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APPLICATION OF EDIBLE COATING BREADFRUIT STARCH AGAINST CAYENNE PEPPER (*Capsicum frustescens*) STORAGE AT ROOM TEMPERATURE

APLIKASI EDIBLE COATING PATI SUKUN TERHADAP PENYIMPANAN CABAI RAWIT (Capsicum frustescens) PADA SUHU RUANG

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ABSTRAK

Tujuan dari penelitian ini adalah untuk mengetahui pengaruh edible coating pati sukun terhadap mutu cabai rawit (Capsicum frestenscens) dan untuk mengetahui berapa lama penyimpanan optimal cabai rawit (capsicum frestenscens) yang dilapisi edible coating pati sukun dan disimpan suhu ruang. Penelitian ini menggunakan Rancangan Acak Lengkap (RAL) dengan 5 taraf perlakuan dan 3 kali ulangan. Data hasil pengamatan dianalisis menggunakan ANOVA dan uji lanjut DNMRT pada taraf 1%. Perlakuan pada penelitian ini adalah lama penyimpanan cabai rawit yang dilapisi edible coating selama 3,6,9,12 dan 15 hari. Hasil penelitian menunjukkan bahwa lama penyimpanan cabai rawit yang dilapisi edible coating berpengaruh nyata terhadap kadar air, vitamin C, pH, dan susut bobot. Berdasarkan hasil uji warna dan tekstur pada cabai rawit yang dilapisi edible coating menunjukkan bahwa penyimpanan cabai rawit hingga hari ke 3 yang paling disukai oleh panelis dengan kadar air 85,32%, kadar vitamin C 268,36 mg/100 g, pH cabai rawit 3,35 dan susut bobot 22,44%.

Kata kunci: edible coating, pati sukun, cabai rawit

ABSTRACT

This study aimed to determine the effect of edible coating of breadfruit starch on the quality of cayenne pepper and to find out how long the optimal storage of cayenne pepper coated with an edible coating breadfruit starch and stored at room temperature. This study used a complete randomized design with 5 treatments and 3 data tests. The observation results were analyzed using ANOVA and the continued test DNMRT at the rate of 1%. The treatment in this study was the duration of storage of cayenne pepper coated with edible coating for 3, 6, 9, 12, and 15 days. The results showed that the length of storage of cayenne pepper coated with edible coating had a significant effect on water content, vitamin C, pH, and weight loss. Based on the color and texture test results of cayenne pepper coated with edible coating, it was shown that storage up to day 3 was most preferred by the panelists, with a moisture content of 85.32%, vitamin C content of 268.36 mg/100 g, pH of 3.35, and weight loss of 22.44%.

Keywords: edible coating, breadfruit starch, cayenne pepper

INTRODUCTION

Cayenne pepper is one of the horticultural crops with a high economic value, since it can be used as both spice and industrial ingredient (Cahyono, 2003). The downside of cayenne pepper is its relatively short shelf life, which is two to three days if stored at room temperature after post-harvesting (Sunyoto *et al.,* 2016). Therefore, appropriate post-harvest management of cayenne pepper is required to extend the storage life of cayenne pepper without causing a significant decrease in cayenne pepper's quality or impacting the economic value of chili as a result of the storage process.

One way to extend the shelf life of cayenne pepper is to do packaging or coating. One of the packaging technologies that can extend the shelf life of cayenne pepper is by using edible coatings. According to Mardiana (2008), edible coating forms a semipermeable layer so that it is able to modify the internal atmosphere in vegetables, thereby delaying maturity and decreasing the transpiration rate of vegetables. The edible coating is also considered as environmental-friendly packaging as it is easily degraded by microbes or biodegradable.

The edible coating is a thin layer that is made and can be consumed directly. The advantages of products packaged with edible coatings include: (a) reducing water activity on the surface of the material, so that damage to microorganisms can be avoided; (b) improving the surface structure of the material such that the surface becomes shiny; (c) reducing

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dehydration, hence preventing weight loss; (d) reducing oxygen contact with ingredients, thereby the oxidation or rancidity can be inhibited; (e) having original properties that do not change e.g., flavor; and (f) improving product appearance (Santoso *et al.*, 2004).

