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Article

# Combination of Starch and Pectin as Raw Materials for Making Edible Film

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### ABSTRACT

Food spoilage, driven by factors like microbes and oxygen, is a major challenge in food preservation. Edible films offer an eco-friendly and biodegradable solution, acting as a protective barrier that reduces waste and extends a product's shelf life. While starch is a common and affordable material for these films, it has limitations, including poor water resistance and brittleness. This study investigates the potential of combining starch and pectin to create a superior composite edible film. A Systematic Literature Review (SLR) and analyzing articles published between 2020 and 2025. The review focused on key evaluation parameters, including tensile strength, elongation at break, water vapor transmission rate (WVTR), and biodegradability. The findings indicate that the synergistic interaction between starch and pectin forms a more stable, dense structure through hydrogen bonds, significantly enhancing these mechanical and barrier properties. Furthermore, the specific structure of the pectin, such as its degree of methylation, was found to be crucial for optimal blending and performance. By carefully controlling these interactions, the resulting edible films can achieve properties comparable to some fossil-based plastics, positioning them as a promising and sustainable alternative for food packaging.

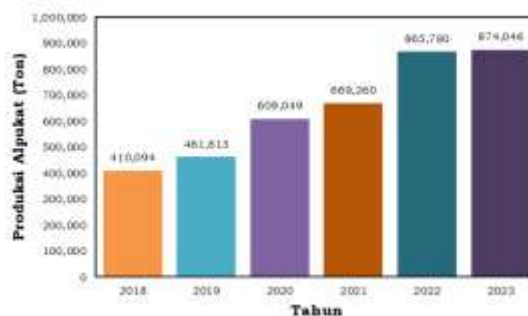
## 1. Introduction

Food, whether fresh or processed, is essential for human survival, but it all eventually spoils. This spoilage is influenced by internal factors like water content, pH, and nutrient composition. For instance, fatty foods spoil faster due to oxidation and rancidity, particularly when combined with high water content. In addition to these internal causes, external factors such as sunlight, humidity, temperature and microbial activity also contribute significantly to food degradation (Santoso, 2020). To combat spoilage and extend shelf life, a promising solution is the use of edible films as a protective layer. These films are an eco-friendly alternative to plastic packaging (Fathoni et al., 2021). They act as a barrier between the food and its surroundings, offering several benefits: they protect the food, they're biodegradable, and they can be eaten, which helps reduce waste (Syahputra et al., 2022). The performance of edible films is essentially determined by their inherent barrier properties against the main decay pathways. Effective preservation is achieved by inhibiting gas transport (e.g., oxygen diffusion that causes oxidative damage), moderating water vapor transmission, and limiting surface microbial proliferation. In addition to its protective capabilities, the sustainable nature of the film (edible and biodegradable) contributes significantly to reducing the environmental burden of packaging (Syahputra et al., 2022).

The films can be made to have properties similar to plastic, such as being transparent and flexible. A common and safe ingredient for these films is starch, which is easily absorbed by the body. Starch-based edible films are effective because they prevent oxygen and carbon dioxide from reaching the food and have good mechanical strength, making them a practical and environmentally responsible packaging option. Some examples of their use include wrappers for sausages and candies (Fathoni et al., 2021). Agricultural waste, such as avocado seeds and dragon fruit peels, holds great promise as a source for edible films. Utilizing this waste will lead to significant opportunities to transform abundant waste into useful products. This contributes to the circular economy and promotes sustainability (Chaves et al., 2025). Currently, avocado seeds are largely discarded and not used to create valuable products, even though data from the Central Statistics Agency

indicates that avocado production in Indonesia has steadily increased from 2018 to 2023 (Badan Pusat Statistik, 2024).

Rising avocado production in Indonesia, projected at 874,046 tons in 2023, is creating a significant amount of waste up to 262,213.8 tons of avocado seeds, which make up 21-30% of each fruit (Mora-Sandi et al., 2021). While this waste poses a major environmental risk, it also offers a valuable opportunity to create edible films (Salazar-López et al., 2020).



