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Extraction and Characterization of Pectin from Kepok Banana Peel and Its Application as a Base Material for Edible Coating on Strawberries

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A B S T R A C T

Strawberries are fruits rich in nutrients and bioactive compounds, but have a short shelf life due to their high respiration rate. The use of edible coatings from natural ingredients such as pectin can help extend the shelf life and maintain the quality of strawberries. This study aims to extract pectin from banana peels, characterize the pectin obtained, and apply it as a base material for edible coating for strawberries. The edible coating solution was made from kepok banana peel pectin (1%), carboxymethyl cellulose (1%), and glycerol (1%). The results of the extraction of banana peel pectin obtained an equivalent weight value of 695.76 mg, degree of esterification 71.71%, methoxyl content 7.98%, pH 2.99, antioxidant capacity 19.845 mgAA/gFW, FTIR results identify the main functional groups of pectin (C-H, O-H, and C-O-C), XRD Shows the amorphous structure of pectin. Edible coating of kepok banana peel pectin shows a bright color with a tendency to green and blue. Strawberries coated with an edible film derived from kepok banana peel pectin were monitored over a 6-day period (days 0 to 6) at room temperature (25°C). The coating effectively delayed visible decay until day 4, with cumulative weight loss reaching 33.33% by day 6.

Contribution to Sustainable Development Goals (SDGs):
SDG 6: Good Health and Well-being
SDG 11: Industry, Innovation, and Infrastructure
SDG 13: Responsible Consumption and Production
SDG 15: Climate Action

1. INTRODUCTION

1.1. Research Background

Strawberries are rich in various nutrients and compounds that are beneficial to human health. Strawberries are a rich source of vitamins and minerals, with high water content and low protein and fat content. Strawberries are known to have a high respiration rate with a general resistance to decay of 1-2 days at room temperature [1]. Strawberries are very susceptible to contamination by pathogens such as microbes and fungi. Pathogens can cause fruit and root rot, as well as anthracnose disease in fruit, which causes strawberries to rot faster. In addition, rotting or softening of strawberries is also influenced by the heating and oxidation processes [2].

The presence of pathogens and the effects of heating and oxidation on strawberry plants can have significant impacts on the industry, requiring the development of effective strategic management [2]. To address these issues, various management tactics are being explored, including the use of host plant resistance and innovative postharvest techniques. One of the postharvest methods that can be used to address this is by using natural and biodegradable materials [3].

Natural and biodegradable materials are becoming a trend in the food coating industry, which can also reduce environmental problems and minimize the production of toxic waste. The development of natural coating materials is an interesting area for research. One method that can be used is edible coating. Edible coating is often made from biological materials such as polysaccharides, proteins and lipids that act as a barrier on the fruit surface [4], thereby delaying ripening and reducing fruit weight loss [3]. Pectin, a natural polysaccharide, can also be used in the development of edible films and coatings, and is able to increase the shelf life of perishable foods by protecting them from external environmental influences, delaying nutrient loss, and helping to maintain physical and chemical components for a longer duration [5].

1.2. Literature Review

1.2.1. Strawberries

Strawberries are a very popular fruit, due to their unique taste and many benefits such as antioxidants and amino acids that greatly contribute to the overall quality of the product. These antioxidants play an important role in fighting free radicals and reducing the risk of degenerative and cardiovascular diseases [6]. Strawberries are a fruit rich in bioactive compounds, especially polyphenols, organic acids, and vitamin C, which contribute to improving health [7].

Fresh fruit quality is a fundamental aspect for consumers and is critical for the success of breeding activities and for increasing the competitiveness and profitability of the fruit industry [6]. Strawberries lose their nutritional value quickly after picking due to their thin and easily damaged skin, so proper post-harvest handling techniques are needed to maintain the quality and nutritional value of the fruit [8].

1.2.2. Edible Coating

Edible coating is a thin, consumable layer applied to the surface of food to extend shelf life and maintain quality. This coating can be made from natural biopolymers such as polysaccharides, proteins, and lipids, which often contain antimicrobial and antioxidant components. The application techniques vary, including dipping and spraying [9]. Edible coatings can effectively reduce the rate of respiration and water loss in fruits and vegetables, thereby delaying spoilage. Natural coatings offer optimal preservation by overcoming respiration and water loss. The effectiveness of this coating depends on the composition of the biopolymer matrix and the additives used [10].

Kepok banana peel has various potential benefits, but it is often considered as waste. Utilization of kepok banana peel can reduce environmental pollution and provide economic value [11]. The use of kepok banana peel as a food coating derived from banana peel has shown promising results in fruit preservation [12]. Kepok banana peel is known to contain pectin. Pectin extract from kepok banana peel shows potential as an edible coating [5]. This coating can extend shelf life by reducing fruit weight loss and slowing the respiration rate [13].

1.3. Research Objective.

In this study, pectin was extracted from kepok banana peels. The obtained pectin was characterised in terms of equivalent weight, degree of esterification, methoxyl content, viscosity, pH, antioxidant content, functional group test, and crystallinity. Analysis of the physical properties of strawberries (*Fragaria sp.*) coated with edible coating was carried out at intervals of 1, 2, 3, 4, 5 and 6 days at room temperature (25°C).

