Application of Edible Coating from Konjac Flour added with Chitosan on the Quality of Red Chili

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Abstract

Red chilies have a relatively short shelf life and are highly perishable. Red chili is one type of vegetable with a water content (60 - 90 %) at the time of harvest and an increase in respiration rate. Therefore, it is necessary to pack a coating that can reduce and suppress respiration and transpiration rates to prevent vegetable damage. One potential way to reduce the damage to red chilies is by applying edible coatings. Edible coating is one technique that can be developed and applied to maintain quality and extend the shelf life of red chili. This study aims to determine the quality characteristics of red chili (Capsicum annuum L) before and after coating edible coating. In addition, to analyze the effect of Konjac flour concentration on the quality characteristics of red chili (Capsicum annuum L) with the addition of chitosan and to find out the best treatment for the application of edible coating with the basic ingredients of Konjac flour with the addition of chitosan. This study used a completely randomized design (CRD) and three replications. The treatment in this study was the storage time of coated red chilies edible coating for 1, 3, 6, and 9 days. The results showed that the storage time of coated red chilies edible coating affects the pH, water content, weight loss, respiration rate, and color. The analysis of the characteristics of red chilies showed that the coating done on red chilies can reduce and suppress the process of respiration rate.

Keywords: *edible coating, red chili, Konjac flour, chitosan*

1. INTRODUCTION

Red chili pepper (*Capsicum annum* L) is a leading commodity in the horticulture sub-sector, which is often used as a cooking spice. Red chili production increases every year in line with the increasing population and the development of industries that require red chili raw materials. The Central Statistics Agency states that the increase in red chili production volume from 2018 was 1,206,750 tons/year to 1,360,571 tons/year in 2021 (Badan Pusat Statistik, 2022). Red chilies have a relatively short shelf life and are easily damaged. Red chili is a type of vegetable that has a water content (60-90%) at harvest and undergoes a process of increasing respiration rate (Mikasari, 2016). Therefore, it is necessary to pack and coat vegetables that can reduce and suppress respiration and transpiration rates to prevent damage to vegetables. One of the potential ways to reduce the damage rate of red chilies is by applying edible coating. The edible coating acts as a barrier against gaseous moisture (O_2 and CO_2) as well as solutes by causing movement of the semipermeable membrane around the fruit, thus inhibiting the rate of respiration, water loss, and oxidation processes (Nawab et al., 2017).

The edible coating uses safe ingredients such as Konjac flour and chitosan. Konjac flour has the property of forming a selectively permeable membrane to CO_2 and O_2 which causes the respiration of fruits and vegetables to be reduced (Amalia et al., 2020). Chitosan compared with beeswax or paraffin, chitosan in chili coating is considered very good because it has the potential as an antimicrobial agent containing the enzyme lysozyme and clusters amino polysaccharides, which can inhibit the growth of microbes (Rohim et al., 2015). The purpose of this research is to determine the quality characteristics of red chili (*Capsicum annum* L) before and after edible coating Konjac flour with the addition of chitosan and determine the best application treatment edible coating with the basic ingredients of Konjac flour with the addition of chitosan.

2. MATERIAL AND METHODS

2.1 Tool and Material

Some types of equipment were used in this research; namely, analytical scales (sartorius), measuring cups, measuring pipettes, dropper pipettes, blender, pH meter, beaker glass, aluminum foil,

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stirrer, spatula, hot plate, magnetic stirrer (Medine scientific), tongs, aluminum pan, scissors, latex gloves, label paper, filter cloth, color reader, 50 ml glass bottle, aluminum cup, desiccator, and oven.

This study used several materials as the main ingredients, namely Konjac flour (Ikarie) and shrimp chitosan (Phy Edumedia). The additional materials used to implement this study were red chili (*Capsicum annum* L). At the same time, the chemicals used in the study namely distilled water, glycerol, benomyl fungicide (Masalgin), water, 0.1N HCL, phenolphthalein, and 0.1N NaOH.

2.2 Research Design

The research design used a laboratory experimental method with a completely randomized design (CRD) which aimed to determine the quality of fresh red chilies during storage. The proportions of Konjac flour and chitosan in five different formulas are distributed into each composition with a total weight of 5 grams, which is presented in Table 1.

Table 1. Design Experimental

Formula	Konjac Flour (%)	Chitosan (%)
F0	0	0
F1	100	0
F2	75	25
F3	50	50
F4	25	75
F5	0	100

2.3 Research Stages

The first stage of research is the identification of problems and objectives. The second stage is the study of literature. The third stage is antifungal immersion (masalgin) 2 grams/liter, and edible coating on red chilies. The fourth stage was testing the observation parameters to determine the best treatment by testing pH, water content, weight loss, color, and respiration rate on days 1st, 3rd, 6^{th,} and 9th.

A. Making Edible Coating

Making process of edible coating starts from weighing each material according to the treatment ,adding 500 ml of distilled water, then homogenizing using a temperature of 60 ^{o}C with a magnetic stirrer for ±10 minutes at 140 rpm (Murni et al., 2013). The homogeneous chitosan solution was added to each Konjac flour according to the treatment, then heated and stirred at 60 ^{o}C for ±10 minutes at 140 rpm. Then, 2 ml of glycerol was added as a plasticizer. Respective application of edible coating on red chili by dipping method, then dried dan stored at room temperature (25^{o}C - 27^{o}C) by hanging. Then observations were made on days 1, 3, 6, and 9.