Numerous studies on edible coatings have been conducted. Generally, edible coatings are composed of hydrophilic substances. Starch (carbohydrates) or protein are two hydrophilic substances that are frequently employed as coatings' primary components. The edible film has three basic components: hydrocolloids, lipids, and composites. Edible coatings must prevent the transfer of O_2, CO_2, and lipids. Starch is one of the abundantly available polysaccharides in nature that is easy to degrade, to get, and to obtain. Starch can also make a somewhat robust covering (García *et al.*, 2011). Starch is a carbohydrate that consists of amylose acid and amylopectin and is a glucose polymer (Herawati, 2011). Starch is utilized extensively as an industrial raw ingredient, particularly in the food, textile, cosmetic, and paper sectors. One source of starch that can be used for edible coatings is starch from breadfruit.

The starch content of breadfruit is 60%. However, its utilization is not yet optimal despite its abundance in nearly every region of Indonesia. Breadfruit (*Artocarpus communis*) is an alternative food crop in Indonesia that was not first widely cultivated but is now extremely common. By and large, the community processes breadfruit into traditional meals such as fried breadfruit, compote, *getuk* breadfruit, and chips (Suprapti, 2002). In addition to being processed into completed items, breadfruit is also processed into breadfruit starch, a semi-finished product.

Breadfruit starch was used in this study as the use of breadfruit until now has not been widely used. Breadfruit starch contains B-complex vitamins, vitamin C, beta-carotene, potassium, and calcium in breadfruit which is also very effective in helping relieve stomach inflammation. The starch content in breadfruit is 18.5 g/100 g with a purity of 98.86%, amylose content of 27.68%, and amylopectin of 72.32% (Rincón and Padilla, 2004). Edible coating made from hydrocolloids has several advantages, including protecting the product against oxygen, carbon dioxide and lipids, and having the desired mechanical properties. While the drawback is that it is not good in terms of barrier towards water vapor migration (Rodríguez *et al.*, 2006).

The addition of a plasticizer will prevent the coating from cracking during handling and storage which can reduce the barrier properties. Plasticizer is an organic material with low molecular weight being added to weaken the rigidness of a coating. Plasticizer can increase the flexibility and durability of coating. The plasticizer that is generally used in the manufacture of edible coatings is glycerol. This research aims to determine the effect of breadfruit starch edible coating on the quality of cayenne pepper (*Capsicum frestenscens*) and the optimal storage time for cayenne pepper (*Capsicum frestenscens*) which has been coated with breadfruit starch edible coating and stored at room temperature.

MATERIALS AND METHODS

Materials

The raw materials used in this study were breadfruit starch and cayenne pepper, 2% glycerol, salt, and distilled water. The equipments for extracting breadfruit starch are blender and filter cloth. Other equipments were cabinet dryer, knife, and balance. For edible coating, the equipments are blender glass, hot plate, volume pipette, stirrer, magnetic stirrer, thermometer, and analytical balance. Other equipments include vessel, knife, grater, 100 mesh sieve, filter cloth, penetrometer, haracus oven, cup, erlenmeyer, desiccator, analytical balance, beaker glass, flask, test tube, measuring cup, blender (Philips), dropping pipette, measuring pipette, 25 mL volume pipette, volumetric flask, 25 mL burette, hot plate (EYELA), stir bar, thermometer, plastic, camera, label paper, 2 cm magnetic stirrer, and stationeries.

Research Methods

This research was conducted in three stages: making breadfruit starch, making an edible coating of breadfruit starch, and applying cayenne pepper with an edible coating of breadfruit starch.