2. MATERIALS AND METHODS

2.1. Material

The materials used were kepok banana peels (Padang), Strawberries (Agam), glycerol (Ecoserol), carboxymethyl cellulose (CMC) (Koepoe), distilled water, 96% ethanol (Novalindo), hidrochloric acid (HCl) 37%, NaOH, phenolphtelein indicator, ascorbic acid, $FeCl_3.6H_2O$, orthophenanthroline (Merck).

2.2. Methods

2.2.1 Extraction of Pectin

Kepok banana peels are cleaned of dirt using water flow, then cut into small pieces and air-dried. The dried Kepok banana peels is then ground using a disk mill and sieved with a 150 µm sieve. 20 grams of dry Kepok banana peels powder is added with 5% HCl solvent with a ratio of dry powder and solvent (1:10). Then extracted with a water bath for 120 minutes at a temperature of 85 °C at a speed of 600 rpm, after which it is filtered. Furthermore, the filtrate obtained is evaporated at a temperature of 100 °C until the volume reaches half, then cooled. The cooled filtrate is then added with 96% ethanol with a ratio of pectin extract and 96% ethanol (1:1) then left for 24 hours, and filtered. The pectin precipitate obtained is then washed with 96% ethanol until the washing water becomes clear. The pectin is dried using an oven for 6 hours at a temperature of 40 ° C.

2.2.2 Characterization of Pectin

The pectin characterisation carried out included an equivalent weight test, degree of esterification, methoxyl content, pH, antioxidant capacity, and functional groups, as determined using Fourier transform infrared spectroscopy (FTIR), and its crystallinity using X-ray diffraction (XRD).

2.2.2.1 Equivalent Weight

Into the Erlenmeyer flask, 0.1 grams of banana peel pectin was added. Then 1 mL of ethanol and 10 mL of distilled water were added. Furthermore, the mixture was stirred for 30 minutes at a temperature of 50ºC with a stirring speed of 300 rpm. From the solution, 10 mL was taken and 1 drop of phenolphthalein indicator was added, then titrated using 0.1 M NaOH until it reached the endpoint of titration, which was marked by a colour change from clear brownish to pink. Repeated three times. The equivalent weight can be calculated using the equation [14]:

$$\text{Equivalent Weight} = \frac{weight\ of\ pectin\ (mg)\ x\ 1000}{V\ NaOH\ (mL)\ x\ [NaOH]} \quad (1)$$

2.2.2.2 Degree of Esterification

0.1 grams of banana peel pectin was added. In the Erlenmeyer flask, 20 mL of distilled water and 2 drops of phenolphthalein indicator were added. Then, the solution was titrated using 0.1 M NaOH, the volume of NaOH (V1) needed was observed and recorded until the color changed to pink, indicating that the titration endpoint had been reached. Furthermore, 5 mL of each solution was stirred until the color disappeared and returned to the color of the initial solution. After that, 5 mL of 0.1 M HCl was added and titrated, then the volume of NaOH (V2) needed was observed and recorded until the color of the solution returned to pink, indicating that the solution had reached the titration endpoint. Repeat three times. The degree of pectin esterification can be calculated using the equation [15]:

$$\text{Degree of Esterification (\%)} = \frac{V2}{V1+V2} x\ 100 \quad (2)$$

2.2.2.3 Methoxyl Content

Put 0.1 grams of banana peel pectin into an Erlenmeyer flask. Then, 1 mL of ethanol and 10 mL of distilled water were added to the Erlenmeyer flask. A total of 10 mL was taken from the solution and added to 12.5 mL of 0.25 M NaOH. Furthermore, the solution was stirred at a stirring speed of 300 rpm for 30 minutes. Furthermore, 12.5 mL of 0.25 M HCl was added, then stirred until homogeneous. After that, one drop of phenolphthalein indicator was added and titrated using 0.1 M NaOH until it reached the endpoint of the titration, which was marked by a colour change from clear brownish to pink. Repeated three times. The methoxyl pectin content can be calculated using the equation [14]:

$$\text{Methoxyl (\%)} = \frac{V\ NaOH(mL) x\ 31\ x\ [NaOH]}{weight\ of\ pectin\ (mg)} x\ 100 \quad (3)$$

2.2.2.4 Antioxidant Capacity

Total antioxidants can be determined using the modified phenanthroline method with a UV-Vis spectrophotometer. 1 mL of banana peel pectin solution (1%) was pipetted and placed into a vial. Subsequently, 2 mL of distilled water, 1 mL of 0.1% $FeCl_3.6H_2O$, and 1 mL of 1.10 orthophenanthroline were added. The mixture was then stirred until homogeneous and left for 20 minutes. After this, the absorbance was measured at a maximum wavelength of 510 nm. This was done three times [16].

2.2.2.5 FTIR

Determination of functional groups of banana peel was tested using ATR-FTIR. The wave number range used was 4000 – 400 cm^{-1}[14].

2.2.2.6 XRD

The crystallinity of pectin from kepok banana peel was tested using XRD operated at 40 kV and 40 mA. The determination of the percentage of pectin crystallinity can be calculated using the following equation [17]:

$$\text{Crystallinity (\%)} = \frac{\text{Crystal peak area}}{\text{Area of all peaks}} x\ 100 \quad (4)$$

2.2.3 Edible Coating Preparation

The Edible Coating technique used is the dipping technique. Pectin, as much as 1% is put into a beaker. Then, glycerol (1%) and CMC (1%) were added, followed by air distillation until the volume reached 50 mL. Furthermore, the solution is heated to 40ºC, stirred for 15 minutes, and then cooled to room temperature.

