JOURNAL LA LIFESCI

VOL. 01, ISSUE 02 (007-016), 2020
DOI: 10.37899/journallalifesci.v1i2.97

The Effect of Coating as Antifungi of Harumanis Mango's Post Harvest Losses

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Article Info
Article history:
Received 27 May 2020
Received in revised form 30 May 2020
Accepted 3 June 2020

Keywords:
Coating
Tobacco Extract
Harumanis Mango

Abstract

The amount of mango production in Indonesia is quite high, but the quality of postharvest mangoes is still quite low. The quality of the fruit will decline due to contamination; one of the contaminants is fungi. The way to reduce the damage of postharvest products is by coating applications. The purpose of this study was to study the physical, chemical and antifungal activities of harumanis mangoes's quality which had been given coating during storage that could cause postharvest losses of harumanis mangoes. There are 3 treatments, each of them are respectively the provision of corn based coating 6% tobacco extract, 8% tobacco extract and 10% tobacco extract. The physical and chemical properties of the antifungal coating of tobacco extract made from corn coating for post-harvest damage on harumanis mangoes were obtained by weight loss, texture, colour, respiration rate, vitamin C and total dissolved solid. Preventing coating can prevent damage after harvest and protect the harumanis mango; therefore the quality of the mangoes can be maintained. The best results from the priority with the largest diameter inhibition zone were given corn starch 10% tobacco extract. Then the higher the concentration of extract used, the greater the diameter of the inhibition zone obtained. Based on all the tests performed (physical, chemical, and antifungal) the best treatment from the treatment was obtained that consisted of mangoes with antifungal layers of corn starch 10% tobacco extract. Because the P3 obtained the best results in maintaining physical, chemical content and fungi for 15 days.

Introduction

The horticulture subsector in Indonesia has good potential in supporting the growth and development of the Indonesian economy, because horticulture products such as fruits can grow well in all regions of Indonesia. The Central Bureau of Statistics (2018) reports five fruits with large production in Indonesia in 2017, namely bananas with 7.1 million tons / year, mango fruits at 2.2 million tons / year, Siamese citrus fruits at 2.1 million tons / year, then pineapple 1.7 million tons / year and zalacca with a total production of 950,000 tons / year. Therefore the local market potential of mango fruit is said to be large with the high productivity of mango fruit in 2017, but Karsinah *et al*. (2014) said that the quality of postharvest mangoes can still be said to be quite low because the number of mangoes is damaged.

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

Fungi that generally infect the fruit and cause decay are Aspergillus sp., Fusarium sp., Penicillium sp., And Alternaria sp. (Miskiyah *et al*., 2010), whereas for anthracnose in mangoes, Colletotrichum spp. (Rakhmawati, 2013). Symptoms of damage to mangoes due to fungal attacks can be in the form of black spots on the skin of the fruit and when the spots spread will make the flesh inside rot. Naufalin *et al*., (2011) postharvest control method that has the potential to inhibit damage to postharvest products is by coating or coating applications on the fruit. One agricultural product that can be used as an antifungal and can be added to the coating is tobacco leaf extract.

Tobacco contains antifungal compounds such as phenolic, triterpenoid, alkaloids, nicotine and tannins. The ingredients in tobacco are able to inhibit the growth rate of fungi. Naufalin et al. (2011) reported that the use of a tobacco extract coating with a concentration of 6% (v/v) produced an average diameter in inhibiting the growth of Pseudomonas aeruginosa by 18.53 mm and on the mold of Rhizopus sp. amounting to 16.91 mm. The use of tobacco in coatings can convert tobacco from cigarettes which is harmful to the body into a mixture of materials in coatings by utilizing the content of antifungal compounds on tobacco. Naufalin et al. (2011) said the content of tobacco leaf extract consisted of nicotine, phenolic, steroid, triterpenoid, alkanoid, and tannin. Therefore, tobacco extract can be one of the best antifungal producing alternatives, so it can be added to coatings. Naufalin et al. (2011) reported that handling tobacco leaf extract into an antifungal coating is very promising in terms of practicality, simplifying application and can be used to handle fruit and vegetable postharvest problems.

Methods

The research material used in this study includes harumanis mangoes with a level of 80-85% from PT. Trigatra Rajasa Situbondo Regency, tobacco, corn starch, aquades, glycerol and PDA (Potato Dextrose Agar). While the main equipment used in this study included color readers, refractometers, alarm glasses, electric heaters, clear glass bottles and laminar air flow.

