependency on import to provide the raw material for processed potato, an

alternative to food processing is required to process the potato tuber variety Granola. An alternative for the processing is applying pretreatments to the tubers, such as drying, edible coating application or modifying the procedure, as well as processed using vacuum fryer. Moreover, processing the tubers become flour as an intermediate product is an alternative for utilizing the tubers. Due to the limitation of potato flour characteristic, therefore, the addition of others ingredients is required to gain potato chips with desired quality.

In addition that potato flour contains various nutrition substances, it also has a high degree of gelatinization and viscosity [5]. Previous researchers reported that the potato flour could be an intermediate product that can be processed further become various kind of food product, such as bread [6], [7], steamed bread, traditional food from China [5], [8].

Investigation of potato flour from table potato variety has been conducted [7]. They used potato variety May Queen and applied the flour on making bread. They concluded that application of flour from table potatoes could be used in bread making process as substitution of wheat flour [7].

Recently, the most popular food products from potato are French fries, potato chips, and dehydrated products. Potato chips are snack food made from thin slices of potatoes with a high-fat content of 35 to 45% [9], [10] and desired color [11]. The fat and calorie content in potato chips are of particular concerns to consumers with high levels of health awareness. In general, potato chips are produced from the fresh tubers that processed through several stages: peeling, slicing, soaking and frying. Another method to produce potato chips is using potato flour as raw material. By this procedure, there is a possibility to improve the quality of end product during the processing stages. For example mixing the flour with other materials, ingredients, or food additives in order to improve nutritional value and increase crispiness.

Potato chips are one of the food products that contain high-fat content. Oil absorption will occur during frying that leads the potato chips to have high oil content. One of several ways to decrease oil absorption on potato chips can be done by coating the potato slices with the edible coating before frying.

Application of edible coating is an alternative pretreatment to improve the quality of potato chips produced from the potato flour. Previous researches presented that application of edible coating from various type of material contributes to increasing the characteristic of chips [12], [13]. In addition, the edible coating could minimize oil absorption during frying [14], [15].

Various types of raw material for edible coating has been examined, such as chitosan [16], pectin [17], starch and protein [18], gelatin [19], alginate [20]. Previous researchers, mostly, applied an edible coating to the potato slices that obtained from the fresh tubers. In this study, the edible coating was introduced to the pieces from the dough and slices from fresh tubers as well.

This study examines the effect of the edible coating on chemical characteristics and sensory properties of potato chips produced from the potato flour variety Granola. For comparison, chips from fresh tubers were also produced.

II. MATERIAL AND METHODS

A. Materials

The materials used in this study were potato variety Granola that obtained from Dieng plateau, one of the potato production centers in Indonesia. In addition to a physical characteristic, the tubers were selected based on the diameter, minimum 40 mm. To produce potato flour, tubers were peeled, sliced, and soaked in a 0.75% citric acid solution. The slices were dried in the cabinet dryer (OV 100, Indonesia) at 50°C for about 12 hours. The slices of potato tubers were ground and sieved with the size of 80 mesh. The flour was kept in the clean and dry container before the chips' processing. Potato chips were prepared from the mixture of potato flour, rice flour and wheat flour with the ratio of 60 %: 20 %: 20%. After the water was added, kneading of the dough was conducted and also the addition of salt and baking powder. The dough was pressed in a pasta machine (Oxone, Indonesia) passed through the 2 mm of the gap. Afterward, the mold, a round shape with a diameter of 50 mm, was applied to the dough in order to have homogenous shape, thickness, and width. The round shape

was selected in order to have similarity with the slices from the fresh tubers. The edible coating was introduced to the pieces by dipping before frying in the electric fryer (Oxone, Indonesia) at 170°C for about 1.5 minutes using palm oil.