Table 1. Edible coating composition

Treatment	Pectin (%)	CMC (%)	Glycerol (%)	Total volume (mL)
Control	-	-	-	50
PKP	1	1	1	50

Description:
PKP: Pectin Kepok Banana Peels

Strawberry samples were dipped into the Edible coating solution with various treatments according to Table 1 for 30 seconds. After all surfaces were coated, the strawberries were dried to prevent excess edible coating from sticking to their surface. After the Edible coating dried, it was stored for 6 days and during the storage period, analysis of decay and weight loss was carried out on days 1, 2, 3, 4, 5, and 6 [18].

2.2.3.1 Characterization Edible Coating

2.2.3.1.1 Viscosity

The viscosity of banana peel pectin edible coating solution was measured at a temperature of 22.6ºC and a speed of 50 rpm using a ViscoQC 300 L viscometer. which is a viscometer with a spindle that is dipped into the sample being tested [19].

2.2.3.1.2 Color

Edible coating color measurement was carried out using a YS6060 spectrophotometer. The sample used was a solution of edible coating pectin from kepok banana peel. The solution was placed in a cuvette, filling 2/3 of its height, and then positioned above the aperture. The values for L *, a *, b *, and were recorded using illuminants D65, A, and F2 (Fcw / CWF) at each observer angle of 10°, 2°, and 2° [20].

2.2.3.2 Physical Properties of Strawberries that have been treated with EC

The analysis of physical properties used in this study focused on testing two main parameters, namely the level of decay and weight loss of strawberries coated with edible coating compared to control fruit without coating.

2.2.3.2.1 Determination of Strawberry Weight Loss

Strawberry samples that had been given treatment were then tested for weight loss on days 1, 2, 3, 4, 5, and 6. To determine the weight loss of strawberries, the following equation was used [18]:

$$\text{Weight Loss (\%)} = \frac{\text{Wo}-\text{Wt}}{\text{Wo}} x\ 100 \quad (5)$$

Description:
Wo : initial weight of strawberries
Wt : Final weight of strawberries

2.2.3.2.2 Determination of Strawberry Total Decay

Total strawberry decay was done visually (Table 2). Strawberry samples that had been treated were then tested for total decay weight loss on days 1, 2, 3, 4, 5, and 6. The equation used to calculate total strawberry decay is as follows.

$$\text{Total Decay (\%)} = \frac{AB}{CD} x\ 100 \quad (6)$$

Table 2. Decay Value Scale

Decay value scale (%)	Decay value
0	0
1-10	1
11-25	2
26-40	3
40-50	4
> 50	5

Description:
A: decay value
B: number of fruits at value A
C: number of fruits treated
D: highest decay value [19]

3. RESULT AND DISCUSSION

3.1. Characterization of Pectin Kepok Banana Peel

Table 3 presents four key parameters that serve as main indicators for determining the ability of pectin to form a gel, its stability in solution, and its potential application as a base material for edible coatings.

Table 3. Chemical composition of kepok banana peel.

Chemical composition	Kepok banana peel
Equivalent Weight (mg)	695.76 ± 5.453
Degree of Esterification %	71.71 ± 0.076
Methoxyl content %	7.98 ± 0.531
pH	2.99 ± 0.012

Mean ± Standard deviation (Three determinations).

The equivalent weight value of banana peel pectin 695.76 ± 5.453 is high, indicating that this pectin has large molecules. and has good potential for application as a thickening agent and gelling agent in food products, including edible coating for strawberries. Degree of Esterification 71.71 ± 0.076 indicates the percentage of carboxyl groups in pectin that have been esterified. The high DE value above 50% indicates that banana peel pectin is high methoxyl pectin. Methoxyl Content 7.98 ± 0.531 indicates the number of methoxyl groups in pectin. The methoxyl group affects the ability of pectin to form gels and interactions with water. pH 2.99 ± 0.012 indicates that banana peel pectin is acidic. The use of solvents in the extraction process affects the DE and methoxyl values in pectin. This is in accordance with research conducted [22][23] which reported that the more acidic the solvent used, the lower the methoxyl and DE values produced.

3.1.1 FTIR

FTIR spectrum was used to identify functional groups present in banana peel pectin. Based on the FTIR spectrum data obtained, several main peaks have been identified, which provide important information about the chemical structure of pectin. The spectrum of the test results of kepok banana peel pectin is shown in Figure 1.

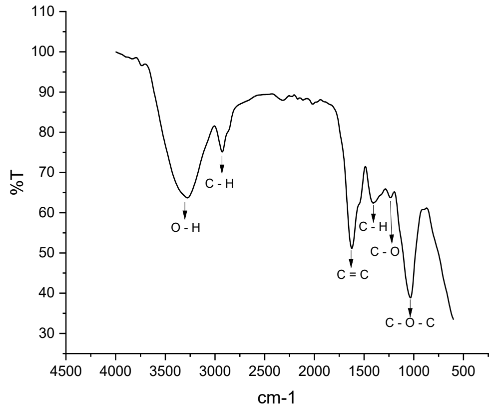

Fig 1 . FTIR spectrum of pectin kepok banana peel.