Making Breadfruit Starch

The making process was started by peeling the skin of the breadfruit and reducing the size and then washing it clean. The pieces were then soaked in 0.1% salt solution for 1 hour. After an hour, the soaked results were crushed with a blender with the addition of water (1:4) and then filtered with a filter cloth. The precipitate was obtained for 24 hours and then dried in an oven at 40 °C. After the breadfruit starch was dried, it was then sieved through an 80-mesh sieve.

Making Edible Coating of Breadfruit Starch

The making process was started by dissolving 4 g breadfruit starch in 100 mL of distilled water and heating it until it reached the gelatinization temperature (70-75 °C). Then, 2 mL of glycerol was added after gelatinization was achieved. It was then heated at 70-75 °C for 30 minutes to mix, followed by cooling it to room temperature.

Application of Cayenne Pepper with Edible Coating of Breadfruit Starch

An edible coating of breadfruit starch was applied to cayenne pepper by immersion. The immersion was done by holding the cayenne pepper stalk and then dipping it in the edible coating of breadfruit starch solution for ±5 seconds. Finally, it was removed and dried at room temperature for 3-5 minutes.

Figure 1. Cayenne pepper: A. Without being coated by edible coating and B. Being coated by edible coating

Observation Variables

Observation variables were carried out on parameters including quality tests, i.e., water content (AOAC, 2005), vitamin C (AOAC, 2005), pH (Munandar and Nurjanah, 2009), weight loss (Mardiana, 2008), color and texture (Setyaningsih *et al.*, 2014) during storage of cayenne pepper.

Data Analysis

The design used in this study was a completely randomized design (CRD) with 5 treatment variations in storage time and 3 replications. The data obtained were analyzed statistically using ANOVA with the F-test and the continued Duncan's New Multiple Range Test (DNMRT) at 1% content.

RESULTS AND DISCUSSION

The analysis of diversity showed that the difference in storage time for cayenne pepper coated with edible coating significantly affected water content, vitamin C, pH, weight loss, color, and texture. In addition, the analysis results were compared to the control to determine if the samples coated with edible coating performed better compared to those without coating.

Water Content

Figure 2 shows that the water content of cayenne pepper coated with edible coating having the lowest water content was on day 15 of 54.80%, compared to other treatments. The longer the cayenne pepper was stored, the water content value decreased. The stored cayenne pepper experienced dryness and evaporation of water content. In general, the water content in samples coated with edible coating is higher than that of uncoated cayenne pepper. The research conducted by Karmida *et al.* (2022) on cayenne pepper coated with an edible coating also exhibited the same thing, the lowest water content was obtained from cayenne pepper with shelf life of 21 days. This was also in accordance with the results of research conducted by Megawati and Johannes (2017), which showed that the longer cayenne pepper was stored, water content contained in cayenne pepper would also decrease. The use of edible coatings on cayenne pepper could inhibit evaporation thereby increasing or extending the shelf life. This was aligned with by Rustan *et al.* (2017) research where the use of sago starch edible coating could extend the shelf life of cayenne pepper up to 15 days. Karmida *et al.* (2022) also showed that the highest water content was found in cayenne pepper with the shortest shelf life of 7 days and had been shown to extend the storage time of cayenne pepper up to 14 days.