The research uses two factors, tobacco extract and storage time. The first factor was treatment without coating / control (P0), harumanis mango with coating 6% tobacco extract (P1), harumanis mango with coating 8% tobacco extract (P2), harumanis mango with coating 10% tobacco extract (P3); while the storage time factor is 0, 6, 9, 12, and 15 days.

Tobacco Extraction

The method used for tobacco extraction is the dekok method which is heat extraction by means of liquid preparations made to filter vegetable simplicia with water solvents at a temperature of 90oC for 30 minutes. The initial stages were carried out to extract tobacco through drying of tobacco leaf casturi and reducing the size of tobacco leaves to form powder. Mixing to homogeneous tobacco powder with distilled water using a ratio of 1:10. After that, the heating process is carried out by not directly contacting the liquid with a heat source, but rather giving the media a water distribution. Then the sample solution is made to keep it at 90oC for 30 minutes, after which cooling is done at room temperature and filtering using filter paper.

Preparation and Application of Coatings

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

The first step is that the mangoes that have been washed with water and soaked in the liquid fungicide for 10 minutes are dried first at room temperature. Then prepare 3 types of edible coating following the instructions in the Pasaribu study (2009). After that, each type of coating was superimposed on harumanis mangoes with a mastery method which was repeated 2 times. Coating coated mangoes were stored at room temperature and tested on days 0, 6, 9, 12 and 15.

Results and Discussion

Weight Loss

The ANOVA calculation obtained with the Sig. <0.05 value indicates a real difference. The highest weight loss occurred in the treatment without coating due to respiration rate, transpiration and microbial activity in the treatment without higher coating than those given coating (Hafdani & Sadeghinia, 2011). Generally weight shrinkage can occur due to water loss in fruits or vegetables caused by the transpiration process (Naufalin et al., 2011). Transpiration in the fruit through the skin part of the fruit. Evaporation of fluids in intercellular spaces causes cells to shrink so that the intercellular space fuses and the pectin substance binds to one another (Qanytah, 2004). Starch coating mixed with tobacco extract is able to withstand the rate of transpiration and respiration in the product. According to Wahyuningtyas (2015), the addition of coatings can increase the barrier properties of water.

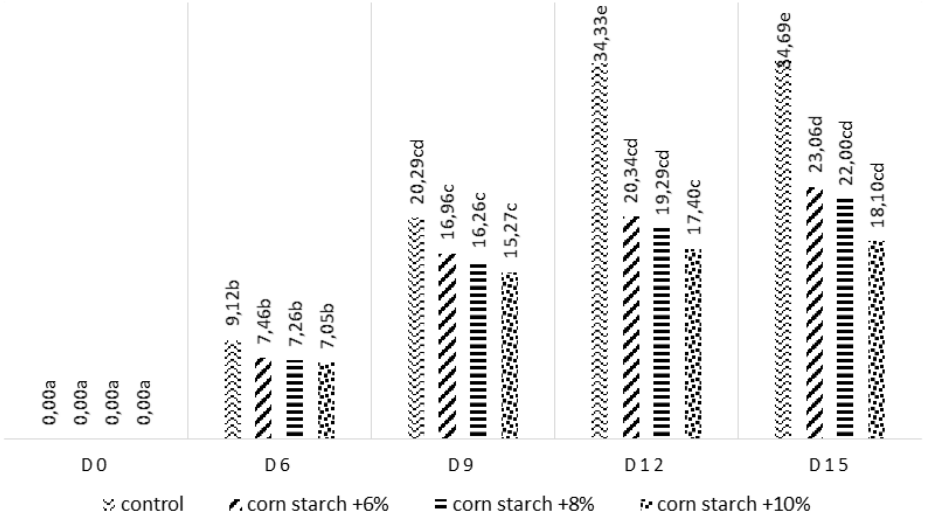

Figure 1. *Weight loss during storage*

Texture

The ANOVA calculation obtained with the Sig. <0.05 value indicates a real difference. Naufalin *et al*. (2011) say that softening vegetables and fruits during storage is caused by protopectin which is not soluble in water to be converted into water-soluble pectic and pectin acids. The breakdown of protopectin will result in weak cell walls so that the binding power between cells will decrease. According to Lathifa (2013) the change in texture is caused by pectin, that during the process of cooking the mango fruit will experience changes in the content of protopectin to pectin by the activity of the enzymes pectinmetilesterase and polygonacanalase which cause the fruit to soften. The difference in the concentration of tobacco extract used is thought to be able to inhibit softening in the mangoes because the

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smaller the calculation results of softness on the mangoes obtained the smaller the susceptibility of microorganisms (Tharanathan *et al*., 2006).

