American Journal of Engineering Research (AJER) ***2020***
American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-9, Issue-4, pp-191-197
www.ajer.org
Research Paper Open Access

Anthocyanin Content and Chemical Composition of Kolang-Kaling Jam Added With Tamarillo Fruit (Cyphomandra Betacea)

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Abstract: *This reseach was aims to know the effect of Tamarillo fruit addition on characteristic of Kolang-kaling jams based on chemical and microbiology properties. This study used a completely randomized design (CRD) with 5 treatments and 3 repetition. Data was analyzed by analysis of variance (ANNOVA), followed by Duncan's New Multiple range (DNMRT) at the 5% significantly level. The treatments in this research are the addition of 20%, 25%, 30%, 35% and 40% tamarillo fruit.The result showed that the addition of tamarillo fruit were significantly affected to moisture content, ash content, activity of water (a_w), pH, total sugar, total soluble solids, crude fiber, anthocyanin content and total phenols of kolang-kaling jams, but not significantly affected to colour, smell and flavor. The best product is B treatment (addition 25% tamarillo fruit) with value of colour (4.0), aroma (3.5) and flavor (3.8), moisture content (25.47%); ash content (0.53%); pH (3.5; a_w (0.81); total soluble solid (48.75%); crude fiber (4.98%); total sugar (24.01%); antioxidant activity (IC_{50}) (3889.48 ppm; anthocyanin content (3.41mg/L); total phenols (5.05 mgGAE/g).*

Key words:-*anthocyanin, chemical analysis,jam, kolang-kaling, tamarillo fruit.*

Date of Submission: 07-04-2020 Date of acceptance: 21-04-2020

I. INTRODUCTION

Kolang-kaling is palm fruit seeds that harvested when the fruit age is not too old and not too young (Widyawati, 2011). High levels of crude fiber and kolang-kaling, causing the fruit is a long digested by the body so that it can suppress appetite and is able to store energy longer (Ratima,2014). The mineral content in kolang-kaling also able to improve the freshness and metabolism (Hidayat, 2015). This type of fiber found in kolang-kaling is galactomannan.

Kolang-kaling fresh have a short shelf life if water immersion is not changed, so we need to processing to extend shelf life, one that is jam. The physical properties of a good jam is brightly colored, crispy, chewy or too hard and has a distinctive flavor of native fruit (Desrosier, 1988). Manufacture of *kolang-kaling* jam still has some drawbacks, especially in the colors of jam.So that the addition of *tamarillo*fruit to improve the color and provide functional value to the jam product. *Tamarillo* fruit can be used as natural dyes by exploiting the fruit because of anthocyanin pigments that can give a purplish red color on the jam (Diniyah, 2010). Judging from the womb, *tamarillo*fruit has a high content of vitamin C and are a natural source of antioxidants which can counteract free radicals in the body. In addition to vitamin C and other natural antioxidants contained in *tamarillo*fruit are vitamin E, vitamin A, vitamin B6, carotenoid and anthocyanin compounds. *Tamarillo*fruit is a fruit that has the aroma, color and flavor so as to improve the sensory aspects of the product produced jam. In this case the need for innovation in maximizing the utilization of the content of anthocyanins and antioxidants found in *tamarillo*fruits by making it as a mixture of the *kolang-kaling* jam and to improve the quality aspects of the resulting jam. In this study also used the additional material is citric acid.

The use of citric acid used in making jam was 0.5 g. This concentration is considered to have been able to provide optimum conditions and according to the product produced jam. Research on the use of *Tamarillo* fruit as a natural colorant in jam and kolang-kaling has not been done. Therefore, the authors conducted a study entitled "Anthocyanin Content and Chemical Composition of Kolang-kaling Jam Added With Tamarillo Fruit (Cyphomandra Betacea)"

II. MATERIAL AND TOOLS

The materials used in this study was kolang-kaling obtained from Pasar Raya Padang, *tamarillo* fruit, sucroce (cane sugar) and citric acid. The chemicals used in the analysis include: destilled water, H_2SO_4, $Na_2S_2O_3$ solution, HCl 25%, NaOH, methanol, a solution of DPPH, buffer solution at pH 1 and pH 4, *Folin ciocateu*solution and fenol solution. The equipment used in the manufacture of jam include: paper filter, blender, aluminium cup, erlenmeyer, oven, pH meter and etc.

