Durian Fruit Response (Durio Zibethinus, Murr.) Minimum Processing Due To The Effect Of Edible Coating Material Formulation And Old Storage At Frozen Emperature

by Yudi Garnida -

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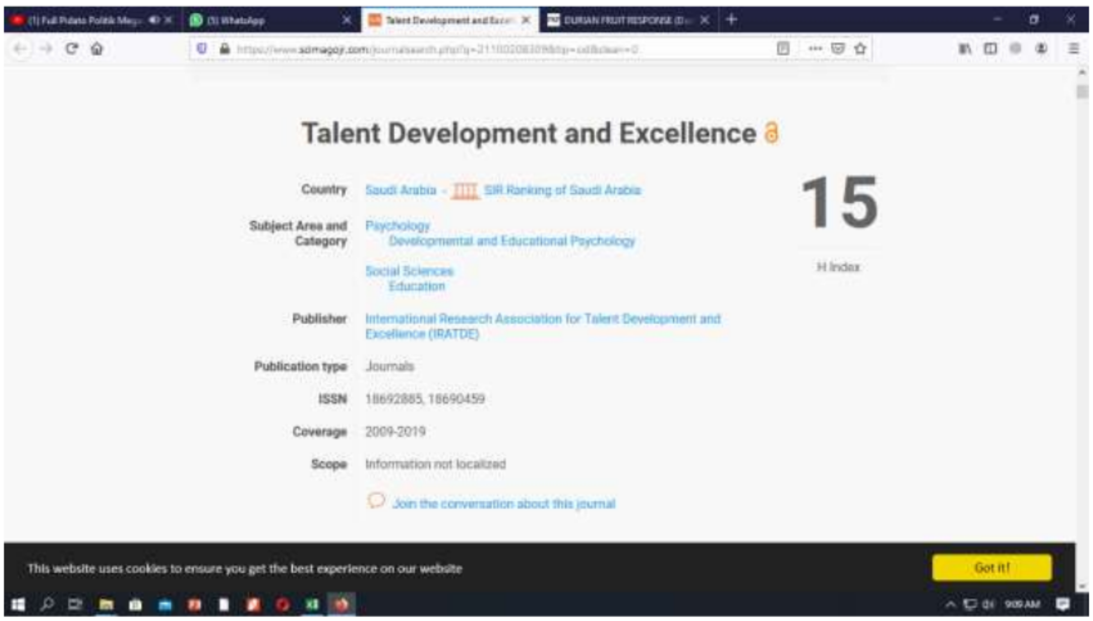

Vol. 12 No. 1 (2020): Issue 2020/1

Articles

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- Yudi Garnida, Giat Suryatmana, Dedy Muchtadi, and Imas Setiasih

Abstract

This research has been carried out to observe the response of minimally processed durian fruit due to the influence of edible coating material formulations and storage time at freezing temperatures. The research was carried out in two stages which were carried out in the Department of Food Technology, Pasundan University from March to July 2005. The experimental design method used in stage 1 was divided plot design (RPPT) with 3 factors repeated twice, carbohydrate source as main plot with levels: pectin, arabic gum and cornstarch, protein source as subplots with levels: gelatin and soy protein isolates, as well as lipid sources: glyceryl monostearate and liquid wax as plot children. Edible film layers formed were analyzed for water vapor transmission rate, tensile strength, elongation percent, thickness and organoleptic testing of color. The experimental design used in stage 2 was a completely randomized design (CRD) with 2 factors repeated four times, namely the formula of edible coating material (with or without edible coating) and storage time (0, 1 and 2 months). The processed durian must be kept for a minimum of 2 months at freezing temperatures of -70 C. The results of the second phase of the study showed that the formula of edible coating material and storage time affected the weight loss, water content, oxygen content and carbon dioxide in the packaging, hardness, total sugar content, vitamin C content, total bacteria and organoleptic tests, but did not affect the pH, total acid, total yeast and mold of durian are minimally processed. The results of the kinetics prediction of the rate of degradation of vitamin C to the minimum processed durian fruit coated with edible coating showed a first-order reaction with a linear equation Y = -0.4517x + 1.9955 and fruit quality could be maintained for 44 days.

