Improving Performance of Edible Coating Protection on The Honey Pineapple Quality Attributes Through the Addition of Roselle (*Hibiscus sabdariffa*) Bioactive Compounds

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Abstract. Honey pineapple, as superior fruit commodity in Pemalang Regency, has a higher fructose content (1.94%) than regular pineapple (1.42%). This causes limited market share due to the shelf life of sliced pineapple, which is only 1–3 days. One way to extend the shelf life of cut pineapple is by coating it using edible coating with the addition of roselle extract. Roselle extract contains bioactive compounds that can function as antibacterial and antioxidant. This study aims to determine the effect of storage temperature and variations in addition of roselle extract concentration in edible coating used on the physical and chemical quality of fresh cut pineapple during storage. Treatments of this research were: roselle concentration addition (R), namely 7.5% (R1), 12.5% (R2), 17.5% (R3); storage temperature (S): 28.1 °C (S1), and 5 °C (S2). Data on physical and chemical variables were analyzed using analysis of variance (F test) at 5% level. If the results have a significant effect, then further tests using the Duncan Multiple Range Test. The best treatment combination is determined using the Effectiveness Index Test. The results show that 1) the addition of variations in the concentration of roselle extract has a significant effect on acidity (pH), and 2) storage temperature has a significant effect on weight loss, hardness and acidity (pH).

Keywords: Pineapple · Edible Coating · Roselle Extract

1 Introduction

Pineapple honey from Pemalang is one of the leading commodities in Pemalang Regency that can be exported. Based on the Fixed Figures (ATAP) pineapple production in Indonesia in 2015 reached 1.73 million tons. Indonesia is the third largest pineapple producer in Southeast Asia after the Philippines and Thailand with a contribution of about 23% [1]. Pineapple contains vitamins A, B, C, and minerals (calcium, phosphorus and iron), as well as compounds that have the potential as antioxidants (polyphenols and flavonoids) [2]. According to [3], fresh cut pineapple has a short shelf life, which is only 1–3 days

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even at optimal temperatures. The higher fructose value should be suspected as the reason for the shelf life of the original Pemalang honey pineapple is shorter than other pineapples, so it needs to be coated with an edible coating.

Edible coating is a thin layer, made of materials that can be consumed. Edible coating materials derived from lipid polysaccharides and proteins cause the edible coating to function as a barrier so as not to lose moisture and slow down the respiration process [4]. Based on existing research, edible coating is able to maintain the freshness of sliced pineapple for up to 6 days at a temperature of 5 °C.

In order to expand market share, it is necessary to increase the ability of edible coatings to maintain the freshness of pineapples. This can be done by adding roselle extract in the composition of the edible coating used. According to [5], the active compounds in roselle are phenolic compounds that function as antioxidants and antibacterials. Antioxidants are compounds that are able to eliminate, clean, hold reactive oxygen or radicals in the body. The bioactive content of roselle has the ability as antibacterial and antioxidant so it is suspected that roselle-based edible coatings are able to have more ability to extend shelf life.

Of course, the amount of roselle extract concentration added also needs to be known so that the edible coating used is more effective in protecting cut pineapple products without affect the taste of the product. In addition, the difference in storage temperature also resulted in differences in the concentration of added roselle extract.

Considering these factors, this study was intended to study the effect of adding variations in the concentration of roselle extract combined with storage temperature in edible coating on the physical and chemical quality of fresh cut pineapple during storage. The opportunity to export fresh cut pineapples with a longer shelf life without changing the physical and chemical quality is expected to help pineapple farmers to expand market share.

2 Research Methods

2.1 Material

The material used in this study was honey pineapple obtained from Belik village, Pemalang Regency. Rosella flower obtained from Beringharjo Market, Yogyakarta, CMC (carboxyl methyl cellulose), glycerol, 70% ethanol, distilled water, 1% amilum indicator. 0.01N iodine solution, PCA (Plate Count Agar) and physiological solution (0.085% NaCl).

2.2 Experimental Design

This study used a completely randomized design research. Factors tested include: The addition of roselle extract (R) which consists of 3 levels, namely; 7.5% (R1); 12.5% (R2) and 17.5% (R3). Storage Temperature (T) which consists of 2 levels, namely: 28.1 °C (T1) and 5 °C (T2).

These two treatments will produce 6 units of treatment combination, and each unit is repeated 3 times so that 18 experimental units are obtained.