Table 1: The formulation of Kolang-kaling jam with addition of *tamarillo* fruit.

Ingredients	Treatments				
	A	B	C	D	E
Kolang-kaling pulp (g)	45	45	45	45	45
Sugar (g)	55	55	55	55	55
Tamarillo fruit pulp (g)	20	25	30	35	40
Citric acid (g)	0.5	0.5	0.5	0.5	0.5

Source: Sundari (2016) with modification

Research Design

The study design used was completely randomized design (CRD) with five treatment and three repetitions. Observational data were analyzed by analysis of variance (ANNOVA) and continued with test of Duncan's New Multiple Range Test (DNMRT) at the 5% significantly level. In this study, at the treatment used was addition of *tamarillo* fruit at the kolang-kaling jam. The formulations used based on the formulation made by Sundari (2016) with modification as well as by pre-study that has been done. The formulation can be seen in the Table 1.

Observation

For raw material analyzed water content, ash content (Yenrina, 2015), pH (Yenrina 2011), total soluble solid (Yenrina, 2015). For jam product analyzed water content (Sudarmadji, 1984), pH (Yenrina, 2011), activity of water (Susanto, 2009), ash content (Yenrina, 2015), total soluble solid (Yenrina, 2015), total sugar, crude fiber content (Yenrina, 2011), anthocyanin total antioxidant value as IC_{50}, and total fenol.

Implementation

Making of Kolang-kaling Pulp

Kolang-kaling washed with clean water and then blended with the addition of water by ratio kolang-kaling: water (5:1 w/v), then kolang-kaling that has been blended weighed based on treatment (A, B, C, D, and E).

Making of *tamarillo* fruit pulp

Tamarillo fruit cleaned of its scales and cleaned using water and peel the skin. Then blended in a blender until smooth.

Making of Jam (Marisa, 2015 with modification)

Kolang-kaling pulp weighed as much as 45 g, sugar 55 g and citric acid 0.5 g, and then put into a container and heated with stirring at a maximum temperature of 40^{o}C. Added the *tamarillo* pulp as much as treatment (20%, 25%, 30%, 35%,40%), continuously stirring during cooking at 90-100^{o}C for 15 minutes. The stirring condition not be too fast bacuase it will cause a bubble that could damage the texture of the product. At the last do "spoon test" to see formed jam. Do the spoon test which takes a bit of dough with a spoon and then spoon was tilted, if dough immediately fell it mean cooking can be stopped. Cooked jam poured into the bottles that have been sterilized beforehand.

III. RESULT AND DISCUSSION

Analysis of Raw materials

Analysis of raw material performed on kolang-kaling pulp namely water content, pH, ash content. While the analysis of *tamarillo* pulp namely water content, ash content, pH and total soluble solid. The result of the analysis of raw materialskolang-kaling and *tamarillo* pulpcan be seen in the Table 2.

Table 2: The Result of the Analysis of Raw Material

Analysis	**Kolang-kaling pulp**	***Tamarillo* pulp**
Water content (%)	95.76	85.8
Ash content (%)	0.26	1.35
pH	5.53	3.52
	-	14.05

Total soluble solid (%)	-	-

Note: (-) no test

The result of analysis of water content kolang-kaling pulp around 95.76%, and *tamarillo* pulp around 85.8%. The water content of kolang-kaling pulp in this result is higher than the value of the water content on research conducted by Torio, (2006) with water content 92%. This is because the addition of water to maked kolang-kaling pulp with a ratio 1:5 (water:kolang-kaling). *Tamarillo* pulp water content was slightly higher when compared to the research conducted by Nallakurumban(2015) where the moisture content obtained by 83.36%.

Based on the analysis of kolang-kaling acidity obtained around 5.53% and *tamarillo* pulp acidity around 3.52%. Indicators pH value at jam making great influence on the formation of a gel (Fachruddin, 2008). Jam acidity measurement is performed to determine the pH value of the product, to prevent crystallization of the jam as well as lowering the pH so as to achieve an optimum pH conditions jam that is 3.1 to 3.5 (Sundari, 2010).

