Dinarto_2019_IOP_Conf._Ser.__Earth_Environ._Sci._379_012003.pdf

IOP Conference Series: Earth and Environmental Science

PAPER • OPEN ACCESS

Effectiveness of botanical hydrocolloid of grass jelly leaf and seaweed to delay ripening of banana

To cite this article: W Dinarto *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **379** 012003

IOP Conf. Series: Earth and Environmental Science **379** (2019) 012003 doi:10.1088/1755-1315/379/1/012003

Effectiveness of botanical hydrocolloid of grass jelly leaf and seaweed to delay ripening of banana

W Dinarto[1], R Riyanto[1] and A Sungkono [2]

[1] Agrotechnology Study Program, Faculty of Agroindustry, University of Mercu Buana Yogyakarta, Jl Wates Km 10 Yogyakarta 55753 Indonesia

[2] Graduate of Agrotechnology Study Program, Faculty of Agroindustry, University of Mercu Buana Yogyakarta, Jl Wates Km 10 Yogyakarta 55753 Indonesia

* Email: wafit@mercubuana-yogya.ac.id

Abstract. Banana has an important purpose as the source of vitamins, minerals, and other substances in supporting nutritional adequacy. However, there is an obstacle in the supply chain of banana from producers to consumers with prime quality because of the nature of banana which is perishable. Therefore, it is necessary to implement any mean to delay the ripening of banana so that the process can be inhibited and the quality of banana maintained, among which is the fruit skin surface coating technology. The aim of this study was to determine the appropriate material and concentration of botanical hydrocolloid to delay ripening of bananas. This research was conducted in November to December 2014 in the Agronomy Laboratory of University of Mercu Buana Yogyakarta. The research is a single factor experiment arranged in a completely randomized design with three replications. The treatments tested were both hydrocolloid material of seaweed (*Euchema spinosum*) concentration of 1.5%, 2%, 2.5% and grass jelly (*Stephania hernandifolia*) with concentration of 2.5%, 5%, 7.5%. The result showed that based on either the percentage of fruit weight loss, fruit skin discoloration, hardness (texture), or total dissolved solids, the grass jelly hydrocolloid with the concentration of 7.5% is the best application in delaying the ripening of banana. The coating of banana with grass jelly hydrocolloid concentration of 7,5% is capable of inhibiting ripening of bananas for 11 days.

1. Introduction

The freshness of unprocessed banana is limited due to its perishable characteristic, because of which mechanical, physical, chemical and biological damage will easily deteriorate its quality. As a climacteric fruit, untreated harvested banana will easily be either broken, commonly signed by the browning process of its skin, or rotten by its respiration as well as microbial activity, therefore the fruit storage duration is short. The shelf life of Raja Bulu, a favorite local cultivar, in consumer hands is only 5 to 8 days when stored at room temperature (27^{o}C) [1].

The respiration rate and ethylene production of banana as a climacteric fruit increase significantly during ripening process which induce fruit softening [2]. The continuous process of catabolism also leads to the degradation of nutritious substances causing further declining in quality and quantity. This eventually brings down its market value leading to the economic loss. The issue is among obstacles of providing fresh high quality banana to market, thus it is necessary to implement appropriate post-harvest technology to either longer banana shelf life or preserve its quality. Fruit post-harvest treatment aims to inhibit naturally-occurring respiration. It can be carried out by several methods, among which are cold, controlled and modified atmosphere storage, film and coating application.

Coating and film substances commonly are made of plastic well-known as plastic film. However, it is susceptible to depolymerization, because of which coated fruit will be contaminated by plastic-derived harmful chemical compounds. Both will either put human being healthiness at risk and cause off-flavor [3]. Furthermore, synthetic film is not degradable which will jeopardize already-polluted environment. Therefore, it is appropriate to utilize edible film and coating materials as an alternative which both preserve fruit and are safe for human beings and their surrounding area. Other benefits from the utilization of edible film which do not exist in plastic, according to [4], are its ability to improve fruit organoleptic attributes, provide nutrients supplement, act as an antibiotics as well as antioxidant agent. Also, it can be in use for both single and layered coating.

