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# The Effect of Taro Starch (*Colocasia esculenta L Schoott*) Edible Coating on the Quality of Red Chili (*Capsicum annuum L*)

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**Abstract:** Edible coating is a barrier, thin layer of consumable material to maintain moisture and slow down the respiration process of a product. In order to preserve the quality of red chili, this study aims to find the ideal taro starch concentration to use as an edible covering. Six treatments of taro starch concentration—0, 1, 2, 3, 4, and 5%—were used in experimental research utilizing a completely randomized design (CRD). Hedonic organoleptic testing produced the data. Analysis of variance (ANOVA) is then performed based on the level of panelist preference, and an LSD test is applied if there is a significant difference. The findings indicated that a 5% concentration of taro starch works best as an edible covering material to preserve the quality of red chili.

**Keywords:** *Colocasia esculenta* L Schoott; Edible Coating; Red Chili; Taro Starch

## Introduction

Red chili (*Capsicum annuum L*) is a member of the Solanaceae family, a group of horticultural crops that are crucial to civilization and frequently used for dietary needs (Dalimunthe et al., 2017; Unta et al., 2020). The spicy taste of chilies and their high nutritional content make chilies a staple ingredient that is really needed by the community (Andani et al., 2020). Red chilies are high in fiber, vitamins, mineral salts (Ca, P, Fe, K), and capsaicin (Ramdani et al., 2019). Antioxidants and capsaicin protect the body from free radical damage, while antioxidants also have anti-cancer properties. However, the problems often faced with red chilies are that they are easily damaged and have a low shelf life (Ermawati et al., 2021; Perdana et al., 2021). It is typical for the market to be overstocked with chiles when harvest time comes, and the reverse occurs when the season does not. Due to the excess supply of chilies compared to market demand, chilies are kept in storage for longer periods of time, which inevitably leads to rotting and other types of damage. If post-harvest management and storage practices are poor, this condition will become worse. Continuous loss of water and solutes, as well as high intensity gas exchange in fresh plant products during post-harvest storage results in weight loss, decreased eating quality, and short shelf life (Ncama et al., 2018). To combat this issue, great care must be taken in order to reduce damage and improve the resilience of chilies during storage.

One potential method that can be applied to reduce the level of damage to red chilies is the application of fruit coating which is generally known as edible coating (Cheung et al., 2021; Ncama et al., 2018). It is believed that the use of edible coatings on fresh food products regulates the flow of gases and water vapor between the food and its surroundings. (Blancas-Benitez et al., 2022). According to Tetelepta et al., (2019), the use of edible coatings is one strategy that might be used to lessen the degree of harm to red chili peppers.

Generally, an edible coating is referred to as a natural preservation strategy. It can be applied around or between food products so that can act as a protective barrier against damage during processing, handling, and storage (Blancas-Benitez et al., 2022). Because it is

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formed of all-natural components obtained from root crops (Hawa et al., 2020), is still edible (Pade, 2019) and easily digestible. According to (Widaningrum et al., 2015), an edible coating is a thin layer that is biodegradable and made of substances that may be digested and can act as a barrier to prevent moisture loss and impede respiration (Aisyah & Winardi, 2023; Fauziati et al., 2016).

Given that the starch content of taro tubers approaches 80%, along with amylose and amylopectin contents of 5.55% and 74.4 percent, respectively they have the potential to be turned into flour or starch (Ladeska et al., 2021). Taro flour contains 75% starch, 3.75% amylose, and 71.43% amylopectin by weight. Taro tubers have more starch than sweet potato and potato tubers, cassava tubers or other tubers (Saputra et al., 2016). Taro tubers have a greater protein level of 1.9% (Rianto, 2018), compared to cassava's 0.8% (Krisnaningsih et al., 2020) and sweet potatoes' 1.8%, but have a lower carbohydrate content of 23.78% compared to those two vegetables' respective

Based on this description, research is required to create taro starch as a raw material for edible coatings that are applied to horticultural products, specifically red chilies, in order to preserve sensory quality. The study is titled "The Effect of Taro Starch (*Colocasia esculenta L Schoott*) Edible Coating on the Quality of Red Chili (*Capsicum annuum L*)."

