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The study of watermelon rind (Citrullus lanatus) and pinenapple fruit (Ananas comosus L.) proportion with caragenan addition on fruit leather physicochemical characteristics

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Abstract presentage of pectin is about 21.03% which suitable for food production such as fruit leather. Fruit leather is one of the snack food products from fruit pulp (puree) were dried in an oven or a dehydrator. Shortage of watermelon rind fruit leather is to produce flavor and color that is less interesting and has a less flexible texture. Therefore, in making fruit leather from watermelon rind is added substitution materials and stabilizers such as pineapple and carrageenan. This study aimed to determine the effect of the proportion of watermelon rind with pineapple and the addition of carrageenan concentration on the physicochemical and sensory characteristics of fruit leather. The study was conducted using a randomized complete block design (RCBD) factorial. The first factor with three levels, namely the proportion of watermelon rind and pineapple (90%:10%, 80%:20%, and 70%:30%). The second factor was carrageenan concentration (0,2%, 0,4%, and 0,6%). Treatment of the proportion of watermelon rind and pineapple had significant effect on water content, ash, vitamin C, hardness, sugar, lightness (L), yellowish (b+). Treatment of carrageenan concentration has significant effect on water content, ash, vitamin C, lightness (L). Fruit leather of watermelon rind that has best physicochemical characteristics was A1K1 treatment is the proportion of albedo rind and pineapple (90%: 10%) and carrageenan concentration 0.2%. organoleptic taste 3.10, aroma 2.70, color 3.00, and favor 3.03.

Keywords: Pectin, watermelon rind, pineapple, carrageenan, fruit leather

Introduction

Watermelon Albedo/ rind is the thickest and most white part of the watermelon skin. Albedo contains nutrients such as vitamins, citrulline, minerals and enzymes, also pectin which is quite high at 21.03%. Therefore, watermelon albedo is very good to be used and developed in Indonesia as a new food source such as fruit leather.

Fruit leather is a snack product from fruit pulp (puree) which is dried in an oven or dehydrator. In principle, making fruit leather is a gel forming process from fruit puree containing pectin. The weakness of this albedo fruit leather is the bland taste and less attractive colors, it is necessary to add another ingredient such as pineapple.

Pineapple (Ananas comosus L.) contains nutrients such as vitamins C, A, B1, iron, phosphorus, calcium, fiber, protein, and pectin by 2.3%. The addition of pectin from watermelon and pineapple albedo was apparently not enough to form the plasticity of fruit leather, so the addition of hydrocolloid is needed, namely carrageenan.

Carrageenan is able to provide elastic properties, so that in the production process it can facilitate the peeling and formation of fruit leather. This study aimed to analyze the proportion of watermelon albedo and pineapple fruit along with carrageenan concentrations effect to improve the physicochemical and sensory characteristics of fruit leather.

Method

The main material that used was watermelon rind var. quality taiwan, pineapple var. queen, carrageenan, sugar, and citric acid. Randomized complete block design factorial with 3 replications was applied, with the first factor was watermelon rind and pineapple proportion 3 level (90%:10%, 80%:20%, 70%:30%). While the second factor was caragenan concentration (0,2%, 0,4%, 0,6%).

The first step was puree watermelon rind and pineapple production. Then it followed with parameter analysis, which was water content, pectin and vitamin C. While the next step was puree mixing with sugar 10%, citric acid 0,2%, and caragenan. The last step was drying process used cabinet dryer 65^{o}C up to 15 hours. Furthermore, parameters analysis, consisted water content, ash, vitamin C, texture of hardness, sugar content, color analysis (L, a+, b+), and organoleptic.

Result and discussion

Water Content

Table 1 showed that increasing watermelon albedo proportion, the water content decreased. This is caused the watermelon albedo has a pectin content, that able to bind the water around it. According to Juwita, et al. (2014), pectin as an emulsifier, stabilizer, thickener, which is can establish a homogeneous disperse system in food, increases the viscosity, and reduce the moisture content of the material itself.

The addition of carrageenan caused the water content also decreased, because carrageenan has the ability to bind large amounts of water. According to Santoso (2007), carrageenan has a sulfate group that can bind water. The content of the sulfate group in the carrageenan was negatively charged along the polymer chain and is hydrophilic which can bind water or other hydroxyl groups. In addition, carrageenan also has an OH^- free ion, which is able to bind to water so that the bond becomes stronger, so that the higher the concentration of carrageenan used, the moisture content of sheet jam will decrease.