The application of thin film on the banana surface area is a mean to slow down aging and ripening process. The use of the coating hampers gas exchange from inside to outside and vice versa. As oxygen is not adequately available, the respiration rate decreases whereas carbon dioxide levels goes up. Consequently, natural damages caused by ripening process of banana are kept in check.Edible film is any thin film composed of edible materials formed on food or placed on or between food ingredients to inhibit steam, oxygen, carbon dioxide, flavor, lipids migration [5]. In addition, It can be a food additive ingredient which contains antioxidant, antibiotic and flavoring agent while also improve mechanical integrity or food characteristic treatment.

According to [4] edible films and coatings produced from renewable biological materials provide opportunities for innovative uses in food protection and preservation. Movement of moisture, gases, and solutes within food or between food and its surrounding environment can be controlled by application of edible protective layers. Moreover, [5] also stated that in many cases an edible film material with good mechanical properties can replace synthetic film.

Available edible material for fruit surface coating is vegetable-based hydrocolloid, such us grass jelly or seaweed. [6] stated that grass jelly extract is made of pectin polysaccharide which forms gel. Pectin contained in grass jelly is among gel-forming hydrocolloid group which if thinly shaved can be well-sticky and transparent, therefore it is a potential edible film agent. In line with previous statements. [7] said that grass jelly contains pectin polysaccharide which can coagulate and form gel. Additionally, seaweed is a well-known source of hydrocolloid widely used in food, non-food and, pharmacy industry as gel-forming material, emulsifier, and coagulant agent. Similar to grass jelly, pectin polysaccharide in seaweed is an organic compound which forms hydrocolloid. According to its properties, polysaccharide from seaweed can be applied as edible film material.The aim of the study was to determine which edible film and in which concentration are optimum to preserve banana quality and longer its shelf live.

2. Materials and Mehods

2.1. Experimental design

The study was conducted in the laboratory of chemistry and agronomy of University of Mercu Buana of Yogyakarta throughout November and December 2014. Materials in the use were banana, grass jelly leaves, seaweed, distilled water, cassava flour, and water. Equipment were hand refractometer, penetrometer, beaker glass, magnetic stirrer, thermometer, thermo-hygrometer, hot plate, weighing instrument, blender, oven, measuring cup, stirrer, fabric filter, fan, knife, and stationery.

The research was a single factor experiment set in a completely-randomized design with 7 treatments and 3 replications. The treatments were composed of without coating (control), seaweed hydrocolloid concentration of 1.5%, 2.0%, 2.5% and grass jelly hydrocolloid concentration of 2.5%, 5.0%, 7.5%. The observed were analyzed by ANOVA (α:5%) followed by Duncan Multiple Range Test with the same degree of certainty [8].

2.2. The making of hydrocolloid flour

The making of seaweed and jelly grass flour refers to the research method carried out. The process begins with the cleaning up of jelly grass and seaweed, then followed by drying up both in oven for 18 hours in 50oC. After the materials dessicate those are grinded softly and filtered.

IOP Conf. Series: Earth and Environmental Science **379** (2019) 012003 doi:10.1088/1755-1315/379/1/012003

2.3. Preparation of grass jelly and seaweed edible film
The making of the edible films refer to the method developed by [9] then modified by [10]. Twenty grams of cassava flour is poured with 150 ml distilled water and boiled up to 80oC. It is heated up for 30 seconds using hot plate then stirred for 30 seconds using magnetic stirrer. Cassava flour solution is poured into beaker glass containing 850 ml of distilled water and hydrocolloid flour based on the treatments (1.5%, 2.0%, 2.5% of seaweed and 2.5%, 5.0%, 7.5% of grass jelly). The solutions are then heated up to 80oC and filtered, after which the edible film solutions are formed.

2.4. Coating application on banana
Edible film is coated on the rind surface of banana according to the method set by [11] then modified by [12]. In the first place, the bananas are washed up to clean them from dirt. After doing so, the bananas are submersed into 50oC edible film solution for a minute. The submersed bananas are then dried up before being stored.

2.5. Banana storage
The storage is conducted in room temperature, During storage period, the banana rind color and its change are observed. The temperature and humidity of storing room are also measured.

2.6. Measurement
The observed variables are banana weight loss percentage, banana rind color change based on banana rind color scale index , banana hardness, and total dissolved solid.

3. Result and Discussion

3.1. Fruit weight shrink percentage
Banana coated with 7.5% of grass jelly hydrocolloid has the lowest number of weight shrinkage even though it does not differ significantly with 5% of grass jelly coating (Table 1). Weight shrinkage occurs because of catabolism process which requires oxygen for substances oxidation.