## Method

*Research Design*

This study is experimental research. The quality of red chili (*Capsicum annuum* L.) and edible coatings manufactured from taro starch (*Colocasia esculenta* (L)) are the independent and dependent variables. The color, texture, and aroma of red chili fruit are all indicators of its quality. This study was conducted over the course of two months, from July to August 2021, at the University of Mataram's Food Technology and Agroindustry Faculty (FATEPA).

*Materials and Tools*

The red chili (*Capsicum annuum* L) utilized in this study was obtained directly from farmers in Mongas Village, Praya Tengah District, Central Lombok Regency, and was uniformly glossy red in color. The Limbungan Hamlet, Taman Sari Village, West Lombok farmers' plantations are the source of the taro tubers.

The instruments used in this investigation were 500 ml Duran Low Shape Glass Beaker, Hot Plate Magnetic Stirrer, Spatula, Stirring Rod, Fan, Brown Tray Cardboard Box, Digital Cooking Thermometer, Label Paper, Aquadest, Filter Paper, Knife, Shredder HTC-2 Digital Hygrometer Temperature (Clock) Humidity HTC-2, Plastic Jar, Fruit Scale (Oxone Fruit Scale), Electronic Kitchen Scale, Sieve, Basin, and Blender.

*Research Procedure*

The research process is generally divided into multiple stages: preparing the taro starch, creating the edible coating solution, coating the red chilies with the edible coating solution, and storing the finished product after coating. These phases are displayed in Figure 1.

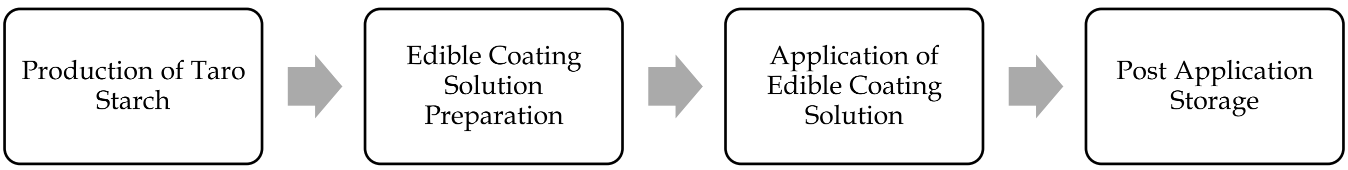



**Figure 1**. Research Procedure

*Taro Starch Production*

Two kilograms of clean taro potatoes were soaked in plain water for 3 hours, shredded, and then dried in the sun. The taro tubers were mixed to make taro flour, which was then weighed to yield 388 grams of taro flour. In addition, the temperature and humidity were controlled (lowest temperature 28.8 C and highest temperature 51.5 C with humidity 39%-74%).

Taro starch is created by combining taro flour with simple water and filtering the mixture. Taro starch is then steeped in plain water for 24 hours before being filtered by separating the water and starch. After drying the obtained wet starch once more, the temperature and humidity were once more regulated. Blended and weighed dried taro starch was used. Up to 60 grams of taro starch were obtained using the weighted starch process, which was followed by sifting. Making edible coating solutions uses refined taro starch as one of the ingredients.

*Preparation of Taro Starch Edible Coating Solution*

In this investigation, an edible coating solution with concentrations of 1%, 2%, 3%, 4%, and 5% was required. Taro starch was dissolved into 500 ml of water at the desired concentration to create the solution. With a magnetic stirrer, the fluid is manually homogenized. Taro starch was further cooked for an additional 25 minutes at 70 C until taro starch gelatinization developed. After that, the edible coating formulation is refrigerated.

*Application of an Edible Coating on Red Chili*

Red chilies with a uniform harvesting age are cleaned thoroughly, drained, and then treated with an edible coating by dipping them in the prepared edible coating solution before being applied with taro starch. According to the procedure, red chilies are immersed in an edible coating solution. The red chili fruit must be immersed for five minutes in the edible coating solution while being held by the stalk of the chili. The red chili is additionally dried at room temperature. Following that, observations were performed over 5, 10, and 15 days.