Analysis of kolang-kaling ash content obtained 0.26%. It's not much different from the results the research conducted by Torio, (2006) in which the ash content obtained kolang-kaling which amounted to 0.29%. Analysis of ash content of *tamarillo* pulp obtained 1.35%, while based on research conducted by Nur, (2018),*tamarillo* pulp ash content obtained by the 1.97%. Minerals content contained in *tamarillo* pulp among potassium, iron and calcium that can refresh the body and unleash the body's metabolism (Ratima, 2014). *Tamarillo* pulp also contains minerals that are good for the body such as potassium (K), calcium (Ca), phosphorus (P), iron (Fe) and magnesium (Mg) (Kumalaningsih, 2006).

In the analysis of crude fiber pulp raw material of kolang-kaling was obtained 1.96%. This result is slightly lower than the results reported by Torio, (2006), in which the coarse fiber content obtained ranges from 2.06%. Meanwhile, crude fiber content of *tamarillo* pulp obtained at 4.77%. According Kumalaningsih and Suprayogi (2006), the crude fiber content contained in *Tamarillo* pulp is equal to 1.4 to 4.7%. High fiber of *tamarillo* fruit known to prevent cancer and constipation (Maulidarmi, 2004).

Analysis of total soluble solids is done on raw materials *tamarillo* pulp fruit. Values of total soluble solids was obtained at 14.05%. Soluble solids consist of sugar reduction and non-reduction, organic acids, amino acids and proteins (Desrosier, 1988).Measurement of total soluble solids in the fruit is used to determine the quality of sweetness to the fruit because it contains sugar which is a major component of soluble solids (Kader, 1985).

Chemical analyisis:-

Water Content:- The result of water content analysis of the kolang-kaling jam with addition *tamarillt* fruit can be seen in Table 3.

Table 3: Average of water content from kolang-kaling jam with addition of *tamarillo* fruit.

Treatment (Addition of *tamarillo* fruit)	Water Content %
A (20%)	23.64 a
B (25%)	25.47 b
C (30%)	26.14 b
D (35%)	30.60 c
E (40%)	32.91 d

Description : The figure in the same coloumn followed by the same lowercase letters are bot significantly different according to DNMRT at the level α = 5%.

Based on the Table 3, known that the addition of the *tamarillo* fruit had significant effect on the level (α < 5%) on water content. The highest water level at treatment E was 32.91% and the lowest water level at treatment A was 23.64%. Water content of raw materials of *tamarillo* pulp had a higher water content around 96.01%. Water in food products is an important component that can affect the texture, the appearance and flavor of food products which will determine the freshness, durability and also*acceptability* (Winarno, 1992). Water in food products consist of free water and bound water. Free water will evaporate during the heating process, while the bound water is more difficult to be evaporated or removed because the water will bind to the protein, cellulose, starch, pectin and other substances contained in a food substance (Effendi, 2009).

pH:-

The result of pH analysis of the kolang-kaling jam with addition *tamarillo*fruit can be seen in Table 4.

Table 4: Average of pH from kolang-kaling jam with addition of *tamarillo* fruit.

Treatment (Addition of *tamarillo* fruit)	pH
E (40%)	3.29 a
D (35%)	3.37 ab
C (30%)	3.41 ab
B (25%)	3.47 bc
A (20%)	3.50 bc

Description : The figure in the same coloumn followed by the same lowercase letters are bot significantly different according to DNMRT at the level α = 5%.

Based on the Table 4, known that the addition of the *tamarillo* fruit had significant effect on the level (α <5%) on pH. The highest pH value was obtained in treatment A (20%) at 3.5, while the lowest pH value obtained in treatment E (40%) of 3.29. The degree of acidity / pH is the acidity levels of a food product which may affect the shelf life and power than food products. pH can affect the rate of growth of microorganisms. The decline in the low pH values were able to prevent the growth of microbes. pH / acidity on products sourced from *tamarillo*fruit, and also the addition of other additives, namely by 0.5% citric acid. The acidity of influence on the formation of jams, if the pH is too acidic product it will dilute the gel in jams or resembling water, as well if the pH is too alkaline then the jam gel structure will not be formed. According to Buckle (1997) The optimal pH for the formation of a gel at jam ranged from 3.2 to 3.5.

Water activity:

The result of water activity (a_w) analysis of the kolang-kaling jam with addition *tamarillo* fruit can be seen in Table 5.