The raw materials for chips production were: potato flour of Granola variety (P1) and potato tubers of Granola variety (P2). The types of edible coating material applied were: Control (without edible coating/ C1), Maltodextrin (C2), Acacia gum (C3), Carboxymethyl Cellulose/ CMC (C4) and Carrageenan (C5). Each slice was immersed in the edible coating solution and drained till no more drops appear and followed by frying. The observed variables include chemical aspects (moisture content, ash content and fat content of chips), and sensory properties (crispiness, color, flavor and overall acceptance).

1) *Moisture content*: Potato chips were crushed into small pieces in a laboratory mortar. Ten-gram of the sample was transferred to a Petri dish and preheated in an oven (Mettler, Germany) at 60°C for 15 hours and then at 105°C for 3 hours. Petri dish was taken and put in a desiccator, after reaching the room temperature, the Petri dish was weighed (Sartorius, Germany). Weighing was conducted until constant weight was reached. Moisture content was measured as follows:

$$\text{Moisture content (\%)} = ((B-C) / (B-A)) * 100\%.$$

A: weight of Petri dish (g)

B: weight of Petri dish + fresh sample (g)

C: weight of Petri dish + dried sample (g)

2) *Ash content*: dry ashing procedures determined ash content to use a high-temperature muffle furnace. After accomplishing moisture content analysis, the sample was transferred in a porcelain container and being weighed (Sartorius, Germany). Then, the container was placed in a furnace (Neycraft, USA) at temperatures of 600 °C for 5 hours. The container was moved to a desiccator for a while before weighing the final weight.

Ash content was calculated using this formula:

$$\text{Ash content (\%)} = ((C-A) / (B-A)) * 100\%.$$

A: weight of porcelain container (g)

B: weight of porcelain container + dried sample (g)

C: weight of porcelain container + ashed sample (g)

3) *Fat content*: Fat content in potato chips were measured by the Soxhlet method, which involves continuous vaporization and condensation of petroleum ether through the sample. Two gram of moisture-free of the sample was put in the extraction thimble and then placed it in the Soxhlet extractor. The Soxhlet extractor was set between the condenser and round bottom flask. The whole set was placed on a heating mantle in order to boil the petroleum ether. After 6 hours, the condensing unit was removed. The flask with the extracted sample then dried in an oven (Mettler, Germany) at 100 °C for 1 hour. Afterward, it was transferred to a desiccator. Flask was weighed (Sartorius, Germany) until obtaining the constant weight.

$$\text{Fat content (\%)} = ((B-A)/C) * 100\%$$

A: weight of empty flask (g)

B: weight of flask + extracted fat (g)

C: weight of fresh sample (g)

4) *Sensory evaluation*: A sensory panel, which consists of 17 undergraduate students of the Department of Food Science and Technology Jenderal Soedirman University, was required to provide an assessment of the product. The panelists were familiar with the procedure of sensory evaluation and scoring for the assessment. They were asked to give their response on a numerical scale by filling of the questionnaire table, from 1 (the lowest) to 4 (the highest). Sensory properties evaluated were consisted of crispiness ("not crispy" to "very crispy"), color ("brown to golden yellow"), flavor ("not detected" to "very intense flavor of potato") and overall acceptance ("do not like" to "very like"). In this scale, there was no middle value in order to produce two groups of the result, either positive or negative to each parameter.

B. Data analysis

The data of chemical variables obtained from the results of the study were analyzed by variance analysis (F test) and if the result of the analysis showed a significant effect, then continued with the test using DMRT 5%. Data of organoleptic test results were analyzed using Kendall W and followed by Wilcoxon Sign Rank Test.

III. RESULT AND DISCUSSION

Pretreatment for optimizing the formula to produce accepted chips was conducted because processing potato chips from the flour of variety Granola is unusual due to its inherent characteristic [4]. In the pretreatment, the proportion of rice flour and maize flour was examined as the addition to potato flour (60%) and wheat flour (20%). Moreover, sodium tripolyphosphate (STPP) was also added that expected to contribute to improving the quality of chips.