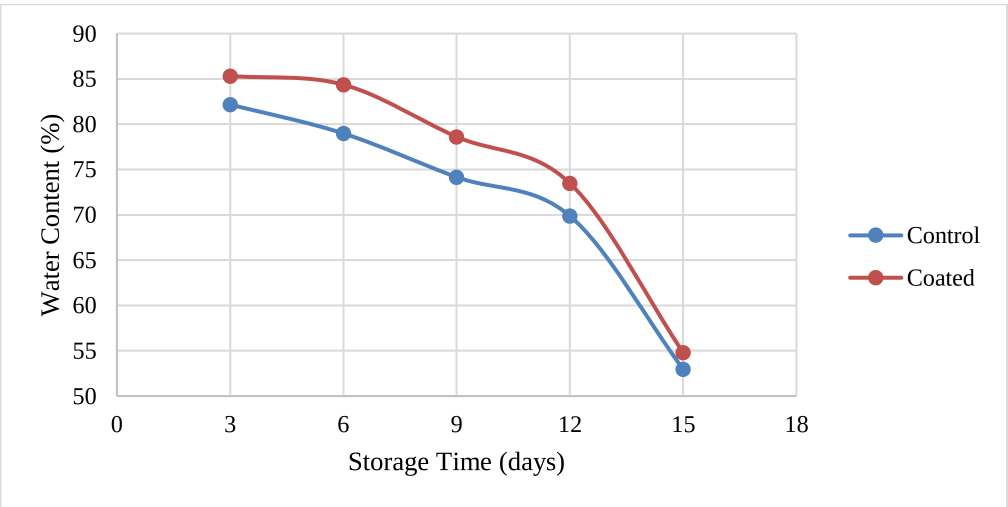

Figure 2. Water content analysis results

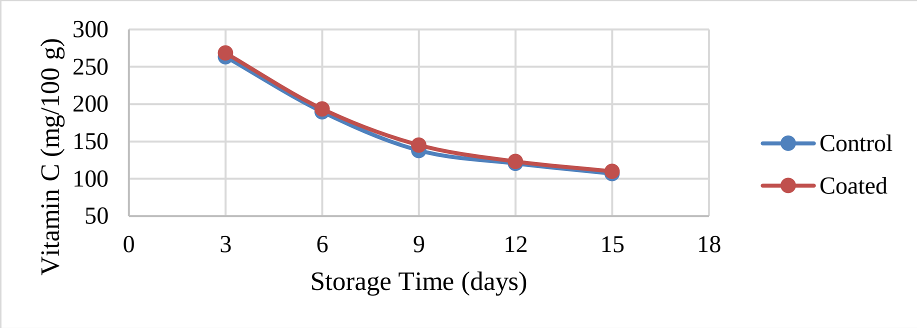

Figure 3. Vitamin C content analysis results

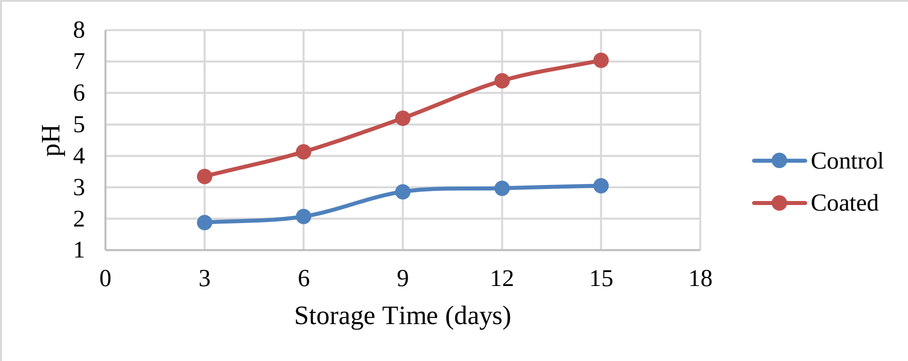

Figure 4. pH measurement results

Figure 3 shows that vitamin C content was ranging between 100 and 270 mg/100 g. The highest vitamin C was found on day 3 of 268.36 mg/100 g whereas the lowest vitamin C was found on day 15 of 109.94 mg/100 g. In general, the difference in vitamin C content between cayenne pepper samples with and without edible coating is almost the same. The longer the cayenne pepper was stored, the vitamin C content decreased. The study results were aligned with Karmida *et al.* (2022) findings in which the highest contents of vitamin C were produced by chilies coated by an edible coating with a storage time of 7, 14, and 21 days. Long storage time is one of the causes of the decline in vitamin C contents in cayenne pepper. According to the research of Safaryani *et al.* (2007), the connection between temperature and storage period impacts the decline in vitamin C and other compounds in fruits and vegetables. According to Rizky (2019), the respiration process can increase the metabolic rate, which causes vitamin C to undergo oxidation and decrease in concentration. Vitamin C oxidation, which is affected by the presence of oxygen, light, temperature, heat, and pH, is responsible for the decline in vitamin C contents in red chil. The oxidation of L-ascorbic acid also causes the decrease in vitamin C content to L-dehydroascorbic. Damage to the cell wall and the overripening process can contribute to the decline in vitamin C content (Parfiyanti *et al.*, 2016). Therefore, an edible coating layer could inhibit the entry of oxygen into the fruit which causes damage to vitamin C through oxidation reactions.

