Development of High Antioxidant Yoghurt Made from a Mixture of Cashew (Anacardium occidentale) Extract and Red Roses (Rosa damascena) Juice

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Abstract: Introduction: Plant-based food products are gaining popularity and assumed to be healthier than animal-based ingredients products. Cashews, which contains a good source of vitamin E, and red roses, which contain vitamin C and anthocyanin, had a promising potential to be developed as desirable plant protein-based yogurt. Objective: to examine sensory properties and nutrients compositions of yogurt made from a different ratio of cashews nut extract (CNE) and red roses juice (RRJ). Methods: This experimental study developed four yogurt formulations. Formula 0/F0 (control) contains 100 ml CNE: 0 ml RRJ, F1 contains 75 ml CNE: 25 ml RRJ, F2 contains 50 ml CNE: 50 ml RRJ, and F3 contain 25 ml CNE: 75 ml RRJ. Sensory properties were assessed by 25 semi-panelists and 30 consumer panelists, nutrients composition, antioxidant activity, viscosity, pH, Total Acid and Total Plate Count (TPC) were analyzed in a food laboratory. One way ANOVA test was used to answer the research question. Results: F2 had high acceptance based on sensory properties while F3 had the highest antioxidant activity. Water, carbohydrate, protein and fat content significantly differed across the formulas. Conclusion: Cashew and red roses can be used to develop a high antioxidant and good sensory plant-based yogurt.

1 INTRODUCTION

In Indonesia, more than 36 million people die due to non-communicable diseases (63% of all deaths) every year. Cardiovascular diseases such as coronary heart disease (CHD), strokes are among the number one causes of death (Kementrian Kesehatan, 2013). A low intake of antioxidants is a significant risk factor of CHD (Frohlich & Quinlan, 2014). Demand for functional food products such as yogurt that help reduce and overcome this CHD problem is increasing.

Traditional yogurt made from a fermentation process of milk by a typical lactic acid bacteria, namely Lactobacillus acidophilus, Lactobacillus bulgaricus and Streptococcus thermophilus (Teguh, Nugerahani, & Kusumawati, 2015). This kind of yogurt already known for their health benefits such as maintaining the digestive system, preventing diarrhea, anti-cancer, can regulate cholesterol levels in the blood (Syainah & Novita, 2014). However, plant protein food products are gaining popularity (Jeske, Zannini, & Arendt, 2018) and assumed to be healthier than animal-based foods. Nowadays, several studies already developed the plant-based yogurt from legumes family such as soy(Favaro Trindade, Terzi, Trugo, Della Modesta, & Couri, 2001) and black nut (Phaseolus vulgaris 'Black turtle') (Triana, Angkasa, & Fadhilla, 2019) and produce almost similar sensory acceptance and nutritional contents.

The current study tries to develop plant-based yogurt from cashew and red rose extract. Cashews (Anacardium occidentale) contains 25-gram unsaturated fats that had a benefit to reduce total cholesterol and LDL (Low-Density Lipid) levels and increasing levels of HDL (High-Density Lipids) (Astawan, 2009). In addition, cashews had a good source of vitamin E (460 µg / g) that can serve as a powerful antioxidant (Griffin & Dean, 2017). In line with cashews, in 100 grams of red rose contains 214.68 vitamin C, 195 mg anthocyanin (flavonoids) that also can serve as antioxidants (Rahmawati, 2019). Red roses also can serve as a natural coloring agent that can improve the sensory properties of yogurt. If compared to another natural coloring agent

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such Roselle calyx (Hibiscus sabdariffa L) can be used but it contains low vitamin C (6.7 mg/100 g) and no anthocyanin (Juniarka, Lukitaningsih, & Noegrohati, 2011).

2 MATERIALS AND METHODS

2.1 Materials

Plant protein-based yogurt or cashews rose yogurt was formulated by mixing cashew extract, red rose juice, pectin, sugar, yogurt starter, vanilla flavor and rose flavor. Details formulation was presented in Table 1.

Table 1: Cashews rose yogurt formulation based on trial and error.