Table 1 shows that treatments of the proportion of rice flour and maize flour and concentration of STPP in the production of potato chips from the potato flour of variety Granola did not give significant effect on moisture content, ash content, and brightness value. The effect of the treatment can be found in the fat content, were using the proportion of rice flour and maize flour at 20% : 0% resulted in the chips with the lowest fat content. This result leads on deciding the proportion of rice flour and maize flour used in the formulation on chips production since food with low-fat content is more healthy and preferred by the customers. In addition, sensory analysis of the chips resulted from these treatments also support that appropriate proportion of rice flour, and maize flour was at 20% : 0% (unpublished data).

TABLE I
THE RESULT OF PRE-TREATMENT ON OPTIMIZING THE CHIPS' FORMULA

Treatment	MC	AC	FC	BV
F1A1	3.32	1.58	24.31 ab	59.28
F1A2	2.67	2.1	22.91 bc	58.57
F1A3	2.87	2.32	23.96 bc	58.29
F2A1	2.83	1.85	22.98 bc	57.25
F2A2	2.22	2.44	24.41 ab	58.09
F2A3	2.81	2.42	24.58 ab	58.06
F3A1	2.57	2.43	22.44 c	58.37
F3A2	2.59	2.16	24.74 a	57.73
F3A3	3.06	2.14	22.88 bc	57.74

Description: The numbers followed by the same letter are not significantly different at a 5%.

F = proportion of rice flour and maize flour: F1= 0% : 20%; F2= 10% : 10%; F3= 20% : 0%

A = concentration of STPP: A1= 0%; A2= 1.5%; A3= 3%

MC = moisture content (%), AC = ash content(%), FC = fat content (%), BV = brightness value (L score).

Based on the preliminary research as presented in Table 1, therefore, the formulation for chips processing from the dough has used the proportion of potato flour: wheat flour: rice flour, 60 %: 20 %: 20%. In this research, the result of the analysis are presented as chemical properties and sensory attributes of potato chips. Moreover, the data will be compared to the National Standard of Indonesia for potato chips (SNI 01-4031-1996) for evaluating the result and recommend further treatments.

A. Chemical Variables

1) Moisture content

Moisture content in food will affects the quality and shelf life of products. Also, there is a rule in Indonesia for regulating the standard of potato chips for the moisture content. The results of the analysis showed that the type of raw material (P) and edible coating type (C) had a significant effect on the moisture content of potato chips. The moisture content of the potato chips from the Granola variety on various types of raw materials is presented in Fig. 1.

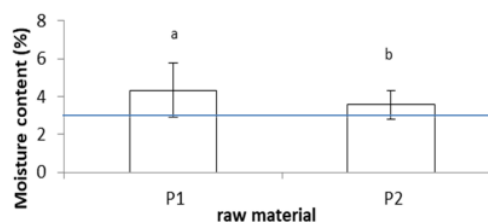


Fig. 1. The moisture content of potato chips on various types of raw materials

The numbers followed by the same letter are not significantly different at a 5%.

P1 = Granola Potato flour, P2 = Granola Potato tuber

The line is a maximal moisture content as regulated in SNI 01-4031-1996 (National Standard of Indonesia).

Fig. 1 shows moisture content of potato chips produced from potato flour Granola variety is higher than potato chips made from potato tuber varieties Granola. It could be due to the raw material in the producing of potato chips from the flour. The dough was mixed of various types of flour that are potato flour, wheat flour, and rice flour. Moreover, there was the addition of moisture during the preparation. Fig. 1 also shows that chips from tuber and flour had higher moisture content than the standard in Indonesia (SNI). Potato tuber variety Granola grown in Indonesia has low dry matter content [4]. Therefore, it could contribute to the high moisture content of the chips.

In addition, compared to other flours, wheat, rice, and green gram, potato flour has the highest water absorption capacity. It represents the ability of flour to associate with water when the availability of water is limited. Therefore, in the potato flour, there is a high amount of starch and fiber [21].

Different types of the edible coating had a significant effect on the moisture content of the resulting potato chips. The moisture content of the potato chips in various types of the edible coating is presented in Fig. 2.

