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Utilization of Vegetable Hydrocolloid Compounds as Edible Coating Material to Extend the Shelf Life of Bananas Muli (*Musa acuminata* Linn.)

AUTHORS INFO

Desi Nurjannah
University of Muhammadiyah Parepare
deshynoerjannah.agro13@gmail.com

Muh. Akhsan Akib
University of Muhammadiyah Parepare
akhsanbagus@yahoo.co.id
+6281343885978

Nur Ilmi
University of Muhammadiyah Parepare
ilmi_261008@yahoo.co.id
+6281342292398

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Abstract

The preserve quality, freshness and extending shelf life of fruit could be done by storing the fruits in the refrigerated room, pressurized room or by modifying the atmosphere of the room. However, this type of storage cost is quite expensive, therefore needed another solution that is fruit coating using edible coating solution made from vegetable hydrocolloids. The aims of this study were to determine the best materials type among the three types of vegetable hydrocoloid materials, namely extract *Aloe vera* leaves, extract *Ceiba pentandra* leaves and extract *Abelmoschus manihot* leaves that are able to preserve the shelf life of *M.acuminata* fruit. This research use was a complete randomized design with four treatments, namely; without edible coating, edible coating of extract Aloe vera leaves, edible coating of extract Ceiba pentandra leaves, and edible coating of extract Abelmoschus manihot leaves, with three replications. The result showed that the lowest shrinkage percentage was found in edible coating of extract *Aloe vera* leaves with an average value of 3.43% and the highest was found in treatment without edible coating of 4.37%. At the end of observation the highest sugar content was obtained in edible coating of extract *Aloe vera* leaves of 20 ^{o}Brix while the lowest was in treatment without edible coating that was 16^{o}Brix. In organoleptic test, panelists prefered edible coating of extract Aloe vera leaves with an value range of 4 or 5 equivalented with neutral or likes, and did not like of edible coating of wxtract Abelmoschus manihot leaves with an value range of 3 or 4 equivalented with slightly dislike or neutral. Based on the conducted observational, the edible coating of extract Aloe vera leaves was able to preserve the shelf life of M.acuminata fruit up to five days after harvesting

Keywords : edible coating, hydrocolloid, shelf life, shrinkage, sugar content

A. Introduction

Fruits are the source of vitamins and minerals for the human body. In addition to containing vitamins and minerals, fruits also contain carbohydrates, fats, proteins, and water. Muli banana fruit (*Musa acuminata* Linn.) contains 26.6 g of carbohydrates, 0.2 g of fat, 1.3 g of protein, 99 kcal of calories and 4 mg of vitamin C (Judarwanto, 2016).

Musa acuminata (*M. acuminata*) is a horticultural product, belongs to climacteric fruits that are susceptible to physical, chemical and biological changes during storage. *M. acuminata* fruit that has been picked still continuing the process of respiration and transpiration. The rate of respiration can be affected by the ethylene hormone. If respiration and transpiration rates are not inhibited then it may result in shorter shelf life of *M.acuminata* (Fransiska, A., Hartanto, R., Lanya, B., & Tamrin., 2013). *M. acuminata* fruit can last for 7 - 10 days of shelf life after harvesting.

Shelf life of *M. acuminata* fruit can be extended by utilizing post-edible coating technology. Components of edible coatings can be divided into three types: hydrocolloids, lipids, and composites (Wahyu, 2009). Hydrocoloid compounds can be obtained from vegetable materials such as *Aloe vera*, cotton leaves and sunset muskmallow leaves.

Result of the research conduted by Marpaung, D.A., Susilo, B., & Argo, B. D. (2015), proved that the coating of star fruit with edible coating of *Aloe vera* leaves succeeded in extending the shelf life of fruit to 21 days by dipping fruit for 5 minutes and using concentration of 1% CMC (*Carboxymethyl Cellulose*). Research of Mahfudin, Prabawa, S., & Sugianti, C. (2016), indicated that the treatment of edible coating of cotton leaves with the addition of 5% glycerol dan dipping temperature of 60 ^{o}C was able to preserve the physical and chemical characteristics of tomatoes in good condition during storage.

