Utilization of ginger extract (Zingiber Officinale) and turmeric extract (Curcuma longa) as edible tomato-packing film

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Abstract. Research on ginger extract and turmeric extract as edible tomato-packing film has been done. This study was conducted to determine the ability of both extracts in increasing the storage time of tomatoes tested by its texture and shrinkage of tomato fruit weight parameters. Research showed that the addition of ginger extract and turmeric extract into edible film able to maintain the quality and life of tomato fruit when reviewed based on 50% of shrinkage weight and 63% of texture damage. Fifty percent of shrinkage of tomato control weight occurred within 45 days. Depreciation of 50% of tomato weight with edible film coating without ginger extract may increase to 48 days. Edible tomato coated with added ginger extract shrink 50% of tomato weight in 65 days, while tomato coated edible film with addition of turmeric extract experience 50% shrinkage of tomato weight in 60 days. Texture reduction of 63% in tomatoes occurred 7 days to 7.5 days with edible film coating without ginger extract, while with edible film coating with the addition of ginger extract to 12 days. While turmeric extract to 186 days.

1. Introductions
Demand for foodstuffs, especially vegetables of good quality, is now being considere by the community along with awareness of the importance of health and nutritional value in food consumed. Consumers demand high-quality fresh fruit that has a good appearance, is durable, and does not quickly wither during storage [1].

Tomatoes are one type of fruit that is very popular with the community. Tomatoes have many nutrients that are good for body health. Nutrient contents in tomatoes that are widely known are vitamin C and minerals are quite high. Tomatoes are a horticultural commodity that is vulnerable to damage. This is cause by metabolic activity that continues even though the fruit has been harvested or stored. During the process takes place there will be a process of deterioration that results in fast damage [2]. Several factors that can affect tomato decay are physiological and microbiological factors. Both of these factors greatly affect the quality of tomatoes. Symptoms could indicate by a decrease in the quality of tomatoes such as changes in physical shape to be softer and texture that looks wrinkled.

One effort that could do to improve the quality and storability of tomatoes is by using edible coatings or edible films. Krochta (1992) explained that edible film is a thin layer made from edible material [3]. Edible films are form to coat coatings that serve as a barrier to mass transfer (e.g. moisture, oxygen, light, lipids, solutes) and / or as an additive carrier and to improve the handling of
food. The protective function of edible films is to prevent oxidation, moisture absorption and desorption, contamination, microbial growth and sensory change [4].

The main components of edible film compilers are three groups, hydrocolloid, fat and composite [5]. One of the basic ingredients for making the edible film is starch. Starch contains amylase that is able to form thin layers with strong bonds so that it can form good edible films [6]. Canna bulbs are one of the sources of starch used in making edible films. Canna starch is one of the sources of starch, which has amylase content, so it has great potential as a raw material for edible films. Its properties that can form gelatin make this material easy to apply as a shaper and can produce good films. Aloe Vera gel was added as a combination of canna starch to obtain high quality edible film characteristics.

Sedyadi (2016) has also carried out edible film applications for food, especially fruit [7]. The development of natural edible coating materials for horticultural commodities that edible coating of aloe vera can maintain the quality and extend the shelf life of cucumber fruit for 9 days. Krochta (1994) also made observations about the development of natural edible coating materials for other horticultural commodities which showed that edible coating of aloe vera can maintain the quality and extend the shelf life of tomatoes for up to 3 days at room temperature [8].

In this study, a comparison of the addition of ginger and turmeric extract to edible films of canna tuber and aloe vera was carried out. Ginger can be used as a source of natural antioxidants because it is rich in phenolic compounds which are active antioxidant compounds [9]. One way to get ginger compounds in the form of extracts is to extract. The compound contained in the turmeric extract is curcuminoid which gives yellow color to turmeric. Curcuminoid is mostly in the form of curcumin, one of which functions as an antioxidant that can protect materials from oxidative destructive [6]. According to Joseph (2009) states that antioxidants are compounds that can extinguish oxidation reactions, because these compounds are able to break the chain of reactions in oxidation or stabilize the oxidation radical compounds [10].