2.3 Roselle Extraction [5]

The manufacture of roselle extract begins with smoothing the previously dried roselle petals. A total of 10 g of dry roselle powder was put into a 250 mL Erlenmeyer and added with 100 mL of distilled water. Then put in the microwave for 5 min at a temperature of 60 °C. Then filtered and the filtrate evaporated for 15 min. This results in a red roselle flower extract.

2.4 Making Edible Coating

The manufacture of edible coatings begins with heating 100 mL of aquadest put in a glass baker then adding 0.5 g of CMC and 0.4 mL of glycerol and cooking using a magnetic stirrer to a temperature of 80–85 °C. After that it is cooled.

2.5 Sample Preparation

Fresh pineapple peeled and cleaned. Then the fruit is cut with a thickness of 1–2 cm [6]. The edible coating that has been made is added with roselle extract with concentrations of 10%, 15% and 20%. Next, the chopped pineapple is dipped into the edible coating to which roselle extract has been added for 30 s and then let it be aerated. After drying, it is packaged using Styrofoam and plastic wrapping. The sample was then stored at room temperature and stored at a cold temperature of about 5 °C [6]. Observations were made every day for 6 days which included the following variables: weight loss [7], acidity level [8], fruit color scale index [9], vitamin content C [10].

2.6 Pineapple Weight Loss

Weight loss value was obtained by comparing the weight of fruit on day n with fruit weight on day (n−1) [7]. Measurement of weight loss was carried out by weighing using an analytical balance. The weighing result is expressed in percent of weight which is calculated by the following equation:

$$\text{Weight Loss } (\%) = W0 - Wn \tag{1}$$

2.7 Acidity Level (pH)

The level of acidity (pH) of the sample can be measured using a pH meter [8]. Before starting the measurement, the instrument was first calibrated using standard buffers 4 and 7, then the electrode was rinsed with distilled water and dried with tissue paper. A total of 30 g of the sample was crushed using a mortar and distilled water was added in a measuring flask to a volume of 100 mL then the electrode was immersed in the sample solution and left until a stable number was obtained as the measured pH value.

2.8 Cut Fruit Color Scale Index

Changes in the color of pineapple pieces have been used as a guide to determine the stages of pineapple ripening [9]. The index of the pineapple peel filtrate scale used is by using a color reader by placing the fruit in front of the sample, it will automatically bring up the value of the color of the fruit.

2.9 Vitamin C Levels

The content of vitamin C is determined based on iodine titration [10]. A total of 200 g of material that has been crushed using a blender until a slurry is obtained. Then as much as 10 g of the sample was put into a 100 mL volumetric flask with the addition of distilled water to the mark. The material is then filtered to obtain the filtrate. 5 mL of the filtrate was taken with a pipette and put into a 125 mL erlenmeyer, then 2 mL of 1% starch indicator and 20 mL of distilled water were added. The solution was titrated with 0.01N iodine until a color change (purple blue). Calculation of vitamin C by standardization of iodine solution is in every 1 mL of 0.01 N iodine equivalent to 0.88 mg of vitamin C.

2.10 Data Analysis

The data obtained were analyzed by means of the test of variance (Test F) at the level of = 0.05. If the results of the study show a significant difference, it will be continued with the Duncan Multiple Range Test (DMRT) test analysis = 0.05%. [10]. Observation data up to day 7 were analyzed using linear regression analysis. The best treatment combination was determined using the Effectiveness Index Test.

3 Result and Discussion

3.1 Weight Loss

Based on Fig. 1, it can be seen that the addition of roselle extract up to 12.5% will result in increased weight loss of chopped pineapple. This is presumably due to the transpiration process so that the water contained in the pineapple moves to the environment which causes shrinkage. The increasing addition of roselle extract will reduce the viscosity of the edible coating produced. This causes the pores of the edible film produced to be larger, which results in greater opportunities for water transfer from the pineapple to the air. According to [11] that transpiration in fruit causes the cell bonds to become loose and the air space becomes large as if shriveled up, the condition of the cell.