The aims of this study were to determine the best materials type among the three types of vegetable hydrocoloid materials, namely extract *Aloe vera* leaves, extract *Ceiba pentandra* leaves and extract *Abelmoschus manihot* leaves that are able to preserve the shelf life of *M.acuminata* fruit.

B. Methodology

The research was conducted at Agricultural Laboratory of Faculty of Agriculture, Animal Husbandry and Fisheries of Muhammadiyah Parepare University, from July to August 2017. This study employed Completely Randomized Design (CRD) with 4 treatments which were without edible coating; edible coating of extract *Aloe vera* leaves; edible coating of extract *Ceiba pentandra* leaves; and edible coating of extract *Abelmoschus manihot* leaves, each treatment repeated 3 times. Each replication consists of 10 experimental units.

C. Result and Discussion

1. Weight Shrinkage of *M.acuminata* Fruit

The result of variance analysis indicated that edible coating had no significant effect on the weight shrinkage of *M.acuminata* Linn fruit. However, the average percentage of fruit weight shrinkage of *M.acuminata* in Table 1 shows that edible coating of extract *Aloe vera* leaves had the lowest weight shrinkage compared to edible coating with cotton leaves, sunset muskmallow leaves and without edible coating.

Table 1. Average percentage of weight shrinkage of *M.acuminata* fruit weight

Treatment	Initial weight 5 DAH (g)	Weight shrinkage (DAH)				Final weight 14 DAH (g)
		7	9	11	13	
Without EC	37,17	1,90	3,10	4,84	7,64	34,36
EC of extract *Aloe vera* leaves	35,09	1,46	2,57	3,72	5,96	32,99
EC of extract *Ceiba pentandra* leaves	39,34	1,49	2,97	4,42	7,37	36,45
EC of extract *Abelmoschus manihot* leaves	40,63	1,61	2,85	4,39	7,13	37,77

Note : EC = Edible coating; DAH = Days after harvesting

Table 1 shows that *M.acuminata* fruit with edible coating of extract *Aloe vera* leaves can slow down the percentage increase of fruit weight shrinkage by 16,40% - 21,98%. This is due to the edible coating of extract *Aloe vera* leaves capable of forming good layer to suppress the respiration rate and transpiration. According to Rudito (2012) and Novita, D.D., Sugianti, U.C., & Asropi. (2015), that the small weight shrinkage is due to a slower rate of respiration. This finding

indicated that *M.acuminata* fruit with edible coating of extract *Aloe vera* leaves can extend the shelf life of fruit to 5 days after harvesting.

Edible coating of extract *Aloe vera* leaves contains oxidase enzyme as an antioxidant serves as a preservative to suppress the rate of respiration when there is an increase in oxygen concentration, exposed by sunlight and metals in pesticides solution hence prevent the occurrence of decay and the appearance of black spots on the food products (Athmaselvi, K.A., Sumitha, P., & Revathy, B., 2012; Chrysargyris, A., Nikou, A., & Tzortzakis, N., 2016; Kumar & Bhatnagar, 2014; Misir, J., Fatema, H.B., & Hoque, M.M., 2014; and Zafika, Y., Mukarlina & Linda, R., 2015). While edible coating of cotton leaves and sunset muskmallows leaves contain tannin compounds which have no effect on coating formation on *M.acuminata* skin (Irwani & Candra, 2016; Maulina, 2016; Ninulia, 2016).

Rapid increase of weight shrinkage in the treatment without edible coating might be due to increased respiration and transpiration rates because of the absence of edible coating which might inhibit the increase of oxygen concentration in the fruit and evaporation of water through the surface of *M.acuminata* (Novita *et al*., 2015) .