The bananas coated with 7.5% concentration grass jelly hydrocolloid shrinks at the lowest percentage (4.2%). It can be caused by the fact that the higher concentration of edible film application is, the thicker edible film is formed. According to [13] stated that the significant difference of edible film thickness is caused by the higher carrageenan concentration. It brings up the total dissolved solids (TDS) within film-forming solution. Consequently, if the applied coating dries up, it results thicker film layer. This is in accordance with the conclusion of [14] stating that film thickness is mainly affected by TDS within film-forming solution and casting plate size.

Table 1. The percentage of the treated banana weight shrink after 7-day storage

Treatments	Weight shrinkage (%)
Without coating (control)	10.78 a
Seaweed hydrocolloid concentration of 1.5%	9.18 ab
Seaweed hydrocolloid concentration of 2.0%	10.76 a
Seaweed hydrocolloid concentration of 2.5%	7.82 bc
Grass jelly hydrocolloid concentration of 2.5%	8.41 abc
Grass jelly hydrocolloid concentration of 5.0%	6.45 cd
Grass jelly hydrocolloid concentration of 7.5%	4.20 d

Note: the value followed by the same letter shows not significantly different according to DMRT (α:5%)

The thicker edible film has the better ability to prevent gas exchange and the longer shelf life of product [15]. According to [16], occuring respiration in fruit breaks down sugar ($C_6H_{12}O_6$) into carbondioxyde (CO_2) and water (H_2O). The latter then vaporizes which in turn shrinks fruit weight. This is also in line with Swho concludes that the increase of respiration rate will lead to catabolism of complex organic compound such us carbohydrate which generates carbondioxyde, energy and water.

The vaporized water causes fruit weight loss. Rudito [17] also stated that banana is a fruit with climacteric respiration pattern which will undergo significant respiration rate increase and weight shrinkage as the rippening process progresses

3.2. Fruit rind colour change

Fruit rind color change was observed using banana ripening color index valued quantitatively from 1 to 8. The results shows that grass jelly hydrocolloid concentration of 7.5% coated banana had not undergone color and rind change significantly (ripening index number 2) after 7-day storage, and green still dominated the rind (Table 2). It presumably occured due to the fact that in the condition where the rind was coated, oxygen intake was lower which consequently disturbed the respiration, therefore it suppressed both the degradation of chlorophyll and the appearance of carotenoids. In brief, the coating postponed the yellowing process on the banana rind[18].

Fruit ripening is a complex process signed firstly by color change. It develops because of either breaking down of chlorophyll or synthesis of other pigments. Synthesis of carotenoids and dismantling of chlorophyll cause fruit rind color change which is the feature of banana ripening [18], stated that in banana yellowing process, chlorophyll begins dissappearing slowly either without or along with carotenoids synthesis in small number. The change of fruit rind takes place because of both anabolism and catabolism of pigment.

Table 2. The value of banana rind color index after 7-day storage in varied hydrocolloid treatments

Treatments	Color index
Without coating (control)	8 a
Seaweed hydrocolloid concentration of 1.5%	7 a
Seaweed hydrocolloid concentration of 2.0%	7 a
Seaweed hydrocolloid concentration of 2.5%	6 ab
Grass jelly hydrocolloid concentration of 2.5%	6 ab
Grass jelly hydrocolloid concentration of 5.0%	4 bc
Grass jelly hydrocolloid concentration of 7.5%	2 c

Note: the value followed by the same letter shows not significantly different according to DMRT (α:5%)

According to the observation on the bananas which had not been reached 8th grade in color index conducted after 7th day, the bananas coated with grass jelly hydrocolloid concentration of 7.5% was the slowest treated banana reaching 8th grade in color index. It reached the grade on the 11st day.

3.3. Banana Texture

After 7 days in storage, the texture and hardness of banana coated with grass jelly hydrocolloid concentration of 7.5% was the highest (4.67 kg). It showed that banana coated with grass jelly hydrocolloid 7.5% was not ripe enough. On the other hands, it indicated that the treatment can postpone the ripening process best compared to the others. Rudito [19] stated that the low respiration rate in banana coated with edible film both results slower ripening process and reduces texture degradation during storage.