Based on Fig. 1 (b), the weight loss at room temperature storage (S1) was higher than the weight loss at cold temperature storage (S2). The increase in the value of pineapple weight loss stored at room temperature is also indirectly related to water loss in the material. Loss of water in the material is caused by the process of respiration rate. The increased respiration rate causes the internal temperature of the fruit to also increase. This is caused by the heat (energy) generated from the respiration process. The respiration rate increases 2–3 times (or more) each time the temperature increases by 10 °C, so the product can spoil more quickly at high temperatures. This is as expressed by [12] that

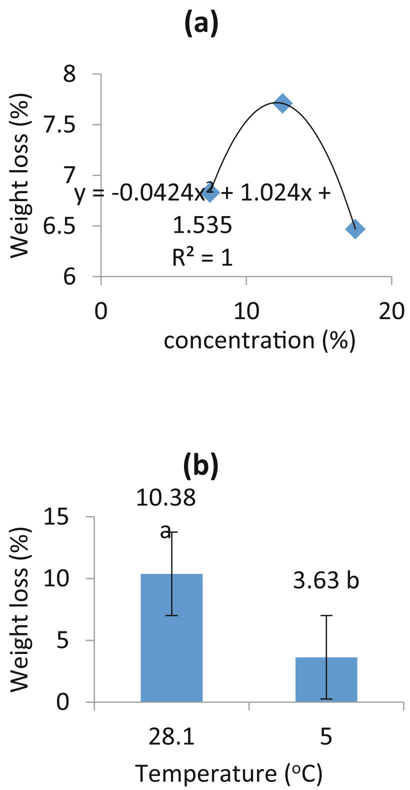

Fig. 1. The influenced of (a) roselle extract concentration and (b) storage temperature to pineapple slice weight loss

for every 10 °C increase in temperature, respiration will take place two or three times greater. The same is true for the opposite. For every 10 °C decrease in temperature, respiration takes place two or three times slower. [13] added that the loss of weight in stored fruits and vegetables, apart from being caused by water loss as a result of the evaporation process, is also caused by the loss of carbon during the respiration process. The cutting process carried out on fresh cuts also causes the inner tissue of the fruit to be exposed to the environment so that it has an impact on increasing the rate of water evaporation [14].

3.2 Color

Color is an index of food quality which is often used as a parameter to assess the physical quality of a product. The color differences found in fruits and vegetables are caused by the pigments they contain. These pigments can generally be divided into four groups, namely chlorophyll, anthocyanins, flavonoids and carotenoids.

Colors can also be divided into two groups, namely polar or soluble in water and non-polar or insoluble in water but soluble in organic solvents (Figs. 2 and 3).

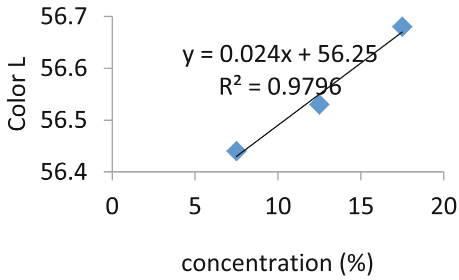

Fig. 2. The influenced of Roselle extract concentration to pineapple slice color L

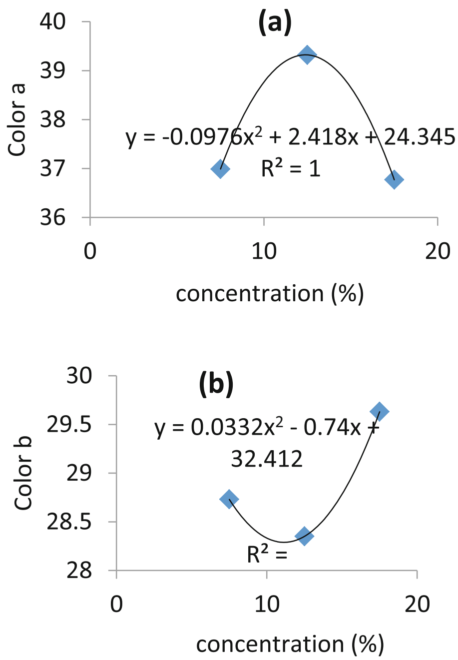

Fig. 3. The influenced of variations of roselle extract concentration to color a* (a) dan b* (b) pineapple slice

Color analysis on pineapple fruit filtrate was measured using a color reader. The measurement method used is the absolute color system measurement L*, a* and b*. The L* value indicates a change in brightness or lightness with a range of values from 0 (black) to 100 (white). The a* value indicates a mixed red-green color with a value of +a* from 0 to 100 for red, and the –a* value with a value of 0 to −80 for green values. The b* value represents a mixed blue-yellow color with a +b* value from 0 to +70 for yellow and a –b* value from 0 to −70 for blue [15].