The presence of ginger and turmeric extract added to edible film can function as an antioxidant. This trait will minimize the process of respiration that occurs so that the quality and storability of tomatoes becomes longer. The addition of active components in edible films can add value to the edible film function. Addition of ginger and turmeric extract to edible canna starch films and aloe vera will have an effect on the mechanical properties of edible films. The quality of tomatoes during the shelf life will also be maintained due to the antioxidant content to inhibit the rate of respiration of tomatoes.[7]

2. Experimental methods

2.1. Preparations of Ginger Extracts
The rhizome of the ginger is peeled and sliced thin and then dried in an oven at 60°C for 6 hours. Dried ginger is smoothed in a blender. 25 grams of ginger powder were dissolved in 96% ethanol in a ratio of 1: 5 and heated for 120 minutes at 40º with stirring. The solution was allowed to stand for 24 hours and then filtered to separate the filtrate from the ginger powder that precipitated. Ginger extract filtrate is then thickened using a vacuum rotary evaporator [4]. Then the FTIR test were carried out.

2.2. Preparations of Turmeric Extracts
Making turmeric extract based on digestion method [8]. A total of 50 grams of turmeric powder plus 96% ethanol with a ratio of 1: 5. The resulting turmeric extract is then thickened using an evaporator. The resulting turmeric extract results were analyzed for an FTIR.

2.3. Edible Film Applications on Tomatoes
Edible film application on tomatoes using the wrapping method. Tomato fruit is cleaned first before being applied with edible film. The tomato fruit is then tightly wrapped using edible film with the addition of ginger and turmeric extract with a concentration of 0% and 0.75%. The storability of tomatoes was observed by weight loss test on 0, 1, 2, 3, 6, and 7 days. Texture tests were carried out
on the 1st and 7th days. The results obtained were compared with tomatoes that were not wrapped in edible film (control).

2.4. Characterizations of plastic
Mechanics tests of Tomatoes have done in Laboratorium Teknologi Pangan Fakultas Teknik Pertanian UGM using Universal Testing Machine at speed test 10 mm per minutes. Functional group determination of plastic has done by using infrared spectrophotometer using KBr pellets methods. Sample pellets analyzed its infrared absorption at wavenumber 4000-400 cm⁻¹.

3. Results and discussion

3.1. Extractions

3.1.1. Extractions of Ginger. The method used to obtain ginger extract is a digestion method. Digestion method is a method that is done by dissolving the material to be extracted in a solvent with a certain ratio and stirring [11]. The resulting extract is dark brownish black in the form of thick paste. The yield obtained was 8.56%. Ginger extract was analysed using FT-IR spectrophotometer to determine the functional groups contained therein and identified at wave numbers 4000-400 cm⁻¹. The FT-IR spectrum from the analysis of ginger extract is shown in the figure 1.

![Figure 1. FTIR Spectrum of Ginger Extracts](image)

Typical uptake that appears in the FTIR spectrum above is at wave numbers 3410.15 cm⁻¹; 1705.07 cm⁻¹; 1604.77 cm⁻¹; and 1226.73 cm⁻¹, each wave number indicates aromatic OH, C = O, C = C and C-O absorption. The group can be said to be typical absorption of ginger or shoal compounds found in ginger extract as an antioxidant compound.
3.1.2. Extractions of Turmeric extract. Turmeric extract obtained in the form of thick red brick extract. The yield of turmeric extract produced using 96% ethanol as much as 9.27% of dry weight simplicity. Turmeric extract was carried out using FTIR spectrophotometer at a wave number of 4000-400 cm\(^{-1}\). Figure 2 shown the result of turmeric extract FTIR.

\[\text{Figure 2. FTIR Spectrum of Turmeric Extracts}\]

Based on the results of the FTIR spectrum in figure 2, it can be seen that there is a wide absorption in the wave number 3286.7 cm\(^{-1}\) that indicates the presence of \(-\text{OH}\) groups. Absorption in waveforms of 2924.09 cm\(^{-1}\) that is indicates the presence of C-H group. The presence of C-O groups is shown in the absorption of wave numbers 1033.85 cm\(^{-1}\). Absorption at wave number 1620.21 cm\(^{-1}\) indicates the presence of C = O carbonyl group and C = C bond is indicated by the presence of wave number absorption of 1512.19 cm\(^{-1}\). Typical functional groups owned by curcumin such as O-H, C = O, C = C, C-O and C-H [12].