Table 1. Fruit Leather Water Content

Treatment		Water Content (%)
Watermelon Rind: Pineapple (%)		
A1	90 : 10	13,24 a
A2	80 : 20	13,97 b
A3	70 : 30	15,47 c
Carrageenan (%)		
K1	0,2	15,89 c
K2	0,4	14,23 b
K3	0,6	12,56 a

Noted: The value followed by the same letter is not significantly different according to Duncan's Test α = 5%

Ash Content

Table 2 described that the decreasing watermelon rind used, the ash content also become lower. The descend in ash content is due to the mineral content of watermelon rind is higher than pineapple. According to Rukmana (1994) stated that minerals contained in 100 grams of watermelon rind were 0.70 gram ash, 31 mg calcium, 11 mg phosphorus, and 0.5 mg iron. While minerals in pineapple according to Barus (2008) stated that in 100 grams of pineapple there were minerals namely calcium 19 mg, 9 mg phosphorus, and iron 0.20 mg.

Table 2. The Ash Content of Fruit Leather

Treatment		Ash Content (%)
Watermelon Rind : Pineapple (%)		
A1	90 : 10	1,64 b
A2	80 : 20	1,58 b
A3	70 : 30	1,45 a
Carrageenan (%)		
K1	0,2	1,33 a
K2	0,4	1,55 b
K3	0,6	1,80 c

Noted: The value followed by the same letter is not significantly different according to Duncan's Test α = 5%

Based on Table 2, the enhancement carrageenan addition increase the ash content. This is because carrageenan contains several minerals. According to Renuga et al. (2013) stated that carrageenan contains several minerals, 5.3 g calcium, 1.14 mg iron, 20.2 mg sulfate, 160 mg magnesium, 869 mg phosphorus, 22.4 mg sodium, and 13.4 mg potassium. So that the addition of carrageenan can increase the ash content of fruit leather.

Vitamin C

Table 3 showed that the more addition of pineapple and carrageenan, the level of vitamin C fruit leather increased. Pineapple can increase the levels of vitamin C fruit leather because according to Harnanik (2013) the fresh pineapple contains vitamin C of 24.00 mg / g. In addition, the watermelon albedo ingredients also contain vitamin C, although not as big as pineapple fruit. The research conducted by Lembang (2012) stated that the content of vitamin C in watermelon albedo is 17.60 mg / g. This is what can make vitamin C levels in fruit leather increased.

Carrageenan was able to increase vitamin C levels of fruit leather because it is able to bind compounds such as vitamin C. According to Winarno (2008) increased concentration of carrageenan is related to ability to bind water molecules as well as other compounds such as vitamin C , organic acids, which are contained in the mixture, so that compounds that are volatile and damaged by the treatment process can be partially inhibited by the addition of carrageenan.

Table 3. Vitamin C of Fruit Leather

Treatment		Vitamin C (mg/g)
Watermelon Rind : Pineapple (%)		
A1	90 : 10	42,754 a
A2	80 : 20	57,168 b
A3	70 : 30	72,217 c
Carrageenan (%)		
K1	0,2	42,723 a
K2	0,4	57,567 b
K3	0,6	71,849 c

Noted: The value followed by the same letter is not significantly different according to Duncan's Test $\alpha = 5\%$

Texture Hardness

Based on Table 4 showed that the highest value of fruit leather texture was A1K3 (90% watermelon rind, pineapple 10% + carrageenan 0.6%) which is 7.98 MPa. While the lowest texture value was A3K1 (watermelon rind 70%, pineapple 30% + carrageenan 0.2%) which was 4.12 MPa. These results indicated that increasing watermelon rind and carrageenan, the value of the texture enhanced. The fruit leather texture is influenced by the presence of pectin which found in watermelon albedo and the concentration of carrageenan used. Pectin and carrageenan act as gelling agents that help of gels formation or hardness in the fruit leather. According to Daryono (2012), pectin is a group of substances contained in fruit juice, which forms colloidal solutions in water and originates from changes in protopectin during the fruit ripening process. In suitable conditions, pectin can form a gel. Maulana (2015) stated that the increase in gel hardness value was due to the addition of pectin. This is because the pectin with sugar and acid forms a strong gel so that it can make the hardness of the gel on the product harder.