Color changes are caused by the activity of pigment-producing microbes that are abundant on the surface of food. Anthocyanin pigments are pigments contained in roselle extract, so that damage and decay run slowly. According to [5], the antioxidant activity of roselle is determined by the anthocyanins and vitamin C contained in it. According to [16], the fruit will undergo a longer process of decay and retain the color of the flesh through a natural ripening process. [17], reported that cut pineapple experienced a change in color to become browner and the yellow color decreased during 6 days of storage at 4 °C due to the activity of the polyphenol oxidase enzyme that forms the pigment melamine.

3.3 pH

Based on Fig. 4, the addition of roselle extract variations to 20% roselle extract concentration caused a decrease in pH in chopped pineapple. This is because the roselle extract itself is acidic, so the more addition of roselle extract the pH value will decrease. According to [18], high acid levels will make the pH low in the manufacture of roselle syrup, so it can be said that this is a food preservation technique. The acidity value (pH) of roselle according to [19], reached 3.14 while the acidity value of pineapple reached 3.2. The pH of the treatment at room temperature tends to be lower than the pH at cold temperatures. The difference in pH between room temperature and cold temperature is due to the reshuffling of compounds that occur in the material. This is in accordance with [20]; [21] that the rate of utilization of carbohydrates by microorganisms at room temperature is greater than the refrigerator temperature. The high number of microbes at room temperature results in the degradation of carbohydrates into acids. The higher the acid produced, the lower the pH.

3.4 Vitamin C

Vitamin C is one of the nutrients found in fruits and vegetables which is an important component needed by humans. Organic substances needed by the human body in small amounts, to maintain metabolic functions. Vitamin C, also known as ascorbic acid, is a vitamin that is easily oxidized by heat, light, alkali, enzymes and oxidizing agents.

The content of vitamin C with the addition of variations in the concentration of roselle extract tends to increase (Fig. 5). This is because roselle extract also contains vitamin C. [5], roselle flower petals contain vitamin C 20.47 ± 0.34 mg/g.

The storage temperature treatment did not significantly affect the vitamin C of chopped pineapple. However, stored vitamin C can be lost due to heat, light, oxygen and enzyme action. According to [22], the decrease in vitamin C during storage occurs due to the oxidation process, where vitamin C is very easily oxidized to L-dehydroascorbic acid which tends to undergo further changes to L-dicotigulonic acid. The decrease in vitamin C levels can be influenced by the respiration process which causes a decrease in the water content of the pineapple changes in the volume of air space so that the weight loss increases.

4 Conclusion

The conclusions obtained from this study are: The addition of the concentration variation of roselle extract has a significant effect on acidity (pH). Storage temperature treatment

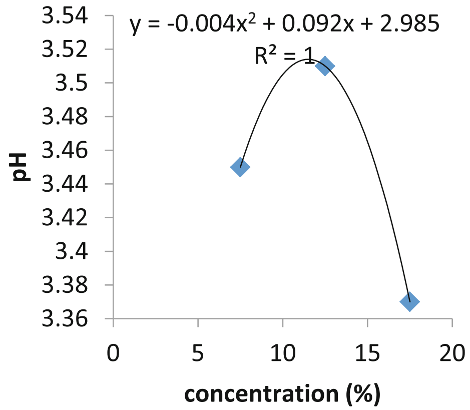

Fig. 4. The influenced of Roselle extract concentration to pineapple slice color L

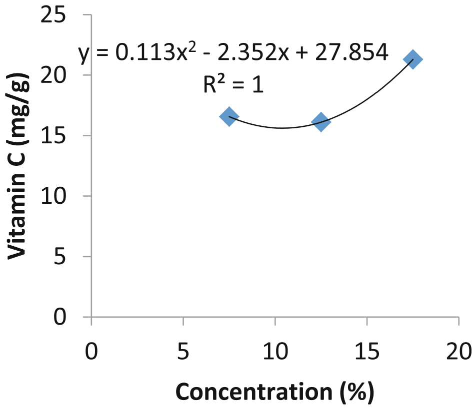

Fig. 5. The influenced of Roselle extract concentration to pineapple slice color L

has a significant effect on weight loss, hardness and acidity (pH) of pineapple pieces. Interaction between the addition of roselle extract concentration variations with storage temperature there is no significant effect on pineapple pieces.