**Figure 1.** Indonesian Avocado Production from 2018-2023

Starch, a common, cheap, and biodegradable material from sources like corn and cassava, is often used for these films (Behrooznia & Nourmohammadi, 2024; P. Singh et al., 2024). However, starch-based films have weaknesses, including poor water resistance and brittleness (Jiang et al., 2019; S. Singh et al., 2025). Starch-based films have a significant limitation when used separately, especially in terms of mechanical integrity and barrier properties. Mechanically, these films are naturally brittle and easily broken, lacking the flexibility needed to withstand physical handling without breaking. This weakness is mostly due to the amylopectin branched molecular structure, which inhibits the formation of strong interchain interactions and results in poor interfacial adhesion within the film matrix. In addition, the hydrophilic properties of starch reduce its resistance to water, resulting in high water vapor permeability. These characteristics make pure starch films ineffective as a barrier against moisture, failing to protect food products from moisture or dehydration (Chaves et al., 2025).

To fix this, researchers can combine starch with pectin, a gel-forming polysaccharide found in many plant cell walls, such as those from dragon fruit peels. The pectin utilized in edible films can be obtained from the rind of fruits like

apple, orange, kiwi, melon and pomegranate (Güzel & Akpınar, 2019). It has been used in foods and beverages because of their hydrocolloid properties, which can easily form gels (Freitas et al., 2021) as well as enhancing the texture and shelf life of the food. This study specifically uses pectin from dragon fruit skin, which is about 22% pectin by weight (Rahma et al., 2024). Pectin obtained from dragon fruit peel has excellent properties and can be utilized as an alternative source of food additives (e.g., emulsifiers, thickeners) in the food industry. According to Chen et al., 2022, pectin from dragon fruit have high content of galacturonic acid ( $87.02 \pm 0.89\%$ ), low value of esterification degree ( $37.26 \pm 1.37\%$ ) and low Molecular weight ( $1181.75 \pm 11.21$  kDa). Higher galacturonic acid content in pectin can increase the film's tensile strength and elongation at break.

## 2. Literature Review

### 2.1 Edible Film

Edible film is a thin, consumable layer created from food-safe ingredients. It can be applied as a coating on a food's surface or as a film placed between food layers. Its main purpose is to act as a barrier that controls the movement of things like moisture, oxygen, and fats, while also serving as a carrier for other food ingredients and making the product easier to handle. A familiar example is the casing on a meat sausage, which you don't need to remove before cooking and eating. These films are typically made from one of three main components: hydrocolloids, fats, or a combination of both. Hydrocolloids are a broad group that includes things like proteins, cellulose, pectins, and starches (Deden et al., 2020). In edible films, the most important properties are rheological, morphological, thermal, mechanical, and barrier properties, that controls efficiency of packaging to be able to endure conditions of processing, packaging, transportation, and storage (Ahmed et al., 2023). Rheological behavior directly determines the spreadability, thickness, and uniformity of the final film, which in turn determines important film qualities such as mechanical strength, barrier properties, and structural integrity (Santhosh et al., 2024). For example, the right viscosity and viscoelasticity are needed to ensure easy application and the formation of a smooth, bubble-free film with effective barrier