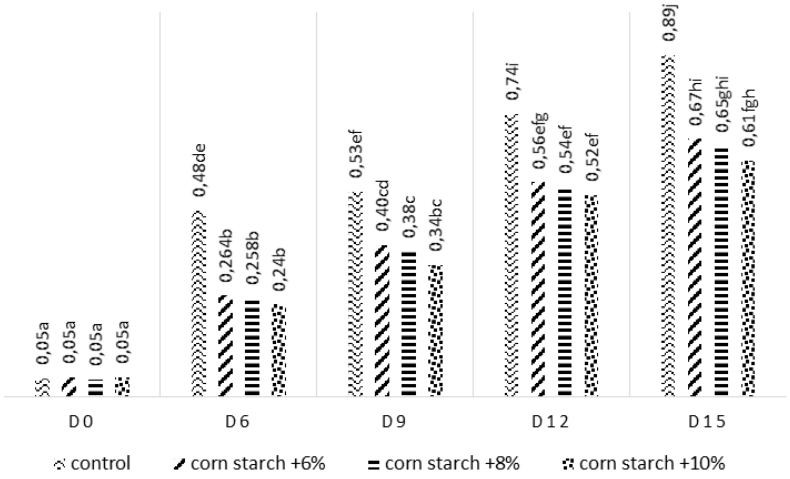

Figure 2. *Texture during storage*

Colour

The ANOVA calculation obtained with the Sig. <0.05 value indicates a real difference. Colour (L) which shows the brightness level with a value of 0 (dark) to +100 (bright). Mango which is given a coating is more able to maintain the L colour (brightness) than the control mangoes. There is a decrease in the brightness of the mangoes due to the longer shelf life of the mangoes. According to Marlina *et al*., (2014) the brightness level is directly proportional to the shelf life because the mangoes undergo a decay process caused by an on-going metabolic process.

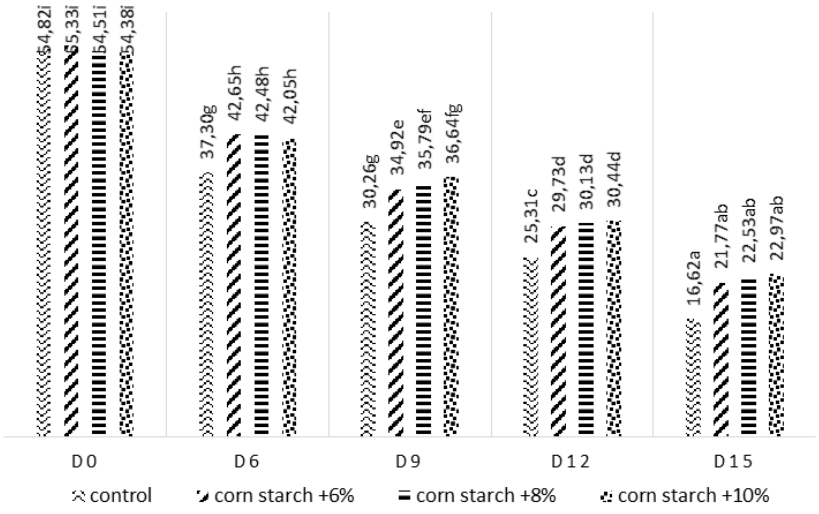

Figure 3. *Colour (L) during storage*

The ANOVA calculation obtained with the Sig. <0.05 value indicates a real difference. Colour (a) is a parameter to describe the type of green-red. The longer the fruit is stored; the green colour caused by ripe chlorophyll of fruit will gradually decrease. Salasa (2005) says the green colour in most fruits is caused by chlorophyll which plays a role in the photosynthesis

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process during maturation. The reduction in the chlorophyll content in the fruit will further lose the green colour. Decrease in colour changes in fruit is caused by coating effects which are able to maintain high concentrations of CO_2 and low O_2 in the internal atmosphere of the fruit thereby inhibiting chlorophyll degradation (Moalemiyan *et al*., 2011).

