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CHEMICAL CHARACTERISTICS OF BEEF RENDANG FROM THE RESULTS OF COCONUT MILK SUBSTITUTION WITH FIBERCREME

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ABSTRACT

Rendang is one of the original Indonesian dishes originating from Minangkabau, West Sumatra. Making rendang in general uses the main ingredients in the form of beef, coconut milk and various kinds of spices and seasonings. Coconut milk contains high saturated fat which has the potential to cause various degenerative diseases if consumed in excess. Coconut milk can be replaced with FiberCreme. FiberCreme is a non-dairy creamer that can replace coconut milk, the main component of which is dietary fiber. FiberCreme has a taste that is almost similar to coconut milk. Adding FiberCreme to food as a substitute for coconut milk will make it taste delicious and creamy. In fact, FiberCreme has a lower fat and calorie content. The purpose of this study was to determine the appropriate substitution treatment of coconut milk with FiberCreme for use in the manufacture of beef rendang. The research material used was gandik beef, coconut milk, FiberCreme, and rendang seasoning. This study used a completely randomized design consisting of P0 (100% coconut milk), P1 (75% coconut milk: 25% FiberCreme), P2 (50% coconut milk: 50% FiberCreme), P3 (25% coconut milk: 75% FiberCreme), P4 (100% FiberCreme) with 4 replications. Data analysis used ANOVA, followed by Duncan's Multiple Distance Test (DMRT) if the results showed significantly different or very significant effects. The values of moisture content, fat content, total calories, free fatty acids (FFA), and thiobarbituric acid (TBA) were used as variables to be analyzed. The substitution treatment of coconut milk with FiberCreme had no significant effect ($P>0.05$) on the moisture content of rendang, but it had a very significant effect ($P<0.01$) on fat content, total calories, free fatty acids (FFA), thiobarbituric acid (TBA). It can be concluded that the use of 100% FiberCreme gave the best results on the chemical characteristics of beef rendang.

Keywords: Beef rendang; coconut milk; FiberCreme; SNI 7474-2009

INTRODUCTION

Rendang is one of the authentic Indonesian originated from the Minangkabau, West Sumatera. Not only popular in their own country, it turns out that rendang is also quite famous and enjoyed in other countries, as evidenced by rendang being the only Indonesian food chosen in 2011, 35000 people who conducted an online poll held by CNN International chose rendang as the number one dish in their review of "World's 50 Most Delicious Foods" (Festivalia et al., 2017) and in 2017 they won the selection of the best Halal Culinary Destinations in the world (Nadra & Nora, 2020). In general, rendang used beef, coconut milk and various spices, and seasonings as the main ingredients. The fat content of coconut milk is the majir factor that affected the rendang quality (Manoj & Shanmugasundaram, 2020). Coconut milk is a food ingredient that contains high saturated fat. Coconut milk contains fat with a group of medium chain saturated fatty acids, namely lauric acid (C12:0) which is the main fatty acid in coconut and capric acid (C10:0) which is another fatty acid in coconut fat (C12:0) (Ariningsih et al., 2020).

This type of fat when entered at room temperature turns into a solid. If it entered to the human body at excessive levels, it can increase LDL (Low Density Level) cholesterol, causing coronary heart disease, high blood pressure, and stroke (Faridah & Holinesti, 2021). Coconut milk contains medium chain triglycerides so it is susceptible to hydrolysis into free fatty acids (FFA) (Manoj & Shanmugasundaram, 2020).

In this millennial era, various types of commercial creamers have emerged with claims that they have high fiber content and low sugar and can replace coconut milk, namely Fiber Creme (Putri et al., 2016). FiberCreme is a combination of oligosaccharides (food fiber) and coconut oil (vegetable fat) which is free of trans fat, so it will not affect cholesterol levels in the body, besides that fiber components can also bind fat when consuming food and excess cholesterol in the body to be excreted through bowel movements. FiberCreme is a powdered creamer that can enhance the taste of food with a soft and no less creamy taste when paired with coconut milk. FiberCreme can replace coconut milk because the color and consistency of dishes made with Fiber Creme are similar to dishes made with coconut milk. The main component of FiberCreme is oligosaccharides. Oligosaccharides reduce chronic diseases such as insulin resistance, diabetes mellitus, hypertension, and metabolic syndrome (Marsono et al., 2020).