pH of Cayenne Pepper

pH is a quantitative measure of acidity used to express the degree of acidity or base that solution has (Wulandari, 2017). Figure 4 shows that the highest pH of cayenne pepper coated with edible coating was on day 15 of 7.04 and the lowest pH was on day 3 of 3.35. The longer the storage of cayenne pepper, the pH value increased. Generally, the pH of cayenne pepper samples with edible coating tends to be higher compared to those without edible coating. The increase in pH was caused by the enzymatic action of microorganisms or the food in general. This increase in pH value is likely not caused by the addition of edible coating. This is congruent with study conducted by Nofiandi *et al.* (2016), who produced edible coatings using breadfruit starch and found the pH of the edible coating to be neutral, between 7.06 and 7.10. This demonstrated that the edible coating produced was neutral. Therefore, it is conceivable that this is because cayenne pepper stalks contain nutrients that can affect pH, where pH is affected by hydroxide or hydrogen bonding in addition to anions and cations. The increase in pH of cayenne pepper coated with edible coating was also affected by the decrease in total acid, the lower the total acid, the higher the pH of cayenne pepper. This was in accordance with Simonovska *et al.* (2016), disclosing that cayenne pepper stalks had low Cu, Zn, and Fe content and had a high Mn content. It was also supported by Arifin (2016) stating that an increase in pH can be affected by excess cations and a decrease in pH is influenced by excess anions.

After fruit has been harvested, one of the characteristics that can be used to determine its quality is its weight loss. This is because the fruit continues to function in physiological processes such as respiration and transpiration after being harvested. Sembara *et al.* (2021) stated that the reduced volume or weight of post-harvest products is closely related to the physiological processes that are still ongoing in the product after it was harvested from the plant. Plants are living organisms that require nourishment to maintain their physiological activities. According to Yuliati (2018), as storage time increases, so does weight loss. The processes of respiration and transpiration contribute to the red chili's increased weight loss. This respiration process is a biological process in which oxygen is absorbed for use in the energy-producing combustion process, followed by the removal of combustion residue in the form of CO_2 and water. The chemical equation reaction that occurs during respiration is as follows:

$$C_6H_{12}O_6 + 6CO_2 \rightarrow 6H_2O + \text{energy}$$

Figure 4 shows that the highest weight loss of cayenne pepper coated with edible coating was on day 15 which was 71.63%, while the lowest weight loss was on day 3 of 22.44%. In general, the weight loss of cayenne pepper samples with edible coating is almost the same as those without edible coating. The longer the cayenne pepper was stored, the weight loss value increased. This is in accordance with the findings of Karmida *et al.* (2022) on cayenne pepper coated with an edible coating utilizing aloe vera gel, the greatest weight loss was observed after 21 days of storage.

In addition, Syaputra *et al.* (2020) stated that water loss resulted in an increase in weight loss in foodstuffs. Cayenne pepper is known to have a high-water content, therefore fruit that loses water will also lose weight. Kusumiyati *et al.* (2018) reported that the longer fruit is stored, the greater the fruit weight loss and the more wrinkled the fruit will seem. Based on the test results, it is known that the water content and weight loss of cayenne pepper occur during storage, and that as the water content decreases, so does the weight.