B. Application Edible Coating

The application process of edible coating starts with choosing the type of red chili that is in a fresh state. Then, washing is done to clean and remove the dirt that sticks. Then, dip antifungal (masalgin) with 2 g/L before the coating process. The red chilies were drained and dried at room temperature for 10 minutes. The dried chilies are then coated with an edible coating made from Konjac flour and chitosan using the immersion method. Observations were made on days 1, 3, 6, and 9, and then data were collected using observation parameters, namely pH test, water content, weight loss, color, and respiration rate.

2.4 Observation Parameters

A. Test pH

Measurement of the degree of acidity (pH) uses a pH meter (Sidabalok, 2021).

B. Test Water Content

Testing the water content was carried out using the gravimetric method (AOAC, 2012). Calculation of the value of water using the following equation.

$$\text{Water content} = \frac{Weight\ of\ the\ water\ evaporated}{Initial\ water\ weight} \text{ x } 100\ \% \quad (1)$$

$$\text{Water content} = \frac{b-c}{c-a} \text{ x } 100\ \%$$

C. Weight Loss Test

Measurement of weight loss was carried out by weighing the red chili sample first before treating it as the initial weight. The final weight was weighed on the n-day during storage (Marwina et al, 2016).

$$\%\ \text{Weight loss} = \frac{initial\ weight - final\ weight}{Initial\ weight} \text{ x } 100\% \quad (2)$$

D. Color Test

Testing the color of red chili using color reader tools. The values shown on the color reader are L* (brightness-dark), a* (red-green) and b* (yellow-blue) (Gunal et al., 2008).

E. Respiration Rate Test

Testing the respiration rate using the titration method with modifications to the ripening stage (Amalia et al., 2020).

$$\text{Respiration rate} = \frac{(t\ sample - t\ blangko)\ x\ N\ HCl}{Weight\ sample/\ time(hour)} \quad (3)$$

2.5 Data Analysis

The data obtained were analyzed statistically using ANOVA with the posthoc Duncan's New Multiple Range Test (DNMRT) at 5% significance level. Research results continued to determine the best treatment of edible coating by using multiple attributes, namely based on certain criteria from the results of the analysis of water content, weight loss, and respiration rate.

3. RESULTS AND DISCUSSION

3.1 pH Value

The pH test was carried out as one of the chemical parameter tests with the aim of knowing the acidity level of red chilies. The results of the initial pH test on red chili before it was carried out edible coating, namely 6. Post Harvest processing using the method of edible coating Konjac flour and chitosan are expected to be able to maintain the quality characteristics of red chili, one of which is the level of acidity. It could happen because changes in fruit pH occur due to an increase or decrease in H ions inside the fruit. The results of the red chili pH test can be seen in Figure 1.

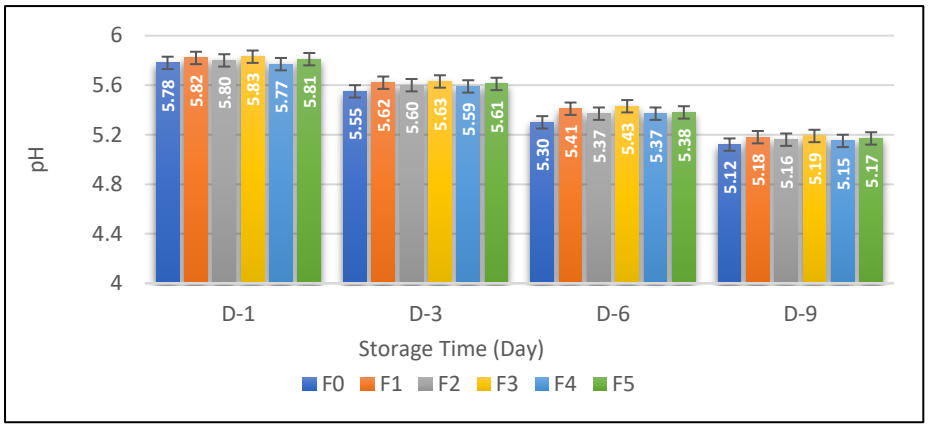

Figure 1. pH Value changes during storage

Based on Figure 1, the results showed that red chili decreased from day 1 to day 9 in all treatments. In the F0 treatment, the lowest decrease was 5.78 to 5.12, while the treatment that experienced the highest decrease occurred in the F3 treatment, which was 5.83 to 5.19. In storage conditions at room temperature, what matters is time. It caused a decrease in pH, but not significantly. On the 9th day, F0 without treatment experienced the lowest decrease, while the coated red chili edible coating was higher due to plating edible coating. This reduces substrate contact with microorganisms. Sulistyaningrum's research (2018), the longer curly chili is stored, the pH decreases, and the effect of packaging or without packaging. The decrease in pH was due to the degradation of carbohydrate compounds into organic acids during storage (Sidabalok, 2021). The increased acid content causes the pH to decrease. Therefore, the longer the storage, the more metabolic reactions occur due to the activity of microorganisms that break down sucrose into organic acids.

3.2 Water Content Test Results

Physiological activities can cause disturbances in plant materials, including evaporation or transpiration, breathing or respiration, and physiological changes. It can affect several content factors contained in food ingredients so proper storage treatment is needed so that they can be preserved. One of the important factors contained in food ingredients is the water content. The water content contained in foodstuffs can be in the form of intracellular and or extracellular components as a solvent medium in various products. Red chili before edible coating has a moisture content of 90%. The process of handling fresh vegetables is necessary for humidity control so that loss of moisture content and damage during storage can be avoided.