Materials	F0	F1	F2	F3
Cashews nut (ml)	100	75	50	25
Red rose juice (ml)	0	25	50	75
Sugar (g)	10	10	10	10
Pectin (g)	5	5	5	5
Skim milk + Yoghurt starter (ml)	15	5	15	15
Vanilla flavor (%)	2	1	1	1
Red rose flavor (%)	0	1	1	1
Total	132	132	132	132

2.2 Methods

This is an experimental study using a completely randomized design (CRD) method with two factors, namely cashew nut extract (CNE) and red rose juice (RRJ). The ratio of CNE and RRJ were formulated into Formula 0/F0 (control) which consist of 100 ml CNE: 0 ml RRJ, F1 75 ml CNE: 25 ml RRJ, F2 50 ml CNE: 50 ml RRJ, and F3 25 ml CNE: 75 ml RRJ. Sensory properties were assessed by 25 semi-panelists and 30 consumer panelists. They were requested to assess the acceptance and quality of four formulations parameters namely color, aroma, texture, and taste (Kurniaty, Angkasa, & Fadhilla, 2018). Proximate analysis was analyzed by AOAC developed methods (Association of Official Agricultural Chemists (US) & Association of Official Agricultural Chemists (US). Committee on Editing Methods of Analysis, 1995). Antioxidant activity was analyzed by DPPH methods (Molyneux, 2004). Physical and chemical properties such viscosity, pH, Total Acid were analyzed following our previous study (Triana et al., 2019) while Total Plate Count (TPC) analyzed with a method used by Yunita (Yunita, Hendrawan, & Yulianingsih, 2015). All samples were analyzed in duplicate. A one-way ANOVA test was used to find the difference between nutritional content and sensory properties across the formulas.

3 RESULTS AND DISCUSSION

Table 2 presents the sensory properties of cashew rose yogurt. Except for color, twenty-five semi-panelists gave similar perception to all other parameters. F3 had a highly preferred color while F1 less preferred.

Formula 1, 2 and 3 were perceived to have traditional yogurt taste and aroma in Table 3. The color is darker as the formula goes from F2 to F3. The viscosity fluctuates where F2 more viscous than F0. Overall, the panelist rate more than 50 points meaning that they were interested in the cashews rose yogurt.

Table 2: Hedonic properties of cashews rose yogurt by 25 semi-trained panelists.

Parameter[3]	Formulation[2] (mean±standard deviation)				Pv[1]
	F0	F1	F2	F3	
Taste(mm)	46.04±12.22[a]	40.96±19.75[a]	45.60±14.37[a]	42.12±15.76[a]	0.591
Color (mm)	61.08±12.69[a]	60.44±14.26[a]	67.20±11.44[ab]	70.56±11.28[b]	0.012*
Texture (mm)	53.92±16.11[a]	53.96±14.30[a]	51.56±15.43[a]	53.40±17.67[a]	0.945
Aroma (mm)	60.48±14.76[a]	54.72±16.59[a]	59.00±12.80[a]	61.12±13.63[a]	0.404
Overall (mm)	53.32±13.01[a]	47.04±16.76[a]	50.44±13.42[a]	48.04±18.04[a]	0.487

[1]One way ANOVA test, numbers followed by different superscript letters in the same line show significantly different values ($p \leq 0,05$), Values are expressed as means ± standard deviation; a, b, c, d mark is Duncan's further test to state the differences in each formula. [2]F0 = 100ml cashew extract: 0 ml red rose juice, F1 = 75ml cashew extract: 25ml red rose juice, F2 = 50 ml cashew extract: 50ml red rose juice, F3 = 25ml red cashew extract: 75ml red rose juice; [3]Visual Analog Scale, 0 (extremely dislike) - 100 (extremely like).

Table 3: Hedonic quality properties of cashews rose yogurt by 25 semi-trained panelists.