Respiration and transpiration activities in fruits continue to occur during storage resulting in shrinkage of fruit weight as a result of water loss and organic material overhaul (carbohydrates, proteins and fats). This is in accordance with the statement of Muchtadi, T.R., Sugiyono, F., & Ayustanigwarno. (2015), that the loss of water during storage can increase the weight shrinkage and cause damage to the fruit thus lowering fruit quality. The loss of water in large quantities will cause the fruit to wither and wrinkle.

The edible coating of extract *Aloe vera* leaves capable of suppressing the respiration and transpiration processes in the fruit thus the water loss affecting the weight shrinkage can be suppressed, hence the average value of weight shrinkage in edible coating of extract *Aloe vera* leaves shows the lowest value of average weight shrinkage. This is in accordance with the statement of Misir *et al.* (2014) that edible coating of extract *Aloe vera* leaves acts as a barrier to the fruit skin thus limiting water loss due to transpiration and carbon reserves loss due to respiration.

The results of this study are in line with research conducted by Hasanah (2009), on paprika fruit coated with *Aloe vera* leaves edible coating with mixture of 1% Carboxy Methyl Cellulose (CMC), it suggested that paprika fruit with coating material showed the lowest weight shrinkage compared to the control treatment. Furthermore, research conducted by Athmaselvi, *et al*. (2012) proved that edible coating of *Aloe vera* leaves can preserve tomatoes shelf life until 39 days while that is only 19 days in the control treatment.

2. Sugar Content of *M.acuminata* Fruit

The sugar content measurement result showed that *M.acuminata* fruit with edible coating of extract *Aloe vera* leaves increased until the end of observation, while in edible coating treatments of extract cotton leaves, sunset muskmallow leaves and without edible coating decreased sugar content before the end of observation as shown in table 2 .

Table 2. Average sugar content of *M.acuminata* fruit (°Brix)

Treatment	Initial Sugar content 5 DAH (g)	Sugar content on (DAH)				Final Sugar content 14 DAH (g)
		7	9	11	13	
Without EC	16,0	17,0	20,5	20,1	17,6	16,0
EC of extract *Aloe vera* leaves	16,0	16,5	17,0	17,5	19,0	20,0
EC of extract *Ceiba pentandra* leaves	15,0	16,5	18,5	19,5	19,0	18,0
EC of extract *Abelmoschus manihot* leaves	15,0	16,5	18,5	19,5	18,15	17,0

Note : EC = Edible coating; DAH = Days After Harvesting

Table 2 shows *M.acuminata* fruit with edible coating of extract *Aloe vera* leaves had slower rate of sugar content increasement, thus sugar content reduction did not occur. Edible coating of extract *Aloe vera* leaves could preserve *M.acuminata* sugar content around 10-20%. This is allegedly due to edible coating of extract *Aloe vera* leaves capable of inhibiting oxygen entry into the fruit. It also indicates that the slower climacteric peak was achieved in *M.acuminata* thus the storage time of the fruit might be extended to 5 days after harvesting. According to Chrysargyris *et al.* (2016), Pradhana, A.Y., Hasbullah, R., & Purwanto, A. Y. (2013) and Singh, S., Sharma, V., &

Soni, M.L. (2011), glucose retardation reactions are inhibited and respiration rate decreases due to the inhibition of oxygen into the fruit which inhibits amylase and phosphorylase activities.

Edible coating of extract *Ceiba pentandra* leaves, sunset muskmallow leaves and without edible coating had decreased the sugar content faster. It is suspected that enzyme activities of amylase and phosphorylase are more active due to the increase of oxygen content in the fruit. According to Winarno (2002) and Yassin, T., Hartanto, R., Haryanto, A., & Tamrin. (2013), the breakdown of starch into the constituent sugars led to the rise of fruit sugar content, while the decrease in fruit sugar content occurs because it is used in the respiration process or sugar is converted to other compounds.