Post Harvest processing using the method of edible coating Konjac flour and chitosan are expected to be able to maintain the quality characteristics of red chili, one of which is water content. Edible Coating produced with Konjac flour can produce Edible Coating which has strong adhesive power; based on the adhesive properties of Konjac flour, it is better when compared to other adhesives such as corn and rice, so it can function to provide a selective barrier against the movement of gases, water vapor and dissolved materials, as well as protection against mechanical damage so that the decrease in the moisture content of the ingredients can be suppressed (Amalia et al., 2020). Moisture content is done by calculating the amount of water content contained in a material using the drying method with an oven during storage time can be seen in the diagram of the results of the research on water content presented in Figure 2.

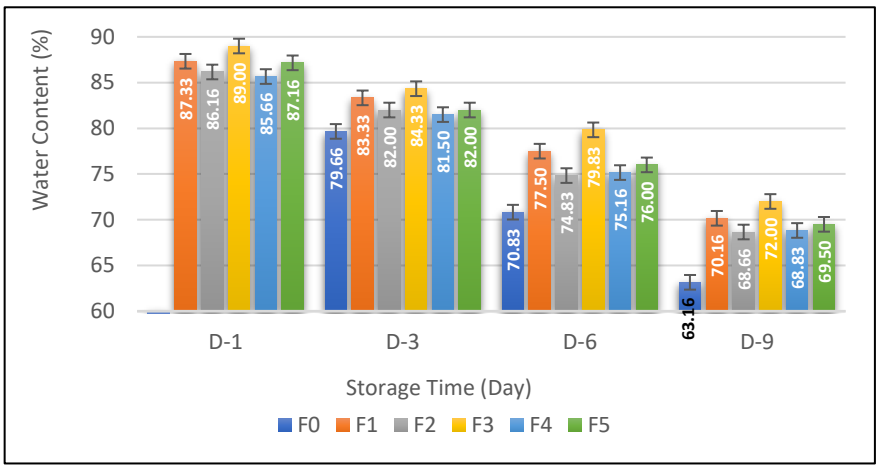

Figure 2. Water Level Test Results

Based on Figure 2, it was found that red chili experienced a decrease in water content from day 1 to day 9. The highest shrinkage occurred in the F0 treatment of 85.16% to 63.16%, while red chili with edible coating Konjac flour and chitosan, which experienced the lowest shrinkage, occurred in the F3 treatment of 89.00% to 72.00%. Changes in red chili water content are affected by storage time. In storage conditions at room temperature, the moisture content decreased with each treatment, which affected time. On the 9th day of storage showed the most significant decrease. According to Sembara (2021), the longer the storage life, the lower the water content in chilies coated with an edible coating made from taro starch on day 1 of 87.90% and day 6 of 75.17%. It could happen because the storage age increases the metabolic rate, and increases the loss of water in chilies, so they dry quickly and wrinkle. The coating method, edible Konjac flour, and chitosan function to provide a selective barrier against the movement of gases, water vapor, and dissolved materials, as well as protection against mechanical damage so that the decrease in the moisture content of the ingredients can be suppressed. Red chilies that are not treated do not have a barrier layer which can prevent water evaporation, so that the water content continues to decrease during storage. Edible coating with Konjac flour can inhibit the evaporation of water from inside the material. This inhibitory property is related to the hydrophilic nature of the polysaccharides (Murni et al., 2015). Application of edible coating Konjac flour can prevent dehydration, fat oxidation, and browning on the surface and reduce respiration rate (Amalia et al., 2020).

Chitosan with high concentration produces an edible coating which is thicker and able to inhibit the interaction between oxygen and fruit tissue so that the rate of respiration can be suppressed (Sitorus et al., 2014). The chilies used had a water content value on the first day 85.16 and on the 9th day 63.16, where the water content decreased by 25%, the decrease in water content was caused by reduced humidity and increased respiration rate due to the influence of chili storage time. According to Rukhana (2017), the water content in foodstuffs changes according to the environment and this is very closely related to the shelf life of food ingredients. Certain relationships exist between water activity, temperature, and nutrients. The water content values for all treatments in this study met the quality requirements based on Mikasari's research (2016), which ranged (60 - 90%).

3.3 Weight Loss Test

Horticultural products such as red chilies can make weight loss an indicator of a decrease in the quality of agricultural products. The initial weight of good, fresh red chilies before edible coating of 15g to 30g. Weight loss is one of the parameters that can be used to see the quality of the fruit after it is harvested. This is because after being harvested, the fruit still carries out physiological activities such as respiration and transpiration. The rates of respiration and transpiration that occur in red chili are not inhibited by any barrier substance. The increased weight loss during storage is caused by transpiration or the release of water in the fruit in the form of vapor through the surface of the fruit skin. In addition, the process of respiration also occurs, namely oxygen (O_2), which is absorbed by the fruit to decompose complex compounds into simple molecules such as carbon dioxide, energy, and water vapor (Al Suhendra et al., 2019).

The result showed that the fruit experienced changes in appearance and texture, such as softening, withering, and shrinking of the fruit (Vázquez et al., 2016). Post Harvest processing using the method of edible coating Konjac flour and chitosan are expected to be able to maintain the quality characteristics of red chili, one of which is weight loss. It could happen due to the coating method edible coating Konjac flour and chitosan function to provide a selective barrier against the transfer of gases, water vapor, and dissolved materials, and chitosan functions as a barrier so that water, gas, and energy produced in the fruit do not come out so that weight loss can be suppressed. The results of the research on red chili weight loss can be seen in the diagram presented in Figure 3.