performance. For characterization morphological of edible film usually used analytical tools such as scanning electron microscopy (SEM), atomic force microscopy (AFM), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), and confocal laser microscopy (CLM). The edible films microstructures are affected preparation method, composition selection, and plasticizer and constituent components interaction (Ahmed et al., 2023). Mechanical properties are critical for maintaining the quality of edible films. To assess a film's ability to withstand stress and maintain its structure during use, two common measurements are routinely taken such as Tensile Strength, which indicates the maximum stress the film can handle, and Elongation at Break, which measures how much the film can stretch before tearing. These values reflect the overall strength and cohesion of the film's components. According to Istiani et al., 2024, increasing of pectin concentration in edible film which made from durian rind pectin, cassava starch, and glycerol, make tensile strength value increased. The more pectin added, the higher the tensile strength value of the edible film. The highest tensile strength was 9 N for composition of edible film material is 3 (starch):1(glycerol):1.25 (pectin). Meanwhile for elongation, the highest elongation percentage (21%) was obtained in the sample with a concentration ratio of 3 (starch):1(glycerol):0 (pectin), this is because the composition of the sample only consists of starch and glycerol without the addition of pectin so that glycerol has a fairly high concentration in the sample (Istiani et al., 2024).

### 2.2 Edible Film Components

Generally, there is three types of edible film components. It comes from proteins (like gelatin) or polysaccharides (like starch); plasticizers (such as glycerol or sorbitol) to make the film flexible and elastic; and other additives that provide specific functions, such as thickening, emulsification, or antimicrobial properties. The choice of film-forming agents depends on their ability to create a film, their biodegradability, and how well they work with other ingredients.

#### 2.2.1 Proteins

Proteins are a common, sustainable material for edible films, offering excellent film-

forming properties. Both plant-based (like soy and gluten) and animal-based (like gelatin and whey) proteins create films that resist moisture, are mechanically strong, and can carry beneficial additives. Milk proteins, specifically casein, are known for forming flexible, clear, and stable films that can deliver antioxidants and antimicrobials (Pawase et al., 2025).

### 2.2.2 Polysaccharides

Polysaccharide films are valued for their ability to provide strength, structural integrity, and a pleasant odor. They create an excellent barrier against oxygen and oil, thanks to their strong hydrogen-bonded network. This barrier helps to delay the ripening of food, significantly extending its shelf life. However, while starch is a primary material for these films, it has some major weaknesses: it performs poorly against water and has a low water vapor barrier. To overcome these issues and create a more stable film, researchers often blend starch with other ingredients, such as arrowroot powder, for use in the food and pharmaceutical sectors (Shanbhag et al., 2023).

### 2.2.3 Lipid

Lipids are used in edible films for their ability to resist water. Because they are hydrophobic, they are excellent at creating barriers against moisture and preventing both microbial and physical degradation. Common lipids, such as waxes and fatty acids, improve a film's moisture resistance. Essential oils, which are also lipids, can add antimicrobial properties to the film antimicrobials (Pawase et al., 2025).

### 2.2.4 Composite Materials and Comparative Analysis

Composite films combine different materials to create a product with enhanced properties. For example, mixing proteins and polysaccharides can improve gas resistance, while adding lipids can significantly boost moisture and oxygen barriers. These films can be multi-layered to optimize their barrier capabilities antimicrobials (Pawase et al., 2025).

When comparing the materials, proteins are valued for their mechanical strength and flexibility. They form strong, elastic networks, making them ideal for applications where durability is important. In contrast, lipids are less

mechanically strong but excel at providing a strong barrier against moisture. By combining proteins and lipids, a composite film can achieve both structural integrity and effective moisture resistance. This allows for the creation of customized films that meet the specific packaging needs of different food products.

**Table 1.** Comparison table mechanical, physical and biodegradation properties of edible film

Source	Tensile Strength	Elongation	Water Vapor Transmission Rate (WVTR)	Biodegradation
Protein	High	Medium to High (varies with plasticizer)	High (poor barrier)	Biodegradable
Lipid	Low (rigid/brittle)	Low (prone to cracking)	Low (excellent barrier)	Biodegradable
Polysaccharide	Medium to high (can be brittle with plasticizers)	Low (brittle without plasticizers)	High (poor barrier due to hydrophilicity)	Biodegradable

Source: (Athanasopoulou et al., 2024; Dewi et al., 2020; Farhan et al., 2025; Gupta et al., 2022; Hassan et al., 2024; Herrera-Vázquez et al., 2022; Hertzler et al., 2020; Khin et al., 2024)