Sugar content of *M.acuminata* with edible coating treatment on 9th day after harvesting decreased by 4.5 ^{o}Brix until 14th day after harvesting with average decrease per day of 0.9 ^{o}Brix. While the *M.acuminata* fruit with edible coating of extract *Aloe vera* leaves increased by 3 ^{o}Brix with average increase per day of 0.6 ^{o}Brix. Thus it can be seen that the *M.acuminata* fruit in the treatment without edible coating began to decrease in quality on the 9th day after harvesting while the edible coating of extract *Aloe vera* leaves preserved the good quality. This means that the edible coating of extract *Aloe vera* leaves can preserve *M.acuminata* fruit shelf life to 5 days after harvesting, of which starting from the 9th day after harvesting; while the *M.acuminata* fruit without edible coating treatment starts to deteriorate.

3. Organoleptic Test of *M.acuminata* Fruit

The results of organoleptic test showed that *M.acuminata* fruit with edible coating treatment of extract *Aloe vera* leaves had better color, texture, aroma and taste compare to edible coating of cotton leaves, sunset muskmallow leaves and without edible coating. Observational data is shown in table 3.

Table 3. Organic test of *M.acuminata* fruit

Treatment	Type of Test				Average
	Color	Texture	Flavor	Taste	
Without EC	4,8	4,3	5,0	2,5	4,2
EC of extract *Aloe vera* leaves	5,1	5,2	3,8	4,4	4,6
EC of extract *Ceiba pentandra* leaves	4,5	4,6	3,2	3,6	4,0
EC of extract *Abelmoschus manihot* leaves	4,0	3,2	2,3	3,7	3,3

Note: The numbers in the table above are symbols or representatives of qualitative data

Table 3 shows the scale of skin color assessment of *M.acuminata* fruit with edible coating of extract *Aloe vera* leaves on a scale of 5 - 6 (moderately like – like scale). This result might be due to the skin color of the *M.acuminata* fruit was bright yellow because of the clear white material, additionally according to Misir *et al.* (2014), discoloration caused by chlorophyll degradation, anthocyanins accumulation and the carotenoids synthesis. While on edible coating treatments of cotton leaves, sunset muskmallow leaves and without edible coating it could be seen that skin color of *M.acuminata* had darker color and browning occured, furthermore it might be due to brownish black colored of edible coating cotton leaves influence and brown yellowish colored edible coating of sunsent muskmallow.

Assessment scale of *M.acuminata* fruit texture with edible coating of extract *Aloe vera* leaves was on a scale of 5 - 6 (moderately like – like scale). This is due to the texture of the *M.acuminata* fruit with edible coating of extract *Aloe vera* leaves was harder than the edible coating of extract *Ceiba pentandra* leaves, sunset muskmallow leaves and without edible coating, these if because of the occurrence of cell wall stretching. Fruit texture changing of *M.acuminata* on edible coating treatments of cotton leaves, sunset muskmallow leaves and without edible coating are suspected due to the occurrence of cell wall stretching. According to Winarno (2008), the cohesion of the cell wall that binds one cell to another cell weakens hence the hardness decreases and the fruit becomes soft due to changes of insoluble protopectin into water-soluble pectate compound. It can not be separated from oxygen concentration increasement in the fruit which affects the starch break down into constituent sugars led to *M.acuminata* hardness reduction.

M.acuminata fruit flavor with edible coating treatment of *Aloe vera* leaves was on the scale of 4 - 5 (neutral - moderately like scale), it might be due to there has been no change in the typical taste of *M.acuminata* fruit. While in the edible coating treatments of cotton leaves, sunset muskmallow leaves and without edible coating had caused bitter taste, it is suspected that there

has been a process of fermentation that produces alcohol (Marsigit, 2005 and Hasanah, H., Jannah, A., & Fasya, A. G., 2012).

M.acuminata flavor with edible coating treatment was on a scale of 5 (moderately like scale), it might be due to the absence of flavor from the EC material. While the *M.acuminata* fruit with edible coating treatment was on a scale of 2 - 4 (sightly dislike – neutral scale) caused by unattractive flavor of edible coating and removed the distinctive flavor of *M.acuminata* fruit.