Based on the FTIR spectrum data obtained, several main peaks have been identified, which provide important information about the chemical structure of pectin. Peak 3277.16 cm^{-1} This peak indicates the presence of stretching vibrations of the hydroxyl group (-OH). This hydroxyl group is an importan t part of the pectin structure, which contributes to the ability of pectin to interact with water and form a gel. Peak 2927.31 cm^{-1} This peak is related to the stretching vibrations of the aliphatic C-H group. This indicates the presence of a carbon chain in the pectin structure, which is part of the polysaccharide framework. Peak 1623.37 cm^{-1} This peak is usually related to the bending vibrations of the water group (H-O-H) or the stretching vibrations of the carbonyl group (C=O) in galacturonic acid, which is the main component of pectin. The presence of this carbonyl group indicates that banana peel pectin has a structure that matches commercial pectin. Peak 1408.41 cm^{-1} This peak can be associated with the bending vibration of the C-H group or the stretching vibration of the carboxylate group (COO-). Peak 1234.27 cm^{-1} This peak is often associated with the stretching vibration of the C-O group in esters or ethers, indicating the presence of methyl ester groups in pectin. The degree of esterification of pectin affects the properties of the resulting gel. Peak 1033.10 cm^{-1} This peak indicates the stretching vibration of the C-O-C group in the polysaccharide structure, which is a characteristic of pectin. The presence of this group indicates that banana peel pectin has a complex polysaccharide structure. The same functional group was also reported [24] who conducted an analysis of pectin extracted from yellow kepok banana peels. In addition, [25] also reported the same functional group of pectin extracted from ripe and unripe kepok banana peels.

3.1.2 XRD

Kepok banana peel pectin was analyzed using the XRD technique to determine its crystallinity level. Based on the XRD data, the pectin structure is known to be amorphous, which is indicated by the diffraction pattern showing wider and less sharp peaks, with lower intensity. Pectin extracted from natural materials exhibits the same structure as reported by [26–28], which, based on the results of its structural analysis, indicates that the pectin extracted from natural materials is amorphous. This amorphous structure is caused by hydrogen bonding interactions between the hydroxyl groups in the pectin chain, which inhibits the formation of a regular crystalline structure. Extraction methods such as high

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pressure and the use of acids can disrupt the crystal structure, resulting in pectin with a more amorphous structure.

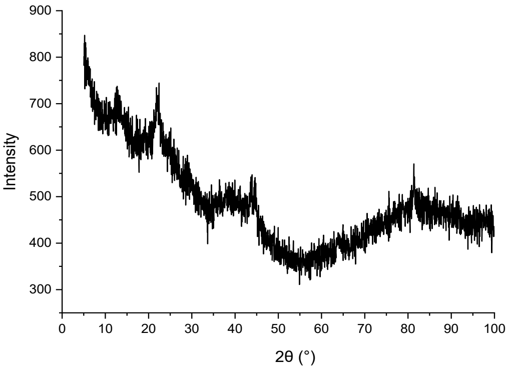

Fig 2. XRD of pectin kepok banana peel.

Amorphous pectin tends to have higher permeability to gases and water vapor, which can help in maintaining the freshness and quality of food products. The amorphous structure allows for the formation of a more uniform and smooth film, which can improve visual appearance and consumer appeal. Amorphous pectin is more suitable for applications that require flexibility, permeability, and the ability to form a uniform film, such as edible coatings.

3.1.3. Antioxidant Capacity

Kepok banana peel is known to contain various phenolic and flavonoid compounds that act as natural antioxidants[29]. In this study, pectin isolated from kepok banana peel was evaluated for its antioxidant capacity using the phenanthroline modification method. To measure antioxidant capacity, a standard curve is needed, which in this case uses ascorbic acid as a comparative standard. The standard curve of ascorbic acid is formed based on the relationship between solution concentration and absorbance at a wavelength of 510 nm, which produces a value of $y = 0.032x - 0.0157$ with the $R^2 = 0.9972$.

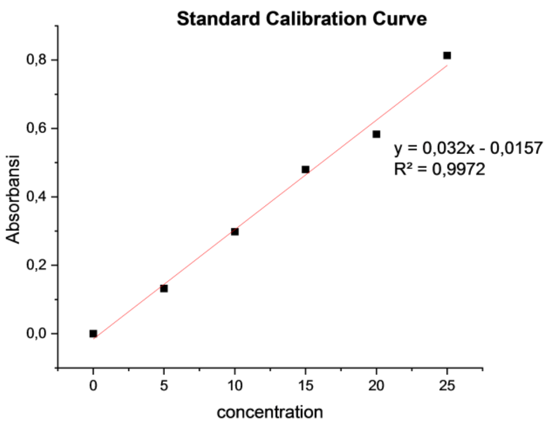

Fig 3. Standard calibration curve of ascorbic acid

From the analysis results, it is known that kepok banana peel pectin contains antioxidants of 19.845 mg AA/g FW. Kepok banana peel pectin has great potential as a material for making edible coating, especially because of its high antioxidant content. Antioxidants play an important role in maintaining the quality and extending the shelf life of strawberries by inhibiting the oxidation process that can cause damage and decay. Antioxidants function as free radical scavengers, which can damage cells and accelerate the decay process, as well as changes in color, taste, and texture of the fruit.