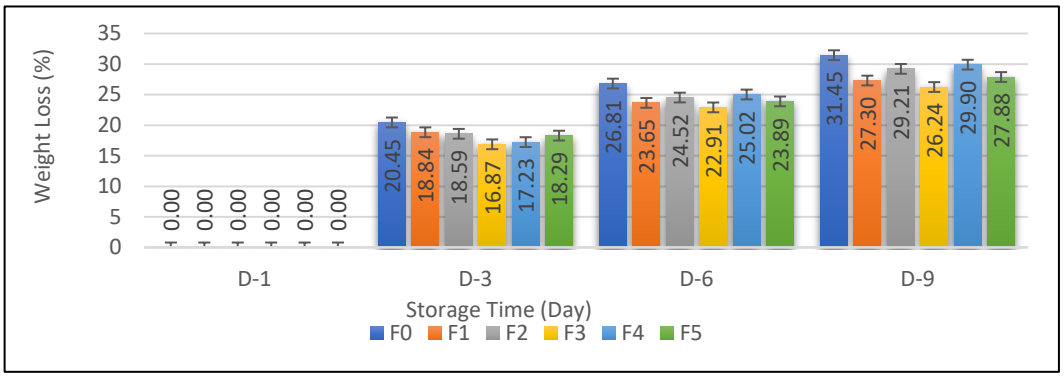

Figure 3. Weight Loss Test Results

Figure 3 shows data that chilies experience a weight loss process during the weight loss process. The highest shrinkage occurred in the F0 treatment of 20.45% to 31.41%, while red chili with edible coating Konjac flour and chitosan which experienced the lowest shrinkage occurred in the F3 treatment of 16.87% to 26.24%. This shows that the Edible Coating treatment can maintain the weight of the chilies. Red chilies that experienced the highest reduction in air content were found in F0 (without treatment). According to Susilowati et al. (2017), the higher the concentration of chitosan, the higher the thickness of the layer so that the pores of the fruit become closed, resulting in the respiration and transpiration processes being suppressed. The application of Edible Coating porang flour can prevent dehydration, fat oxidation, and browning on the surface and reduce the respiration rate by controlling the composition of CO2 and O2 gases in the atmosphere (Amalia et al., 2020). The reduction in the weight of red chilies occurs due to the loss of air and volatile components during processing and transpiration during the storage period (Marlina et al., 2014).

Red chilies have a high water content so losing air will result in a decrease in fruit weight. Based on the results of testing the water content and weight loss of red chilies during storage, the higher the reduction in water content, the higher the weight loss. The results of the correlation test between weight change and moisture content showed a value of -0.839. This result indicates that the correlation between these two components is inversely proportional. The correlation test results show that the relationship between weight loss and moisture content is very strong (0.839). The data show that an increase in weight loss will be accompanied by a decrease in moisture content. According to Kusumiyati et al. (2018) the longer the fruit is stored, the higher the weight loss of the fruit will be, besides that visually the fruit will become wrinkled. Loss of fruit weight during storage is caused by loss of air, which can reduce quality and cause damage. This air loss is caused by some of the air in the tissue experiencing evaporation or transpiration (Susilowati et al., 2017).

3.4 Respiration Rate Test

The decline in the quality of chili is caused by the respiration process which continues even though it has been harvested. The respiration process depends on the storage temperature, where the higher the storage temperature, the faster the respiration process takes place (Maftoonazad and Ramaswamy, 2019). Respiration is a process of absorption of oxygen (O_2) and release of carbon dioxide (CO_2) and the energy used to maintain metabolic reactions (Rahayu et al., 2021). Therefore, it is necessary to pack and coat vegetables which can reduce and suppress respiration and transpiration rates to prevent damage to vegetables (Nurlatifah et al., 2017). Post Harvest processing using the

method of edible coating Konjac flour and chitosan are expected to be able to maintain the quality characteristics of red chili, one of which is respiration rate. It could happen due to the coating method edible coating Konjac flour and chitosan function to provide a selective barrier against the transfer of gases, water vapor, and dissolved materials, and chitosan functions as a barrier so that water, gas, and energy produced in the fruit do not come out so that weight loss can be suppressed. The results of the research on the respiration rate of red chilies can be seen in the diagram presented in Figure 4.

