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Application of Fragrant Lemongrass Essential Oil To Inhibit The Rate Decay in Bananas (*Musa acuminata*)

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Abstract. Fragrant lemongrass oil (Cymbopogon bernadus L.) is one of the essential oils that have antimicrobial activity so it can be applied to post-harvest handling of bananas to extend shelf life. This study aims to identify the combination of fragrant lemongrass essential oil with chitosan as an edible coating to inhibit the rate of damage to bananas. The manufacture of fragrant lemongrass emulsion and chitosan consists of 5 treatments. 1) CH 1% (Chitosan 1%)., 2) CH + EO 0.5% (chitosan 1% + Esensisal Oil 0.5%)., 3) CH+EO 1% (chitosan 1% + Essential Oil 1%) ., 4) CH+EO 0.04% (chitosan 1% + essential oil 0.04%)., and 5) EO 1% (essential oil 1%). The results showed that the CH+EO treatment of 0.5% is the best because it can inhibit the process of ripening bananas and maintain the level of hardness and inhibit the rot of bananas, with a level of hardness of 14.25 kg/cm2 (*105 pa) followed by CHS treatment of 1% in milk bananas 14.55 kg/cm2 (*105 pa) and lower damage rate in ch treatment 1% milk banana, EO 0.1% milk banana Mushroom growth is effectively controlled by CH+EO 0.5% and CH 1% milk banana followed by 0.1% EO in milk bananas. This study concludes that the combination of CH 1% and EO 0.5% is the recommended treatment to increase fruit hardness and inhibit the percentage of damage to milk bananas and plantains.

Keywords: milk banana, plantain, chitosan, fragrant lemongrass oil

INTRODUCTION

Banana fruit (Musa acuminate L) is the most widely consumed fruit in Indonesia. High consumption is followed by high banana production. Based on data from the Central Statistics Agency, the highest production of fruit crops (horticulture) in 2020 is banana plants at 8 million tons then followed by other fruit crops. Bananas are widely consumed they are one of the sources of energy because they contain high carbohydrates. Bananas also contain vitamins A, B1, B2, B6, B12 and vitamin C (Prabawati, 2008). In addition, bananas also contain nutrients such as minerals (potassium, magnesium, calcium, sodium, iron, zinc), dietary fiber, and antioxidants that are high (Haslinda, 2009). Bananas have the characteristic of being easily damaged after harvest because they still carry out metabolic activities (Napitupulu, 2013). The shelf life of bananas is known to be relatively low because it is a climacteric fruit and followed by the growth of microorganisms such as *Colletotrichum sp* and *Fusarium* (Istianto, 2009). Climacteric fruit is a fruit that continues to do respiration after harvest until the ripening process continues. In the ripening stage, bananas experience a decrease in quality due to changes in the composition of chemical content, discoloration, softening of fruit flesh, and aroma production (Itenour et al. 1997). Efforts to extend the shelf life have been widely carried out by farmers and scientists. Several techniques have been performed to increase shelf life such as hypobaric storage, edible coating, low-temperature storage, and the addition of antimicrobial agents (Duc et al, 2021)

Fragrant lemongrass oil (Cymbopogon bernadus L.) is one of the essential oils that have antimicrobial activity so it can be applied to post-harvest handling of bananas to extend shelf life (Istianto, 2009, Abu-seif, et al 2009). According to Putriningtyas (2014) fragrant lemongrass oil can be used to inhibit the growth of Escherichia coli and Staphylococcus aureus bacteria. Some components contained in fragrant lemongrass essential oils such as citronella, citronellol, and geraniol can inhibit bacterial activity (Luangnarumitchai et al. 2007). Research conducted by Brugnera (2011) stated that fragrant lemongrass essential oil from Brazil contains the chemical components of citronella 34.6%, geraniol 23.17%, citronellol 12.09% and can inhibit the activity of S.aureus, E.coli, and Pseudomonas aeruginosa bacteria. some studies add fragrant lemongrass oil as an edible coating and are applied to fruits such as bananas, papayas, peppers (Maqbool et al., 2011); and pineapples (Azarakhsh, et al, 2014., Asgar Ali et al 2015). Fragrant lemongrass essential oil is widely used in various formulations for anthracnose control of various fruits such as avocados (Mpho et al 2013); banana, and papaya (Maqbool et al., 2011); and mango (Duamkhanmanee, 2008).