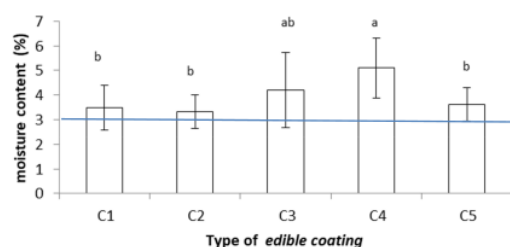


Fig. 2. The moisture content of potato chips in various types of edible coating

The numbers followed by the same letter are not significantly different at α 5%.
C1 = Control (without edible coating), C2 = Maltodextrin, C3 = Gum arab, C4 = CMC, and C5 = Carrageenan.
The line is a maximal moisture content as regulated in SNI 01-4031-1996 (National Standard of Indonesia).

Fig. 2 shows that the moisture content of the potato chips from Granola variety with CMC edible coating had the highest moisture content. It could be due to the coating of potato slices before being fried that caused the moisture contained in potato slices was more challenging to evaporate during frying. In addition, CMC is also a hydrophilic colloid that is effective for binding moisture.

2) Ash content

Ash content of the chips was determined related to the national standard of potato chips in Indonesia. The level of the potato chips in various types of raw materials can be seen in Fig. 3.

Potato chips made from potato flour of Granola variety (P1) had higher ash content than potato chips produced from potato tuber (P2). The average value of the ash content was 2.29% while the chips produced from potato tuber had an average of 1.31%. This result was related to the composition of the material contained in the product. Potato chips from potato flour were made by mixing several types of flour that were potato flour, wheat flour₂ and rice flour. The three types of flour contribute to the average amount of ash content of potato chips

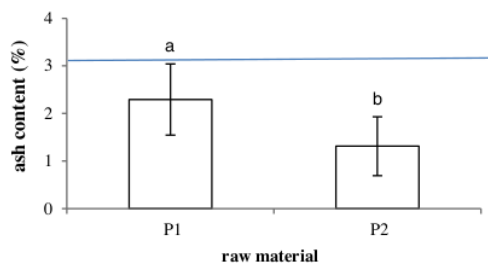


Fig. 3. Ash content of potato chips in various types of raw materials

The numbers followed by the same letter are not significantly different at α 5%.

P1 = Granola Potato flour, P2 = Granola Potato tuber
The line is a maximal moisture content as regulated in SNI 01-4031-1996 (National Standard of Indonesia).

3) Fat content

Fried products generally absorb oil during processing. The absorbed oil will influence the distinctive flavor and crispiness of the product. On the other hand, it gives negatively impact of the product, due to the appearance of oily chips. This appearance will decrease in consumer acceptance levels. In addition, high oil absorption may lead to more rancid products [11].

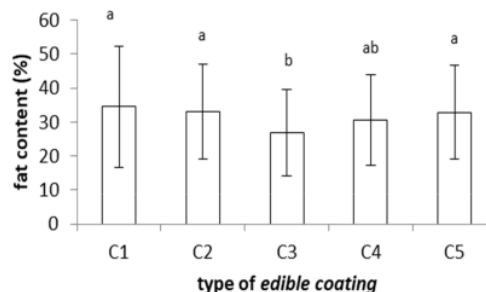


Fig. 4. The fat content of potato chips in various types of edible coatings

The numbers followed by the same letter are not significantly different at α 5%.

C1 = Control (without edible coating), C2 = Maltodextrin, C3 = Acacia Gum, C4 = CMC, and C5 = Carrageenan.

The result showed a significant difference in the type of edible coating (C) on the fat content of potato chips. The fat content of potato chips in various types of edible coating (C) can be seen in Fig. 4.