Kepok banana peel pectin contains antioxidants at a concentration of 19.845 ± 0.569; the data displayed is the mean ± standard deviation (SD). Base on this data, pectin kepok banana peel has great potential as a material for making edible coating for strawberries. The use of this edible coating can provide physical and chemical protection, extend shelf life, and maintain the quality of strawberries during storage.

3.2. *Characterization of Edible Coating*

Figure 4 A shows an edible coating solution made from banana peel pectin added with CMC as a thickener and glycerol as a plasticiser. This solution appears homogeneous and has a bright colour, which is due to the dissolved pectin. Figure 4 B shows the process of coating strawberries with edible coating solution. Strawberries are dipped into the edible coating solution for 30 seconds to ensure that all surfaces of the fruit are well coated.

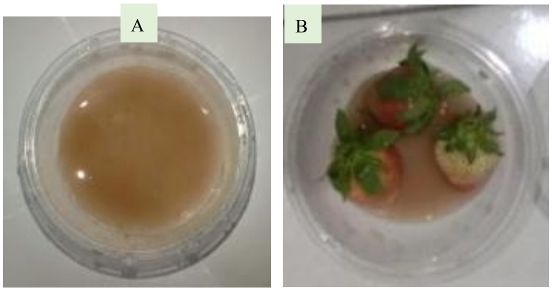

Fig 4. (A) Edible coating pectin kepok banana peel solution, (B) coating strawberries with edible coating pectin kepok banana peel (PKP)

Figure 5 shows strawberries observed on days 0, 1, 2, 3, 4, 5, and 6 with the control treatment and edible coating treatment of kepok banana peel pectin (PKP). Figure 5 shows the results of visual observations of strawberries that have been coated with edible coating of kepok banana peel pectin and control strawberries (without coating) during a storage period of 6 days at room temperature (25°C). Observations were made every day to evaluate the level of decay and weight loss of strawberries. Day 0 Strawberries in their initial condition before storage. Day 1 to Day 6, Shows changes in strawberry conditions every day during storage to analyze % decay and % weight loss of strawberries

Fig 5. Strawberries in observation Day 0, 1, 2, 3, 4, 5, and 6 with control and PKP treatments

3.2.1 Viscosity

Viscosity is an important parameter in the formulation of edible coating because it affects the ability of the solution to form a uniform and stable protective layer on the surface of food products. In this study, the edible coating solution was formulated from banana peel pectin (1%), CMC (1%), and glycerol (1%) as a plasticizer. The measurement results using a ViscoQC 300-L digital viscometer showed that the solution had a viscosity of 418.2 mPa s at a temperature of 22.6 °C. This viscosity value indicates that the solution has a medium to high viscosity, which is suitable for edible coating applications using the dipping or brushing method. The combination of pectin and CMC plays an important role in increasing the viscosity of the solution. Pectin, as a natural polysaccharide from banana peel, has the ability to form gels and increase viscosity. Meanwhile, CMC is a cellulose derivative known as an effective thickening and stabilizing agent in colloidal systems.

The viscosity of 418.2 mPa s provides several advantages in edible coating applications, such as sufficient viscosity to form a layer that is not too thin, so that it can cover the entire fruit surface and provide optimal protection. The layer formed can slow down the respiration rate, reduce water loss, and inhibit the growth of microorganisms. Thus, the combination of banana peel pectin, CMC, and glycerol produces an edible coating solution that has viscosity characteristics that are suitable for food industry applications.

3.2.2 Color

Color and transparency are the first impressions that are considered when assessing the quality of edible coating. The results of the color parameter tests of the edible coating solution, including brightness (L*), red-green components (a*), and yellow-blue components (b*) are shown in Table 4.

Based on the results of colorimeter data analysis, edible coating pectin from kepok banana peel shows specific color characteristics. The chromaticity data obtained include L * (lightness), a * (green to red), and b * (blue to yellow) values under three different lighting conditions: D65/10°, A/2°, and F2(Fcw/CWF)/2°.

Tabel 4. Color parameters of edible coating kepok banana peel

Color parameters	Lighting conditions		
	D65/10°	A/2°	F2(Fcw/CWF)/2°
L*	75.56	74.72	75.01
a*	-2.82	-4.443	-1.71
b*	-5.38	-6.49	-6.32

The L* value indicates the brightness level of the sample. In this study, the L* value ranged from 74.72 to 75.56, indicating that the edible coating has a fairly high brightness level. This high brightness level can provide an attractive visual appearance to the coated product, which can increase consumer appeal. The a * value indicates the colour position on the green-red axis. The negative values obtained, ranging from -4.43 to -1.71, indicate that the edible coating has a colour tendency towards green. This green color may be caused by the natural pigment content in the banana peel, which is used as a base material for pectin. The b* value indicates the color position on the blue-yellow axis. The negative values obtained, ranging from -6.49 to -5.38, indicate that the edible coating has a colour tendency towards blue. This blue color tendency can also be associated with the chemical components in the banana peel.

Bright colors with green and blue tendencies can provide a fresh and natural appearance to the coated strawberries. This can increase the visual appeal and consumer preference for the strawberries. The results of the colorimeter data analysis showed that edible coating pectin from kepok banana peel has bright color characteristics with a tendency towards green and blue. These characteristics can provide an attractive visual appearance and increase consumer appeal to coated strawberries.