Chitosan is a natural polysaccharide resulting from the process of distillation (removal of coch3-group) chitin. The coating on the fruit can provide mechanical strength to the skin and resist the exchange of gases entering or exiting through the fruit skin as well as reducing fruit respiration (Chailoo and Asghari, 2011., Chungsiripom J, 2011., (Jiang & Li, 2001; Jongsri et al., 2016; Petriccione et al., 2015; Donhowe and Fennema, 1994., Ali, Tengku, Kamaruzaman, & Siddiqui, 2010; Perdones, Sa´nchezGonza´lez, Chiralt, & Vargas, 2012; Zahid, Ali). The advantages of chitosan in addition to safe consumption (because it comes from the shells of marine animals) are also able to form a strong, elastic, flexible, hard-to-tear film layer (Abdou et al., 2008) and inhibit microbial growth (Wahab and Rashid, 2012; Shehata at al., 2012., Adiletta et al., 2018; Petriccione et al., 2015). Penelitian conducted (Asgar et al, 2015) the combination of chitosan and fragrant lemongrass oil can increase the hardness of paprika fruit and inhibit the rate of fruit damage. Based on this background, this study aims to identify the combination of chitosan and fragrant lemongrass essential oil in bananas to increase fruit hardness and inhibit the rate of damage to bananas.

MATERIALS AND METHODS

Materials

The main ingredients used in this study were bananas and milk bananas obtained in the kelaten farmer group. Another ingredient used is fragrant lemongrass oil obtained from The Essential Home Store, Chitosan obtained from CV. Primary Chem-Mix, acetic acid, NaCl, and tween80 *emulsifier*.

Preparation

Bananas are in sortation based on their size and color and selected fruit with good conditions, not deformed and free from disease. Furthermore, the fruit is cleaned using equates and sterilized using a Solution of NaCl then drying is carried out using a fan.

Manufacture of fragrant lemongrass oil emulsion and chitosan

The manufacture of a 1% chitosan solution, namely chitosan 15 grams dissolved in 1.5 liters of acetic acid solution 1% then stirrer 15 minutes at a speed of 1500 rpm (Asgar ali, 2015). Medium making 1% essential oil solution which is 2.5 ml of essential oil added 500 ml aquadest and 0.625 ml tween 80. The manufacture of fragrant lemongrass emulsion and chitosan consists of 5 treatments. 1) CH 1% (Chitosan 1%)., 2) CH + EO 0.5% (chitosan 1% + Esensisal Oil 0.5%)., 3) CH+EO 1% (chitosan 1% + Essential Oil 1%) ., 4) CH+EO 0.04% (chitosan 1% + essential oil 0.04%)., and 5) EO 1% (essential oil 1%

Emulsion application

Bananas are coated with an emulsion of fragrant lemongrass essential oil and chitosan using the dipping method until all parts are at various concentrations. Dried fruit is then placed in a sterile container and squeezed in a storage room 26oC - 29oC (Asgar Ali, 2015).

Test parameter analysis

Observation and measurement of Test parameters are carried out for 7 days with intervals of 4 days. Observed parameters include hardness by using a penetrometer and damage during storage.

Data Processing

The data obtained in the study was analyzed using SPSS 2016 One Way Anova to assess variance and unrest during observations. If the effect is very noticeable on the observation variable then followed by Duncan's Multiple Range Test (DMRT) at a confidence level of 95% ($\alpha = 0.05$).