Table 4. Texture Hardness of Fruit Leather

Watermelon Rind : Pineapple (%)	Carrageenan (%)	Texture (MPa)
A1K1 (90 : 10)	0,2	5,86 bc
A1K2 (90 : 10)	0,4	6,47 cd
A1K3 (90 : 10)	0,6	7,98 e
A2K1 (80 : 20)	0,2	5,14 b
A2K2 (80 : 20)	0,4	7,06 de
A2K3 (80 : 20)	0,6	7,88 e
A3K1 (70 : 30)	0,2	4,12 a
A3K2 (70 : 30)	0,4	5,79 bc
A3K3 (70 : 30)	0,6	7,15 de

Noted: The value followed by the same letter is not significantly different according to Duncan's Test α = 5%

According to Fitranti et al. (2014), an increase in the value of fruit leather literature due to the addition of carrageenan, related to the ability of carrageenan to bind water and subsequently form a gel. The ability to form carrageenan gel occurs when the hot solution is allowed to cool because it contains a 3,6-anhydrogalactose group which plays a role in the formation of double helix, so it can form a gel.

Sugar Content

Based on Table 5, it showed that the more addition of pineapple, the fruit leather sugar content was increased. This is caused by pineapple contains sugar as Kartika and Nisa (2015) stated that pineapple contains 7.89% sucrose. The more pineapple added, the greater amount of sugar measured, because sucrose is a non-reducing sugar and reducing sugar derived from fruit and the organic acid formed counts as total sugar.

Tabel 5. Fruit Leather Sugar Content

Treatment Watermelon Rind : Pineapple (%)	Sugar Content (°Brix)
A1 (90 : 10)	38,78 a
A2 (80 : 20)	41,90 b
A3 (70 : 30)	44,89 c

Noted: The value followed by the same letter is not significantly different according to Duncan's Test α = 5%

Treatment of carrageenan addition had no significant effect (P> 0.05) on fruit leather sugar content (Fig. 1). This is caused by carrageenan has no sugar content. According to Imeson (2010), carrageenan has no taste but only has gel-forming compounds that can bind water.

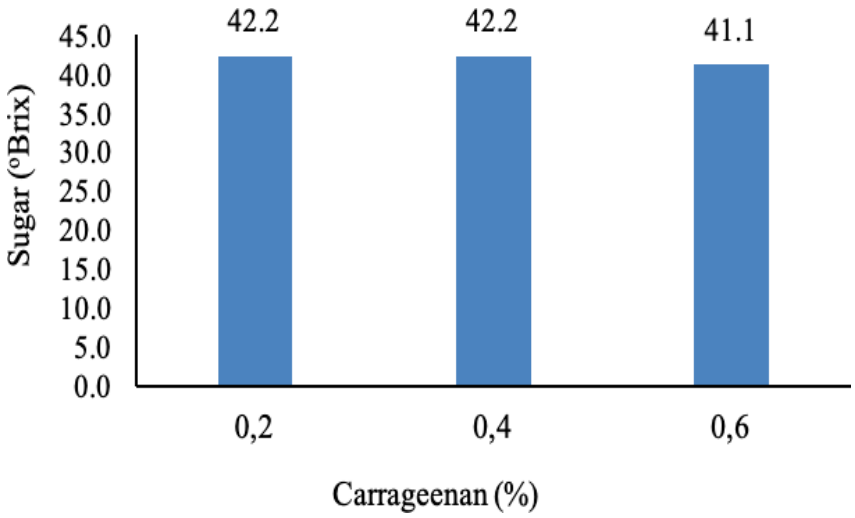

Figure1. Fruit Leather Sugar Content as Carrageenan Treatment

Lightness

Table 6 showed that the highest color intensity of brightness (L) was A1K1 (watermelon rind 90%, pineapple 10%, + carrageenan 0.2%) which was 49.70, and the lowest was A3K3 (watermelon rind 70%, pineapple 30 %, + carrageenan 0.6%) which was 44.73. The increasing addition of watermelon albedo, the value of brightness (L) in fruit leather was enhanched. Watermelon Albedo makes fruit leather brighter because it has a white color. According to Sobir and Firmansyah (2010) stated that watermelons have thick, fleshy and slippery fruit skin. Watermelon skin meat called Albedo, and the color is white.