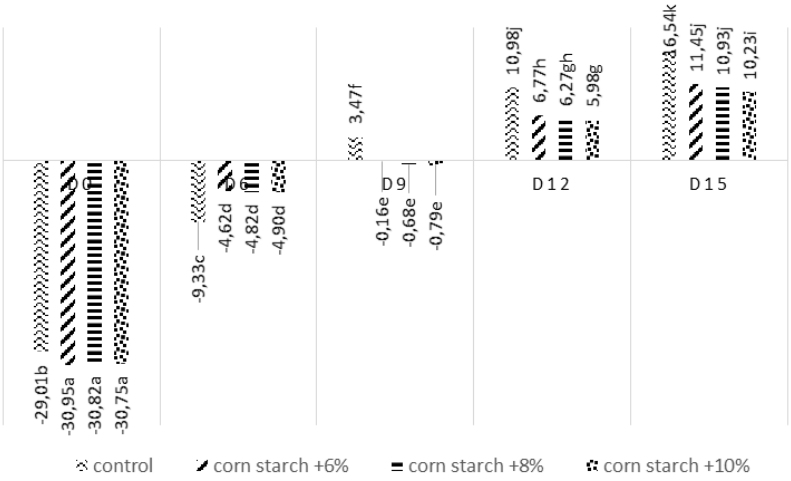

Figure 4. *Colour (a) during storage*

The ANOVA calculation obtained with the Sig.<0.05 value indicates a real difference. Colour (b) is a parameter to describe the type of yellow-blue. The results obtained showed that the longer the mango fruit is stored, the higher the positive value of color (b) is obtained so that the color of the mango will get yellow, which means that the mango undergoes an increasingly fast drying process. But with the coating can inhibit the rate of increase in color value (b). Yellow pigments (β-carotene and xanthophyll) are produced when the fruit ripening process starts (Naufalin et al., 2011). Decreasing the color change in fruit is caused by a coating effect which is able to maintain high concentrations of CO_2 and low O_2 in the internal atmosphere of the fruit which inhibits the formation of β-carotene (Moalemiyan et al. 2011).

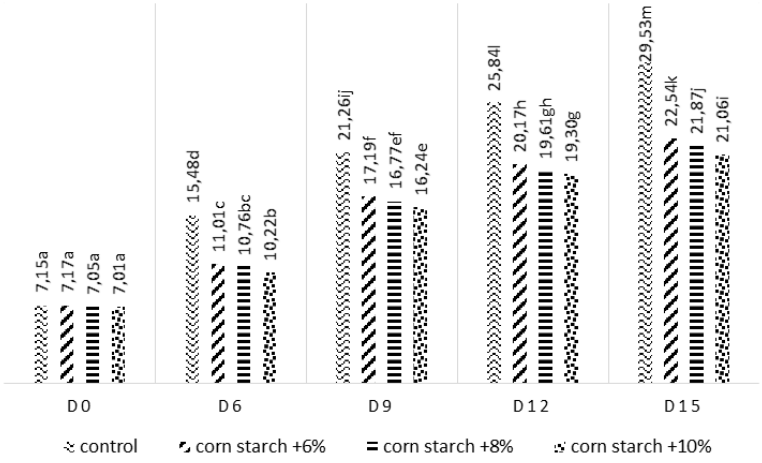

Figure 5. *Colour (b) during storage*

Respiration Rate

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

Coating coated mangoes have lower yields than non-coated coatings. Control mangoes (without coating) showed respiration rates that increased from day 0 to day 6 but decreased on day 9 to day 15. While mangoes with coating treatment showed an increase in respiration rate on day 0 to day 9, but decreased respiration rate on days 12 to 15. Naufalin *et al*., (2011) coating using starch mixed with tobacco extract was able to withstand the rate of transpiration and product respiration. According to Broto (2003) the presence of respiration in harumanis mangoes results in oxidative disassembly of complex materials such as starch, sugar, and organic acids into simpler molecules along with the production of energy used by cells for synthesis reactions. Coatings are reported to delay fruit ripening by modifying CO2, O2 and ethylene levels in fruit (Meindrawan, 2016).