RESULTS AND DISCUSSION

Hardness Test

Data hardness application coating chitosan and essential oil presented on the bar diagram

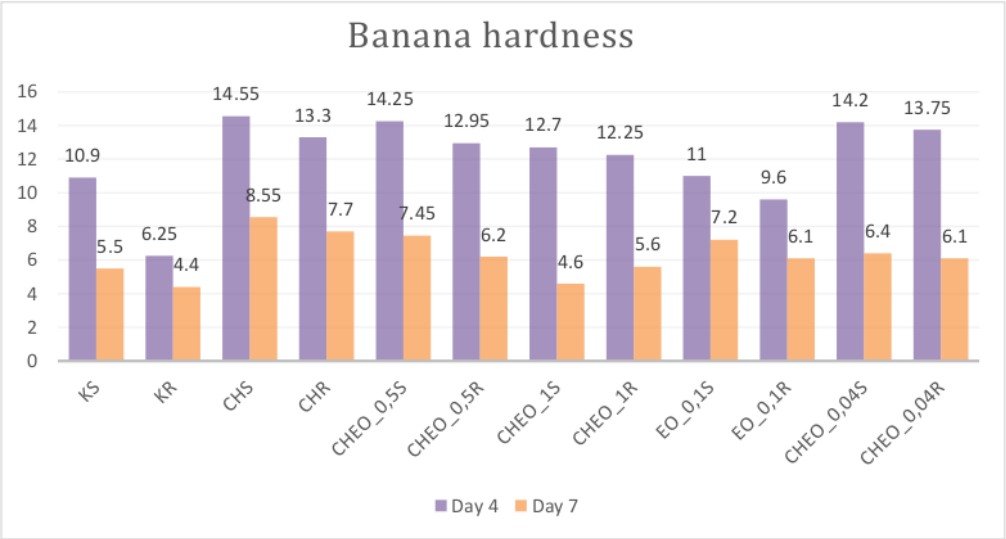

Figure 1. The hardness of bananas from various treatments of essential oil emulsion and chitosan

Description: 1) CH 1% (Chitosan 1%)., 2) CH + EO 0.5% (chitosan 1% + Esensisal Oil 0.5%)., 3) CH+EO 1% (chitosan 1% + Essential Oil 1%) ., 4) CH+EO 0.04% (chitosan 1% + essential oil 0.04%)., and 5) EO 1% (essential oil 1%., 6) KS , KR (kontrol) ., KS (banana milk) KR (Plantains)

Percentage of fruit damage during storage

Table 1. Banana fruit damage during storage

Day (sampel Code	Fruit State	Description	Percentage of damage %
4 (KS)		The entire surface of the skin is yellow, fully ripe	0
7 (KS)		Kunig-colored bananas, rotting parts of the banana widening	40
4 (KR)		The entire surface of the skin is yellow, fully ripe.	0
7 (KR)		Kunig-colored bananas, rotting parts of the banana it's getting wider.	80
4 (CHS 1%)		green fruit skin, hard fruit	0
7 (CHS 1%)		The entire surface of the skin is yellow, fully ripe.	0
4 (CHR 1%)		Full green fruit skin, hard fruit	0
7 (CHR 1%)		Bananas are green, brown spots increase many and large, black patches and growing mushrooms	70
4 (CH+EO 0,5% S)		The entire surface of the skin is yellow, fully ripe.	0
7 (CH+EO 0,5% S)		Yellow banana fruit, rotting part of the banana began to widen.	20
4 (CH+EO 0,5% R)		Full green fruit skin, hard fruit	0
7 (CH+EO 0,5% R)		Green fruit skin slightly black patches	20
4 (CH+EO 1% S)		The skin of the green fruit slightly spots black and begins to turn yellow	0
7 (CH+EO 1% S)		Blackish brown patches, overripe, soft fruit flesh, the aroma is very strong and overgrown with mushrooms.	100
4 (CH+EO 1% R)		Bananas are green, brown spots increase many and large, black patches and growing mushrooms	50
7(CH+EO 1% R)		Bananas are green, brown spots increase many and large, black patches and growing mushrooms	90
4 (EO 0,1% S)		green fruit skin, hard fruit	0
7 (EO 0,1% S)		The entire surface of the skin is yellow, fully ripe	0
4 (EO 0,1% R)		The entire surface of the skin is yellow, fully ripe.	0
7 (EO 0,1% R)		Blackish brown patches, overripe, soft fruit flesh, the aroma is very strong and overgrown with mushrooms.	70
4 (CH+EO 0,04% S)		Full green fruit skin, slightly hard fruit	0
7 (CH+EO 0,04% S)		Bananas are green, brown spots increase many and large, black patches and growing mushrooms	50
4 (CH+EO 0,04% R)		Bananas are green, brown spots increase many and large, black patches and growing mushrooms	10
7 (CH+EO 0,04% R)		Bananas are green, brown spots increase many and large, black patches and growing mushrooms	10