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This research has been carried out to observe the response of minimally processed durian fruit due to the influence of edible coating material formulations and storage time at freezing temperatures. The research was carried out in two stages which were carried out in the Department of Food Technology, Pasundan University from March to July 2005. The experimental design method used in stage 1 was divided plot design (RPPT) with 3 factors repeated twice, carbohydrate source as main plot with levels: pectin, arabic gum and cornstarch, protein source as subplots with levels: gelatin and soy protein isolates, as well as lipid sources: glyceryl monostearate and liquid wax as plot children. Edible film layers formed were analyzed for water vapor transmission rate, tensile strength, elongation percent, thickness and organoleptic testing of color. The experimental design used in stage 2 was a completely randomized design (CRD) with 2 factors repeated four times, namely the formula of edible coating material (with or without edible coating) and storage time (0, 1 and 2 months). The processed durian must be kept for a minimum of 2 months at freezing temperatures of -70 C. The results of the second phase of the study showed that the formula of edible coating material and storage time affected the weight loss, water content, oxygen content and carbon dioxide in the packaging, hardness, total sugar content, vitamin C content, total bacteria and organoleptic tests, but did not affect the pH, total acid, total yeast and mold of durian are minimally processed. The results of the kinetics prediction of the rate of degradation of vitamin C to the minimum processed durian fruit coated with edible coating showed a first-order reaction with a linear equation Y = -0.4517x + 1.9955 and fruit quality could be maintained for 44 days.

Keywords: *edible coating, edible film, minimally processed fruit, durian, storage, and freezing temperature.*

I. INTRODUCTION

Durian (Durio zibethinus, Murr.) Is a type of tropical fruit that is quite popular. This fruit has a delicious taste and distinctive aroma (Sunarjono, 1995). Demand for durian fruit tends to increase in line with the increasing demand for tropical fruit. Durian fruit production as a whole in 1999 was 194,359 tons, with the largest production in East Java (37,956 tons) and West Java (29,090 tons). In 2000 its production increased to 236,794 tons, in 2001 it was 347,118 tons, in 2002 it was 525,064 tons and in 2003 it produced 645,786 tons (Sunaryono, 2004).

ISSN 1869-0459 (print)/ISSN 1869-2885 (online)

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Talent Development & Excellence
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Consumption of durian fruit in a whole condition has several disadvantages including: impractical because it has to open hard and sharp skin, consumers cannot immediately see the condition of their flesh and cannot buy as needed. To overcome the above weaknesses, minimal processing needs to be done.

Minimally processed fruits (minimally processed fruits) are fruits that have been subjected to the treatment of washing, sorting, stripping, cutting and or slicing into smaller parts with specific shapes in accordance with the commodity. The fruit can be served in a short time so that the processed fruit is minimally practical, consumers can buy as needed, and offer quality assurance compared to the fruit in one piece because consumers can immediately see the condition of the fruit. Behind these advantages, as well as fresh agricultural commodities, processed fruit is at least easily damaged, both during handling and storage.

According to Setiasih (1999), to extend the shelf life of processed fruit at a minimum, proper and optimum handling is required. One alternative that is expected to reduce the rate of decline in the quality of processed fruit at a minimum and extend its shelf life is to coat it with an edible coating combined with storage at low temperatures. Therefore, research on edible coatings needs to be done to obtain results with clear characteristics and specifications. Low temperature storage (frozen) is one way to inhibit the rate of decline in the quality of fruits because it will reduce the rate of evaporation of water, slow the rate of chemical reactions and the rate of microbial growth. The lower the storage temperature, the slower the rate of chemical reactions, enzyme activity and microbial growth.

II. METHOD

This study consisted of 2 experimental stages, namely:
Trial Phase 1: Selection of Edible Coating Formula Formula to be Applied.
Phase 1 experiment aims to find the best edible coating formula from various mixtures of carbohydrate, protein and lipid sources. The main ingredients used in this study were edible coating formulations consisting of low methoxy pectin (LMP), Arabic gum, wax (britex), gelatin, soy protein isolate (GPA), cornstarch, gelatin and glyceril monostearate (GMS). Other ingredients are glycerol, calcium chloride and distilled water.

The treatment combination was repeated twice. The factors and levels are:
1. Carbohydrate source (A) as the main plot (main plot), consisting of:
   a. Low methoxy pectin (LMP), with a concentration of 3% (a1)
   b. Arabic gum with a concentration of 3% (a2)
   c. Maize flour with a concentration of 3% (a3)
2. Sources of protein (B), as subplots, consist of:
   a. Gelatin with a concentration of 0.75% (b1)
   b. Soy protein isolate (GPA) with a concentration of 0.75% (b2)
3. Source of lipids (C) as plot children (sub-plots) consist of:
   a. Glyceril monostearate (GMS), with a concentration of 2% (c1)
   b. Liquid wax (wax), with a concentration of 2% (c2)

Thus there were 12 treatment combinations (3x2x2) and two replications.
Trial Phase 2: Application of Edible Coating in Minimal Processed Durian Fruit
The purpose of the main research phase 2 is for the application of edible coatings to durian fruit. The research factor is 1 selected edible coating formulation obtained from stage 1 experiments and storage time. As a comparison, control is used, namely durian fruit without edible coating treatment.