3.3. Physical Properties of Strawberries that have been treated with EC

3.3.1 Weight Loss

Significant weight loss can indicate loss of moisture and nutrients, which affects taste and texture. The treatments applied were control, and edible coating of kepok banana peel pectin. Data on the weight loss of strawberries after being coated with edible coating of banana peel pectin can be seen in Fig 6.

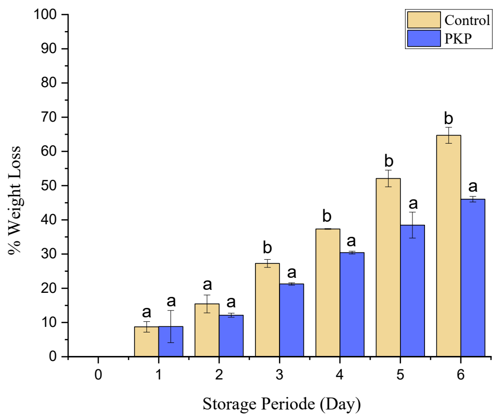

Fig 6. The Effect of pectin type and storage time on the % weight loss of strawberries.

Strawberries in the control treatment group experienced the highest weight loss because they lacked a protective layer that could inhibit water loss through respiration. This confirms the importance of using edible coating in slowing down the decline in fruit quality during storage. EC pectin of kepok banana peel resulted in a lower weight loss of strawberries compared to the control, because the layer formed was quite stable. Its antioxidant content also helped in inhibiting tissue damage that could cause oxidation in the fruit, so that it could slow down or inhibit the rate of fruit respiration, which resulted in a lower weight loss of the fruit.

Without an edible coating, strawberries experience a high respiration rate. High respiration rates cause drastic weight loss. Fruit treated with an edible coating made from kepok banana peel pectin showed good effectiveness in reducing the weight of strawberries. The use of pectin as an edible coating that shows its effectiveness in slowing down the weight loss of strawberries has also been reported [30-32].

3.3.2 Decay of Strawberries

Based on the research results, edible coating treatment has a significant effect on the rate of strawberry fruit decay during

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storage. Observations were made every day for 6 days at room temperature (25°C). The graph of observation results can be seen in Figure 7. The results of the observations showed that the application of edible coating had a significant effect on the rate of strawberry fruit decay during storage. Room temperature is a common storage condition to study, but tends to accelerate the decay process, especially in soft fruits such as strawberries that have high water content and fast respiration activity. The difference in the time of onset of decay in each treatment reflects the effectiveness of each treatment in slowing down fruit damage.

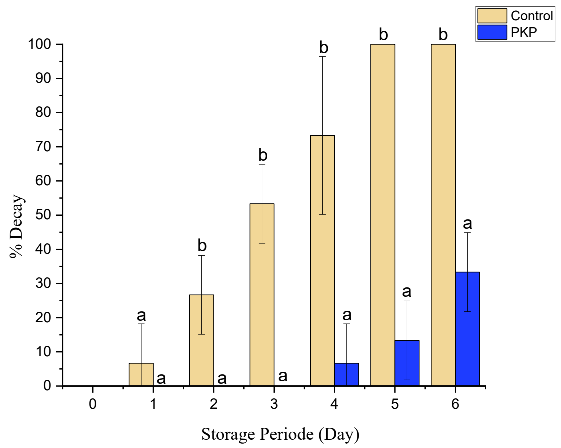

Fig 7. The Effect of pectin type and storage time on the % of strawberry decay.

In the control treatment, decay had begun to appear since the first day, and continued to increase until it reached a completely rotten condition on the 5th day. This shows that without a surface coating, strawberries are very susceptible to water loss and high respiration. Strawberries are known as a fruit that is easily damaged because of their high water content and soft fruit tissue. Meanwhile, in fruit coated with kepok banana peel pectin, decay began to appear on the 4th day, indicating that the pectin layer was able to inhibit the rate of decay during the first few days of storage. Pectin forms a semipermeable layer that limits the diffusion of gas and water vapor, and reduces respiration activity. However, its effectiveness began to decline after the third day, possibly because the pectin layer degraded or was not strong enough to withstand the biological pressure of the fruit that was starting to ripen. Inhibition of strawberry fruit decay using edible pectin coating has previously been reported [30-32] and produced the same conclusion, namely the use of pectin as an edible coating can slow down the process of strawberry fruit decay.

4. CONCLUSION

This study shows that pectin extracted from kepok banana peel has characteristics that can be used as a base material for edible coating. Observations during storage at room temperature showed that strawberries coated with edible coating survived until the 4th day before showing signs of decay, with a weight loss of 33.33% on the 6th day. Overall, pectin from kepok banana peel has excellent potential as a natural ingredient for edible coating in extending shelf life, reducing the rate of decay, and maintaining the visual quality of strawberries during storage at room temperature (25ºC).