Potato chips with an edible coating of Acacia gum type (C3) had the lowest fat content value compared to other edible coating types. Moreover, the fat content of chips coated with acacia gum is lower than control (without edible coating). Edible coatings are known to inhibit the absorption of oil. The fat content of potato chips decreases due to the dipping of potato slices into the edible coating solution, causing the gel formation on the surface of the product at the beginning of the frying. This is related to the secondary characteristics of hydrocolloids that can form a gel layer due to the thermal gelation of hydrocolloids. This result was agreed with the previous report [12], they reported that a low amount of oil absorption was caused by the formation of covalent links within films during heating.

The raw material of potato chips also influences oil absorption by the slices during frying. Potato chips from potato flour varieties Granola was made by mixing other flours (wheat flour and rice flour). The starch contained in rice flour contains amylose and amylopectin groups. In potato, it also contains starch but with less amount compared to the total amount of starch in the composite flour used to make potato chips. In addition, compared to other flour, such as: wheat, rice, and green gram, potato flour has the highest oil absorption capacity [21].

The edible coating can act as a barrier between food surface and atmospheric oxygen [14]. Therefore, it contributes on the extension of shelf-life and minimizing rancidity. Moreover, the edible coating also decreases the oil absorption up to 30% during frying compared to the control as reported by [15]. Previous researches reported that the edible coating contributes to minimizing the oil absorption [14], [15]. This leads to the better appearance of the chips because the surface becomes dry and not oily.

B. Sensory Variables

1) Crispiness

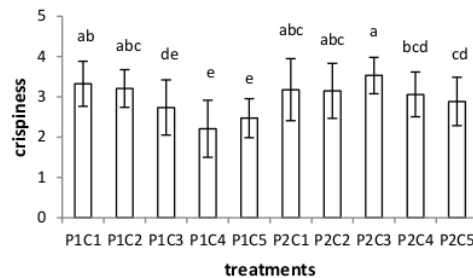


Fig. 5. The crispiness of potato chips as resulted from the treatment between the type of raw material and the type of edible coating

P1 = Granola Potato flour, P2 = Granola Potato tuber
C1 = Control (without edible coating), C2 = Maltodextrin, C3 = Acacia Gum, C4 = CMC, and C5 = Carrageenan.

The sensory evaluation shows that regarding crispiness, panelists prefer potato chips that coated by an edible coating of Acacia gum with the highest average value of 3.53 (very crispy). The average value of the smallest crispiness according to panelists is the chips of potato flour with coating edible coating type CMC with an average value of 2.21. This decline in the value of crispiness is also associated with moisture content. Chips from potato tuber had lower moisture content than chips made from flour. In addition, the use of CMC-type edible coatings also provides the highest moisture value in potato chips products. Drying process during preparation on the making of potato flour will effect on moisture content, damaged starch content particle size and brightness of color [7]. Starch plays a vital role in determining the crispiness of food product. Moreover, other factors that influenced the crispiness of coated chips due to low oil absorbed during frying, therefore, the chips were not soggy. The previous report that measures the crispiness using Texture Analyzer (TA-XT Plus, Texture Technologies USA) showed that coated chips had higher crispiness value than uncoated chips [15].

Addition of potato flour influenced the rheological properties of dough as well as in the making of steamed bread. Therefore, an appropriate amount of potato flour must be determined in order to produce the desired quality of end product. Addition high amount of potato flour will lead to a higher degree of gelatinization and viscosity that caused difficulties in the fermentation process and shaping [5].

2) Colour

Color is one of the essential properties of potato chips that will influence the consumers' preference. The color of potato chips is affected by the Maillard reaction that depends on reducing sugars and amino acids content of slices. This process is occurred during frying and influenced by the temperature and time of frying [15].

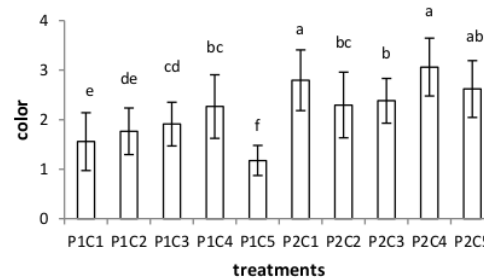


Fig. 6. The color of potato chips as resulted from the treatment between the type of raw material and the type of edible coating

P1 = Granola Potato Flour, P2 = Granola Potato tuber
C1 = Control (without edible coating), C2 = Maltodextrin, C3 = Acacia Gum, C4 = CMC, and C5 = Carrageenan.