Discussion

Based on the results of research that have been done, chitosan and fragrant lemongrass oil affect the hardness of milk bananas, and plantains. Milk bananas and plantains on the first day of storage have uniform hardness. The treatment of CHS (milk banana) on the 4th day of storage has the highest hardness rate of 14.55 kg / cm2 (*105 pa) followed by a combination of CH + EO_0.5 hardness values of 14.25 and CH + EO_0.04 S hardness value of 14.2. However, with the combination of CH +EO 1% S the lowest hardness value is 12.7 and EO 0.1% S hardness value 11, this shows that the combination of chitosan with a higher EO and EO without chitosan will reduce the hardness value in the fruit so that the process of fruit damage is faster. it has a higher hardness rate followed by a combination of chitosan and 0.5% fragrant lemongrass oil.

The treatment of CH +EO 0.04 % R plantain on the 4th day of storage has the highest hardness rate of 13.75 kg / cm2 (*105 pa) followed by a combination of CH 1% R hardness value 13.3 and CH + EO 0.045 % hardness value 12.95. However, with the combination of CH+EO 1% R, the lowest hardness value is 12.25 and EO 0.1% R hardness rate of 9.6, this shows that the combination of chitosan with a higher EO and EO without chitosan will reduce the hardness value of the fruit so that the process of fruit damage is faster. it has a higher hardness rate followed by a combination of chitosan and 0.5% fragrant lemongrass oil.

At the beginning of storage, there is a decrease in the hardness of the skin of the fruit. This can be caused by the rupture of property into substances with a lower molecular weight due to the activity of the enzyme polygalacturonase. The enzyme polygalacturonase decomposes properties with the main component of polygalacturonic acid into galacturonic acid so that it dissolves in water and results in weak cell walls and decreased cohesion forces that bind to each other (Pantastico, 1993). According to Winarno (2002), the texture of the fruit becomes soft during storage due to the rupture of pectin and hemicellulose, so the hardness of the fruit decreases. During fruit storage occurs the breakdown of pectin, which is caused by the activity of the enzymes methyl esterase pectin and polygalacturonase, some insoluble property is converted into soluble pectin. As a result the cohesion power of the cell wall with each other decreases. This decrease in cohesion power further results in a decrease in fruit hardness. The increase in hardness value is caused by the evaporation of water. The evaporated cell water makes the cell shrink so that the space between cells merges and pectin substances become bound to each other. The decreased hardness of fruits during storage is caused by loss of turgor pressure, an overhaul of starch into glucose, and degradation of cell walls (Pantastico, 1993).

Damage to bananas needs to be considered, where the shelf life of the fruit shows the old limit of fruit storage so that it is still suitable for consumption. The index of the shelf life of bananas can be determined by looking at the change in the banana peel to the maturity level of bananas. Based on the results of edible coating research a combination of chitosan and fragrant lemongrass oil on milk bananas and plantains showed a significant influence on fruit damage. KS treatment at 4 days storage is yellow ripe overall while CHS 1% fruit skin is still fully green and hard. The storage of the 7th day KS percentage of damage is 40% while the treatment CHS 1% the entire surface of the skin is yellow and there has been no damage. This shows that edible coating chitosan 1% can inhibit the maturity of milk bananas because it inhibits the development of ethylene fruit.

The treatment of a combination of chitosan and 0.5% fragrant lemongrass essential oil in milk bananas was also able to inhibit the maturity of the fruit on the 7th day of storage compared to control, but the treatment of CH + EO 1% and CH + EO 0.04% on day 7 storage the damage rate reached 70% this shows that the higher and lower the concentration of essential oils combined with the percentage of damage is much higher. EO fragrant lemongrass oil treatment of 0.1% can limit the damage to bananas milk storage on day 7 compared to the control treatment. This is because fragrant lemongrass oil protects anti-bacterial substances so that it can inhibit the fruit maturity process.