## 2.2 Edible Film Making Method

There are four primary ways to make edible films: solvent casting, hot melt extrusion, semisolid casting, and rolling solvent casting. Each method has its own unique features. Among these, solvent casting is the most widely used and has been for over a century, thanks to its simplicity and practicality. This method has evolved significantly and can now directly produce finished edible film products. The

properties of an edible film, such as its shape and characteristics, are directly influenced by the ingredients used to make it. A particularly important ingredient is the plasticizer. Plasticizers are added to make the film more flexible and stretchy, preventing it from cracking. They also increase the film's permeability to gases and water vapor, and improve its overall elasticity (Hijiriawati & Febrina, 2016). Plasticizers work primarily based on free volume to increase polymer flexibility by increasing free volume and reducing cohesive forces. Plasticizer molecules interacted between polymer chains, acting as diluents. This increases the average interchain distance and free volume fraction in the system. This extra space facilitates movement. To reduce cohesive forces, plasticizers interact with polymer chains, disrupting and weakening the interchain attractive forces. This lowers the cohesive energy required to separate chains. The increase in free volume fraction and reduction in cohesive forces collectively increase the entropy and lower the energy barrier required for coordinated chain movement. This leads to an increase in molecular mobility and a significant decrease in the Glass Transition Temperature ( $T_g$ ), causing the material to transition from a rigid (glass) state to a soft (rubber) state at a lower temperature (Lim & Hoag, 2013).

### 2.3 Factors that influence edible film

Edible films have a wide range of uses, from preserving fruits and vegetables to protecting meat and poultry, and even encapsulating flavors. Their main purpose is to create a semi-permeable barrier that controls the movement of gases and moisture. They can also deliver beneficial additives like antimicrobials, antioxidants, and texture enhancers directly to the food. These films are particularly useful for whole fruits and vegetables, as they can reduce post-harvest damage by creating a protective layer. For the film to be effective, it must be specifically designed to maintain the ideal internal gas composition for that particular fruit or vegetable. When creating an edible film, several key factors must be considered:

- a. How the film-forming solution will affect the food product.
- b. How the film's properties will change over time.
- c. How the film might interact with the

food and potentially alter its flavor.

- d. How storage conditions will impact the coating.

The method used to find the shelf-life of edible film is the Accelerated Shelf Life Test (ASLT), which utilizes the Arrhenius equation (Afifah & Ratnawati, 2021). The degradation of the food over time is initially modeled by a kinetic equation:

$$dt = k[A]^n \quad (1)$$

Equation (1) relates the change in a measured component's concentration (A) to the time (t), the kinetic constant (k), and the order of reaction (n). To use this equation correctly, the reaction order must first be determined through some steps such as guess an value, and then integrate and linearize the kinetic equation. After that plot the experimental data (storage duration versus the concentration data) according to the linearized model. The k value that provides the highest  $R^2$  (coefficient of determination) is selected, as this indicates the best fit to the experimental data. The calculated k values which obtained at various temperatures are then plotted against the experimental temperature using the Arrhenius equation:

$$k = k_0 \exp(-E_a/RT) \quad (2)$$

This relationship is often linearized to find the activation energy ( $E_a$ ):

$$\ln k = \ln k_0 \exp(-E_a/RT) \times (1/T) \quad (3)$$

R is the gas constant (1.9872 cal/mol/K), T is the absolute temperature (K),  $k_0$  is the rate constant, and  $E_a$  is the activation energy. Plotting  $\ln k$  against  $1/T$  yields a straight line whose slope is equal to  $E_a/R$  (Afifah & Ratnawati, 2021). The  $E_a$  calculated from this slope allows the k at normal storage temperatures to be predicted, which is crucial for determining the final shelf-life. Storage temperature significantly affects permeability in edible film due to the diffusion processes governing material transport are highly temperature-dependent, following Arrhenius-type relations (Raisi et al., 2009). The general relationship is expressed by the Arrhenius equation, which describes how the diffusion