Organoleptic Test

Color

The color of a food ingredient or product is readily discernible prior to other variables. Color will have a direct impact on the panelists' perception. Table 1 shows the color assessment of cayenne pepper coated with an edible coating. On day 3, the color value was 6.47 and the panelist rated it as very like, whereas on day 15 the color value was 3.94 and the panelist rated it as dislike. The longer the cayenne pepper was stored, the less the panelists preferred it. Based on the results, the score obtained for the control was generally lower compared to the cayenne pepper coated with an edible coating. Cayenne pepper coated with edible coating was preferred on day 3 because the color remained bright green. This was because the edible coating can maintain the shiny color of cayenne pepper. This is in accordance with study conducted by Ariviani *et al.* (2019) who found that in addition to serving as a barrier, edible coating also prevented color deterioration during storage and clarified the resulting gel. On day 15, the panelists disliked the color since the chilies had begun to decay and were yellowish brown. The results of this study were also confirmed by research conducted by Sembara and Salihat (2021), which demonstrated that red chilies treated with an edible coating made from taro starch and glycerol could maintain their red color and freshness until the 6th day. Then, on the 15th day, the decomposition process begins. This is because the fruit continues to undergo respiration until the decomposition process is complete, even after it has been harvested (Susilowati, 2008).

Texture

Table 1 shows the texture values of cayenne pepper coated with an edible coating. On day 3, the texture value was 6.46 and the panelists rated it very like, whereas on day 15, the texture value was 3.86 and they rated it as dislike. The longer the cayenne pepper was stored, the more its texture deteriorated. After up to 15 days of storage, cayenne pepper turned dry and wrinkled in texture. Like the color test, the results of the texture test showed that cayenne pepper coated with an edible coating was preferred by the panelists compared to the control.

Table 1. Recapitulation of the average organoleptic test of coated cayenne pepper with edible coating

Storage time (days)	Score				Average Score	
	Color		*Texture*			
	Control	Coated	*Control*	*Coated*	Control	Coated
3	6.23	6.47	6.12	6.46	6.18	6.47
6	6.02	6.44	5.87	6.42	5.95	6.43
9	5.63	5.87	5.32	5.83	5.48	5.85
12	4.06	4.92	4.08	4.92	4.07	4.92
15	3.32	3.94	3.42	3.86	3.37	3.90

Note: The scale of favorability includes the following values: 7 = extremely like, 6 = very like, 5 = like, 4 = slightly like, 3 = dislike, 2 = very dislike, and 1 = extremely dislike; the value shaded in gray is the highest score.

The pectin content of fruits and vegetables' cell walls has a significant impact on the texture of their tissues. Pectin in immature tissues exists as protopectin, which is insoluble in water. During maturation, protopectin is transformed into water-soluble pectin (Pujimulyani, 2009). The transformation of protopectin into water-soluble pectin causes the texture of the cayenne pepper to soften. The loss in texture is caused by the high rate of transpiration, which causes the fruit's water content to decrease and its texture to become more rigid.

CONCLUSION AND SUGGESTION

Conclusion

The utilization of edible coating made from breadfruit starch on cayenne pepper significantly influenced its water content and pH, where the coated cayenne pepper had higher water content and pH compared to the control. Meanwhile, there was no significant difference observed in weight loss and vitamin C content between the treatment and control. Based on organoleptic tests (color and texture), panelists preferred cayenne pepper coated with edible breadfruit starch coating for up to 3 days of storage, with the value of water content of 85.32%, vitamin C content of 268.36 mg/100 g, pH 3.35, and weight loss of 22.44%. In addition, the 3-day storage treatment showed the highest vitamin C content compared to the other treatments or controls.

Suggestion

The application of the edible coating method using materials such as breadfruit starch can be tested to be applied to vegetables with short storage life such as spinach, lettuce, and cabbage, or on fruits with short shelf life such as bananas, papayas, and mangos. In addition, a comparison of the effectiveness of plant-based edible coatings with animal-based ones should be conducted. The implementation of nano edible coatings can also be used to enhance the effectiveness and safety of edible coatings. In this regard, nanoparticles can be utilized to enhance the antioxidant and antimicrobial properties as well as improve the penetration and durability of the edible coating.