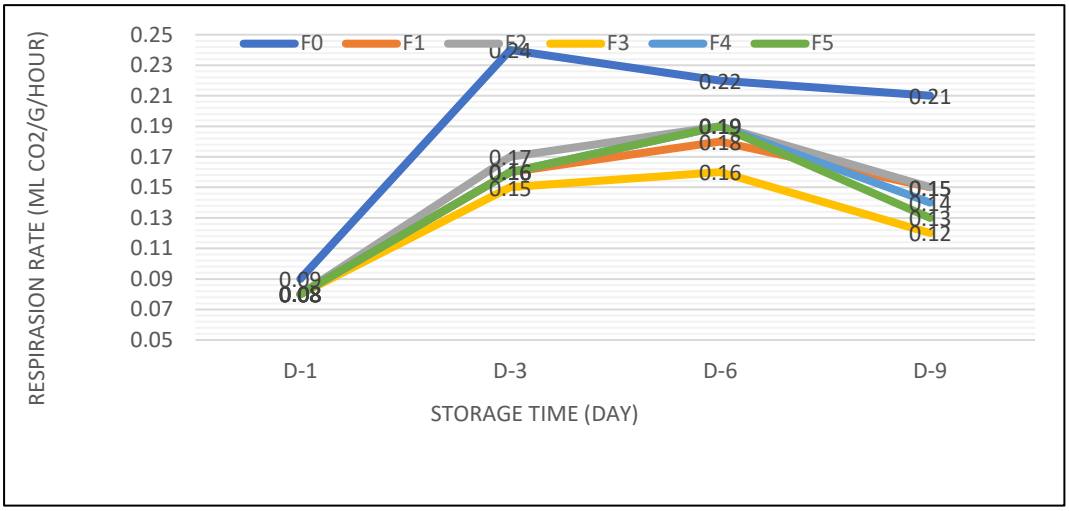

Figure 4. Respiration Rate Test Results

Based on Figure 4, the results of the respiration rate of red chilies during the room temperature storage process begin with an increase in respiration rate and then a decrease in respiration rate. Red chili is a climacteric fruit that has a climacteric pattern. The climacteric pattern is characterized by an increase in respiration rate, an increase in ethylene production, and physical and chemical changes in the fruit until finally it reaches a climacteric peak (Rahayu et al., 2021). F0 without treatment showed an increase in respiration rate from day 0 to day 3 and a decreased respiration rate from day 6 to day 9. Coated red chilies edible coating experiences a slower and lower climax peak on the 6th day, then declines on the 9th day. Treatment coating in this study is suspected to delay fruit ripening by modifying CO_2, O_2 and ethylene in fruit. Edible coating is able to reduce the amount of O_2 for respiration activity and limit the diffusion of CO_2 off the network. CO_2 internal in high fruit can also be delayed (Moalemiyan et al., 2012).

Edible coating with Konjac flour can inhibit the evaporation of water from inside the material. This inhibitory property is related to the hydrophilic nature of the polysaccharides (Murni et al., 2015). Application edible coating Konjac flour can prevent dehydration, fat oxidation and browning on the surface and reduce respiration rate by controlling the composition of CO_2 and O_2 in the atmosphere (Amalia et al., 2020). Making process edible coating Konjac flour with a heating temperature of 60^oC and the stirring time t=30 minutes for Konjac flour there is still an increase in viscosity. Glucomannan molecule chains at 75^oC - 90^oC, there is a change in the physical properties of the Konjac flour solution so that at this heating temperature, the final viscosity value is lower when compared to heating at 60^oC. Higher viscosity values lead to better solution stability, which is characterized by a more stable material because the movement of particles tends to be difficult the more viscous a material is. The result showed that the application of edible coating could inhibit the rate of respiration, the inhibition of the rate of respiration is due to edible coating on the surface of the fruit covering the lenticels and cuticles.

Konjac flour is a hydrophilic compound so the film matrix breaks easily because it binds to water components in the environment, while the formulation of the addition of chitosan as a hydrophobic component in edible coating polysaccharides is known to be able to increase the gas barrier so that it can significantly reduce the respiration rate of fruit (Velickova et al., 2013). It caused F3 to experience the lowest respiration rate.

3.5 Color Test

Color is an important component in determining the quality or degree of acceptance of a food ingredient. Determining the quality of a material, one of which is the color factor which is considered

visually. Color changes in large red chilies can be done by calculating the values of L, a, and b. The value of L indicates the brightness level of dark and light colors, the value of an indicates the chromatic color level of red and green, and the value of b indicates the chromatic color level of yellow and blue.

3.5.1 Value of L*

In general, fruits and vegetables experienced a decrease in quality, one of which is the color brightness level during postharvest. Post Harvest processing innovation using the method of edible coating Konjac flour and chitosan are expected to be able to maintain the quality characteristics of large red chilies, one of which is the brightness level of large red chilies. The results of measuring the brightness of the red chili color are expressed in the form of the Value of L* obtained from using a color reader. Color L test results on good and fresh red chilies before edible coating is 71.00 to 75.00. Color L shows the difference in brightness between dark and light colors. The higher the Value of L*, the brighter the captured color, while the lower the L* value, the darker the captured color. The L*value is between 0 and 100. The Value of L* is the result of research in Figure 5.

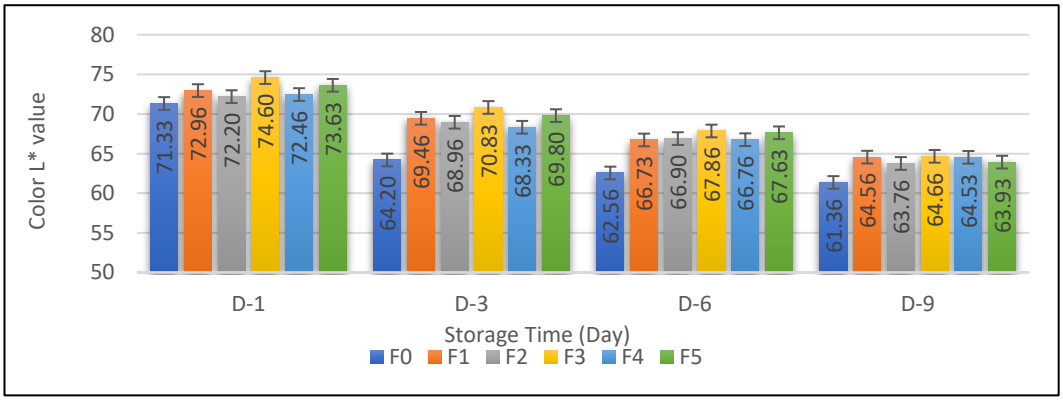

Figure 5. Red Chili Value of L* Color Test Results

Based on Figure 5, the color value of L*red chili decreased from day 0 to day 9. The F0 treatment experienced the lowest brightness level of 61.36. The cause of the decrease in the value of the brightness level is damage to the carotenoid pigments contained in red chilies. Pratiwi (2019), the decrease in brightness level is caused by the nature of β-carotene contained in chili experiencing oxidation and also β-carotene which is sensitive to light because light affects the oxidation of β-carotene resulting in carotenoid damage which accelerates the color change of red chilies to dark.