The subtitution of coconut milk with FiberCreme can breakthrough for healthier types of rendang food, so that traditional Indonesian dishes can adapt to the healthy food trend in the culinary world. Based on the description, the use of coconut milk produces unhealthy food, so it is necessary to investigate the substitution of coconut milk with FiberCreme on the quality of rendang in terms of chemical characteristics which include moisture content, fat content, total calories, free fatty acids (FFA) and thiobarbituric acid (TBA).

MATERIALS AND METHODS

Materials

The ingredients used in making rendang are beef from the outer thigh (gandik/eye round), coconut milk, FiberCreme, and rendang seasoning which

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includes onion, garlic, curly chilies, ginger, galangal, turmeric, bay leaves, lime leaves, lemongrass, turmeric leaves, nutmeg, coriander, cardamom, cloves, star anise, cinnamon, cumin, candlenut. Beef and rendang seasoning are obtained from the traditional market of Blimbing, Malang. Thick coconut milk is obtained from the Mergan traditional market, Malang. FiberCreme is obtained from minimarkets in Malang.

The equipment used for rendang includes analytical scales, knives, cutting boards, spoons, porcelain dishes, tweezers, soxhlet, glass stirrer, cotton wool, Erlenmeyer, blander, plastic clips, scissors, permanent markers, and clear plastic mica.

Methods

The research was conducted experimentally using completely randomized design with 5 treatments and 4 replications consisting of P0 (100% coconut milk:0% FiberCreme), P1 (75% coconut milk:25% FiberCreme), P2 (50% coconut milk:50% FiberCreme), P3 (25% coconut milk:75% FiberCreme), P4 (0% coconut milk:100% FiberCreme).

Moisture content analysis

Analysis of the moisture content of beef rendang based on (Legowo et al., 2005), namely the drying method using an oven. A porcelain dish that has been coded as a sample is prepared, heated in an oven at a temperature of 105°C for 1 hour, put in a desiccator for ±15 minutes, then weighed. Add ± 3 grams of sample, then weighed. It was dried for 6 hours at a temperature of 105°C, put in a desiccator until the temperature was cold (± 30 minutes), then weighed until it was constant. The percentage of moisture content is calculated as follows:

$$\text{Moisture content (\%)}: \frac{(\text{Sample initial weight} - \text{Sample final weight})(\text{g})}{\text{Sample initial weight}} \times 100\%$$

Fat content analysis

Analysis of beef rendang fat content based on (AOAC, 2005) using the Soxhlet method. The cleaned boiling flask was put in an oven at 105°C for 1 hour, then cooled in a desiccator for 15 minutes, then weighed (A g). Weigh the sample 2-3 g (X g). The sample was put into a filter sleeve made of filter paper, covered with fat-free cotton. The filter sleeve is inserted into the soxhlet, then install the condenser device sufficiently, according to the size of the soxhlet used.

The hexane solvent is poured into the boiling flask sufficiently according to the size of the soxhlet used. Reflux for at least 5 hours until the solvent drops back into the boiling flask and becomes clear. Distill the solvent in the Erlenmeyer, collect the solvent, then the flask containing the extracted fat is increased in an oven at 105°C for 1 hour or more until the weight is constant. Cool in a desiccator for 30 minutes, then weigh the boiling flask along with the fat (B g). The percentage of fat content is calculated as follows:

$$\text{Fat content (\%)} = \frac{B-A}{X} \times 100\ \%$$

Total calories analysis

Analysis of the total calories of beef rendang based on IKA® Werke (2015) using the bomb calorimeter IKA C 200. The rendang sample was weighed ± 1 gram, the vessel was inserted into the calorimeter. Oxygen will flow into the vessel through the oxygen filling apparatus until the pressure is determined to reach 30 bar. Water flows into the device and is heated to 25°C or 30°C, the water temperature is controlled. The increase in temperature of the water in the bomb vessel calorimeter is measured and calorie results from the sample are obtained. The total calorie test results listed on the computer screen can then be printed.