coefficient (D)) changes with absolute temperature:

$$D = D_0 \cdot e^{-E_a/RT} \quad (4)$$

Where D is diffusion coefficient, which directly correlates to the material's permeability and  $D_0$  is the pre-exponential factor (or frequency factor). This is a material-specific constant that represents the theoretical maximum diffusion coefficient at infinite temperature. A higher diffusion coefficient means higher permeability and faster transport of a substance through the material (for example oxygen through an edible film). Other important characteristics to consider are the film's thickness, color, and flavor, as these can all influence the final quality of the coated product (Ismaya et al., 2021).

### 3. Research Methodology

The articles selected for this insight study discuss the effectiveness and quality of edible film production using a combination of starch and pectin as raw materials. These articles were obtained from leading baseline data from 2020 to 2025.

This study uses a Systematic Literature Review (SLR) to systematically map the research literature on edible films made from a combination of starch and pectin. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach was meticulously followed to ensure the review process is transparent, structured, and replicable. Through this method, we focused on literature published within the 2020–2025 timeframe. The process begins with the identification phase, where a comprehensive search strategy employing precise keywords (e.g. edible film, starch, pectin, blend) linked by Boolean operators (And / Or) is executed across major databases to gather all potentially relevant records. Next, screening phase involves removing duplicate records and then subjecting the remaining unique titles and abstracts to an initial assessment by two independent reviewers to exclude those clearly unrelated to starch-pectin composite films, thereby yielding a set of reports for full-text retrieval. Subsequently, the eligibility phase requires retrieving the full-text articles and rigorously assessing them against detailed, pre-defined inclusion and exclusion

criteria (Product must be an edible film, intervention must be a Starch AND Pectin blend, Outcome must include characterization of physical, mechanical, or barrier properties). Finally, the inclusion phase specifies the remaining articles that have successfully passed the eligibility check as the definitive set of studies for data extraction, critical evaluation, and synthesis in final review.

### 4. Results and Discussion

Edible film production can use raw materials derived from proteins, polysaccharides, lipids, or a combination of these materials. This research focuses on edible films using a combination of starch and pectin. Combining starch and pectin in edible films creates a stronger, more effective material than using either polysaccharide alone. This composite approach improves the film's tensile strength and flexibility. Starch is known for its ability to block gases, while pectin's gelling properties contribute to the film's overall stability. When a plasticizer like glycerol is added, the resulting film has enhanced water vapor resistance and is more durable, making it ideal for food packaging. Tapioca starch is a popular choice for making edible films because it's a great film-forming material (Song et al., 2023). However, films made from pure tapioca starch tend to be weak, with high flexibility but low tensile strength. For this reason, tapioca starch is often combined with other natural compounds to improve its overall properties. For instance, researchers have successfully blended tapioca starch with sodium and carboxymethyl cellulose to create edible film or combining tapioca starch with chitosan and pineapple leaf fiber for edible film synthesis and it resulted better mechanical strength and faster degradation. Similarly, while pectin is an excellent film-forming material, films made from pure pectin also have poor physical and mechanical properties that limit their use. To overcome this, pectin is often blended with other materials. For examples mixing pectin with potato starch and using glycerol as a plasticizer resulted in a strong, biodegradable film with an excellent oxygen barrier (Song et al., 2023).

The combination of raw material from starch and pectin is shown in Table 2.