Respiration occurring in fruits is a biological process in which oxygen is absorbed to burn organic ingredients in fruits to produce energy, followed by the release of residual combustion of carbon dioxide and water. The rate of respiration is an indicator of tissue metabolism, high respiration rates are usually accompanied by short shelf life (Siagian, 2009).

M.acuminata fruit with edible coating of extract *Aloe vera* leaves enters stage V (the whole surface of yellow fruit peel is still green), while in the treatment without edible coating has entered stage VII (yellow with little brown spots) on the nine days after harvesting observation. On the fourteen days after harvesting, observation of *M.acuminata* fruit with edible coating of extract *Aloe vera* leaves enters stage VII while in treatment without edible coating has entered stage VIII (yellow with brown spots).

D. Conclusion

Extract *Aloe vera* leaves are the best edible coating material that can extend the shelf life of fruit banana Muli (*Musa acuminata* Linn.) to five days after the harvesting.

E. References

Athmaselvi, K.A., Sumitha, P., & Revathy, B. (2012). Development of *Aloe vera* Based Edible Coating for Tomato. *Jurnal International Agrophysics,* 27, pp. 369 – 375.

Chrysargyris, A., Nikou, A., & Tzortzakis, N. (2016). Effectiveness of *Aloe Vera* Gel Coating for Maintaining Tomato Fruit Quality. Department of Agricultural Science, Biotechnology and Food Science. Cyprus University of Technology. Cyprus.

Fransiska, A., Hartanto, R., Lanya, B., & Tamrin. (2013). Karakteristik Fisiologi Manggis (*Garcinia mangostana* L.) dalam Penyimpanan Atmosfer Termodifikasi. *Jurnal Teknik Pertanian Lampung*, *2* (1), pp. 1 – 6.

Hasanah, H., Jannah, A., & Fasya, A. G. (2012). Pengaruh Lama Fermentasi Terhadap Kadar Alkohol Tape Singkong (*Manihot utilissima* Pohl.). *Jurnal Alchemy, 2* (1), pp. 68 – 79.

Hasanah, U. (2009). Pemanfaatan Gel Lidah Buaya sebagai Edible Coating untuk Memperpanjang Umur Simpan Paprika (*Capsicum annum* varietas *Sunny*). (Unpublished Thesis). Departemen Teknologi Industri Pertanian. Fakultas Teknologi Pertanian. Institut Pertanian Bogor.

Irwani, N. & Candra, A. A. (2016). Ekstrak Daun Gedi (*Abelmoschus manihot*) pada Ayam Broiler. *Prosiding Seminar Nasional Pengembangan Teknologi Pertanian*. Politeknik Negeri Lampung. pp. 281 – 285.

Judarwanto, W. (2016). Kandungan Gizi dan Manfaat Buah Pisang. Available at *https://klinikgizi.com.*

Kumar, S. & Bhatnagar, T. (2014). Studies to Enhance the Shelf Life of Fruits Using *Aloe Vera* Based Herbal Coatings: A Review. *International Journal of Agriculture and Food Science Technology, 5* (3), pp. 211 – 218.

Mahfudin, Prabawa, S., & Sugianti, C. (2016). Kajian Ekstrak Daun Randu (*Ceiba pentandra* L.) Sebagai Bahan Edible Coating Terhadap Sifat Fisik Dan Kimia Buah Tomat Selama Penyimpanan. *Jurnal Teknotan, 10* (1), pp.16 – 23.

Marpaung, D.A., Susilo, B., & Argo, B. D. (2015). Pengaruh Penambahan Konsentrasi CMC dan Lama Pencelupan pada Proses Edible Coating Terhadap Sifat Fisik Anggur Merah (*Vitis vinifera* L.). *Jurnal Keteknikan Pertanian Tropis dan Biosistem, 3* (1), pp. 67 – 73.

Marsigit, W. (2005). Penggunaan Bahan Tambahan pada Nira dan Mutu Gula Aren yang Dihasilkan di Beberapa Sentra Produksi di Bengkulu. *Jurnal Penelitian Universitas Bengkulu, 11* (1), pp. 42 – 48.