Free fatty acids (FFA) analysis

Free fatty acid (FFA) analysis of beef rendang based on Sudarmadji et al. (1989)The sample is weighed as much as 3 grams into a 25 ml Erlenmeyer, then add 5 ml of 95% ethanol, add 3-5 drops of pp indicator (phenolphthalein) and titrate with 0.1 N NaOH standard solution until the color changes to pink (no change for 15 seconds). Tested for 3 times. The percentage of free fatty acid content can be calculated as follows:

$$\% \text{ FFA} = \frac{\text{mL NaOH x Fatty acid molecular weight} \times 100\ \%}{\text{Sample weight x } 1000}$$

Thiobarbituric acid (TBA) analysis

Analysis of thiobarbituric acid beef rendang based on Tarladgis et al. (1960). Weigh the sample as much as 3 grams, put it in a waring blender, add 50 ml of distilled water and crush it for 2 minutes. Transferring 47.5 ml of distilled water quantitatively to a distillation flask while washing, add ±2.5 ml of 4 M HCl until the pH becomes 1.5. Add boiling stones, then attach the distillation flask to the distillation apparatus. The distillation process was carried out on high heat to obtain a distillate of 50 ml.

Stirring the distillate evenly, pipette 5 ml of the distillate into a closed test tube. The addition of 5 ml of TBA reagent, closing, mixing, and then heating for 35 minutes in boiling water. Blanks were made using 5 ml of distilled water and 5 ml of reagent, then carried out as a sample. Cooling the test tube for ± 10 minutes then measuring the absorbance at 528 nm with a blank solution as the zero point and using a cell sample with a diameter of 1 cm. TBA calculation: TBA = (3 x Abs x 7.8 x 1000)/g sample expressed as mg MDA/kg sample.

Statistical analysis

Data were analyzed statistically using analysis of variance (ANOVA). If the results show significant or highly significant differences, then further analysis is carried out using Duncan's Multiple Range Test (DMRT)

RESULTS AND DISCUSSION

The results of the analysis of variance showed that the substitution treatment of coconut milk with FiberCreme had non significant effect (P>0.05) on moisture content, but had a highly significant effect (P<0.01) on fat content, total calories, free fatty acids (FFA) and thiobarbituric acid (TBA) of beef rendang as shown in Table 1.

Table 1. Average Chemical Characteristics of Beef Rendang Treatment of Coconut Milk Substitution with FiberCreme

Treatments	Moisture content (%)	Fat content (%)	Total calories (kcal)	Free fatty acids (%)	Thiobacbituric Acid (ppm)
P0	18.46±2.16^{a}	32.57±1.77^{c}	344.20±8.08^{c}	2.02±0.15^{c}	2.94±0.17^{c}
P1	19.56±1.84^{a}	28.07±2.29^{b}	327.13±16.17^{c}	1.48±0.31^{b}	2.66±0.62^{c}
P2	19.45±3.00^{a}	24.54±2.28^{b}	294.10±18.87^{b}	1.15±0.09^{b}	2.18±0.27^{bc}
P3	20.67±1.70^{a}	20.24±0.90^{a}	264.23±10.01^{a}	0.50±0.28^{a}	1.82±0.25^{ab}
P4	17.75±1.58^{a}	17.24±1.88^{a}	278.43±13.80^{ab}	0.39±0.15^{a}	1.62±0.09^{a}

Description: ^{a,b,c} Different superscripts in the same column showed a highly significant effect (P<0.01)

Moisture content

The moisture content in food has various values. Analysis of moisture content is important because it relates to the stability and quality of the food produced. Moisture content is one of the factors that affect the durability of food products, the lower the moisture content, the slower the growth of

microorganisms so that food products can last longer. Table 1 shows that the substitution treatment of coconut milk with FiberCreme had non significant effect (P>0.05) on the moisture content of rendang.

Based on the data obtained in Table 1, it can be seen that the average moisture content of beef rendang obtained ranged from 17.75% - 20.67%. (Kumar & Haruman, 2010) explained that the type of rendang can be divided into 2 types, namely wet rendang and dry rendang. Wet rendang known as kalio has a moisture content range of 40-60%, while dry rendang has a moisture content of less than 40%.

Based on this explanation, the beef rendang in this research is a type of dry rendang. According to (BSN, 2009) based on SNI 7474:2009, the moisture content of rendang products is a maximum of 20%, so the moisture content of rendang in this research is almost all following SNI with a range of values between 17.75% - 20.67%. The use of coconut milk and FiberCreme in making rendang shows an average value of moisture content that is almost the same. This is presumably because the volume of water in coconut milk and FiberCreme used is 1 liter.