Damage to bananas needs to be considered, where the shelf life of the fruit shows the old limit of fruit storage so that it is still suitable for consumption. The index of the shelf life of bananas can be determined by looking at the change in the banana peel to the maturity level of bananas. Based on the results of edible coating research with a combination of chitosan and fragrant lemongrass oil on plantain and plantain showed a significant influence on fruit damage. Kr treatment on 4 days storage is yellow ripe as a whole while CHR 1% fruit peel is still fully green and hard. The storage of the 7th day of KRpersentasi damage is 40% while the CHR treatment is 1% the entire surface of the skin is yellow and there has been no damage. This shows that edible coating chitosan 1% can inhibit the maturity of plantains because it inhibits the development of ethylene fruit.

The treatment of a combination of chitosan and 0.5% fragrant lemongrass essential oil in plantains is also able to inhibit the maturity of the fruit on the 7th day of storage compared to control, but the treatment of CH + EO 1% and CH + EO 0.04% on the storage of day 7 the damage level reaches 70% this shows that the higher and lower the concentration of essential oils combined with the percentage of damage is much higher. Treatment of EO fragrant lemongrass oil 0.1% can limit the damage of the plantain king storage on day 7 compared to control treatment. This is because fragrant lemongrass oil protects anti-bacterial substances so that it can inhibit the fruit maturity process.

The treatment of combinations or without a combination of chitosan and fragrant lemongrass oil does not differ markedly from the level of hardness and damage of milk bananas and plantains, based on the results of research into

2 types of The banana with the treatment of edible coating chitosan and fragrant lemongrass oil can increase hardness and inhibit the percentage of fruit damage.

CONCLUSION

The treatment of combinations or without a combination of chitosan and fragrant lemongrass oil does not differ markedly from the level of hardness and damage of milk bananas and plantains, based on the results of research into 2 types of The banana with the treatment of edible coting chitosan and fragrant lemongrass oil can increase hardness and inhibit the percentage of fruit damage.

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REFERENCES

1. Adiletta, G., Pasquariello, M. S., Zampella, L., Mastrobuoni, F., Scortichini, M., & Petriccione, M. (2018). Chitosan coating: A postharvest treatment to delay oxidative stress in loquat fruits during cold storage. Agronomy, 8(54), 1–13. https://10.33 90/agronomy8040054
2. Abu-Seif, F. A., Abdel Fattah, S.M., Abo Sreia, Y. H., Shaaban, H. A., & Ramadan, M.M. (2009). Antifungal properties of some medicinal plants against undesirable and mycotoxin producing fungi. Agricultural Journal of Mansoura University, 34, 1745–1756
3. Abdou, E.S., Nagy, K.S.A. and Elsabee, M.Z. (2008). Extraction and characterization of chitin and chitosan from local sources. Bioresources Technology 99(5):1359–1367
4. Azarakhsh, N., Osman, A., Ghazali, H.M., Tan, C. P., & Mohd Adzahan, N. (2014). Lemongrass essential oil incorporated into alginate-based edible coating for shelf-life extension and quality retention of fresh-cut pineapple. Postharvest Biology and Technology, 88, 1–7
5. Asgar A, Nurasyikin M, N, Maysoun A. Mustafa., 2015. Antimicrobial activity of chitosan enriched with lemongrass oil against anthracnose of bell pepper, Food Packaging and Shelf Life Volume 3, March 2015, Pages 56-61
6. Abd-Alla, M. A., El-Gamal, N. G., El-Mougy, N. S., & Abdel-Kader, M.M. (2014). Post-harvest treatments for controlling crown rot disease of Williams banana fruits (Musa acuminata L.) in Egypt. *Plant Pathology and Quarantine*, *4*(1), 1-12.
7. Adeyemi, M.M., Bawa, M. H., & Muktar, B. (2018). Evaluation of the Effect of Calcium Carbide on Induce Ripening of Banana, Pawpaw and Mango cultivated within Kaduna Metropolis, Nigeria". *Journal of Chemical Society of Nigeria*, *43*(2).
8. Anggraeni, D.M.. 2012. Escherichia Coli Bacterial Disinfection Test Using Cavitation Water Jet. Thesis.
9. University of Indonesia, Depok.
10. Anggraeni, N. I., Hidayat, I. W., Rachman, S. D., & Ersanda. (2018, February). Bioactivity of essential oil from lemongrass (Cymbopogon citratus Stapf) as antioxidant agent. In *AIP Conference Proceedings* (Vol. 1927, No. 1, p. 030007). AIP Publishing LLC.
11. Ahmad U. 2013. Post-harvest Handling Technology of Fruits and Vegetables. Yogyakarta (ID): Graha Ilmu.
12. Almeida, R. N., Navarro, D. S., & Barbosa-Filho, J.M. (2001). Plants with central analgesic activity. *Phytomedicine*, *8*(4), 310-322.
13. Ali, A., Tengku, M., Kamaruzaman, S., & Siddiqui, Y. (2010b). Potential of chitosan coating in delaying the postharvest anthracnose (Colletotrichum gloeosporioides Penz.) of Eksotika II papaya. International Journal of Food Science and Technology, 45, 2134–2140
14. Budiyanto, M. A. K. (2010). Banana-based food security development model through revitalization of local wisdom values. *Journal of Industrial Engineering*, *11*(2), 170-177.
15. Bourtoom, T. (2008). Edible films and coatings: characteristics and properties. International Food Research Journal Technology 15(3): 237–248.
16. Cahyono B. 2009. Banana Farming Business and Post-harvest Handling. Yogyakarta (ID): Kanisius