Parameter[3]	Formulation[2] (mean±standard deviatioo)				Pv[1]
	F0	F1	F2	F3	
Taste[4] (mm)	47.12±20.17[a]	52.92±16.48[ab]	55.48±18.97[ab]	61.24±14.97[b]	0.049*
Aroma[5] (mm)	31.20±21.48[a]	63.80±14.05[b]	67.68±14.61[bc]	75.80±15.05[c]	0.001*
Color[6] (mm)	13.56±12.78[a]	60.84±13.98[b]	70.04±12.75[c]	79.32±11.08[d]	0.001*
Texture[7] (mm)	37.16±18.30[a]	40.88±14.26[a]	47.76±20.67[a]	38.56±18.61[a]	0.175
Overall[8] (mm)	56.32±16.134[a]	59.84±14.559[a]	58.84±16.499[a]	57.30±16.492[a]	0.869

[1]One way ANOVA test, numbers followed by different superscript letters in the same line show significantly different values ($p \leq 0,05$), Values are expressed as means ± standard deviation; a, b, c, d mark is Duncan's further test to state the differences in each formula. [2]F0 = 100ml cashew extract: 0 ml red rose juice, F1 = 75ml cashew extract: 25ml red rose juice, F2 = 50 ml cashew extract: 50ml red rose juice, F3 = 25ml red cashew extract: 75ml red rose juice; [3]Visual Analog Scale, [4]0 (no taste) - 100 (typical yoghurt), [5]0 (no rose aroma) - 100 (typical rose aroma), [4]0 (White) - 100 (dark red), [4]0 (plain) - 100 (highly viscous), [4]0 (not interested) - 100 (highly interested).

Table 4: Hedonic properties of cashews rose yoghurt by 30 consumer panellists.

Parameter[3]	Formulation[2] (mean±standard deviation)				Pv[1]
	F0	F1	F2	F3	
Taste (mm)	56.57±22.18[a]	56.57±13.43[a]	64.03±18.97[a]	45.80±14.97[a]	0.005*
Aroma (mm)	61.17±18.10[a]	61.97±13.21[a]	70.33±14.61[b]	72.43±15.05[b]	0.012*
Color (mm)	51.93±14.22[a]	51.93±13.66[a]	56.97±12.75[a]	55.40±20.28[a]	0.608
Texture (mm)	60.13±15.55[a]	60.27±9.68[a]	63.13±20.67[a]	62.30±15.13[a]	0.799
Overall (mm)	59.77±13.85[a]	57.97±11.89[ab]	62.00±16.49[ab]	52.67±17.40[a]	0.092

[1]One way ANOVA test, numbers followed by different superscript letters in the same line show significantly different values ($p \leq 0,05$), Values are expressed as means ± standard deviation; a, b, c, d mark is Duncan's further test to state the differences in each formula;
[2]F0 = 100ml cashew extract: 0 ml red rose juice, F1 = 75ml cashew extract: 25ml red rose juice, F2 = 50 ml cashew extract: 50ml red rose juice, F3 = 25ml red cashew extract: 75ml red rose juice;
[3]Visual Analog Scale, 0 (extremely dislike) - 100 (extremely like).

In contrast with semi-trained perception, consumer panelists (Table 4) reported a higher score for all parameters. In addition, taste and aroma were parameters that differ across the formulas. F2 was the most preferred by consumer panelists for almost all parameters. Consumer panelists may act as public or general consumers meaning it will determine final product acceptance.

A current study found that semi-panelist likeness only determined by the color of the cashews rose yogurt. Consumer panelists mostly determined the likeness of the tested product not by the color but by the aroma and taste, meaning that color was not the main factor to choose the yogurt in consumer panelist's perception. In most food products, color is one of the important parameters to determine the quality and acceptance of a food product (Triana et al., 2019). The cashews rose yogurt's color derived from the addition of red rose juice. The higher the concentration of red rose juice, the brighter the red color. In this yogurt that is as a natural coloring for yogurt is the content of red rose juice. Red rose contains anthocyanin which can be an alternative the natural coloring of a food product (Priska, Peni, Carvallo, & Ngapa, n.d.). However, the taste is the most determinant of a food product. Product with good color may not perceive as a good product if the taste was not accepted. Aroma and taste theoretically associated with each other since both of it assessed by the connected olfactory sensors. The aroma is a parameter that appears by chemical stimuli smelled by olfactory nerves that are in the nasal cavity (Negara et al., 2017). The aroma is an important parameter to determine the level of consumer acceptance of a food product. The study of yogurt with the addition of noni fruit which states that the addition of food can affect the aroma of a food product and can increase the level of consumer preferences for these food products. In this study, the aroma of yogurt is influenced by the addition of red rose extract. Red roses can affect the color of food in addition to the aroma of a food product (Priska et al., n.d.). The aroma of roses is caused by volatile acidic volatile or volatile acids that can affect the aroma of a product (Rahmawati, 2019). In addition, there is a little aroma of cashews because cashews contain glutamic acid and aspartic acid which gives a distinctive aroma (Handayani, 2010).