*Storage of Red Chili*

After being covered with an edible coating, the red chilies are air-dried with a fan before being placed into individual carton boxes (chocolate trays) and kept at room temperature (25–30 C).

*Data Collecting and Analysis*

Organoleptic tests (sensory tests) were used to gather information on the red chili's (*Capsicum annuum* L.) quality. Five, ten, and fifteen days after coating, tests were conducted. The Organoleptic Test Form is a scale test that is used to score red chili in order to determine its quality (Sensory Test).

In order to determine if customers or panelists like or detest a product, organoleptic tests were conducted on three parameters: color, texture, and scent. By assigning a specific score based on the panelists' preferences in accordance with a predetermined scale, responses to likes and dislikes are carried out. On the basis of the distribution of panelists' scores, the assessment's findings are subsequently compiled.

A group of 25 University of Mataram Bachelor of Food Technology students served as the study's moderately trained panel of experts. Hedonic Scale 5 was employed in this investigation. Very like (5), Like (4), Like a little (3), Dislike (2), and Don't Like at all (1). The panelists were instructed to rate the color, texture, and aroma of the red chili after it had been coated with taro starch to make it edible. Analysis of variance (ANOVA) was used to assess the data. If the test findings indicate an effect, carry out a follow-up experiment using the LSD test.

## Result and Discussion

*Starch from taro tubers*

The grating, drying in the sun, soaking in plain water for 24 hours, and settling are the steps in manufacturing starch from taro flour. In the process of settling and drying taro tuber flour, a white solid powder is produced.

*Impact of Taro Starch Concentration Treatment on Chili Quality*

The application of an edible coating made of taro starch had a very substantial impact on the red chili's quality on days 5, 10, and 15 following storage, including color, texture, and aroma, according to the results of the analysis of variance. Table 1 gives a summary of the outcomes of the analysis.

According to Table 1, the following outcomes are significantly impacted by the use of edible coatings made with taro starch. The color of red chiles that have been preserved for five, ten, or fifteen days. The texture of red chilies reaches the 5th to 10th day of storage. And the last that is the scent of red chili on days 10 and 15 after storage.

The average organoleptic test results for the quality of red chili in each treatment for each indication of chili quality that exhibited significant results were further compared in the LSD test based on the findings of the analysis of variance. The average organoleptic test results for each indication used to gauge the quality of chili are shown in Table 2.

**Table 1.** Result of ANOVA

| Measuring on the day | Measurement on the day after storage (HSP) | | | | | |
|---|---|---|---|---|---|---|
| | Color | | Texture | | Scent | |
| | Mean score | Sig | Mean score | Sig | Mean score | Sig |
| 5 | 0.540 | 0.000 | 2.060 | 0.000 | 0.368 | 0.080 |
| 10 | 2.007 | 0.000 | 2.459 | 0.000 | 0.827 | 0.026 |
| 15 | 2.103 | 0.001 | 0.736 | 0.145 | 1.696 | 0.004 |