17. Cui, H. Y., Wu, J., & Lin, L. (2016). Inhibitory effect of liposome-entrapped lemongrass oil on the growth of Listeria monocytogenes in cheese. *Journal of dairy science*, *99*(8), 6097-6104.
18. Changsiripom J, Manuskwan J. Effect of chitosan coating on postharvest quality and shelf life of banana fruit. editors. TIChE International Conference. Songkhla Thailand: E-Publishing Inc; 2011. p. 11.1-11.4.
19. de Almeida, R. N., Motta, S.C., de Brito Faturi, C., Catallani, B., & Leite, J. R. (2004). Anxiolytic-like effects of rose oil inhalation on the elevated plus-maze test in rats. *Pharmacology Biochemistry and Behavior*, *77*(2), 361-364.
20. Duamkhanmanee, R. (2008). Natural essential oils from lemongrass (Cymbopogon citratus) to control postharvest anthracnose of mango fruit. International Journal of Biotechnology, 10, 104–108.
21. Djiuardi, E., & Nugraha, T. (2017). Antibacterial activity of the microemulsion design of cinnamon essential oil. *AGROINTEK*, *11*(1), 21-26.
22. Ghaouth, R., Ponnampalam, F., Castaigne and Arul, J. (1992). Chitosan coating to extend the storage life of tomatoes. Hortscience 27(9): 1016–1018.
23. La, D. D., Nguyen-Tri, P., Le, K. H., Nguyen, P. T., Nguyen, M. D.B., Vo, A. T., ... & Nguyen, D. D. (2021). Effects of antibacterial ZnO nanoparticles on the performance of a chitosan/gum arabic edible coating for post-harvest banana preservation. *Progress in Organic Coatings*, *151*, 106057.
24. Mahendra, F. I., Wisnujati, N. S., & Siswati, E. (2020). ANALYSIS OF PLANTAIN EXPORTS IN THE MARKET
INTERNATIONAL. *Journal of Socio-Agribis Scientific*, *20*(1).
25. Food and Agricultural Organization, 2003 Food and Agricultural Organization Report on Plantain nursery Practice. A Reference Manual (2003).
26. Hadjilouka, A., Mavrogiannis, G., Mallouchos, A., Paramithiotis, S., Mataragas, M., & Drosinos, E. H. (2017). Effect of lemongrass essential oil on Listeria monocytogenes gene expression. *LWT*, *77*, 510-516. Habauzit, V., & Horcajada, M. N. (2008). Phenolic phytochemicals and bone. *Phytochemistry Reviews*, *7*(2), 313-344.
27. Haslinda, W. H., Cheng, L. H., Chong, L.C., & Aziah, A. N. (2009). Chemical composition and physicochemical properties of green banana (Musa acuminata× balbisiana Colla cv. Crew) flour. *International journal of food sciences and nutrition*, *60*(sup4), 232-239.
28. Sinha, N. K., Sidhu, J., Barta, J., Wu, J., & Cano, M. P. (Eds.). (2012). *Handbook of fruits and fruit processing*.
29. John Wiley & Sons.
30. Istianto, M. (2009). Antifungal Activity of Essential Oil against Anthracnos Disease banana fruit in storage in laboratory conditions. *Journal of Horticulture*, *19*(2).
31. Jo, W. S., Song, H. Y., Song, N.B., Lee, J. H., Min, S.C., & Song, K.B. (2014). Quality and microbial safety of 'Fuji'apples coated with carnauba-shellac wax containing lemongrass oil. *LWT-Food Science and Technology*, *55*(2), 490-497.
32. Jongsri, P., Rojsitthisak, P., Wangsomboondee, T., & Seraypheap, K. (2017). Influence of chitosan coating combined with spermidine on anthracnose disease and qualities of 'Nam Dok Mai'mango after harvest. Scientia Horticulturae, 224, 180–187. https://10. 1016/j.scienta.2017.06.011
33.
34. Kumar, V., Tewari, R., & Singh, K. (2015). Comparative studies of drying methods on yield and composition of the essential oil of Cymbopogon citratus. *Journal of Essential Oil Bearing Plants*, *18*(3), 744-750.
35. Lu, M., Han, Z., & Yao, L. (2013). In vitro and in vivo antimicrobial efficacy of essential oils and individual compounds against P hytophthora parasitica var. nicotianae. *Journal of applied microbiology*, *115*(1), 187-198.
36. Maqbool, M., Ali, A., Alderson, P. G., Mohamed, M. T.M., Siddiqui, Y., & Zahid, N. (2011). Postharvest application of gum arabic and essential oils for controlling anthracnose and quality of banana and papaya during cold storage. Postharvest Biology and Technology, 62, 71–76.
37. Maqbool, M., Ali, A., & Alderson, P. G. (2010). Effect of cinnamon oil on incidence of anthracnose disease and postharvest quality of bananas during storage. International Journal of Agriculture and Biology, 12, 516–520.
38. Mpho, M., Sivakumar, D., Sellamuthu, P. S., & Bautista-Banos, S. (2013). Use of lemongrass oil and modified