3.2. Edible Film Applications on Tomatoes

3.2.1. Test of weight loss on tomatoes with Ginger Extract Edible Film. Weight loss is a condition caused by the occurrence of post-harvest fruit respiration and transpiration as a biological process in which oxygen is absorbed to burn organic matter in fruit to produce energy followed by the release of residual combustion in the form of carbon dioxide gas and evaporated water [13] Respiratory reactions [14] that cause increased weight loss are as follows:

\[\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Energy}\]

Due to reduced water content in the fruit due to the transpiration, process which will cause the fruit to experience shrinkage. The weight loss experienced by tomatoes without coating edible films was 1.54-
8.16% greater than that of tomatoes coated with edible film without the addition of ginger extract with a percentage of 0.94-7.14% and shrinking the weight of tomatoes coated with edible film with concentration of 0.75% is 0.89-5.39%. Edible film with the addition of ginger extract with a concentration of 0.75% tends to show a lower weight loss value compared to edible film without the addition of extract. The addition of ginger extract to edible film of canna-aloe Vera increases the functional value of edible films by carrying active antioxidant components that can act as antioxidants to inhibit oxygen contact with tomatoes that trigger the rate of respiration that causes damage to tomatoes. According to Carp (2004) and Sedyadi (2016) a coating using polysaccharide-based edible films has the ability to inhibit the maturity of various fruits that are climatic and able to increase shelf life without producing a high anaerobic atmosphere[14][7]. The results of measurements of tomato weight loss are presented in figure 3.

![Figure 3. Correlations of Addition of Ginger Extracts in Edible Film to Tomatoes Weight Loss](image)

The ability of edible films to extend tomato shelf life based on weight loss can be seen by shrinking the weight lost up to 50% in tomatoes. In tomatoes without edible film coating (control) will lose 50% weight loss on 45 days, then in tomatoes with edible film coating without the addition of ginger extract will lose weight by 50% on 48 days, while edible tomatoes the film with the addition of ginger extract had a longer time than the control tomato and tomato coating of edible film without the addition of extract that was on the 64th day. The very large difference in the days showed edible films with the addition of ginger extract had a significant effect in extending the shelf life of tomatoes by inhibiting the shrinkage of tomato weight.

3.2.2. Test of weight loss on tomatoes with turmeric extracts edible film.

Weight loss is a process of weight loss due to the process of respiration and transpiration. The process of transpiration and respiration causes the water content in tomatoes to decrease. According to Cervera (2003), loss of fruit weight during storage is mainly due to water loss [15]. Water loss in fresh products can also reduce quality and cause damage. Based on figure 3 showed a graph of the increase in shrinkage value of tomato weight, which was not wrapped in edible film (control), tomatoes wrapped in edible film of tuber of aloe Vera, and tomatoes wrapped in edible film tuber of aloe Vera
with the addition of extract turmeric. The shrinkage value of tomato weight, which was not wrapped with edible film (control) during storage, ranged from 1.54-8.15%. The shrinkage value of tomato weight wrapped in edible film tuber of aloe Vera ranged between 0.94-7.13% while the shrinkage value of tomato weight wrapped in edible film tuber of aloe Vera with the addition of turmeric extract during storage ranged between 0.56-5.56%.

Based on the graph in figure 4 it can be said that at the end of the observation the lowest shrinkage value of tomato fruit occurred in the treatment of tomato fruit wrapped in edible film with the addition of turmeric extract. The highest shrinkage value of tomato fruit occurred in tomato fruit treatment which was not coated with edible film (control) The absence of edible film in tomatoes which functions as a barrier causes O2 which enters the tomato fruit to be high so that respiration increases and the loss of water in tomatoes is also high. This means that the edible film coating treatment is able to form a layer that is good enough to suppress the respiration process so that the transpiration and shrinkage of the weight of tomatoes could also be suppressed.

![Figure 4. Correlations of Addition of Turmeric Extracs in Edible Film to Tomatoes Weight Loss](image)

The shelf life of tomatoes is determined based on the damage of tomatoes to the weight loss of 50% by using the line equation. From the calculation, results of tomatoes that were not coated with edible film (control) experienced a 50% loss in weight loss on the 45th day. On the 48th day tomatoes coated with edible film without the addition of turmeric, extract experienced 50% weight loss while tomato fruit coated with edible film with the addition of 0.75% turmeric extract lost 50% weight loss on the 60th day. From these data the calculation of shelf life can be seen from the loss of 50% weight loss from tomatoes. Tomato fruit coated with edible film without the addition of turmeric extract can extend the shelf life to 3 days longer than tomatoes without coating while tomatoes coated with edible film with the addition of turmeric extract can extend the shelf life to 15 days longer than tomatoes without coating.

3.2.3. *Test of textures on tomatoes with ginger extract edible film*. Texture is one of the tests related to fruit hardness. The longer the storage, the fruit will experience a decrease in violence or getting softer. The process of respiration and transpiration in the fruit influences fruit softening. Respiration that occurs in postharvest fruit will cause the process of overhauling polysaccharides and compiler cell walls. The fruit will become softer as the polysaccharide changes over time [9]. According to Blouis
(1958), changes in texture in fruit are caused by the overhaul of starch into simple sugars in the form of glucose, fructose, and sucrose [12].