The result of the proximate analysis was presented in Table 5. Moisture, fat, protein and carbohydrate significantly differed across formulas. This research is in line with (Triana et al., 2019) which says that the water content is significantly different from the statistical tests on each formula and can be influenced by the food contained in the yogurt. In yogurt cashew juice and red rose, juice are influenced by the addition of red rose juice. At an average irregular water content between formulations, this may be caused by food and during the fermentation process of yogurt. The content of water content in food products can affect the shelf life, acceptability of the product and the quality of the food product (Winarno, 2002).

Ash content of formula tends to decrease as the formula goes from F0 to F3. It meant the lower the cashew the lower the ash content. Ash content is a proxy indicator for mineral content meaning that the mineral content of F3 may be lower than F0. However, the ash content fulfilled the national standard of Indonesia (SNI 2981-2009).

Related to fat content, all formula fulfilled the national standard of Indonesia. In line with Failasufa and Pratjojo (Failasufa, Sunarto, & Pratjojo, 2015) states that the results of the fat content in their yogurt which made from sweet corn and soy, meet SNI (SNI 2981-2009). Triana et al (Triana et al., 2019) also stated that their yogurt contained low fat so that it had no effect on the total fat in the yogurt. The protein content of currently developed yogurt did not meet the SNI (SNI 2981-2009). In contrast with other studies (Anggrek et al., 2018) (Triana et al., 2019) which met the SNI. Protein content in fermented beverages such as yogurt is influenced by the number of bacteria, where bacteria will affect the enzymes used to break down proteins into peptides which will then be hydrolyzed into amino acids (Failasufa et al., 2015). The higher the concentration of red rose juice, the higher the lower the carbohydrate content. It may cause by the lower content of carbohydrate in red rose juice. Triana et al reported that (Triana et al., 2019) the carbohydrates in each formulation can be influenced by how much the ratio of ingredients and many nutritional contents of carbohydrates in each 100gr material.

Table 6 reported the antioxidant activity (AA) of the cashews rose yogurt. The highest AA was found in formula F3 which had IC50 about 15.51. The antioxidant test uses the DPPH (1,1-Diphenyl-2-Pikrilhidrazin) method to determine the 50% IC50 or Inhibition Concentration level in cashew nut yogurt and red rose juice. IC50 is an extract concentration value that can inhibit and reduce half the free radicals. Based on Table 6, the highest IC50 results were obtained in the F3 formulation and the lowest in the F0 formulations. So in F3 only 15.51 µl / mL of yogurt is needed to inhibit 50% of free radicals while in F0 it takes 1042.10 µl / mL to be able to inhibit 50% of free radicals. Based on the above results, it can be ascertained that the cashew nut yogurt product with the addition of red rose juice contains very high antioxidants.

Table 5: Nutritional Content of cashew rose yogurt.

Parameter	Formulation (mean±standard deviation)				Pv	SNI
	F0	F1	F2	F3		
Moisture (g)	90.35±0.021[a]	91.66±0.123[b]	94.60±0.120[c]	93.57±0.601[d]	0.001*	-
Ash (g)	0.0025±0.001[a]	0.0020±0.001[a]	0.0018±0.001[a]	0.0011±0.001[a]	0.333	Maks. 1
Fat (g)	2.51±0.014[c]	2.73±0.001[d]	1.45±0.009[a]	1.75±0.023[b]	0.001*	0.6-2.9
Protein (g)	1.94±0.001[c]	1.50±0.001[d]	1.14±0.001[a]	1.25±0.001[b]	0.001*	Min. 2.7
Carbohidrat (g)	7.68±0.001[d]	6.67±0.173[c]	4.23±0.001[a]	5.15±0.001[a]	0.001*	-

[1]Numbers followed by different superscript letters in the same line show significantly different. SNI = national standard of Indonesia.