**Table 2.** Comparison of raw material between starch and pectin for edible film production

Raw Material	Antioxidant material	Result
Tapioca starch and pectin (Song et al., 2023)	Broccoli leaf polyphenols	Adding BLP to a composite film made of tapioca starch and pectin improves its effectiveness. The film with 3% BLP showed the best results, becoming stronger and forming a dense barrier. When used to wrap chilled mutton, this film significantly slowed spoilage and oxidation, extending the meat's shelf life to 12 days while maintaining its quality.
Arrow root powder and Pectin (Shanbhag et al., 2023)	-	Higher thermal stability up to 280 °C, thickness 0.180 ± 0.001mm, Bursting strength 1.5 ± 0.013 kg/cm <sup>2</sup> , Tensile strength 0.1230 ± 0.001 kg/cm <sup>2</sup> , Elongation at Break 35.33 ± 0.34 %, Young's modulus 0.0035 ± 0.0002 kg/cm <sup>2</sup> , Moisture content 13.69 ± 0.12 %
Corn starch and pectin (Febrianti, 2021)	-	The best results were achieved with a film containing 0.9g of pectin and 1mL of chitosan. This specific combination produced a film with a thickness of 0.211 mm, a swelling degree of 1.69%, and a high water resistance of 98.31%. It also had a water content of 14.36%, a solubility of 38.54%, and a degradation rate of 47.14%. Its mechanical properties were a tensile strength of 1.292 MPa, elongation of 13.7%, and elasticity of 0.096 MPa.
Corn starch,	-	The best edible film was made from 1 gram of pectin

Raw Material	Antioxidant material	Result
papaya peel (as pectin source) (Halim & Darmawan, 2021)	-	and 0.5 grams of corn starch. This specific formula resulted in a film with a low water vapor transmission rate (3.447 g.mm/m <sup>2</sup> /hour), a moderate tensile strength (1.3121 MPa), a moderate elongation of 9.42%, and a thickness of 0.11 mm.
Potato starch and Pectin (Bhatia et al., 2025)	Juniper Berry Essential Oil	Antioxidant testing shows a significant increase in the radical scavenging capacity of the films. The scavenging capacity for DPPH increased from 11.31% to 17.28%, and for ABTS, it rose from 3.06% to 25.53%.
Cassava Starch and Durian Rind Pectin (Istiani et al., 2024)	-	This research explored using pectin from durian rind to create edible films, combining it with cassava starch and glycerol. The study found that increasing the amount of pectin made the films stronger and more flexible, while adding more glycerol also improved strength and flexibility. The best results were achieved with a specific ratio of ingredients: 3 parts cassava starch, 1 part glycerol, and 1.25 parts pectin. This combination produced an edible film with thickness of 0.112 mm, a strong tensile strength of 9.32 N, and a high elongation of 79.59%.

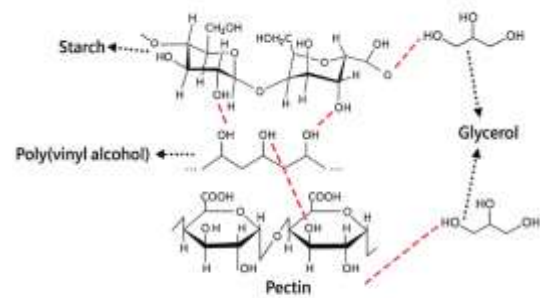
All hydrocolloids have unique properties that cause different molecular changes and interactions, so it's essential to carefully control how these biopolymers interact to get the desired qualities in new food products. A lot of research has been done on various hydrocolloids,