Vegetables in storage still carry out physiological activities, namely the process of respiration. Mutia et al. (2014), during the respiration process, an enzymatic process occurs, which causes the overhaul of complex compounds to form energy with the end result in the form of water and carbon dioxide, which are released into the air, resulting in a decrease in weight during storage. Lamona (2015), the color change of red chilies during storage is caused by the gradual oxidation of carotene and xanthophyll pigments due to contact with free air.

Discoloration of fruits and vegetables can occur along with a decrease in quality due to metabolic processes that affect the physical appearance of the product during storage. When fruits and vegetables are stored at low temperatures or room temperature, the product changes color because the product tries to balance the chemical and water content due to a lack of O_2 so that there is a change in the chemical process, namely fermentation, which causes the product to release water in its body so that light reflects due to the presence of a layer of water on the surface of fruits and vegetables. The result showed that the fruit experienced changes in appearance and texture, such as softening, withering and shrinking of the fruit (Vázquez et al., 2016). The color change in chilies is also caused by rot caused by the fungus species *Colletotrichum sp*. The fruit rot in red chilies is presented in Figure 6.

Figure 6. Anthracnose Fruit Rot on Red Chili

Chili fruit that has anthracnose disease has signs of small round brown spots on the fruit. The spots will widen, and if the quantity increases, they will connect with other spots and form large, non-round spots. If the spots are complete, they will make the fruit too dry out and shrivel to a dark brownish color (Inaya et al., 2022). It could happen in line with the results of a study which showed that F0, F2, and F4 experienced anthracnose disease in red chilies at first showing symptoms of round black dots on the skin of the fruit, then the black area widened with almost 50% of the fruit surface turning black and in that area the fruit looks soft because of rot. If at a high level of severity, the symptoms are experienced, namely, the whole fruit turns brown or even black in color with the whole fruit drying and wrinkled (wrinkled). The development of this species of fungus in infecting chilies is strongly influenced by environmental aspects such as pH, temperature, and humidity.

3.5.2 Value of a*

The color Value of a* indicates the value of the red and green chromatic differences. , The color test result value of a* on good and fresh red chilies before edible coating is 5 to 6. If the color a*value increases, then the color tends to be red, and if the value of a* decreases, then the color tends to be green. The result showed that the color of red chili and its influence on edible coating Konjac flour and chitosan are found in Figure 6.

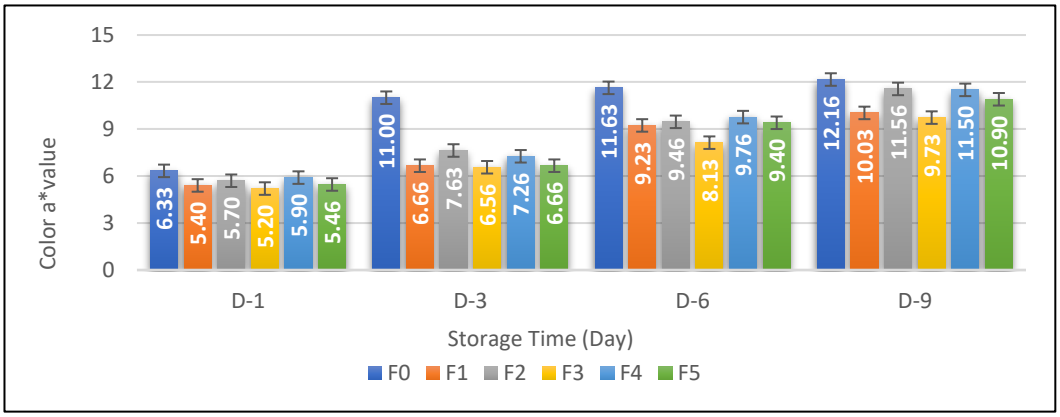

Figure 7. Color Test Results Value of a* Red Chili

Based on Figure 6, it was found that red chili experienced an increase in color value of a* from day 1 to day 9. The color value of a*, which experienced the highest increase, was in the F0 treatment of 12.16. F0 has the highest value, this is because the chili has undergone decay so that the color tends to be red. The red color change is caused by the degradation of carotenoids in red chilies. Jonathan (2011), color changes occur due to carotenoid degradation in chilies. Pigments in chili include β-carotene, lutein, and capsanthin, which are types of provitamin A. Edible coating Konjac flour and chitosan are able to suppress the rate of respiration, which causes the acceleration of the red color in chilies.

3.5.3 Value of b*

Color b shows yellow and blue chromatic colors, if color b increases, then the color is close to yellow, and if the value decreases, then the color is close to blue. The results of the b color test on

good and fresh red chilies before being edible coating, namely 3 to 4. The results of the measurement of the color value of b* of red chili with edible coating Conjac flour and chitosan in Figure 8.