Table 5: Average of water activity t of jam from kolang-kaling with addition of *tamarillo* fruit.

Treatment (Addition of *tamarillo* fruit)	Water activity
A (20%)	0.74 a
B (25%)	0.81 b
C (30%)	0.82 bc
D (35%)	0.82 bc
E (40%)	0.85 bc

Description : The figure in the same column followed by the same lowercase letters are bot significantly different according to DNMRT at the level α = 5%.

Based on the table, known that the addition of *tamarillo* fruit had significant effect on the level (α <0.05) on water activity. The highest value obtained in the treatment aw E (40%) of 0.85, while the lowest a_w value obtained in treatment A (20%) is 0.74. The more the addition of the *tamarillo* fruitresulting a_w value is also higher. The water content and water activity bind to each other which showed that the higher the water content, the value of water activity / a_w is also increasing.

Water activity or a_w freely determine the water content in the food product to be used as a place of growth for microorganisms (Winarno, 1984). According Muchtadi (2013) features a wet semi food have aw values ranged from 0.60 to 0.85. The a_w value in the range of microorganisms which often grows is the type of mold and yeast, while the rare bacteria because bacteria often grow in value a_w above 0.90

Ash content

The result of ash content analysis of the kolang-kaling jam with addition *tamarillo*fruit can be seen in Table 6.

Table 6: Average of ash content from kolang-kaling jam with addition of *tamarillo* fruit.

Treatment (Addition of *tamarillo* fruit)	Ash content %
A (20%)	0.41 a
B (25%)	0.53 b
C (30%)	0.72 c
D (35%)	1.21 d
E (40%)	1.62 e

Description : The figure in the same coloumn followed by the same lowercase letters are bot significantly different according to DNMRT at the level α = 5%.

Based on the table, known that the addition of *tamarillo* fruit had significant effect on the level (α <0.05) on ash content. . The value of the highest ash content was obtained in treatment E (40%) by 1.62%, while

the average low ash content obtained by treatment of A (20%) is 0.41%. The more the addition of *tamarillo* fruit then the value of the ash content of kolang-kaling jam also increased. This is due to the addition of fruit will cause the higher content of minerals contained in the product (Ramadhani, 2016).

Total soluble solid

The result of total soluble solid analysis of the kolang-kaling jam with addition *tamarillo*fruit can be seen in Table 7.

Table 7: Average of total soluble solid from kolang-kaling jam with addition of *tamarillo* fruit.

Treatment (Addition of *tamarillo* fruit)	Total soluble solid %
A (20%)	46.11 a
B (25%)	48.75 b
C (30%)	50.16 bc
D (35%)	50.61 bc
E (40%)	55.38 d

Description : The figure in the same coloumn followed by the same lowercase letters are bot significantly different according to DNMRT at the level α = 5%.

Based on the table, know that addition of *tamarillo* fruit had significant effect on the level (α <0.05) on total soluble solid. The average value of the highest total dissolved solids obtained in treatment E (40%) of 55.38%, while the average value of the lowest total dissolved solids obtained in treatment A (20%) is equal to 46.11%. The more the addition of the *tamarillo* fruit content of total dissolved solids and kolang-kaling jam produced is also increasing.

According to Winarno (2004), total soluble solids are also affected by a material soluble pectin and the addition of sugar which also gives effect to the soluble solid food products. Soluble solids content products include sugar reduction and non-reduction, organic acids, pectin and protein (Desrosier, 1988).

According to ISO (2008) total soluble solids is at least 65%. Total soluble solids is very bound to the sugar content in the food that determines the quality of foodstuffs, especially fruits (Silva, 2006).

Crude Fiber Content

The result of crude fiber content analysis of the kolang-kaling jam with addition *tamarillo* fruit can be seen in Table 8.

Table 8: Average of crude fiber content from kolang-kaling jam with addition of *tamarillo* fruit.

Treatment (Addition of *tamarillo* fruit)	Crude fiber %
A (20%)	4,48 a
B (25%)	4,98 ab
C (30%)	6,38 bc
D (35%)	6,52 bc
E (40%)	6,89 c

Description : The figure in the same coloumn followed by the same lowercase letters are bot significantly different according to DNMRT at the level α = 5%.