ISSN 1869-0459 (print)/ISSN 1869-2885 (online)

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The factors and the level of the experiment are:
1. Edible coating (A) formulation, consisting of:
   a. Durian without coated edible coating material (A0)
   b. Coated edible coating material (A1)
2. Storage time (B) at freezing temperature (-70 C), consisting of:
   a. Storage 0 months (b0)
   b. 1 month storage (b1)
   c. 2 month storage (b2)

III. RESULTS AND DISCUSSION

Trial: Phase 1.

Water Vapor Transmission Rate Based on the results of statistical analysis, there is an interaction between carbohydrate, protein and lipid sources on the rate of water vapor transmission (Appendix 3.1.). The highest water vapor transmission rate is obtained from a3b1c2 treatment (mixture of cornstarch, gelatin and liquid wax), which is 919.06 g / m2 / 24 hours. The lowest water vapor transmission rate is obtained from a2b2c2 (a mixture of Arabic gum, GPA and liquid wax), which is 438.26 g / m2 / 24 hours.

The addition of gelatin and GPA results in different transmission rates. The addition of GPA turned out to produce a better rate of water vapor transmission compared to gelatin.

Table 1. Effect of Carbohydrate, Protein and Lipid Sources on Water Vapor Transmission Rate (g / m2 / 24 hours).

Carbohidrat (A)	Protein (B) / Lipid (C)			
	Gelatin (b_1)		I PK (b_2)	
	GMS (c_1)	Wax (c_2)	GMS (c_1)	Wax (c_2)
Pektin (a_1)	559,80 ^{b} A	741,91 ^{b} C	678,73 ^{a} B	857,97 ^{b} D
Gum Arab (a_2)	Not Measured	659,71 ^{a} B	Not Measured	438,260 ^{a} A
Maizena (a_3)	527,56 ^{a} A	919,06 ^{c} D	838,33 ^{b} B	881,06 ^{c} C

Note: Based on proven AxBxC variability. The average value followed by different letters (uppercase letters are read horizontally, lowercase letters read vertically) shows a real difference according to LSD test at 5% level.

The results of the experiment showed that the addition of glyceril monostearate (GMS) component, which is a fat derivative in a hydrophilic mixture of pectin and GPA, can reduce the transmission rate of edible film water vapor produced. The condition is thought to be due to the presence of a hydrophobic group on the GMS compound. According to Park et al. (1994a), edible films derived from lipid components have good moisture resistance properties. In his research it was stated that the higher the concentration of lipids (fatty acids), the lower the rate of transmission of water vapor film. Avena-Bustillos and Krochta (1994) stated that the addition of acetylated monoglyseride to the sodium caseinate component significantly decreased the permeability of water vapor.

Tensile strength

ISSN 1869-0459 (print)/ISSN 1869-2885 (online)

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Based on the results of statistical analysis, there is an interaction between carbohydrate, protein and lipid sources on the tensile strength of edible films (Appendix 3.2.). The highest tensile strength is obtained from a mixture of pectin, GPA and wax (britex) that is equal to 5.86 kgf / mm2. The lowest tensile strength is obtained from a mixture of arabic gum, gelatin and wax (britex) that is equal to 0.41 kgf / mm2.

Table 2. Effects of Carbohydrate, Protein and Lipid Sources on Tensile Strength (kgf / mm2)

Carbohidrat (A)	Protein (B) / Lipid (C)			
	Gelatin (b_1)		I PK (b_2)	
	GMS (c_1)	Wax (c_2)	GMS (c_1)	Wax (c_2)
Pektin (a_1)	2,97 ^{b} B	2,80 ^{c} B	0,54 ^{a} A	5,86 ^{c} C
Gum Arab (a_2)	Not Measured	0,41 ^{a} A	Not Measured	1,58 ^{b} B
Maizena (a_3)	0,76 ^{a} A	1,260 ^{b} C	4,66 ^{b} D	0,92 ^{a} B

Note: Based on proven AxBxC variability. The average value followed by different letters (uppercase letters are read horizontally, lowercase letters read vertically) shows a real difference according to LSD test at 5% level.