Table 3. Texture (hardness) of banana after 7-day storage treated on varied hydrocolloid coatings

Treatments	Fruit hardness (kgs)
Without coating (control)	2.06 a
Seaweed hydrocolloid concentration of 1.5%	2.63 a
Seaweed hydrocolloid concentration of 2.0%	2.60 a
Seaweed hydrocolloid concentration of 2.5%	2.87 ab
Grass jelly hydrocolloid concentration of 2.5%	2.63 ab
Grass jelly hydrocolloid concentration of 5.0%	3.50 bc
Grass jelly hydrocolloid concentration of 7.5%	4.67 c

Note: the value followed by the same letter shows not significantly different according to DMRT (α:5%)

Kismaryanti [17] stated that high firmness number indicates that fruit is not ripe yet, and vice versa. The decrease of firmness number develops as the unsoluble pectin is degraded into soluble for. It then reduces cohession force among cell walls bonding them to each other.

3.4. Total (TDS)
The result shows that the bananas coated by 5.0 and 7.5% grass jelly hydrocolloid have the lower TDS value compared to the others (Table 4). The increase of TDS in fruits occurs as simple sugar compounds are formed from degradation of Polisaccharides during ripening stage. [19] reported that throughout ripening process, starches are torn apart into simple carbon compounds. As the level of starch goes down, sucrose concentration increases, after which it is degraded into glucose and fructose. Thesemonosaccharide are the dissolved solid detected by refractometer.

Table 4. Total dissolved solid (TDS) in banana 7-day storage treated on varied hydrocolloid coatings

Treatments	^{0}Brix
Without coating (control)	23.45 a
Seaweed hydrocolloid concentration of 1.5%	23.00 ab
Seaweed hydrocolloid concentration of 2.0%	21.33 abc
Seaweed hydrocolloid concentration of 2.5%	21.44 ab
Grass jelly hydrocolloid concentration of 2.5%	21.00 bcd
Grass jelly hydrocolloid concentration of 5.0%	18.67 cd
Grass jelly hydrocolloid concentration of 7.5%	18.45 d

Note: the value followed by the same letter shows not significantly different according to DMRT (α:5%)

Matto et. al. [20] said that during ripening stage, TDS will gradually enhance as the soluble sugar compounds in fruit increase. Furthermore, [21] stated that TDS will increase as ripening process undergoes. The enhancement will sharply occurs when respiration rate speeds up.

4. Conclusion
The grass jelly hydrocolloid with the concentration of 7.5% is the best application in delaying the ripening of banana based on either the percentage of fruit weight loss, fruit skin discoloration, hardness (texture), and total dissolved solids.

References
[1] Nurhasanah N 2006 *Survey of banana storage conditions (Musa paradisiaca) Raja Bulu cultivar in Kramat Jati central market and around Bogor* (Bogor Agricultural University)
[2] Widodo S E, Zulferiyenni and Arista R 2013 Coating effects of chitosan and plastic wrapping on the shelf-life and qualities of “Mutiara” and “Crystal” guavas *J. Int. Soc. Southeast Asian Agric. Sci.* **19** 1–7
[3] Mannheim C H and Passy N 1990 Interaction between packaging materials and foods *Packag. Technol. Sci.* **3** 127–32
[4] Gennadios A and Weller C L 1990 Edible Films and Coatings from Wheat and Corn Proteins *Food Technol.* **44** 63–9
[5] Krochta J M and Mulder-Johnson C De 1997 Edible and biodegradable polymer films: challenges and opportunities *Food Technol.* **51** 61–74
[6] Rochima E, Zakaria F R, Suhartono M T and Siregar N C 2010 Potential of green leaves cincau (Premna oblongifolia , Merr) from Indonesia as anti cancer *Sustain. Futur. Hum. Secur. 11-12 December 2010* 35–42
[7] Milani J and Maleki G 2012 Hydrocolloids in Food Industry *Food Ind. Process. - Methods Equip.*
[8] Gomez K A and Gomez A A 1984 *Statistical Procedures for Agricultural Research* (Canada: John Wiley & Sons)
[9] Murdianto W, Marseno D W and Haryadi H 2005 Sifat fisik dan mekanik edible film dari ekstrak daun janggelan (mesona palustris BI *Agrosains* **18**