References

1. Center for Agricultural Data and Information Systems. 2016. Horticulture sub-sector agricultural commodities. Ministry of Agriculture Indonesia.
2. Hossain, Md., Shaheen, A., & Mustafa, A. 2015. Nutritional Value and Medicinal Benefits of Pineapple. *International Journal of Nutrition and Food Sciences*, 4(1): 84-88.
3. González-Aquilar, G.A., Ruiz-Cruz S., Cruz-Valenzuela R., Rodriguez-Félix A. & Wang C.Y. 2004. Physiological and quality changes of fresh-cut pineapple treated with anti browning agents. *LWT-Food Sci. Technol*, 369–376.
4. Krochta, J.M., Baldwin, E. A. & Nisperos Carriedo, M.O. 2002. Edible Coating and Film to Improve Food Quality. *Lancastar Pa.* Techomic Publishing.

5. Purbowati, I.S.M. 2018. Antibacterial activity of phenolic compounds of roselle extract (*Hisbiscus sabdariffa* L.) resulted from several variations of drying methods and duration. *Jurnal Teknologi Industri Pertanian, 28(1):19–27.*
6. Pangabean, Y. 2010. The effect of chitosan edible film on the shelf life of the quality of fresh pineapple (*Ananas comosus* L. Merr) minimally processed during modified atmosphere storage. *Skrpsi.* Fakultas Teknologi Pertanian, IPB, Bogor.
7. Minh, N. P. 2021. Influence of hot water treatment to quality properties of pineapple (Ananas comosus) fruit during storage. *Food Research,* 5(5): 186-194.
8. Nurhayati, Hanum, T., Rangga, A. & Husniati (2014). Optimization of chitosan coating to increase the shelf life of fresh cut fruit products *Jurnal Teknologi Industri dan Hasil Pertanian,* 19(2): 161–178.
9. Darmajana. 2017. Effect of carrageenan edible coating on quality of cut melon in cold storage. *Jurnal agritech,* 280–287.
10. Sabari. 2006. Harvest maturity level of Sampit pineapple for fresh consumption and jam. *J.Hort*, 16(3):258-266.
11. Suhardjo. 1992. Study of the sweet fruit phenomenon (*Malussy Ivestris*) of the Rome beauty cultivar (*Desertasi*). Program Pascasarjana, IPB, Bogor.
12. Muchtadi, T.R. 1992. *Teknologi Proses Pengolahan Pangan.* Depdikbud PAU Pangan dan Gizi. IPB, Bogor.
13. Lathif H. 2013. The effect of the type of starch as an edible coating material and storage temperature on the quality of tomatoes. *Skripsi.* Universitas Islam Negeri Maulana Malik Ibrahim, Malang.
14. Perera, C.O. 2007. Minimal processing of fruits and vegetables. *Di dalam* : Rahman, M. S. (Ed), Handbook of Food Preservation, 2nd Ed. CRC Press, New York, p. 137–150.
15. Kaemba, A., Edi, S., & Christine, F. M. 2017. Physico-chemical characteristics and antioxidant activity of rice analogue of sago baruk (*Arenga microcarpha*) and purple sweet potato (*Iphomea batatas L.* Poiret). *J. Ilmu Pangan dan Teknologi Pangan*, 5(1).
16. Martorejo, T. 2009. *Ilmu Penyakit Pasca Panen.* PT. Bumi Angkasa, Jakarta.
17. Rocculi, P., Coci, E., Romani, S., Saccheti & Rosa, M.D. 2009. Effect of MCP treatment and N2O MAP on physiological and quality changes of fresh cut pineapple. *J. Postharvest Biol. Technol,* 371–377.
18. Mukaromah, U., Sri, H.S. & Siti A. 2010. Vitamin C content, physical quality, pH and organoleptic quality of roselle syrup (*Hibiscus Sabdariffa, L*) based on the extraction method. *Jurnal Pangan dan Gizi, 1(1).*
19. Mohamad, O., Mohd. N, B., Abdul Rahman, M. & Herman, S. (2002). Roselle: A new crop in Malaysia. Buletin PGM Dec 2002, p, 12–13.
20. Fasajiro S.B., Ashayi O.A., Adoela A., & Samuel F.O. 2005. Chemical and storybility of fruit flavoured (*Hibiscus sabdariffa*). drinks. *World J. Agric.* Sci, 165–168.
21. Ashaye, O.A., Taiwi O.O., & Adegoke G.O. 2006. Effect of local perservatives (Aframomum danielli) on the chemical and sensory properties of stored warakanshi. *Afri. J. Agric. Res*, 10–16.
22. Winarno, F.G. 1997. *Kimia Pangan dan Gizi.* Gramedia Pustaka Utama, Jakarta.