atmosphere packaging on control of anthracnose and quality maintenance in avocado cultivars. Journal of Food Quality, 36, 198–208.
39. Mardiana DN. 2017. Handling of post-harvest harvest and banana crop production center in Indonesia [thesis]. Bandung (ID): UIN.
40. Mani López, E., Valle Vargas, G. P., Palou, E., & López Malo, A. (2018). Penicillium expansum inhibition on bread by lemongrass essential oil in vapor phase. *Journal of food protection*, *81*(3), 467-471.
41. Maduwanthi, S. D. T., & Marapana, R. A. U. J. (2019). Induced ripening agents and their effect on fruit quality of banana. *International journal of food science*, *2019*.
42. Ng, S. P., & Fong, C. S. (2000). Banana enhances your anti-cancer power. *Health discovery. Petaling Jaya Malalysia: Life Publisher Berhad*.
43. Petriccione, M., Mastrobuoni, F., Pasquariello, M. S., Zampella, L., Nobis, E., Capriolo, G., et al. (2015). Effect of chitosan coating on the postharvest quality and antioxidant enzyme system response of strawberry fruit during cold storage. Foods, 4 (4), 501–523. https://10.3390/foods4040501.
44. Perdones, A., Sa´nchez-Gonza´lez, L., Chiralt, A., & Vargas, M. (2012). Effect of chitosan–lemon essential oil coatings on storage-keeping quality of strawberry. Postharvest Biology and Technology, 70, 32–41
45. Reis-Teixeira, F.B., Sousa, I. P., Alves, V. F., Furtado, N. A. J.C., & De Martinis, E.C. P. (2019). Evaluation of lemongrass and ginger essential oils to inhibit Listeria monocytogenes in biofilms. *Journal of Food Safety*, *39*(4), e12627.
46. Reyes-Jurado, F., Navarro-Cruz, A. R., Ochoa-Velasco, C. E., Palou, E., López-Malo, A., & Ávila-Sosa, R. (2020). Essential oils in vapor phase as alternative antimicrobials: A review. *Critical reviews in food science and nutrition*, *60*(10), 1641-1650.
47. Timung, R., Barik, C. R., Purohit, S., & Goud, V. V. (2016). Composition and anti-bacterial activity analysis of citronella oil obtained by hydrodistillation: Process optimization study. *Industrial Crops and Products*, *94*, 178-188.
48. Statistics, Central Agency. "Fruit Plant Production- Bananas." (2017).
49. Santin, M. R., dos Santos, A. O., Nakamura, C. V., Dias Filho, B. P., Ferreira, I.C. P., & Ueda-Nakamura, T. (2009). In vitro activity of the essential oil of Cymbopogon citratus and its major component (citral) on Leishmania amazonensis. *Parasitology research*, *105*(6), 1489-1496.
50. Silva, C. D.B. D., Guterres, S. S., Weisheimer, V., & Schapoval, E. E. (2008). Antifungal activity of the lemongrass oil and citral against Candida spp. *Brazilian Journal of Infectious Diseases*, *12*(1), 63-66.