REFERENCE

[1] Friedrichsen JSA, Bruni ARS, Alves ES, Saqueti BHF, Figueiredo AL, Souza PR de, et al. Biodegradable Coatings Based on Cassava Starch and Poly(Vinyl Alcohol): Potential Application for Prolonging the Shelf Life of Strawberries (Fragaria ananassa) cv. San Andreas. ACS Food Sci Technol [Internet]. 2024 Feb 16;4(2):365–72. Available from: https://doi.org/10.1021/acsfoodscitech.3c00456

[2] Pastrana AM, Shea EA, Fernandez-Bayo JD, Allison B, Watson DC, Toniato J, et al. Impact of biosolarization with almond hull and shell amendments for the control of Fusarium oxysporum f. sp. lactucae in a lettuce/tomato cropping system. Crop Prot [Internet]. 2022;152:105856. Available from: http://dx.doi.org/10.1016/j.cropro.2021.105856

[3] Kocira A, Kozłowicz K, Panasiewicz K, Staniak M, Szpunar-Krok E, Hortyńska P. Polysaccharides as Edible Films and Coatings: Characteristics and Influence on Fruit and Vegetable Quality—A Review. Agronomy [Internet]. 2021;11(5):813. Available from: http://dx.doi.org/10.3390/agronomy11050813

[4] Salehi F. Edible Coating of Fruits and Vegetables Using Natural Gums: A Review. Int J Fruit Sci [Internet]. 2020;20(sup2):S570–89. Available from: http://dx.doi.org/10.1080/15538362.2020.1746730

[5] Mahardiani L, Larasati RM, Susilowati E, Hastuti B, Azizah N. Potential edible coating of pectin obtained from banana peel for fruit preservation. J Phys Conf Ser [Internet]. 2021;1912. Available from: https://api.semanticscholar.org/CorpusID:235367086

[6] Amoriello T, Ciccoritti R, Ferrante P. Prediction of Strawberries' Quality Parameters Using Artificial Neural Networks. Agronomy [Internet]. 2022; Available from: https://api.semanticscholar.org/CorpusID:248221980

[7] Newerli-Guz J, Śmiechowska M, Drzewiecka A, Tylingo R. Bioactive Ingredients with Health-Promoting Properties of Strawberry Fruit (Fragaria x ananassa Duchesne). Molecules [Internet]. 2023;28. Available from: https://api.semanticscholar.org/CorpusID:257605374

[8] Fan TT, Zhang J, Cao J, Xia MH, Wang T, Cao S. Effects of resveratrol treatment on quality and antioxidant properties of postharvest strawberry fruit. J Food Biochem [Internet]. 2022;e14176. Available from: https://api.semanticscholar.org/CorpusID:248025548

[9] Andriani V, Abyor Handayani N. Recent technology of edible coating production: A review. Mater Today Proc [Internet]. 2023 [cited 2025 Jan 22];87:200–6. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2214785323009604

[10] Patil V, Shams R, Dash KK. Techno-functional characteristics, and potential applications of edible coatings: A comprehensive review. J Agric Food Res [Internet]. 2023 Dec [cited 2025 Jan 17];14:100886. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2666154323003939

[11] Seliawati I, Adirianto B, Rafli M, Setiawan Y. Pemanfaatan Limbah Kulit Pisang Ambon (Musa Paradisiaca) Menjadi Kerupuk Bernilai Ekonomis. J Agroekoteknologi Dan Agribisnis [Internet]. 2020; Available from: https://api.semanticscholar.org/CorpusID:225936363

[12] Khamidah N, Sofyan A, Elena N. Teknologi Edible Coating dari Pati Kulit Pisang terhadap Mutu Buah Apel Malang (Malis sylvestris). J Ilm Inov [Internet]. 2022;

Available from: https://api.semanticscholar.org/CorpusID:252146142

[13] Amalia UN, Maharani SE, Widiaputri SI. Aplikasi Edible Coating Pati Umbi Porang Dengan Penambahan Ekstrak Lengkuas Pada Buah Pisang. In 2020. Available from: https://api.semanticscholar.org/CorpusID:225978687

[14] Duggal M, Singh DP, Singh S, Khubber S, Garg M, Krishania M. Microwave-assisted acid extraction of high-methoxyl kinnow (Citrus reticulata) peels pectin: Process, techno-functionality, characterization and life cycle assessment. Food Chem Mol Sci [Internet]. 2024 Dec [cited 2025 Jan 17];9:100213. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2666566224000200

[15] Mobasserfar R, Shiri A, Mofid V, Shahidi Noghabi M, Gharibzahedi SMT. Grape pomace high-methoxyl pectin: A new prebiotic stabilizer for low-fat synbiotic yogurt gels – Optimization and characterization. Int J Biol Macromol. 2024 Dec 1;282.

[16] Yefrida Y, Suyani H, Aziz H, Efdi M. Validasi Metode MPM untuk Penentuan Kandungan Antioksidan dalam Sampel Herbal serta Perbandingannya dengan Metode PM, FRAP dan DPPH. J Ris Kim [Internet]. 2020 Mar 30 [cited 2025 Jan 20];11(1):24–34. Available from: http://jrk.fmipa.unand.ac.id/index.php/jrk/article/view/342

[17] Doumeng M, Makhlouf L, Berthet F, Marsan O, Delbé K, Denape J, et al. A comparative study of the crystallinity of polyetheretherketone by using density, DSC, XRD, and Raman spectroscopy techniques. Polym Test [Internet]. 2021 Jan [cited 2025 Jan 22];93:106878. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0142941820321073

[18] Refilda R, Gustira D, Yefrida Y, Hanifa D. Edible coating effect on physicochemical properties of banana (Musa sapientum L.) during storage. IOP Conf Ser Earth Environ Sci [Internet]. 2024 Jun 1 [cited 2025 Jan 20];1356(1):012017. Available from: https://iopscience.iop.org/article/10.1088/1755-1315/1356/1/012017