Addition of carbohydrate sources (pectin), GPA and wax will produce high tensile strength (5.86 kgf / mm2), whereas in the use of Arabic gum carbohydrate sources with GPA and wax will produce higher tensile strength (1.58 kgf / mm2) compared when mixed with gelatin and GMS (0.41 kgf / mm2). Likewise, other carbohydrate sources, namely cornstarch which when mixed with GPA and GMS will produce a higher tensile strength (4.66 kgf / mm2) when compared to mixed with gelatin and wax (1.26 kgf / mm2). Addition of pectin with protein sources (gelatin and GPA) and fat sources (GMS and wax) will produce a high tensile strength as well.

The tensile strength of edible films made from a mixture of carbohydrate, protein and lipid sources varies from 0.41 kgf / mm2 to 5.86 kgf / mm2. The results of the diversity analysis showed that the combination of edible film formula constituents significantly affected the tensile strength.

Trial: Phase 2

Water content Based on the results of statistical analysis, the interaction between edible coating and storage time has an effect on minimal durian treated water content. Further test results (Table 13) at 1 month storage showed that the durian fruit coated with edible coating material was different from the control durian fruit (not using edible coating). The water content of durian fruit with edible coating was higher (79.21%) compared to durian fruit without edible coating (77.27%). This situation shows that the decrease in water content of durian fruit without edible coating is higher than that of durian fruit with edible coating treatment.

ISSN 1869-0459 (print)/ISSN 1869-2885 (online)

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Table 3. Effect of Edible Coating Material Formulation and Storage Duration on Minimal Durian Processed Water Moisture Content.

Coating with *Edible Coating* (A)	Water Content (%)		
	Storage Time (B)		
	0 month (b_0)	1 month (b_1)	2 months (b_2)
Without Coating (a_0)	$80{,}41^a$ C	$77{,}27^a$ B	$75{,}75^a$ A
Coating Treatment (a_1)	$80{,}34^a$ B	$79{,}21^b$ AB	$78{,}50^b$ A

Note: Based on the proven variety of AxB variance. The average value followed by different letters (uppercase letters are read horizontally, lowercase letters read vertically) shows a real difference according to the level 5 duncan test.

At 2 months storage, the moisture content between durian with edible coating is different from the durian control. As with 1 month storage, the water content of durian with edible coating was higher (78.50%) compared to the water content of durian fruit without edible coating treatment (75.75%). These results indicate a decrease in water content in durian fruit without edible coating is higher than durian fruit that gets edible coating treatment during storage. This condition can be seen from the water content at the beginning of storage (80.41%), then decreased significantly at 1 and 2 month storage, namely 77.27% and 75.75%.

Decreased water content of durian fruit during storage is probably caused by the loss of some water through transpiration. Baldwin (1994) states that the path of water loss varies from commodity to commodity. The relatively high water content of durian fruit that was given a coating layer was thought to be due to the ability of the coating to inhibit the transpiration of water vapor.

Total Sugar Levels Based on the results of statistical analysis, the interaction between the use of edible coatings and storage time affects the total sugar content of the minimum processed durian.

Table 4. Effect of Edible Coating Material Formulation and Storage Duration on Total Total Sugar Content of Durian Processed Fruits.

Coating with *Edible Coating* (A)	Total Sugar Content (%)		
	Storage Time (B)		
	0 month (b_0)	1 month (b_1)	2 months (b_2)
Without Coating (a_0)	$2{,}49^a$ A	$7{,}54^a$ B	$9{,}96^a$ C
Coating Treatment (a_1)	$3{,}21^a$ A	$7{,}29^a$ B	$9{,}09^a$ C

Note: Based on the proven variety of AxB variance. The average value followed by different letters (uppercase letters are read horizontally, lowercase letters read vertically) shows a real difference according to the duncan test at 5% level.

ISSN 1869-0459 (print)/ISSN 1869-2885 (online)

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At 2 months storage, the total sugar content between the durian without edible coating was significantly different from the control durian. Total sugar content in processed durian with minimal edible coating was lower (9.09%) compared to total sugar content in processed durian with minimal edible coating treatment (9.96%). The higher total sugar content in durian fruit without edible coating is caused by the process of reshaping the components contained in durian fruit due to the respiration process, while the edible coating treatment of respiration process can be slowed down by the presence of a coating layer on the surface of the durian fruit.

Vitamin C levels Vitamin C is a nutrient that is quite important in fruits. The content of vitamin C is high when the old fruit is ripe and will decrease when the fruit is too ripe so that it can be used as an indicator of fruit ripening. Vitamin C is very sensitive and easily damaged by external factors such as temperature, light, alkali, enzymes, oxygen and metal catalysts (Winarno and Safe, 1981).