51. Rihayat, T., Putra, A., Fona, Z., Safitri, A., Riskina, S., & Syahputra, W. (2019, April). Composition on Essential Oil Extraction from Lemongrass Fragrant by Microwave Air Hydro Distillation Method to Perfume Dermatitis Production. In *IOP Conference Series: Materials Science and Engineering* (Vol. 506, No. 1, p. 012053). IOP Publishing.
52. Shehata, S.A., Fawzy, Z.F. and El-Ramady, H.R. (2012). Response of cucumber plants to foliar application of chitosan and yeast under greenhouse conditions. Australian Journal of Basic and Applied Sciences 6(4): 63–71.
53. Park, B., Shin, A., Park, S. K., Ko, K. P., Ma, S. H., Lee, E. H., ... Yoo, K. Y. (2011). Ecological study for refrigerator use, salt, vegetable, and fruit intakes, and gastric cancer. *Cancer causes & control*, *22*(11), 1497-1502.
54. Valentine, V., Sutedja, A.M., & Marsono, Y. (2015). The effect of Na-CMC (Sodium- Carboxymethyl Cellulose) concentration on the characteristics of white kapok banana flour cookies (Musa paradisiaca L.) pregelatinization. *Journal of Agrotechnology*, *9*(02), 93-101.
55. Wahab, S.M.A. and Rashid, I.A.S. (2012). Safe postharvest treatment for controlling Penicillium molds and its impact maintaining navel orange fruits quality. American-Eurasian Journal Agriculture and Environmental Science 12(7): 973–982.
56. Winarno, F.G. (2002). Physiology of Harvesting Horticultural Products. M-BRIO Press, Bogor.
57. Wany, A., Kumar, A., Nallapeta, S., Jha, S., Nigam, V. K., & Pandey, D.M. (2014). Extraction and characterization of essential oil components based on geraniol and citronellol from Java citronella (Cymbopogon winterianus Jowitt). *Plant growth regulation*, *73*(2), 133-145.
58. Yunita, M., Hendrawan, Y., & Yulianingsih, R. (2015). Quantitative analysis of microbiology on aviation food (Aerofood ACS) garuda Indonesia based on TPC (Total Plate Count) with pour plate method. *Journal*

of Tropical Agricultural Engineering and Biosystems, *3*(3), 237-248.

59. Zahid, N., Ali, A., Manickam, S., Siddiqui, Y., & Maqbool, M. (2012). Potential of chitosan-loaded nanoemulsions to control different Colletotrichum spp. and maintain quality of tropical fruits during cold storage. Journal of Applied Microbiology, 113, 925–939
60. Zhang, W., Zhao, H., Zhang, J., Sheng, Z., Cao, J., & Jiang, W. (2019). Different molecular weights chitosan coatings delay the senescence of postharvest nectarine fruit in relation to changes of redox state and respiratory pathway metabolism. Food Chemistry, 289, 160–168. https://10.1016/j.foodchem.2019.03.047

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