**Table 2.** LSD Test Results for The Typical Organoleptic Test for Chili Quality

| Organoleptic Parameters | Measurement on day after storage (HSP) | Taro Starch Concentration (%)/ Average of Organoleptic | | | | | | $LSD_{0,05}$ |
|---|---|---|---|---|---|---|---|---|
| Color | 5 | $P_0$ (0%) 4.40 a | $P_5$ (5%) 4.60 ab | $P_4$ (4%) 4.64 b | $P_2$ (2%) 4.68 b | $P_1$ (1%) 4.80 b | $P_3$ (3%) 4.83 c | 0,209 |
| | 10 | $P_0$ (0%) 4.24 a | $P_1$ (1%) 4.44 ab | $P_2$ (2%) 4.52 bc | $P_4$ (4%) 4.72 c | $P_3$ (3%) 4.92 c | $P_5$ (5%) 4.96 c | 0,171 |
| | 15 | $P_0$ (0%) 3.88 a | $P_5$ (5%) 4.32 b | $P_4$ (4%) 4.36 b | $P_2$ (2%) 4.48 bc | $P_1$(1%) 4.64 c | $P_3$ (3%) 4.68 c | 0,207 |
| Texture | 5 | $P_0$ (0%) 3.88 a | $P_1$ (1%) 4.52 b | $P_2$ (2%) 4.56 b | $P_4$ (4%) 4.56 b | $P_5$ (5%) 4.62 b | $P_3$ (3%) 4.64 b | 0,257 |
| | 10 | $P_1$ (1%) 3.82 a | $P_0$ (0%) 4.00 a | $P_2$ (2%) 4.28 b | $P_4$ (4%) 4.32 b | $P_3$ (3%) 4.44 bc | $P_5$ (5%) 4.68 c | 0,264 |
| Scent | 10 | $P_0$ (0%) 4.12 a | $P_1$ (1%) 4.32 ab | $P_2$ (2%) 4.48 b | $P_3$ (3%) 4.48 b | $P_4$ (4%) 4.52 b | $P_5$ (5%) 4.64 c | 0,313 |
| | 15 | $P_0$ (0%) 4.16 a | $P_4$ (4%) 4.24 a | $P_3$ (3%) 4.56 a | $P_1$ (1%) 4.68 b | $P_2$ (2%) 4.68 b | $P_5$ (5%) 4.80 b | 0,455 |

Information:
Numbers in the same row that are followed by the same letter do not differ significantly at the 5% probability level.

As seen in Table 2, it is known that the greatest outcomes for red chilies' color come from taro starch concentrations of 3% (for 5 HSP and 15 HSP measures) and 5% (for 10 HSP measurements); the greatest outcomes for red chilies' texture come from taro starch concentrations of 3% (for 5 HSP measures) and 5% (for 10 HSP measurements); and for both 10 HSP and 15 HSP assessments, a concentration of 5% of taro starch for edible coating produces the greatest results for the aroma of red chili.

According to the panelists' evaluation, it can also be said that the treatment of edible coating with taro starch at 5% treatment demonstrated the highest quality in terms of color, texture, and scent indicators. This outcome supports the claim made by (Blancas-Benitez et al., 2022) that the use of edible coatings permits the combination of several active ingredients in the coating matrix. Since the fruits and coating material are in direct contact in this instance, the fruits' shelf life and organoleptic qualities will be improved while maintaining the same nutritional value. Additionally, these extra coatings can be consumed straight with the coated fruit products.

The application of edible coating immediately after harvest is believed to have succeeded in reducing water loss and delaying aging or ripening, maintaining firmness, color, texture, and nutritional content (Athmaselvi et al., 2013; Mondal, Bhattacharjee, et al., 2022). Apart from that, this coating can also increase the antimicrobial properties of the product (Ncama et al., 2018; Tetelepta et al., 2019). The application of edible coatings derived from various basic ingredients such as algae, aloe vera, chitosan, and starch has reportedly also been carried out on various types of fresh fruit products other than chilies, such as tomatoes, apples, potatoes, blueberries, jackfruit, oranges, and other fresh vegetables (Chaudhary et al., 2020; Mondal, Bhattacharjee, et al., 2022; Mondal, Goud, et al., 2022; Sharma et al., 2019).

*Color*

The findings suggested that the presence of an edible coating made of taro starch significantly changed the color of red chilies. This effect was evident at the three observation times, 5, 10, and 15 HSP, as shown in Table 1, with the color of the chili receiving the highest average panelist preference at 15 HSP observations. In further detail, the graph in Figure 2 below compares the panelists' preferences for the color of red chili during each treatment and observation period.