[19] Mitrea L, Teleky BE, Plosca MP, Nemes SA, Pascuta MS, Ranga F, et al. Enhancing eco-friendly coatings: Aqueous olive leaves extract fortifies macroalgae-based packaging materials. LWT [Internet]. 2024 Oct [cited 2025 May 21];209:116805. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0023643824010880

[20] Didar Z, Soltan-Dallal MM, Goharjoo B. The effect of synbiotic coating of flaxseed mucilage-defatted rice bran carbohydrate on quality of dried mango, viability of *Bifidobacterium animalis* subsp. *Lactis* BB12 on storage and simulating gastrointestinal condition. Food Sci Nutr [Internet]. 2024 Aug [cited 2025 May 21];12(8):5548–60. Available from: https://onlinelibrary.wiley.com/doi/10.1002/fsn3.4206

[21] Hernández-Carrillo JG, Orta-Zavalza E, González-Rodríguez SE, Montoya-Torres C, Sepúlveda-Ahumada DR, Ortiz-Rivera Y. Evaluation of the effectivity of reuterin in pectin edible coatings to extend the shelf-life of strawberries during cold storage. Food Packag Shelf Life [Internet]. 2021 Dec [cited 2025 May 9];30:100760. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2214289421001289

[22] Sayed MdA, Kumar J, Rahman MdR, Noor F, Alam MdA. Effect of extraction parameters on the yield and quality of pectin from mango (Mangifera indica L.) peels. Discov Food [Internet]. 2022 Oct 10 [cited 2025 May 9];2(1):28. Available from: https://link.springer.com/10.1007/s44187-022-00029-1

[23] Spinei M, Oroian M. The Influence of Extraction Conditions on the Yield and Physico-Chemical Parameters of Pectin from Grape Pomace. Polymers [Internet]. 2022 Mar 28 [cited 2025 May 9];14(7):1378. Available from: https://www.mdpi.com/2073-4360/14/7/1378

[24] Andri Cahyo Kumoro ACK, Shinta Mariana SM, Tri Hanly Maurice THM, Jefri Pandu Hidayat JPH. Pectin Derived from Hydrolysis of Ripe Kepok Kuning Banana Peel Powder Employing Crude Pectinases Produced by Aspergillus niger. Sains Malays [Internet]. 2022 Jul 31 [cited 2025 May 9];51(7):2047–59. Available from: http://www.ukm.my/jsm/pdf_files/SM-PDF-51-7-2022/9.pdf

[25] Ahsan M, Ashraf H, Iahtisham-Ul-Haq, Liaquat A, Nayik GA, Ramniwas S, et al. Exploring pectin from ripe and unripe Banana Peel: A novel functional fat replacers in muffins. Food Chem X [Internet]. 2024 Oct [cited 2025 May 9];23:101539. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2590157524004279

[26] Islam KS, Mustak MdH, Shishir MdKH, Karim MdM, Khan GMdA. Biosynthesis of ZnO nanoparticles using banana peel pectin for antibacterial and photocatalytic applications. South Afr J Chem Eng [Internet]. 2025 Apr [cited 2025 Feb 25];52:127–40. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1026918525000137

[27] Wang R si, He X hong, Lin H, Liang R hong, Liang L, Chen J, et al. Solubility Difference between Pectic Fractions from Creeping Fig Seeds. Polymers [Internet]. 2019 Jan 17 [cited 2025 May 8];11(1):159. Available from: https://www.mdpi.com/2073-4360/11/1/159

[28] Mamiru D, Gonfa G. Extraction and characterization of pectin from watermelon rind using acetic acid. Heliyon [Internet]. 2023 Feb [cited 2025 Jan 17];9(2):e13525. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2405844023007326

[29] Nofita, Putri, S. G., Syafitri, S., Tutik, & Amalia, P. (2024). Analisis Kandungan Vitamin C dan Antioksidan dalam Sediaan Masker Gel Peel Off Ekstrak Kulit Pisang Ambon dan Pisang Kepok. Jurnal Mandala Pharmacon Indonesia, 10(2), 589–600. https://doi.org/10.35311/jmpi.v10i2.630

[30] Zantar Y, Noutfia Y, Laglaoui A, Maurady A, Alfeddy MN, El Abbassi N, et al. Impact of a coating of pectin and Cinnamomum Zeylanicum essential oil on the postharvest quality of strawberries packaged under different modified atmosphere conditions. Discov Food [Internet]. 2025 Jan 18 [cited 2025 May 9];5(1):11. Available from: https://link.springer.com/10.1007/s44187-025-00271-3

[31] Khodaei D, Hamidi-Esfahani Z, Rahmati E. Effect of edible coatings on the shelf-life of fresh strawberries: A comparative study using TOPSIS-Shannon entropy method. NFS J [Internet]. 2021 Jun [cited 2025 May 9];23:17–23. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2352364621000055

[32] Zebua DN, Prima EC, Yelliantty, Garnida Y. Effect of a pectin edible coating with lemon peel extract to maintain strawberry fruit's quality during cold storage. Food Humanity [Internet]. 2025 May [cited 2025 May 9];4:100541. Available from: https://linkinghub.elsevier.com/retrieve/pii/S294982442500045X