This non-enzymatic browning reaction causes a lower brightness value. Fig. 6 show that most panelists prefer the color of potato chips from the treatment of potato chips from potato tubers with coating edible coating of CMC. The average value of this treatment is 3.06 (yellow). The lowest average of panelist assessment on the color of chips is on the treatment of P1C5 (chips of potato flour with coated edible coating type of carrageenan) with an average of 1.18 (brown). In this research, the chips' color was identified from dark brown to light yellow. Therefore, in the sensory evaluation, the panelist was asked to convey their response regarding the color of the chips. The higher the value means, the more attractive the color.

Flour-based potato chips have a darker color than the chips from potato tubers. Although the dough was added with other flours, but the proportion of potato flour was the highest one. This is because during the process of making potato flour undergoes enzymatic browning reaction. Although it has been soaked in a 0.75% citric acid solution to inhibit the browning reaction its concentration is still considered to be lacking. The color of tuber of potato variety Granola is yellow.

The color determination in this research was conducted by sensory evaluation to the panelist. For the comparison, the previous research that used chromameter for color examination showed that preparing the potato flour by drying will lead to the darker color of the flour compared to boiling [7]. The flour that prepared by drying had lower L* value and higher a* value, this result could be the effect of browning of potato slices during drying. In this research, drying in a cabinet was applied during process of flour making. Moreover, potato variety Granola is susceptible to blackspot and after cooking blackening [4].

3) Potato flavor

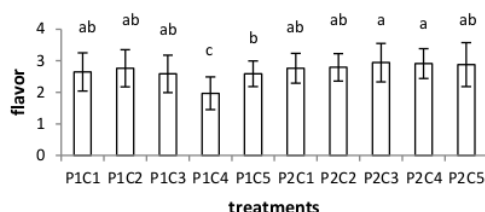


Fig. 7. The flavor of potato chips as resulted from the treatment between raw material type and edible coating type.

P1 = Granola Potatoe Flour, P2 = Granola Potato tuber
C1 = Control (without edible coating), C2 = Maltodextrin, C3 = Acacia Gum, C4 = CMC, and C5 = Carrageenan.

Fig. 7 shows that the highest average value given by panelists is on the treatment of P2C3 (potato chips with an edible coating of acacia gum). While the lowest average value of P1C4 treatment (chips from potato flour coated with edible coating CMC). In general, potato chips processed from potato tubers have a higher average value compared to chips from potato flour. Considering raw material type, the chips were produced without mixing with other ingredients. Therefore, the original taste of the potatoes was intense. In the present research, panelists were asked to taste the intensity of potato flavor. It is very important to know the response of panelists in order to have an appropriate formulation on producing chips from the flour. The higher the value is more intense of the potato flavor in chips.

In the present research, the proportion of potato flour was 60%. This amount was determined based on the preliminary research, higher amount of potato flour added in the dough will give a flavor of potato more intense, but there was difficulty on shaping the dough become smooth pieces. For comparison, previous research recommended potato flour was added up to 55% on the making of steamed bread to produce desired quality [5].

4) Overall acceptance

Fig. 8 shows the preference of panelists to the potato chips produced from tuber and flour of variety Granola. Overall acceptance was measured to know the preference of panelists to the chips. Measurement of the panelists as a response to the effect of chips' attribute. The preferred quality of samples was presented in the high score in sensory evaluation.