REFERENCES

AOAC. 2005. *Official method of Analysis. 18th Edition, Association of Officiating Analytical Chemists*.

Arifin R. 2016. *Bisnis Hidroponik Ala Roni Kebun Sayur*. AgroMedia.

Ariviani S, Kusumawati M, and Atmaka W. 2019. Chitosan-garlic essential oil incorporation on beef meatball edible coatings as antioxidant-based functional food. *IOP Conference Series: Materials Science and Engineering*. 633(1): 012032, DOI: 10.1088/1757-899X/633/1/012032

Cahyono B. 2003. *Teknik Budidaya dan Analisis Usaha Tani Cabai Rawit*. Yogyakarta: Kanisius.

García NL, Ribba L, Dufresne A, Aranguren M, and Goyanes S. 2011. Effect of glycerol on the morphology of nanocomposites made from thermoplastic starch and starch nanocrystals. *Carbohydrate Polymers*. 84(1): 203–210, https://doi.org/10.1016/j.carbpol.2010.11.024

Herawati H. 2011. Potensi pengembangan produk pati tahan cerna sebagai pangan fungsional. *Jurnal Litbang Pertanian*. 30(1): 31–39. doi:10.21082/jp3.v30n1.2011.p31-39.

Karmida, Hayati R, and Marliah A. 2022. The Effect of Immersion Time in Aloe vera Gel Edible Coating and Storage Time On the Quality of Cayenne Papper (Capsicum frutescens L.). *Jurnal Floratek*. 17(2): 80–97.

Kusumiyati K, Farida F, Sutari W, Hamdani JS, and Mubarok S. 2018. Pengaruh waktu simpan terhadap nilai total padatan terlarut, kekerasan dan susut bobot buah mangga arumanis. *Kultivasi*. 17(3): 766–771, https://doi.org/10.24198/kultivasi.v17i3.18698

Mardiana K. 2008. *Pemanfaatan Gel Lidah Buaya Sebagai Edible Coating Buah Belimbing Manis (Averrhoa carambola L)*. Bogor: IPB.

Megawati SS and Johannes E. 2017. Pengaruh Perlakuan Penyimpanan Cabai Rawit (Capsicum Frutencens L) Var Cengek Terhadap Kandungan Vitamin C, Kadar Air Dan Kapsaisin). *Jurnal Aplikasi Teknologi Pangan*. 3(5): 1–8.

Munandar A and Nurjanah NM. 2009. Kemunduran mutu ikan nila (Oreochromis niloticus) pada penyimpanan suhu rendah dengan perlakuan cara kematian dan penyiangan. *Jurnal Pengolahan Hasil Perikanan Indonesia*. 12(2): 88–101.

Nofiandi D, Ningsih W, and Putri ASL. 2016. Pembuatan dan Karakterisasi Edible Film dari Poliblend Pati Sukun-Polivinil Alkohol dengan Propilenglikol sebagai Plasticizer. *Jurnal Katalisator*. 1(2). https://doi.org/10.22216/jk.v1i2.1113

Parfiyanti EA, Hastuti RB, and Hastuti ED. 2016. Pengaruh suhu pengeringan yang berbeda terhadap kualitas cabai rawit (Capsicum frutescens L.). *Jurnal Akademika Biologi*. 5(1): 82–92.

Pujimulyani D. 2009. Sifat Antioksidasi, Sifat Kimia dan Sifat Fisik Manisan Basah dari Kunir Putih (Curcuma mangga Val.). *Agritech: Jurnal Fakultas Teknologi Pertanian UGM*.

29(3): 167–173. https://doi.org/10.22146/agritech.9703

Rincón AM and Padilla FC. 2004. Physicochemical properties of Venezuelan breadfruit (Artocarpus altilis) starch. *Archivos Latinoamericanos de Nutricion*. 54(4): 449–456.