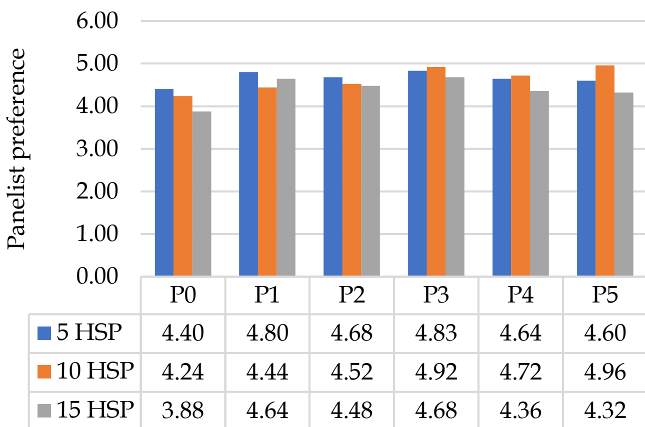



**Figure 2.** Panelist preference for red chili color

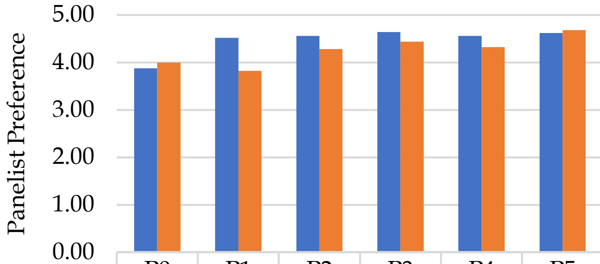
Figure 2 displays the preferences of the panelists for the color of red chili, with the edible coating treatment at 5% (P5) on the tenth day after harvest (10 HSP) receiving the highest ratings. These findings suggest that edible coatings with 5% taro starch concentrations are more effective in preserving the red chili color than edible coatings with 0%, 1%, 2%, 3%, and 4% taro starch concentrations. This is perhaps because red chilies can be perfectly covered by the edible layer of taro starch 5% (P5), which prevents pigment deterioration in the fruit. According to (Hatmi et al., 2020), adding an edible coating to a product can have a number of benefits, such as preserving color, minimizing weight loss, preserving sensory quality, lowering respiration rate, and extending shelf life. Taro starch is also used in the production of edible coatings in an effort to increase appearance, strength, and matrix formation (Darmawansyah & Ulpah, 2021). The persistence of the color of red chilies coated with taro starch as the storage time increases is an indication that the respiration rate is slow, resulting in a slow fruit ripening process. Another study reported that the application of edible coating to tomatoes showed that the tomatoes appeared shinier and remained firm even after 20 days of storage (Mondal, Goud, et al., 2022).

Further details include the fact that on the fifteenth day of observation, the panelists' preference for the color of red chilies that did not receive the edible coating treatment was at its lowest. The red chilies changed significantly in color on the day of the observation. This has to do with the respiration process, which carries on even after the chilies are harvested and accelerates the synthesis of their color pigments (Umarudin et al., 2020). Additionally, the absence of an artificial coating formed of taro starch which was applied to this treatment caused the discoloration, because the application of edible coatings was reported to have an effect on the morphology and characteristics of the product being coated (Hatmi et al., 2020).

*Texture*

The findings of the analysis of variance demonstrated a highly significant relationship between the concentration of taro starch and the organoleptic test of red chili's texture. The texture of red chili, which was assessed on the tenth day after harvest (10 HSP) with an average score of 2.459, received the highest average panelist preference level. Figure 3 compares the preferences of the panelists for the texture of red chili at each treatment and observation period.

Referring to Figure 3, it appears that the texture of red chili treated with taro starch coating with a concentration of 5% at 10 HSP was most liked by the panelists. This shows that the taro starch coating is able to reduce the degree of softening of the chilies as a result of the decreased respiration rate caused by the presence of the taro starch coating on the whole surface of the red chilies. As with red chilies in this study, fruit products that were given an edible coating application had better gas diffusion resistance compared to products that were not treated with an edible coating (Hatmi et al., 2020).




| | P0 | P1 | P2 | P3 | P4 | P5 |
|---|---|---|---|---|---|---|
| 5 HSP | 3.88 | 4.52 | 4.56 | 4.64 | 4.56 | 4.62 |
| 10 HSP | 4.00 | 3.82 | 4.28 | 4.44 | 4.32 | 4.68 |