The low moisture content in rendang is due to the slow cooking process of making rendang so that the rendang becomes dry, besides that the rendang cooking process also takes hours, which causes the liquid in the rendang to blend with various spices until it becomes dry (Nurmufida et al., 2017). Cooking rendang in this research takes ± 3 hours, with a temperature of around 80-93°C. In fresh conditions, the water content of beef is 60-70% (Winarno, 1980).

The long cooking process makes the moisture content of beef rendang decrease. The longer the food is exposed to heat, the less water will be in the rendang. This is also following the statement of (Novia et al., 2019) that the longer the cooking time, the lower the moisture content in the rendang, this is due to the evaporation process.

Fat content

Fat is an effective source of energy compared to carbohydrates or protein. In every 1 gram, fat provides about 9 kcal for the body (Mamuaja, 2017). The chemical characteristics of beef rendang can be seen based on the fat content in rendang. The ANOVA results in Table 1 show that the substitution of coconut milk with FiberCreme had a highly significant (P<0.01) on the fat content of rendang.

Based on the data obtained in Table 1, it can be seen that the average fat content of beef rendang from the substitution of coconut milk with FiberCreme ranges from 17.24 – 32.57%. The highest average fat content in the P0 treatment was 32.57%, while the lowest average fat content in the P4 treatment was 17.24%. According to (BSN, 2009) in SNI 7474-2009 the fat content of good beef rendang is a maximum of 30%, more than that it can be said that the beef rendang has poor quality, when compared with the results of the research, only P0 has a value more than SNI. This is thought to be due to the use of thick coconut milk in beef rendang.

Moreover, coconut milk in this research used old coconut, older coconuts contain higher fat. According to (Lad & Murthy, 2012) fresh coconut milk contains 35-37% fat and (Rini et al., 2016) also stated that coconut milk without the addition of water (thick coconut milk) contains 32-40% fat. Novia et al. (2019) stated that the use of thick coconut milk and old types of coconut caused an increase in the fat content of rendang. (Laboko, 2020) also stated that the older the coconut fruit, the fat content in the coconut flesh will increase but at a moderate level of fruit maturity, the fat content in the fruit flesh will decrease due to the absorption of nutrients by the coconut fruit institution.

Fat is one of the important components in coconut milk. The fat contained in coconut milk will affect the fat in rendang (Ariningsih et al., 2020). Long cooking time also affects the fat content of rendang. Faridah & Holinesti (2021) stated

that long cooking of beef rendang causes coconut milk to release oil and increases the fat content of rendang.

Total calories

Total calories can be defined as the total amount of energy contained in food, used by the body for activities and various body functions that are adjusted to the energy needs in the body. The ANOVA results in Table 1 show that the substitution of coconut milk with FiberCreme had a highly significant effect ($P<0.01$) on the total calories of rendang.

Based on Table 1, it can be seen that the total caloric value of beef rendang has an average value of 264.23-344.20. Total calories decrase with the use of more and more FiberCreme concentrations, this is presumably because FiberCreme contains less fat than coconut milk. Putri et al. (2016) stated that FiberCreme contains isomalto-oligosaccharides (IMO), IMO was developed into FiberCreme which is a creamer that has low calories and sugar. FiberCreme contains less fat than coconut milk. The decrease in total calorie value is because the number of calories produced from food has a close relationship with the fat content contained in the food. Fat has an important role in increasing calories from food products, this is because fat contributes the most energy when compared to other nutrients (Erfiza et al., 2018). 1 gram of fat contains 9 calories. The high total calories at P0 is thought to be due to the high fat content produced. This is in following with the research of Erfiza et al. (2018) which states that an increase in the value of the fat content produced will be followed by an increase in the total calorie content in the food.

If we look closely, rendang calories are relatively high, so it is necessary to pay attention to the level of consumption. When the calories in are more than the calories out, the excess will be stored as fat. Excess calories from any source will also be stored as fat. Calories that have been stored as the fat will not be expended until the body needs additional energy. This is why excess calories are very dangerous in the long run (Kurniali, 1980). Inadequate calorie intake will affect health. The most visible impact of excess calories is obesity. People who are obese are generally susceptible to various degenerative diseases (Fathonah & Sari, 2020).