Table 5. Effect of Edible Coating Material Formulation and Storage Duration on Vitamin C Levels of Minimal Processed Durian Fruit.

Coating with *Edible Coating* (A)	Vitamin C Content (mg/100 g))		
	Storage Time (B)		
	0 month (b_0)	1 month (b_1)	2 months (b_2)
Without Coating (a_0)	$94{,}07^{a}$ C	$35{,}69^{a}$ B	$9{,}47^{a}$ A
Coating Treatment (a_1)	$93{,}61^{a}$ C	$39{,}08^{b}$ B	$11{,}69^{b}$ A

Note: The average value followed by different letters (uppercase letters are read horizontally, lowercase letters read vertically) show significant differences according to the duncan test at 5% level.

Based on the results of statistical analysis, the interaction between the use of edible coatings and storage time has an effect on minimal levels of processed vitamin C durian. The results of duncan further test 5% (Table 20) at 1 month storage showed that the durian fruit that received edible coating treatment was different from the control durian fruit (not using edible coating). The vitamin C content of durian fruits with edible coatings is higher (39.08 mg / 100 g) compared to durian fruits without edible coatings (35.69 mg / 100 g). This situation shows that the decrease in levels of vitamin C durian fruit without edible coating is higher than the durian fruit with edible coating treatment.
Volatile Compounds.
Based on the results of identification of the minimum volatile durian processed components that are treated with edible coating or not (control) there are various components, including aldehydes, alcohols, esters, aliphatic hydrocarbons, carboxylic acids, ketones and methane. During 1 month of storage, there was a change in the volatile component of durian fruit which was treated or not edible coating. In general, the formation of volatile components that intensively occur at 1 and 2 months storage.

ISSN 1869-0459 (print)/ISSN 1869-2885 (online)

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Volatile components formed from durian fruit with treatment without edible coating at 1 month storage include tetranitromethane, 4-metoxyphenyl, ethyl alcohol, octyl-4-carboxylic acid, methanol, 7-hydroxy tetra hydroindoliziaine, 5-metoxy-6-oxabicyclo hexane, 1,2,2-trimethylcyclopropylamine, diacetyldioxime, 2-isopropylthio-5- trifluoracetyl-1,3-oxathiolyium-4-olat, glycine, carboxylic acid, and cyano-acetic acid. While the volatile components that are formed in durian minimally processed with edible coating treatment include: 5-metoxy-1-aza-6-oxabicyclo hexane, octyl-4-carboxylic acid, 7-hydroxy tetrahydroindoliziaine, tetranitromethane, carbamic acid, glycine, carboxylic acid, methyl ester, cyanoiminoacetic acid, methyl peroxide, alanine, 2-methylpentane, propene, 2,2,4-trimethylpentane, and 2-isopropylthio-5-trifluoracetyl.

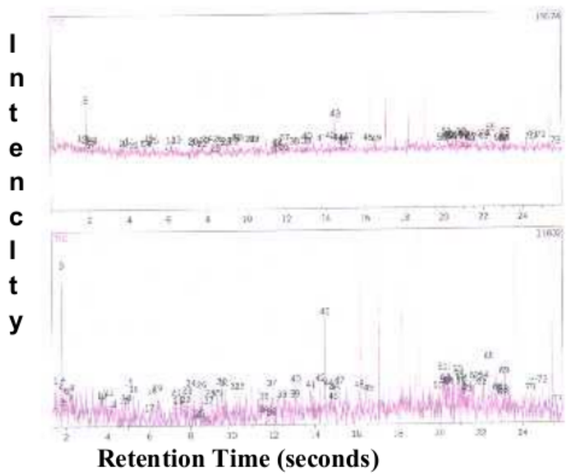

Figure 1. Graphic pattern of minimally processed durian fruit volatile compounds coated with edible coating material at 2 months storage.

IV. CONCLUSION

The conclusions are as follows :

1. Interactions between carbohydrate, protein and fat sources influence the rate of water vapor transmission, tensile strength and percent elongation, but do not affect thickness and organoleptic testing.
2. The interaction between edible coating and storage time affects weight loss, oxygen content, carbon dioxide content, water content, hardness, total sugar content, vitamin C content, total bacteria and organoleptic assessment.
3. Edible coating mixture materials from carbohydrate, fat and protein sources can be applied to minimally processed durian fruit.
4. Sources of carbohydrates, proteins and fats selected as edible coatings applied to minimally processed durian fruits are pectin (3%), soy protein isolate (0.75%) and wax (2%).

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