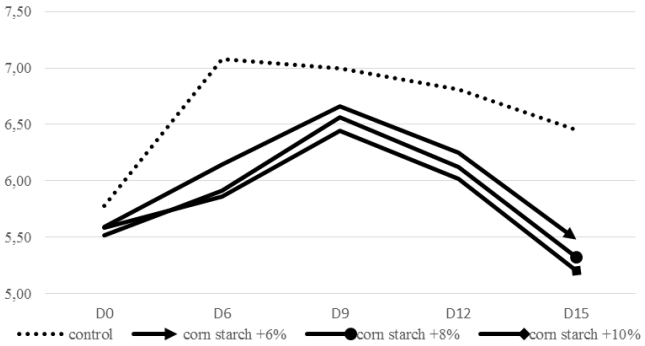

Figure 6. *Respiration rate during storage*

Vitamin C

Decreasing vitamin C occurs because of the enzyme activity of ascorbate oxidase (Santosa et al., 2011). Decrease in the content of vitamin C because ascorbic acid is oxidized to dehydroaskorbat acid, both of them still have activity as vitamin C and will undergo further changes by the hydrolysis reaction so that L-diketogulonate acid is formed which has no active vitamin C. The coating can be said to have influence in reducing the oxidation of ascorbic acid so that it can maintain the content of vitamin C present in mangoes, as stated in Moalemiyan *et al*. (2011) that coating on mangoes can have an effect on maintaining the quality of the mango.

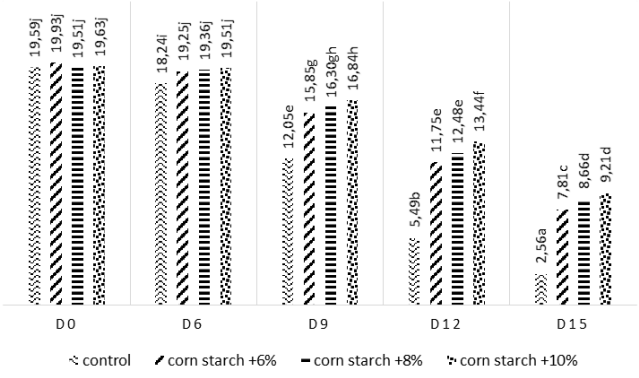

Figure 7. *Vitamin C during storage*

Total Dissolved Solid

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

The total dissolved solids in the harumanis mango with coating experienced an increase in total dissolved solids from day 0 to day 9 and decreased on days 12 to 15, while controls would experience an increase in total dissolved solids from day 0 to day 6 and decreased from 9th to 15th day. This is caused by increasing sugar content in the fruit during the ripening process (Pandarinathan & Sivakumar, 2011), so that the total value of dissolved solids in general has increased. But after the process of improvement there will be a decrease in the total value of dissolved solids as well as the pattern of respiration rate because the mango is a climacteric fruit. According to Tirkey et al (2014) when the fruit experiences decay and damage, the sugar content in it will be degraded, so the total value of dissolved solids will also decrease.

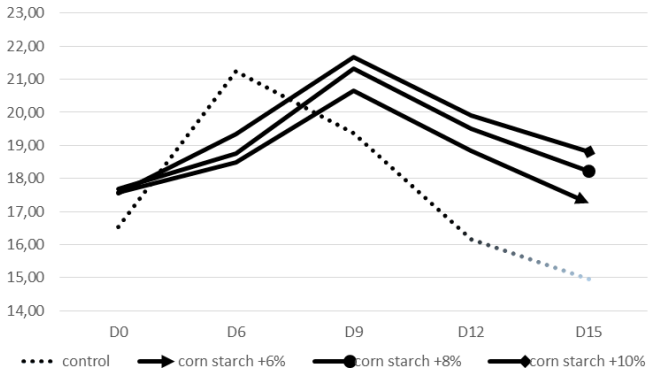

Figure 8. *Total dissolved solid during storage*

Antifungal Activity of Corn Tobacco Extract Based on Corn Starch

The biggest measurement of inhibition zone is the addition of 10% tobacco extract with an average value of the inhibition zone of 9 mm. Based on the resulting inhibitory zone value, it can be said that the highest concentration of tobacco extract has a moderate potential as an antifungal of Aspergillus niger. It is based on Davis' provision in Rahayu (2009) that the inhibition zone area of 20 mm or more has a very strong antifungal potential, 10-20 mm potentially strong, 5-10 mm medium potential and less than 5 mm potentially weak.