Maulina, I. (2016). Uji Toksisitas Ekstrak Air Daun Kapuk Randu *Ceiba pentandra* Gartn. Terhadap Hama Ulat Api pada Kelapa Sawit *Setora niteus* Eeck. (Lepidoptera : Limacodidae). (Unpublished Thesis). Jurusan Biologi. Fakultas Matematika dan Ilmu Pengetahuan Alam. Universitas Lampung. Bandar Lampung.

Misir, J., Fatema, H.B., & Hoque, M.M. (2014). *Aloe vera* Gel as a Novel Edible Coating for Fresh Fruits: A Review. *American Journal of Food Science and Technology*, *2* (3), pp.93 – 97.

Muchtadi, T.R., Sugiyono, F., & Ayustanigwarno. (2015). *Ilmu Pengetahuan Bahan Pangan*. Bogor, Alfabeta.

Ninulia, P. P. (2016). Aktivitas Antibakteri Ekstrak Etanol Daun Randu (*Ceiba pentandra* (L.) Gaertn.) Terhadap *Methicillin Resistant Staphylococcus aereus* (MRSA). (Unpublished Thesis). Program Studi Biologi. Fakultas Teknobiologi. Universitas Atma Jaya. Yogyakarta.

Novita, D.D., Sugianti, U.C., & Asropi. (2015). Aplikasi Kemasan Berpenyerap Etilen pada penyimpanan Buah Jambu Merah (*Psidium guajava* L.). *Jurnal Teknik Pertanian Lampun, 4* (3), pp. 227 – 234.

Pradhana, A.Y., Hasbullah, R., & Purwanto, A. Y. (2013). Pengaruh Penambahan Kalium Permanganat Terhadap Mutu Pisang (CV Mas Kirana) pada Kemasan Atmosfer Termodifikasi Aktif. *Jurnal Pascapanen, 10* (2), pp. 83 – 94.

Rudito. (2012). Perlakuan Komposisi Gelatin dan Asam Sitrat dalam Edible Coating yang Mengandung Gliserol pada Penyimpanan Tomat. *Jurnal Teknologi Pertanian, 6* (1), pp. 1 – 6.

Siagian, H.F. (2009). Penggunaan Bahan Penjerap Etilen pada Penyimpanan Pisang Barangan dengan Kemasan Atmosfer Termodifikasi Aktif. (Unpublished Thesis). Departemen Teknologi Pertanian. Fakultas Pertanian Universitas Sumatera Utara. Medan.

Singh, S., Sharma, V., & Soni, M.L. (2011). Biotechnological Applications of Industrially Important Amylase Enzyme. *International Journal of Pharma and Bio Sciences, 2* (1), pp. 486 – 496.

Wahyu, M.K. (2009). Pemanfaatan Pati Singkong sebagai Bahan Baku Edible Film. Beswan Djarum. Fakultas Teknologi Industri Pertanian. Universitas Padjadjaran. Bandung.

Winarno, F.G. (2002). *Fisiologi Lepas Panen Produk Hortikultura*. Bogor, Mbrio Press.

Winarno, F.G. (2008). *Kimia Pangan dan Gizi*. Bogor, Mbrio Press.

Yassin, T., Hartanto, R., Haryanto, A., & Tamrin. (2013). Pengaruh Komposisi Gas Terhadap Laju Respirasi Pisang Janten pada Penyimpanan Atmosfer Termodifikasi. *Jurnal Teknik Pertanian Lampung*, *2* (3), pp. 147 – 160.

Zafika, Y., Mukarlina & Linda, R. (2015). Pemanfaatan Gel Lidah Buaya (*Aloe chinensisi* L.) yang Diaplikasikan dengan Gliserin sebagai Bahan Pelapis Buah Pisang Barangan. *Jurnal Protobiont, 4* (1), pp. 136 – 142.