[10] Adi Nugroho A and Baskara Katri R A 2013 Kajian Pembuatan Edible Film Tapioka Dengan Pengaruh Penambahan Pektin Beberapa Jenis Kulit Pisang Terhadap Karakteristik Fisik Dan Mekanik Study the Manufacture of Tapioca Edible Films With the Effect of Addition of Pectin Some Type of in Banana Peels Ag *J. Teknosains Pangan Januari Jur. Teknol. Has. Pertan. Univ. Sebel. Maret J. Teknosains Pangan* **2** 2302–733
[11] McHugh T H and Senesi E 2000 Apple Wraps: A Novel Method to Improve the Quality and Extend the Shelf Life of Fresh-cut Apples *J. Food Sci.* **65** 480–5
[12] Siswanti S, Anandito R B K and Manuhara G J 2009 Characterization of composite edible film from glucomanan of iles-iles (Amorphopallus muelleri) tuber and cornstarch *Biofarmasi J. Nat. Prod. Biochem.* **7** 10–21
[13] Handito D 2011 Pengaruh Konsentrasi Karagenan Terhadap Sifat Fisik Dan Mekanik Edible Film (the Effect of Carrageenan Concentrations on Mechanical and Physical Properties of Edible Films) *Agroteksos* **21** 151–7
[14] McHUGH T H, HUXSOLL C C and KROCHTA J M 1996 Permeability Properties of Fruit Puree Edible Films *J. Food Sci.* **61** 88–91
[15] McHugh T H and Krochta J M 1994 Sorbitol- vs Glycerol-Plasticized Whey Protein Edible Films: Integrated Oxygen Permeability and Tensile Property Evaluation *J. Agric. Food Chem.* **42** 841–5
[16] Kader A A 2002 Quality and safely factors: definition and evaluation for fresh horticultural crops *Postharvest Technology of Horticultural Crops.* (University of California Division of Agriculture and Natural Resources) pp 279–86
[17] Roiyana M, Izzati M and Prihastanti E 2012 Potensi dan Efisiensi Senyawa Hidrokoloid Nabati Sebagai Bahan Penunda Pematangan Buah *Bul. Anat. dan Fisiol.* **XX** 40–50
[18] Pantastico E B 1975 Post-harvest physiology, handling and utilization of tropical and subtropical fruits and vegetables. *Post-harvest physiology, handling and utilization of tropical and subtropical fruits and vegetables.* (Avi Publishing Company, Inc.)
[19] Winarno F G 1984 *Pengantar Teknologi Pangan* (Jakarta: Gramedia)
[20] Rosalina Y, Widayati S, Rohana A and Prihantoro J 2015 Application of Edible Coating on Rimau Gerga Lebong Orange (RGL Orange) at Room Temperature Storage *International Seminar on Promoting Local Resources for Food and Health* pp 12–3
[21] Pujimulyani D 2012 *Teknologi pengolahan sayuran dan buah-buahan* (Yogyakarta: Graha Ilmu)

Dinarto_2019_IOP_Conf._Ser.__Earth_Environ._Sci._379_01..

ORIGINALITY REPORT

12%

SIMILARITY INDEX

PRIMARY SOURCES

1	A de Vernal. "Marine palynology and its use for studying nearshore environments", IOP Conference Series Earth and Environmental Science, 01/01/2009 Crossref	70 words — 2%
2	www.er-c.org Internet	50 words — 2%
3	digitalcommons.unl.edu Internet	42 words — 1%
4	Escalona, V.. "Modified atmosphere packaging inhibits browning in fennel", LWT - Food Science and Technology, 200402 Crossref	40 words — 1%
5	W A Yulianto, C L Suryani, S Ulfah. "Evaluation of Cooking Quality of Chromium Fortified – Parboiled Rice", IOP Conference Series: Materials Science and Engineering, 2017 Crossref	33 words — 1%
6	qspace.qu.edu.qa Internet	21 words — 1%
7	jtsl.ub.ac.id Internet	13 words — < 1%
8	ejurnal.litbang.pertanian.go.id Internet	13 words — < 1%
9	sciencedocbox.com Internet	13 words — < 1%

10	ageconsearch.umn.edu Internet	10 words — < 1%
11	www.perlindungan-tanaman.net Internet	8 words — < 1%
12	Biorelated Polymers, 2001. Crossref	8 words — < 1%
13	docplayer.net Internet	8 words — < 1%
14	paduaresearch.cab.unipd.it Internet	8 words — < 1%
15	digilib.unimed.ac.id Internet	8 words — < 1%