Based on the table, known that addition of *tamarillo* fruit had significant effect on the level (α <0.05) on crude fiber content. The average value of the highest crude fiber in this study were obtained in treatment E (40%) by 6.89%, while the value of crude fiber content products obtained at the lowest jam treatment A (20%) namely 4.48%. Increased crude fiber content is influenced by the presence of coarse fibers contained in the raw materials. Based on the analysis of raw materials, crude fiber content of kolang-kaling and*tamarillo* fruit are 1.96% and 4.77%.

Fibers composed of two groups: soluble fiber and insoluble. Soluble fiber in the form of pectin, gum, mukilase and glucan, while the water-insoluble fibers such as cellulose, hemicellulose and lignin (Almatsier, 2006).

Total Sugar Content

The result of total sugar content analysis of the kolang-kaling jam with addition *tamarillo* fruit can be seen in Table 9.

Table 9: Average of total sugar content from kolang-kaling jam with addition of *tamarillo* fruit.

Treatment (Addition of *tamarillo* fruit)	Total Sugar Content %
A (20%)	18.59 a
B (25%)	24.01 b

C (30%)	28.42	c
D (35%)	36.95	d
E (40%)	40.33	d

Description : The figure in the same coloumn followed by the same lowercase letters are bot significantly different according to DNMRT at the level α = 5%.

Based on table, known that addition of *tamarillo* fruit had significant effect on the level (α <0.05) of the total sugar content. The average value of the highest total sugar content was obtained in treatment E (40%) of 40.33%, while the value of the lowest total sugar content obtained in treatment A (20%).
The level of sugar in jam products derived from sucrose / sugar as the main raw material in the manufacture of jam. In this study, the amount of sugar added for each treatment is the same, so it can mean the difference total sugar content generated in this analysis comes from the Dutch eggplant fruit. Increased sugar levels can also be caused due to the increasing number of sugar that is hydrolyzed to glucose and fructose by the presence of an acid. The addition of sugar in jam making is very important, and this is because the sugar will affect the texture of the resulting jam (Naeem, 2013). High sugar concentration (70%) were able to inhibit the growth of microbes or microbial pathogen destroyer food (Muchtadi , 2013).

Anthocyanin Content
The result of anthocyanin content analysis of kolang-kaling jam with addition *tamarillo* fruit can be seen in Table 10.

Table 10: Average of anthocyanin content from kolang-kaling jam with addition of *tamarillo* fruit.

Treatment (Addition of *tamarillo* fruit)	Anthocyanin content (mg/L)
A (20%)	3.18 a
B (25%)	3.41 ab
C (30%)	3.56 ab
D (35%)	3.85 b
E (40%)	4.50 c

Description: The figure in the same coloumn followed by the same lowercase letters are bot significantly different according to DNMRT at the level α = 5%.

Based on the tablet, known that addition of *tamarillo* fruit had significant effect on the level (α <0.05) of the anthocyanins content. The average value of the highest anthocyanin content obtained in treatment E (40%) of 4.50 mg/L, while the average value of the lowest anthocyanin levels obtained in treatment A (20%) namely 3, 18 mg/L.

Anthocyanins are compounds that act as antioxidants and including flavonoid. Stability of anthocyanins is influenced by several factors such as pH, temperature, light, sugar content and the presence of sulfur dioxide. Several studies have demonstrated the beneficial effects of anthocyanins on health, namely as an anti-carcinogenic, anti-inflammatory, preventing degenerative diseases and chronic disease and lower the risk of heart disease. However, anthocyanins are unstable and easily influenced by various factors such as pH, temperature, oxygen, light and activity of the enzyme (Hirsch, 2015).

IV. CONCLUSION

Based on the research that has been done on addition of *tamarillo* fruit on *kolang-kaling* jams conclusion as follow:
The result of analysis were significantly different (α <0.05) on the water content, ash content, activity of water (a_w), pH, total sugar, total soluble solids, crude fiber, anthocyanin content and total phenols of *kolang-kaling* jams.

Suggestion
Based on the research conducted authors suggest for further research to analyze the shelf life of the product.

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Rini, Fauzan Azima,etal." Anthocyanin Content and Chemical Composition of Kolang-Kaling Jam Added With Tamarillo Fruit (Cyphomandra Betacea).” *American Journal of Engineering Research (AJER)*, vol. 9(04), 2020, pp. 191-197.