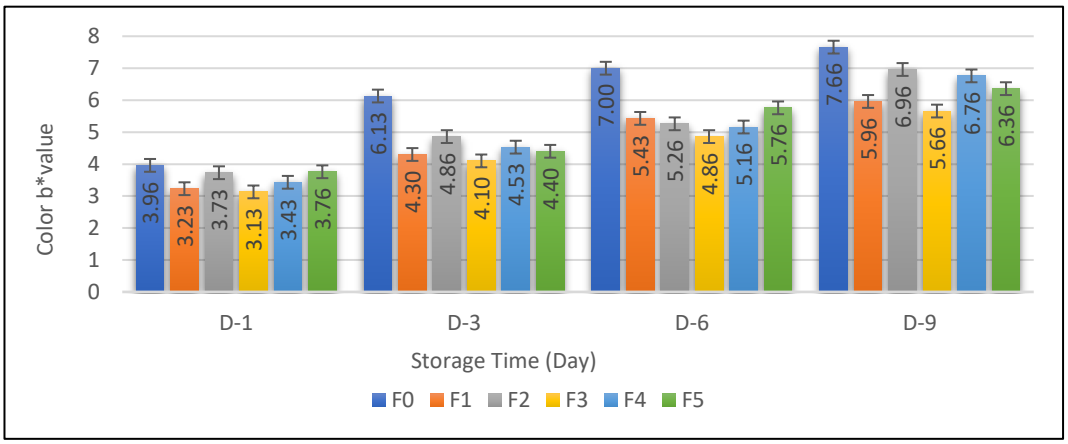

Figure 8. Color Test Results value of b* Red Chili

Based on Figure 4.7, the results show that the color b*value of red chili has increased from day 1 to day 9. The highest increase in b*value color was found in the F0 treatment of 7.66. The yellow-red discoloration is due to the decomposition of carotenoid pigments. Jonathan (2011), the yellow color of chili is caused by browning maillard non-enzymatic, formation of brown pigment, and decomposition of carotenoid pigments.

4. CONCLUSIONS

Based on the results of the research, it can be concluded that Edible Coating produced from Konjac flour and chitosan is effective for development because it can produce low air content, low weight loss, and low respiration rate, which indicates a longer shelf life of red chilies. The best treatment was obtained in the F3 treatment with the results of a slower and lower climax respiration rate on day 6. In addition, on the last day of storage, (day 9), pH was 5.19, air content was 72.00%, weight loss was 26.24 %, color L 64.66, color a 9.73, and color b 5.66.

REFERENCES

Al Suhendra, Ridawati, & Santoso, A. I. 2019. Pengaruh penggunaan edible coating terhadap susut bobot, pH, dan karakteristik organoleptik buah potong pada penyajian hidangan dessert. Seminar Nasional FMIPA-UT, 52(1), 1–5. Doi: http://repository.ut.ac.id/id/eprint/2377

Amalia, U. N, Maharani, S, & Widiaputri, S. I. 2020. Aplikasi edible coating pati umbi Konjac dengan penambahan ekstrak lengkuas pada buah pisang. Jurnal Edufortech, 5(1), 36-43. Doi: http://ejournal.upi.edu/index.php/edufortech

Association of Official Analytical Chemists [AOAC]. 2012. Official Methods of Analysis of AOAC International, 19 th edition. Washington DC (US): AOAC International.

Badan Pusat Statistik. 2022. Distribusi Perdagangan Komoditas Cabai Merah Indonesia 2022. 3. BPS RI. Doi: https://www.bps.go.id/publication/2022/10/24/1c3eb22e94bf4523bc029d1b/distribusi-perdagangan-komoditas-cabai-merah-di-indonesia-2022.html

Gunal, H, Ersahin, S, Yetgin, B, & Kutlu, T. 2008. Use of chroma meter-measured color parameters in esti- mating color-related soil variables. Communications in Soil Science and Plant Analysis, 39(5), 726-740. Doi: http://dx.doi.org/10.1080/00103620701879422

Inaya, N, Meriem, S, & Masriany. 2022. Identifikasi morfologi penyakit tanaman cabai yang disebabkan oleh patogen dan serangan hama lingkup kampus UIN Alauddin Makassar. Jurnal Mahasiswa Biologi, 2(1), 1-4. Doi: https://doi.org/10.24252/filogeni.v2i1.27092

Jonathan, R. 2011. Perubahan kandungan β-karoten dan warna pada cabai rawit merah selama pengeringan dengan menggunakan cabinet dryer, solar tunnel dryer, dan freeze dryer. Universitas Katolik Soegijapranata, Semarang.