Table 6: Antioxidant activity of cashew rose yogurt.

Formulation	Sample (gram)	AEAC Score (mg Vit.C/100gsample)	IC50 Score (mg/ml)
F0	7.5371	13.59±9.25[a]	1042.10
F1	7.5161	129.05±13.97[b]	32.86
F2	7.5322	177.69±107.77[bc]	17.43
F3	7.5181	245.95±73.36[c]	15.51

[1]Numbers followed by different superscript letters in the same line show significantly different values ($p \leq 0{,}05$), Values are expressed as means ± standard deviation.

[2]The ABCD mark is Duncan's further test to state the differences in each formula

[3]F0 = 100ml cashew juice: 0ml red rose juice, F1 = 75ml cashew juice: 25ml red rose juice, F2 = 50ml cashew juice: 50ml red rose juice, F3 = 25ml red cashew juice: 75ml red roses juice.

Table 7: Physical and chemical properties of cashew rose yogurt.

Parameters	Formulations				Pv
	F0	F1	F2	F3	
Viscosity (cP)	16	24	24	24	-
pH	4.06	4.11	3.90	3.96	Min.3.00-4.00
Total acid (%)	0.378	0.318	0.414	0.419	0.5-2.0% (SNI)
TPC	$1.1x10^8$	$3.7x10^7$	$6.4x10^3$	$3.5x10^3$	Max. $1x10^8$ *CFU*/ ml (SNI)
Energy content	50.21	46.13	28.00	33.54	88 (USDA)

TPC=total plate count.

Table 7 reported the physical and chemical properties of the cashew rose yogurt. The viscosity of this yogurt does not meet SNI. This might be due to the different types of starter cultures and the use of pectin as a stabilizer whereas in yogurt the previous research by (Harjiyanti, Pramono, & Mulyani, 2013) only using two types of starter culture and no addition of pectin so that yogurt meets SNI. The lower the pH of eating yogurt will increasingly thicken. Therefore, it can be possible that the viscosity of yogurt is influenced by low pH levels. The pH levels in the cashew nut yogurt and red rose juice have fulfilled the SNI min.3.00-4.00. This research is in line with (Al-Baarri, 2013) in the yogurt drink study with the addition of star fruit which said a decrease in pH can be influenced by BAL (Lactic Acid Bacteria) which breaks lactose into lactic acid, then lactic acid is produced as a result of sugar metabolism. The more broken down of sugar by BAL, the faster the pH decrease. Streptococci bacteria will reduce the pH to 5.00, then will be followed by Lactobacilli bacteria until the pH reaches 4.50.

The highest total acid in cashew rose yogurt is in the F3. All formulas did not meet total acid SNI (SNI 2981-2009), which is 0.5-2.0%. In contrast with Al-Baarri (Al-Baarri, 2013) the total acid in their product fulfilled the SNI. The total acid content in the cashew rose yogurt is lower because the amount of LAB is far more than in previous studies. The total plate count or total plate count in all formulations of cashew nut and red rose juice products have fulfilled SNI (SNI 2981-2009) because it is below 1x CFU / ml. The decrease in the TPC in each formula might be influenced by the addition of red rose juice in each formulation. The more addition of red rose juices the smaller the amount of TPC in the cashew roses yogurt. Related to energy content, F2 can be classified as low calorie when compared to USDA (United States Department of Agriculture).

4 CONCLUSIONS

Sensory evaluation of cashew rose yogurt suggested F2 as the most preferred formulation. Moisture, fat, protein, and carbohydrate content differed among the formulas. F3 had highest antioxidant activity (IC50 = 15.51). Other properties such as pH and met the SNI.

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