**Figure 3.** Panelist preference for red chili texture

Previous studies reported that the low respiration rate of chilies coated with edible coatings caused a delay in maturity and reduced texture degradation during storage. Coating using edible coatings is also able to inhibit the rate of respiration and reduce the occurrence of softening. The texture of chilies during storage has increased, so that the softening process does not occur due to pectin degradation. Pectin degradation will produce sugar and water which can cause the fruit to become soft. The application of an edible coating layer on the surface of the fruit is also intended to inhibit the release of gas, water vapor, and avoid contact with oxygen, so that the process of ripening and softening of the fruit can be slowed down. According to (Blancas-Benitez et al., 2022), after the harvesting process, fresh food products, especially fruit, will continue to lose water and other nutrient as a result of biological activity. Edible taro starch coating has a good barrier to $CO_2$ and $O_2$ gas exchange. Less O2 gas that enters the tissues, the enzymes involved in the process of respiration and tissue softening become less active so that the rate of transpiration decreases and ultimately, allows the fruit's water content and texture to be preserved.

By regulating the gas composition of CO2 and O2, polysaccharide edible coatings can minimize respiration rates, oxidize fat and browning on the surface, and prevent dehydration (Ansar et al., 2020; Elfaini & Domonita, 2016). Because they have the capacity to function as permeable membranes that are exchanged for CO2 and O2 gas exchange, polysaccharides, which are frequently employed, especially in fruits and vegetables, are used as fundamental materials in edible coatings. Additional benefits of polysaccharide-based edible coatings include enhancing flavor, texture, and color (Ulyarti et al., 2018), as well as enhancing appearance and lowering spoilage (Anggarini et al., 2016).

*Aroma*

The results of this investigation suggest that the red chili's scent is significantly influenced by the concentration of taro starch. With an average rating of 1.696 from the panelists, red chile, which was detected at 15 HSP, received the highest average rating for its scent. Figure 4 shows the panelists' ratings of the red chili scent at various edible coating concentrations and during the observation period.

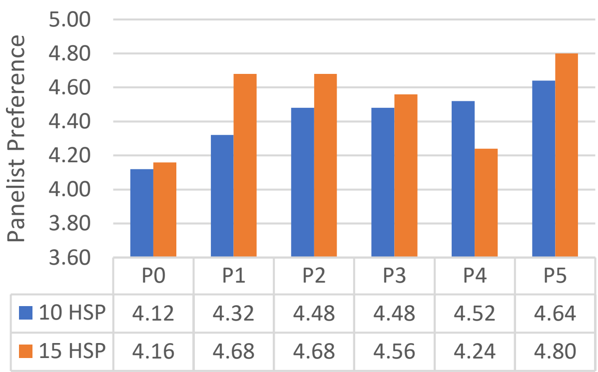



**Figure 4**. Panelist preference for red chili aroma

Based on Figure 4, the 5% starch coating on chili that was observed at 15 HSP had the highest rating from the panelists, while red chili that had received a 0% treatment received the lowest. These findings suggest that the edible coating used on red chilies is effective at delaying ethylene production, which in turn impacts the period of storage, and prevents the growth of bacteria that cause degradation (Hatmi et al., 2020) The existence of artificial coatings made from natural ingredients can slow down the rate of respiration and prevent red chilies from spoiling (Ridiyanto et al., 2017).

## Conclusion

Artificial coatings made from taro starch have a significant effect on the color, texture, and aroma of red chilies. Edible coating made from taro starch at a concentration of 5% showed the highest effect compared to other concentrations.

## Author Contributions

Each author contributed in some way to the project's completion. The main author and the second author decided on the study materials, fundamental ideas, and research methods. Subsequently, all authors share responsibility for data collection, data analysis, the review process, and paper writing; the third author serves as an assistant in all aspect of this project.

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## Conflicts of Interest

Regarding this study, the author declares that there is no conflict of interest.

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