Kusumiyati, Farida, W, Sutari, J.S, Hamdani, S, & Mubarok. 2018. Pengaruh waktu simpan terhadap nilai total padatan terlarut, kekerasan dan susut bobot buah mangga arumanis. Jurnal Kultivasi, 17(3), 766-771. Doi: https://doi.org/10.24198/kultivasi.v17i3.18698

Lamona, A, Purwanto, Y. A, & Sutrisno, S. 2015. Effect of different packaging and low temperature storage on the quality changes of fresh red curly chili. Jurnal Keteknikan Pertanian, 3(2),1–8. Doi: http://journal.ipb.ac.id/index.php/jtep

Maftoonazad, N, & Ramaswamy, H. S. 2019. Application and evaluation of a pectin-based edible coating process for quality change kinetics and shelf-life extension of lime fruit. Coatings, 285 (9), 1-14. Doi: https://doi.org/10.3390/coatings9050285

Marlina, L, Purwanto, Y. A, & Ahmad, U. 2014. Aplikasi pelapisan kitosan dan lilin lebah untuk meningkatkan umur simpan salak pondoh. Jurnal Keteknikan Pertanian, 2(1), 65–72. Doi: https://doi.org/10.19028/jtep.02.1.%25p

Marwina, R, Agustina, R, & Putra, B. S. 2016. Perubahan mutu tomat dengan variasi konsentrasi pelapisan gel lidah buaya dan suhu penyimpanan. Jurnal Ilmiah Mahasiswa Pertanian, 1(1), 985–994. 6 Doi: www.jim.unsyiah.ac.id/JFP

Mikasari, W. 2016. Peningkatan nilai tambah komoditas cabai melalui penerapan inovasi penyimpanan dan pengeringan di Provinsi Bengkulu. Badan Pengkajian Teknologi Pertanian Bengkulu.

Moalemiyan, M., dan Ramaswamy, H. S. 2012. Quality retention and shelf-life extension in mediterranean cucumbers coated with a pectin-based film. Journal of Food Research, 1(3), 159-166. Doi: http://dx.doi.org/10.5539/jfr.v1n3p159

Murni, S.W., Pawignyo H., Widyawati D., dan Sari N. 2015. Pembuatan Edible Film dari Tepung Jagung dan Kitosan. Jurnal Pengembangan Teknologi Kimia untuk Pengolahan Sumber Daya Alam Indonesia, B17, 1-9. http://jurnal.upnyk.ac.id/index.php/kejuangan/article-/view/407.

Mutia A.K., Purwanto Y.A., dan Pujantoro L. 2014. Perubahan kualitas bawang merah (Allium Ascalonicum L) selama penyimpanan pada tingkat kadar air dan suhu yang berbeda. jurnal pascapanen, 11(2), 108- 115. Doi: https://repository.pertanian.go.id/items/28124dcf-93b3-440a-bd73-135af37d7bc8/full

Nawab, A, Alam, F, & Hasnain, A. 2017. Mango kernel starch as a novel edible coating for enhancing shelf- life of tomato fruit. International Journal of Biological Macromolecules, 103, 581–586. Doi: 10.1016/j.ijbiomac.2017.05.057

Nurlatifah, D, Cakrawati, & Nurcahyani, P. R. 2017. Aplikasi edible coating dari pati umbi Conjac dengan penambahan ekstrak lengkuas merah pada buah langsat. Jurnal Edufortech, 2 (1), 7-14. Doi: https://doi.org/10.17509/edufortech.v2i1.6166

Pratiwi, I. 2019. Pengaruh suhu dan waktu exhausting terhadap kualitas puree cabai merah selama penyimpanan. Universitas Jambi, Jambi.

Rahayu, D, Bintoro, N, & Saputro, A. D. 2021. Pemodelan laju respirasi buah klimakterik selama penyimpanan pada suhu yang bervariasi. Jurnal Agrointek, 15(1), 80–91. Doi: https://journal.trunojoyo.ac.id/agrointek/article/view/7625/pdf

Rohim, M, Destiarti, L, & Zaharah, T. A. 2015. Uji organoleptis produk tahu tersalut kitosan. Jurnal Kimia Khatulistiwa, 4(3), 54–58. Doi: https://jurnal.untan.ac.id/index.php/jkkmipa/article/view-/10623

Sembara, E. L., Yurnalis & Salihat, R. A. 2021. Aplikasi edible coating pati talas dengan gliserol sebagai plasticizer pada penyimpanan cabai merah. Journal of Scientech Research and Development, 3(2), 134-145. Doi: http://idm.or.id/JSCR

Sidabalok, I, Fitria, E. A, Susanto, A, & Karina, I. 2012. Application of edible coating breadfruit starch against cayenne pepper storage at room temperature. Jurnal Teknologi Industri Pertanian, 33(1), 72-78. Doi: https://doi.org/10.24961/j.tek.ind.pert.2023.33.1.72

Sitorus, R. F, Karo, T, & Lubis, T. 2014. Pengaruh konsentrasi kitosan sebagai edible coating dan lama penyimpanan terhadap mutu buah jambu buah merah. Jurnal Rekayasa Pangan dan Pertanian, 2(1), 37-46. Doi: https://talenta.usu.ac.id/index.php/jrpp

Sulistyaningrum, A, & Darudriyo. 2018. Penurunan kualitas cabai rawit selama penyimpanan dalam suhu ruang. Jurnal Agronida, 4(2), 64-71. Doi: https://ojs.unida.ac.id/JAG

Susilowati, P. E, Fitri, A, & Natsir, M. (2017). Penggunaan pektin kulit buah kakao sebagai edible coating pada kualitas buah tomat dan masa simpan. Jurnal Aplikasi Teknologi Pangan, 6(2), 1- 4. Doi: http://dx.doi.org/10.17728/jatp.193

Vázquez, D. C, Ramos, H, Rivera, D. M, Barrios, M. E, & Mercado, E. M. 2016. Effects of waxing, microperforated polyethylene bag, 1-methylcyclopropene and nitric oxide on firmness and shrivel and weight loss of "Manila " mango fruit during ripening. Postharvest Biology and Technology, 111, 398–405. Doi: 10.1016/j.postharvbio.2015.09.030