Free fatty acids (FFA)

Free fatty acids are values that indicate the amount of free fatty acids present in the fat after hydrolysis. The hydrolysis reaction can be caused by the amount of water, the activity of microorganisms or the presence of enzymes. FFA are the result of the degradation of triglycerides as a result of oil defects. The ANOVA results in Table 1 show that the substitution treatment of coconut milk with FiberCreme gave a highly significant effect ($P<0.01$) on the FFA of rendang.

The resulting FFA value is used to determine the degree of defect of the fat. Table 1 shows the average range of FFA content of beef rendang is 2.02-0.39. The highest average of FFA is sample P0 and the lowest is sample P4. In this research, the levels of FFA decreased as the concentration of FiberCreme increased. The low FFA are related to the water content of the oil. If the water content in the oil is high, a hydrolysis reaction will occur which can increase the FFA level, and vice versa (Bouta et al., 2020). This is also reinforced by the statement of (Raharja and Dwiyuni, 2005) which states that the higher the water content in the oil, the more likely it is that the fatty acid content is also high. It is suspected that the low content of FFA is due to the low water content of rendang. Mamuaja (2017) explained that the fat hydrolysis reaction can occur in the presence of water and heating. Fat hydrolysis can occur in saturated fat or unsaturated fat. At first the fat will be hydrolyzed to form glycerin and free fatty acids, then a further reaction will occur which causes the breakdown of glycerin and free fatty acids molecules. By triggering the heating process, the fat (triglycerides) is hydrolyzed

to form free fatty acids and glycerol. At heating temperature, fats (triglycerides) are hydrolyzed into free fatty acids and glycerol. At too high a heating temperature, the bonds in glycerin can break, causing the release of two water molecules and the formation of acrolein compounds. Acrolein is volatile and forms fumes that can irritate the eyes.

The average FFA in this research ranged from 2.02-0.39. For edible foods with a high concentration of fat or oil, the maximum FFA is 2%. The higher the FFA, the food product has signs of fat defect. The high concentration of FFA in fats/oils in food indicates that the food is damaged, where at maximum levels the food is not suitable for consumption. Damage to fats and oils from hydrolysis will cause rancidity (Azima et al., 2016). Rancidity will certainly affect the aroma and flavor of the rendang product. In addition, Sukatno et al. (2017) also explained that the hydrolysis of fats in foodstuffs not only results in unpleasant odors but can also reduce the nutritional value, due to damage to vitamins and essential fatty acids in fats.

Thiobarbituric acid (TBA)

Thiobarbituric acid (TBA) is generally used to measure the rancidity of fats/oils or food products that contain fat/oil. In the fat oxidation reaction, the components resulting from fat decomposition that can be formed are aldehyde derivative compounds, namely malonaldehyde. The presence of malonaldehyde in food products containing fat/oil indicates that the fat/oil has undergone further oxidation (Mamuaja, 2017). The ANOVA results in Table 1 show that the substitution treatment of coconut milk with FiberCreme gave a highly significant effect ($P<0.01$) on thiobarbituric acid (TBA) rendang.

The resulting TBA was used to determine the degree of rancidity of the fat. Table 1 shows the average TBA levels of beef rendang ranging from 1.62-2.94 ppm. The highest average of TBA is in sample P0 and the lowest is in sample P4. From the table it can be seen that the higher the concentration of the addition of FiberCreme, the lower the TBA value of rendang. This is presumably due to the low fat content in FiberCreme when compared to coconut milk.

The TBA value is related to the fat and FFA content, the fat and FFA content increases followed by the increase in the TBA value. Cherian et al. (2002) stated that meat products containing higher fat will have a higher TBA value. This indicates that the rate of oxidation is influenced by fat content (Young *et al*., 2003). In addition, the FFA that are formed are caused by a series of oxidation of FFA which will decompose into aldehydes, ketones and fatty acids (Ketaren, 2005). The higher the TBA value, the lower the quality of the resulting product due to rancidity. Research (Köse et al., 2001) it is known that the TBA value above 3-4 mg malonaldehyde/kg indicates a decrease in the quality of the resulting product. Based on this value, all beef rendang in the research was still suitable for consumption.

CONCLUSION

The results showed that the substitution of FiberCreme up to 100% could improve the chemical quality of beef rendang which was characterized by reduced fat content, total calories, free fatty acids (FFA) and thiobarbituric acid (TBA). So it can be concluded that the use of 100% FiberCreme gives the best results in terms of chemical quality.

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