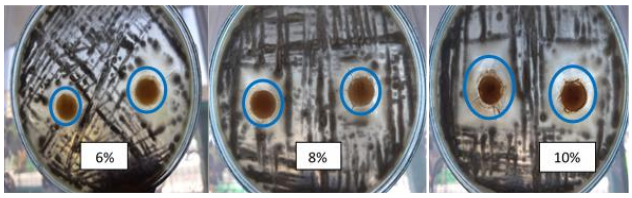

Figure 9. *Diameter of the inhibition zone*

Tobacco contains compounds such as phenolics, steroids, triterpenoids, alkaloids, tannins, nicotine and glycosides. The contents of this tobacco can inhibit the growth rate of fungi. Triterpenoids are compounds that can affect the permeability of cell membranes so that cells from fungi can experience lysis or rupture (Liu & Nes, 2009). Alkaloids are chemical compounds that can precipitate proteins and can damage cells so that fungal growth can be inhibited (Utama, 2007). The content of tannins can also inhibit the growth rate of microbes but must be at a high enough level (Naufalin *et al*., 2011). Susanti and Hasan (2011) nicotine is a potent nerve poison and acts as a contact poison for fungi. The content contained in tobacco

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

is thought to be able to inhibit the rate of activity of Aspergillus niger fungi as evidenced by the diameter of the formed ring. Addition of antimicrobial tobacco extract is a coating that is able to inhibit bacterial and fungal test, practical use and have better stability of environmental factors (heat, light, oxygen) (Naufalin *et al*., 2011).

3.8 Physical appearance of Harumanis Mango

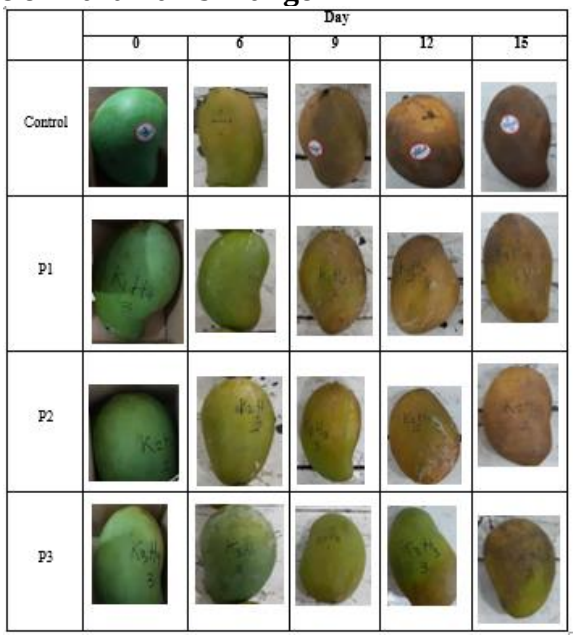

Figure 10. *The appearance of harumanis mangoes for 15 days*

Coating of mangoes that only use a single polysaccharide does not have a significant effect because it tends to be hydrophilic (Kittur et al., 2005). The difference in results obtained, although not much different between treatments for all physical and chemical tests caused by the content of tobacco extract which is added will vary, namely; 6% (P1), 8% (P2), and (10%) P3. Phenolic content in tobacco extract which is antioxidant is thought to inhibit damage to mangoes. When the mangoes begin to experience wilt, the fruit's skin is increasingly unable to protect the fruit. This causes the fruit cells to be in direct contact with oxygen so that the oxidation process occurs. The phenolic content in tobacco extract contains antioxidants, where antioxidants are nutritional and non-nutritional substances contained in food ingredients and are able to prevent or inhibit the occurrence of damage due to the oxidation process (Badriyah *et al*., 2017). The higher the level of tobacco extract added, the more phenolic content can function as a barrier to oxidation damage.

Conclusion

Coating was able to inhibit physical and chemical damage in post-harvest harumanis mangoes by testing results for weight loss, texture, color (L, a, b), respiration rate, vitamin C and total dissolved solid and was included in the medium category in inhibiting the growth of Aspergillus niger, although the results obtained from the three treatments were not much different.

ISSN 2721-1304 (Print), ISSN 2721-1207 (online)

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