Carrageenan has an influence on the brightness of fruit leather. According to Wicaksono and Zubaidah (2015), the enhanching concentration of carrageenan, the brightness level of soursop leaf jelly drinks decreased. This is caused by carrageenan is able to form a strong gel. Gelling is a phenomenon or cross-linking of polymer chains to form a continuous three-dimensional mesh. Furthermore, this mesh can capture or immobilize the water in it so that it can form a strong and rigid structure.

Table 6. Fruit Leather Lightness

Treatment Watermelon Rind : Pineapple (%)	Carrageenan (%)	Lightness (L)	Notasi
A1K1 (90 : 10)	0,2	49,70	e
A1K2 (90 : 10)	0,4	48,17	d
A1K3 (90 : 10)	0,6	45,63	ab
A2K1 (80 : 20)	0,2	46,30	bc
A2K2 (80 : 20)	0,4	46,97	c
A2K3 (80 : 20)	0,6	45,37	ab

A3K1 (70 : 30)	0,2	44,97	a
A3K2 (70 : 30)	0,4	45,00	a
A3K3 (70 : 30)	0,6	44,73	a

Noted: The value followed by the same letter is not significantly different according to Duncan's Test α = 5%

Redness

Based on analysis of variance, it wasn't significant effect (P> 0.05) between the treatment of watermelon albedo and pineapple fruit proportion with carrageenan concentration to the redness (a +) of fruit leather. The reddish (a +) fruit leather's intensity is in the range of 0.37 - 0.77, which indicates that the more pineapple is added, the more intense the reddish color. This is shown in Treatment A3K2 (watermelon Albedo 70% pineapple 30% and carrageenan 0.4%) which is 0.77 (Figure 2). While, the result was not significant because the color produced by pineapple is more dominant in yellow. According to Harijono, et al. (2001) stated that carotenoid pigments commonly found in pineapple fruit will influence the intensity of yellow and red. The occurrence of oxidation in carotenoid compounds during heating is thought to be the cause of the decrease in red intensity (a + value) in jelly candy.

The addition of carrageenan had no significant effect (P> 0.05) on the intensity of the fruit leather reddish color. According to Agustin and Putri (2014), it was shown that the maturity level of starfruit and the addition of carrageenan and their interactions did not have a significant effect on the reddish (a +) starfruit drink. This is possible because of the ingredients of starfruit jelly drinks such as star fruit, sugar and carrageenan, there is no red donation in it. The more mature the fruit is and the more sugar is added to the starfruit jelly drink, the higher the possibility of phenol release reaction occurs because of the warming and the color of the starfruit jelly drink produced is getting darker.

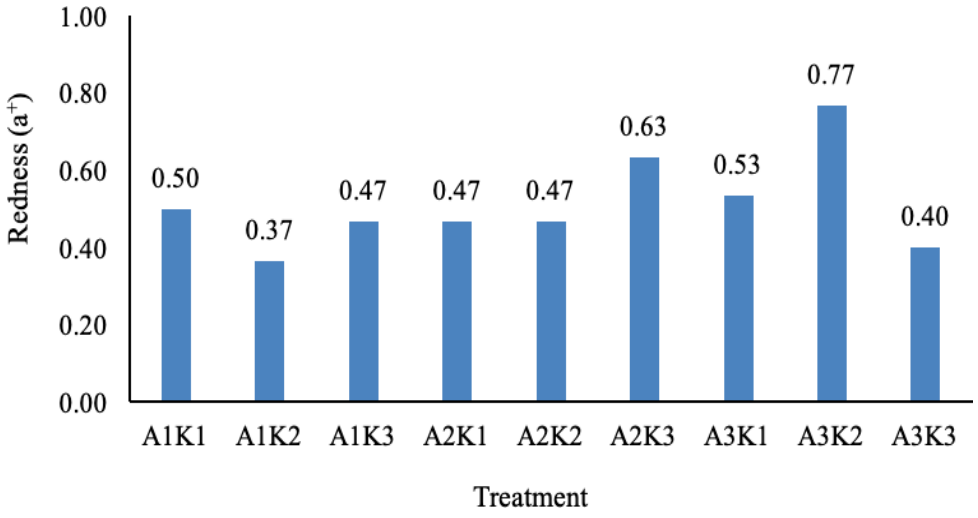

Figure 2. Fruit Leather Reddish Colour

Yellowish

Table 7 showed that the watermelon and pineapple albedo treatment had a significant effect (P <0.05) on the yellowish (b +) fruit leather value. The highest yellowness (b +) was found in A3 (70% watermelon albedo and 30% pineapple) which was 8,84, and the lowest (b +) value on A1 (90% watermelon albedo and 10% pineapple) was 7,23. The intensity of the fruit leather yellowish color is influenced by the addition of pineapple, where the more the addition of pineapple, the yellowish color of fruit leather increases. This is because pineapple contains yellow pigments, namely carotenoids, where this carotenoid is a group of pigments that are yellow, orange, red and orange red.