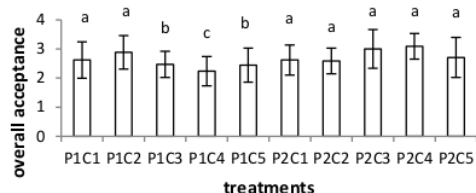


Fig. 8. The acceptance of potato chips as resulted from the treatment between raw material type and edible coating type

P1 = Granola Potato flour, P2 = Granola Potato tuber
C1 = Control (without edible coating), C2 = Maltodextrin, C3 = Acacia Gum, C4 = CMC, and C5 = Carrageenan.

Fig. 8 showed that chips produced from all treatments were accepted by the panelist, the score was above 2.0. Mainly, chips resulted from potato tubers had no significant differences among others. The level of panelist preference is influenced by various factors, such as crispiness, color, and flavor of potatoes. These factors will affect the overall acceptance of the panelist's preference levels in the product. According to the previous report, edible coating improves sensory properties of chips, including appearance, color, flavor, taste, crispy that lead to increasing the score of overall acceptability [12].

As a comparison, the characteristics of potato chips produced were compared with SNI 01-4031-1996 which regulates the quality of potato chips that allowed to be distributed in Indonesia. The standard value for moisture content and ash content is a maximum of 3%, and there is no provision on fat content. Sensory properties, yellow to brown evenly for color, standard potato flavor, and crispy texture. Based on the result of this research, the appropriate treatment for potato chips of Granola from potato flour as well as from potato tuber was obtained from the treatment of edible coating of acacia gum. This treatment produced chips with the sensory properties and ash content meet the requirements, but the moisture content of potato chips is still higher than the provisions in SNI 01-4031-1996.

According to previous research, the addition of potato starch resulted the bread with good appearance, regular and smooth crust and the color was less dark compared to bread with wheat flour [6]. They reported that substitution of potato starch till 80% did not give adverse effect of dough and resulted in bread with no significant difference on nutrition, physical and chemical properties compared to control (from wheat flour). In this research, the potato flour used was 60% because based on the preliminary research that this concentration was the optimal one for the formulation combined with rice flour and wheat flour. Sufficient amount of wheat flour was required to improve the characteristic of the dough in order to be processed into thin and smooth pieces due to the gluten content. Compared to wheat flour, rice flour, and green gram flour, potato flour had the highest value of swelling capacity, water absorption capacity, oil absorption capacity and emulsion stability. Moreover, potato flour had also good functional properties that will increase the nutritional properties of end products [15]. Additional potato flour in the dough for steamed bread can increase the content of dietary fiber, starch, total polyphenol and antioxidant activity [8].

The application of different concentration of coating to the potato slices will influence the properties of potato chips [12]. Therefore, it is also essential to examine the effect of level of concentration of coating in addition to various raw material of the edible coating.

The result of this research indicates that pretreatments, application of the edible coating, could improve the characteristic of potato chips resulted from tuber variety Granola. However, further research is required in order to have the chips that appropriate with the National Standard of Indonesia (SNI 01-4031-1996), particularly in moisture content. Therefore, additional treatments could be applied, such as decreasing initial moisture content of slices or drying before frying. In addition, applying vacuum frying could

also be an alternative treatment for obtaining a good quality of potato chips prepared from the flour because previous research showed a significant effect of this method [22].

As a comparison, in China, the development of steamed bread that contains 55% of potato flour was succeeded and recently has been produced for the commercial purpose [5]. Potato flour is recommended for substitution in food processing because it has good functional properties and contributes to increasing the nutritional value as well [21]. This statement is also supported by [5] [6] [7] and [8] who processed various food product with the substitution of potato flour.

IV. CONCLUSION

Potato variety Granola could be utilized as raw material for potato chips by applying an edible coating to the slices before frying. Application of edible coating in the potato chips processing could contribute to improving the quality of the product. The edible coating made of acacia gum could be applied in the process of producing potato chips from tuber and flour of potato variety Granola. This edible coating resulted in better chips' quality than using other material of edible coatings in the present research. However, additional treatments are still required in order to produce potato chips that conform to the National Standard of Indonesia (SNI 01-4031-1996).

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