including starch and pectin, for their use in a wide range of food products like dairy, fruit, and meat. Starch is a popular and affordable ingredient used to modify the texture of many foods, such as jams, jellies, and sauces. However, pure starch has limited use because it doesn't dissolve well in water and can retrograde (thicken and become grainy). To overcome these limitations, starch is often combined with other hydrocolloids. For example, using both pectin and tapioca starch in fruit fillings has been shown to improve firmness and maintain a consistent texture. This positive effect is caused by the formation of strong bonds, like hydrogen bonds and other molecular interactions, between the hydrocolloids and the food (Alam et al., 2025). According to Bai et al., 2023, research which made edible film from combination of pea starch and pectin from citrus peel and pea starch with sugar beet pectin, show the structure of pectin affects the performance of edible films. High-methylated pectin improved the film's ability to resist water and act as a moisture barrier. However, if the pectin's substitution level (with methyl or acetyl groups) was above 57%, it negatively impacted how well the pectin and starch blended together. On the other hand, the presence of carboxylic groups in pectin seemed to improve its wettability and adhesion, which significantly strengthened the starch films. When a citrus pectin with a very low degree of methylation was used, it didn't fully dissolve during processing. This created clumps of pectin within the film, leading to poor mixing and a weak overall structure. Therefore, selecting the right pectin structure is crucial for optimizing the film's performance, as it directly impacts how the film will function.

Mixing starch and pectin creates a more organized and stable material due to a specific interaction between them. Pectin, a large molecule, has various groups like carboxyl, hydroxyl, and methyl groups. When it's blended with starch, these groups form non-covalent bonds, primarily hydrogen bonds, with the hydroxyl groups on the starch molecules. This bonding creates a new, more dense structure within the mixture. This new structure changes the properties of the starch, making it more resistant to both gelatinization. It also increases the starch's internal order, including its crystallinity. In short, the addition of pectin significantly alters the structure of starch, which

is a key reason for the improved properties of the final blend (Lin et al., 2022).

Chaves et al., 2025, made edible films using corn starch mixed with citrus pectin, glycerol plasticizer, and PVA. In this study, variations in the composition of starch and pectin were tested. From the mechanical property testing, there was an increase in strength as the pectin concentration increased, from 0.029 MPa to 0.035 MPa. This proves the synergistic effect of hydrogen bonds between starch and pectin, creating a stronger structure than each material alone. Increasing the pectin concentration also increased the film's flexibility from 1.69% to 2.98%. Pure starch films tend to be stiff and brittle (easily broken), while the pectin mixture provides a little extra flexibility, which is important so that the packaging does not tear easily when wrapping fruits with uneven contours.



**Figure 2.** Schematic diagrams starch–pectin molecular bonding and the effect of plasticizers and PVA on network structure (Chaves et al., 2025)

Edible films composed only of pectin or starch tend to be fragile and have low mechanical strength. This weakness is related to the three-dimensional structure of the polysaccharides that compose the film. In starch, the presence of two main components, namely amylose and amylopectin, affects the ability to form films. Linear amylose is able to self-assemble spontaneously, thereby supporting the formation of a more regular structure, while branched amylopectin causes a decrease in chain linearity and inhibits inter-chain interactions, resulting in less stable films. In pectin, the polymer structure is also insufficient to produce a strong film network when used without additives. Therefore, glycerol is used as a

plasticizer to increase flexibility. PVA is also can be used as a reinforcing agent to increase the strength and barrier properties of the film. Both of these materials are capable of forming hydrogen bonds with the –OH groups in polysaccharides, thus creating cross-linking bonds between components such as pectin–glycerol, PVA–pectin, starch–glycerol, starch–PVA, and combinations of three components such as starch–glycerol–pectin and starch–PVA–pectin. These cross-linking interactions significantly strengthen the film matrix (Chaves et al., 2025).

## 5. Conclusion

Blending starch and pectin often yields better results than using either one alone. This is due to a synergistic interaction between the two polysaccharides, primarily through hydrogen bonds, which improves the material's overall properties. This combination creates a more stable structure that can enhance texture and viscoelasticity. The mixture improves how the material feels and behaves, making it more flexible and cohesive. Increasing of pectin concentration in mixture corn starch- citrus pectin edible film can increase tensile strength from 0.029 MPa to 0.035 MPa and increased the film's flexibility from 1.69% to 2.98%. Beside that it leads to better performance in swelling, gelatinization temperature, and paste viscosity. As a result, the combined use of starch and pectin can produce superior outcomes for a wide range of food products and applications.

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