Based on figure 5 results indicate the length of storage affects the texture of tomatoes. Tomatoes without edible film coating on the first day of texture values were 2.26 to 0.82 N on the 7th day. The results of tomato observation with the addition of edible film without addition showed a change on the 1st day texture value of 2.11 N then on the 7th day to 0.89 N. Meanwhile, tomatoes coated with edible film with the addition of ginger extract on the day 1 is 2.35 N and on the 7th day is 1.56 N.

Tomatoes coated with edible film showed a decrease in the level of violence that was not large on the 7th day, when compared to tomatoes without coating which experienced a significant decrease in the level of violence on the 7th day. Tomatoes coated with edible film with the addition of ginger extract showed a lower level of hardness compared to tomatoes coated with edible film without addition. In tomatoes without coating occurs a faster metabolic process compared to tomatoes coated with edible film.

![Figure 5. The Texture Difference between Tomatoes unwrapped, wrapped by edible film and wrapped by edible film with ginger extracts](image)

These results indicate that edible films with the addition of ginger extract can maintain the level of tomato hardness or inhibit the softening process due to respiration and transpiration that occur in tomatoes. Edible film will inhibit oxygen that will enter the tissue so that the enzymes involved in the process of respiration and softening of the tissue become less active [16]. Respiratory rate that runs slowly can delay tomato maturity and reduce texture degradation during storage [17].

The ability of edible films to extend the shelf life based on the hardness level of tomato texture can be seen from the percentage of tomato hardness decrease for 7 days. The percentage decrease in tomato violence for 7 days was 63%. Tomato coating with edible film without ginger extract decreased the hardness level by 63% that is 7.5 days, while tomatoes coated with edible film with the addition of ginger extract will experience a decrease in the level of violence on the 12th day of shelf life. The difference between tomato control (without coating) was not much different from tomatoes coating edible films without the addition of ginger extract, but tomatoes with edible film coating with the addition of ginger extract showed a very significant difference. These results show the real effect of adding ginger extract to edible films in extending the shelf life[18].

3.2.4. Test of textures on tomatoes with Turmeric Extract Edible Film. Tomatoes texture will be increasingly soft along with the fruit ripening process, so that it can lead to a decrease in the quality of tomatoes. Based on Figure 6 the results of observation of texture test on tomato fruit during storage,
the texture of tomato fruit has decreased. On observations on day 1 and day 7, the results of tomato texture test were not wrapped in edible films, which were 2.26 N and 0.82 N, while the results of tomato texture were wrapped in edible film of tuber of aloe Vera, namely 2.11 N and 0.89 N. The results of texture test of tomato fruit wrapped in edible film with the addition of turmeric extract at 1.68 N and 1.64 N.

The low texture test results on tomatoes wrapped in edible film of tuber of aloe Vera with the addition of turmeric extraction are caused by the inhibition of the transpiration process, so that the loss of water in tomatoes is reduced and softness of tomatoes is lower than the control and edible film of canna tuber without addition. According to Saragih (2015) states that the decrease in violence is influenced by the rate of respiration where high respiration rates will cause faster metabolism [19].

Based on the results of the research that has been done, tomato fruit which is not wrapped or wrapped in edible film without the addition of turmeric extract has decreased the test of almost the same texture. The results of the decrease in texture test were greater than those of tomatoes wrapped in edible film with the addition of turmeric extract so that the texture of tomatoes wrapped in edible film with the addition of turmeric extract could still be maintained. Tomato fruit texture is increasingly soft due to the transpiration and respiration processes in tomatoes.[20]

![Figure 6. The Texture Difference between Tomatoes unwrapped, wrapped by edible film and wrapped by edible film with turmeric extracts](image_url)

The shelf life of tomatoes can be determined based on the results [21] of the texture testing that has been done, namely by using the line equation. Decreased texture percentage as much as 63% on tomatoes which were not coated with edible film for 7 days, to achieve a 63% reduction in texture percentage on tomatoes coated with edible film of aloe Vera for 7.5 days while tomato fruit coated with edible film with the addition of 186 days of turmeric extract.

4. Conclusions
Depreciation of 50% tomato weight with edible film coating without ginger extract may increase to 48 days. Edible tomato coated with added ginger extract shrink 50% tomato weight in 65 days, while tomato coated edible film with addition of turmeric extract experience 50% shrinkage of tomato weight in 60 days. Texture reduction of 63% in tomatoes occurred 7 days to 7.5 days with edible film coating without ginger extract, while with edible film coating with the addition of ginger extract to 12 days. While turmeric extract to 186 days.
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