Table 7. Fruit Leather Yellowish

Watermelon Rind : Pineapple (%)	Yellowish (b^+)	Notasi
A1 (90 : 10)	7,23	a
A2 (80 : 20)	7,72	ab
A3 (70 : 30)	8,84	b

Noted: The value followed by the same letter is not significantly different according to Duncan's Test α = 5%

Carrageenan treatment had no significant effect (P> 0.05) on the yellowish (b +) fruit leather intensity (Figure 3). This is caused by carrageenan does not contain pigment compounds that produce yellow. According to Febiando (2014) the addition of carrageenan to red tilapia meatballs were not significantly different from the criteria of appearance. The addition of carrageenan did not affect the appearance of manyung fish meatballs allegedly because carrageenan had a white color, so the addition of carrageenan in this study which was not more than 2.5% did not significantly affect the appearance of manyung fish meatballs.

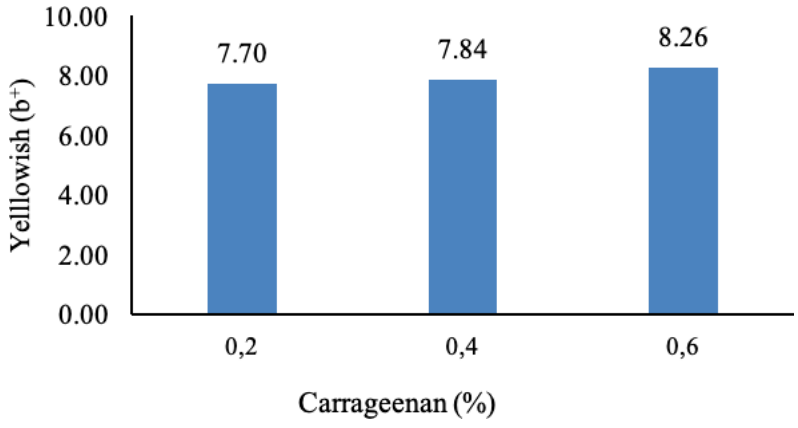

Figure 3. Fruit Leather Yellowish Color based on Carrageenan

The best treatment can be determined from de garmo's analysis, it was A1K1 (watermelon albedo 90% pineapple 10% and carrageenan 0.2%). Based on physicochemical analysis Treatment A1K1 has a moisture content of 15.08%, ash content of 1.33%, texture of 5.86 MPa, vitamin C 42.58 mg / g, sugar content of 38.33°Brix, brightness (L) 49.70, redness (a +) 0.50, yellowish (b +) 7.10. Whereas based on organoleptic parameters Treatment A1K1 (watermelon albedo 90% pineapple 10% and carrageenan 0.2%) had a level of taste preference 3.10, aroma 2.70, color 3.00, and preference 3.03.

Conclusion

Watermelon and pineapple albedo proportion with carrageenan concentration significantly interacted on the texture/ hardness and brightness (L) intensity of the fruit leather. Proportions of watermelon and pineapple albedo significantly affected on water content, ash content, vitamin C, hardness texture, sugar content, brightness intensity (L), yellowish color intensity (b +), organoleptic taste, color, and preference for fruit leather. While, carrageenan concentration significantly affected water content, ash content, vitamin C, brightness intensity (L), organoleptic taste, color, and preference for fruit leather. The best physicochemical and organoleptic properties of fruit leather were obtained on A1K1 treatment (90% watermelon albedo, 10% pineapple and 0.2% carrageenan) with water content 15.08%, 1.33% ash content, 5.86 Mpa hard texture, vitamin C 42.58 mg/ g, sugar content 38.33 °Brix, brightness (L) 46.70, redness (a +) 0.50, yellowness (b +) 7.10, organoleptic taste 3.10, aroma 2.70, color 3.00, and favo r 3.03.

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