Rizky P. 2019. Pembuatan Edible Film Pati Sukun (Artocarpus Altilis) Termodifikasi Dari Proses Asetilasi Menggunakan Asetat Anhidrat. *Journal Ready Star LPPM Politeknik Teknologi Kimia Industri Medan*. 2(1).

Rodríguez M, Osés J, Ziani K, and Maté JI. 2006. Combined effect of plasticizers and surfactants on the physical properties of starch based edible films. *Food Research International*. 39(8): 840–846.

Rustan ND, Ansharullah, and Asyik N. 2017. Aplikasi Edible Coating Berbasis Pati Sagu Dengan Penambahan Asam Sitrat Untuk Meningkatkan Daya Simpan Cabai Rawit (Capsicum Frustescens). *J. Sains Dan Teknologi Pangan*. 2(6): 997–1005.

Safaryani N, Haryanti S, and Hastuti ED. 2007. Pengaruh suhu dan lama penyimpanan terhadap penurunan kadar vitamin C Brokoli (Brassica oleracea L). *Anatomi Fisiologi*. 15(2): 39–45.

Santoso B, Saputra D, and Pambayun R. 2004. Kajian teknologi edible coating dari pati dan aplikasinya untuk pengemas primer lempok durian. *Jurnal Teknologi dan Industri Pangan*. 15(3): 239–252.

Sembara EL and Salihat RA. 2021. Application Of Edible Coating Talas Starter With Glycerol As Plasticizer In Storage Of Red Chillies (Capsicum Annum L.). *Journal of Scientech Research and Development*. 3(2): 134-145, https://doi.org/10.56670/jsrd.v3i2.28

Setyaningsih D, Apriyantono A, and Sari MP. 2014. *Analisis Sensori untuk industri pangan dan argo*. Bogor: IPB Press.

Simonovska J, Škerget M, Knez Ž, Srbinoska M, Kavrakovski Z, Grozdanov A, and Rafajlovska V. 2016. Physicochemical characterization and bioactive compounds of stalk from hot fruits of Capsicum annuum L. *Macedonian Journal of Chemistry and Chemical Engineering*. 35(2): 199–208, https://doi.org/10.20450/mjcce.2016.944

Sunyoto M, Fetriyuna F, and Tiara J. 2016. Kajian Iradiasi Sinar Gamma Terhadap Karakteristik Cabai Rawit (Capsicum Frutescens L.) Untuk Memperpanjang Masa Simpan. *Prosiding Semnas Hasil Penelitian*.

Suprapti ML. 2002. *Tepung Sukun, Pembuatan dan Pemanfaatannya*. Yogyakarta: Kanisius.

Susilowati S. 2008. *Isolasi dan identifikasi senyawa karotenoid dari cabai merah (Capsicum annuum L.)* [Doctoral dissertation]. Universitas Islam Negeri Maulana Malik Ibrahim.

Syaputra MD, Sedyadi E, Fajriati I, and Sudarlin. 2020. Aplikasi Edible Film Pati Singkong Dengan Penambahan Ekstrak Lidah Buaya (Aloe Vera) Pada Cabai Rawit (Capsicum Frutascens L.). *Integrated Lab Journal*. 01(01). https://doi.org/10.5281/zenodo.3270926

Wulandari DD. 2017. Analisa kualitas madu (keasaman, kadar air, dan kadar gula pereduksi) berdasarkan perbedaan suhu penyimpanan. *Jurnal Kimia Riset*. 2(1): 16–22.

Yuliati RT. 2018. *Pengaruh Penambahan Ekstrak Daun Sirih pada Edible Film Pati Ganyong dan Lidah Buaya (Aloe vera L) terhadap Masa Simpan Cabai Merah (Capsicum annuum L.)*. [Skripsi]. UIN Sunan Kalijaga Yogyakarta.