The Effect of Kinds of Sugar on Chemical and Physical Quality of Ground Beef Jerky with Sun Drying

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ABSTRACT

Sugar is one of food preservatives. There are kinds of sugar source in Indonesia, namely coconut tree, palm tree and sugar cane. Each sugar has different characteristics, including color, taste, and sweetness. This study was conducted to determine the effect of kinds of sugar on chemical and physical quality of ground beef jerky with sun drying. The materials used were ground beef, sugars, and spices which include salt, garlic, coriander, belching and galangal. There were 3 kinds of sugar as a treatment, namely coconut sugar, palm sugar and sugar cane. Ground beef was mixed with sugar and spices until being homogeneous. The dough was cured for 24 hours, then placed on a baking sheet, coated with aluminum foil and flaked with a thickness of approximately 2 mm. The dough was then dried in the sun drying for 6 hours per day for 3 days, with a temperature of approximately 50^0C. The variables observed were chemical composition including moisture, protein and fat contents, and physical quality including pH value and tenderness. The data were analyzed by using a oneway classification of Completely Randomized Design and continued by Duncan's Multiple Ranges Test. The results analysis showed that the kinds of sugar had no significant effect on moisture, protein, and fat content of ground beef jerky flesh ($P>0.05$). The kinds of sugar also gave no significant effect on pH value and tenderness of ground beef jerky ($P>0.05$). The results of this study could be concluded that the three kinds of sugar can be used as a material of making ground beef jerky without affecting the chemical and physical quality of ground beef jerky.

Keywords: Ground beef, Jerky, Kinds of sugar, Chemival quality, Physical quality.

INTRODUCTION

Jerky is a form of traditional meat preservation in Indonesia. It is very popular in Indonesia, because it is an intermediate moisture food product. It can be made from various kinds of meat, but beef jerky is the most popular beef jerky in Indonesia compared to other meat. The process of making jerky is usually with the addition of sugar. In the market, many kinds of sugar were found including coconut sugar derived from coconut trees, palm sugar derived from palm trees, and sugar cane derived from cane trees. Coconut sugar is the result of processing coconut tree juice (*Cocos Nucifera Linn*) with a distinctive taste, but serves as a sweetener, coconut sugar also serves as a brown dye. It has a light brown color, distinctive aroma of coconut, sweet and slightly dirty so it needs to be filtered when it will be used in liquid form (Kristianingrum, 2009). Muchaymien *et al.* (2014) stated that the coconut sugar contains a reducing sugar content of 5.46%.

Kurniasari and Yuwono (2015) added that moisture content of coconut sugar was 11.67%. Sutrisno and Susanto (2014) stated that protein content of coconut sugar is 1.64% and fat is 10%. Palm sugar or *aren* sugar is a sugar produced from palm sugar sap processing (*Arenga pinnata Merr*) (SNI, 1995). Palm sugar has a distinctive aroma, darker brown color, taste sweeter and cleaner (Kristianingrum, 2009). Rumokoi (1990) stated that palm sugar contains moisture content of 9.16%, sucrose 84.31%, reducing sugar 0.53%, fat 0.11%, protein 2.28%, total mineral 3.66%, calcium 1.35%, and phosphorus 1.37%. Sugar cane is a sugar made from cane juice that undergoes crystallization process. The color is white and brown (raw sugar), because the size of the grains like sand, sugar cane is often called sugar. It is usually used as a sweetener for cooking, drink, cake or other snacks. The quality of sugar produced is affected by the main raw material, sugar cane juice. One of the properties of sugar cane juice is an acid with a pH of 4.9 to 5.5 (Erwinda and Susanto, 2014). Rumokoi (1990) stated that sugar cane contains 10,32% water content, sucrose 71,89%, reducing sugar 3,70%, fat 0,15%, protein 0,06%, total mineral 5.04%, calcium 1,64%, and phosphorus 0.06%. The objective of this study was to determine the effect of kinds of sugar on chemical characteristics and physical quality of ground beef jerky.

MATERIALS AND METHODS

Materials

The materials used in this study were ground beef, coconut sugar, palm sugar, cane sugar, kitchen salt, coriander powder, mashed garlic, galangal, belching, and cooking oil. Materials used in physical and chemical quality test were aquadest, buffer 7, H_2SO_4, K_2SO_4, $CuSO_4$, kjeltab tablets, zinc stones, NaOH, HCl, BCG + MR indicator, boric acid and chloroform methanol.

Methods

Groun jerkey production

Ground beef was weighed at approximately of 200 g. Spices consisted of salt (2%), garlic (2%), coriander (2%), belching (0.05%) and galangal (1%), and sugar (30%) of meat weight. There were 3 kinds of sugar as a treatment, namely coconut sugar, palm sugar, and sugar cane. Ground beef was mixed with all mashed spices until being homogeneous. The dough was then cured for 1 night. The dough was then placed on a sheet coated by aluminum foil and flattened with a thickness of approximately 2 mm. The dough is then dried in the sun drying for 6 hours a day for 3 days, with a temperature of approximately 50^0C.

Chemical characteristics

Moisture content test. Moisture content was tested by heating the jerky samples at 105^0C for 12 hours. The weight difference between before and after heating is the moisture content of the sample (AOAC, 1975).

Protein content test. The protein content was tested by the Kjeldahl method, which consisted of destruction, distillation and titration. Principally the nitrogen content in the sample will be multiplied by a protein factor of 6.25 (AOAC, 1975).

Fat content test. Fat content was tested by Soxhlet extraction method with a mixture of chloroform and methanol mixtures with a ratio of 2:1. The extraction is carried out for 6 hours or until the solvent in the Soxhlet flask becomes uncolored. The weight

difference between before and after extraction were the fat content of the sample (Atkinson *et al*., 1972)

Physical quality

pH value test. Beef jerky sample was weighed at about 10 g and finely chopped, and then added with 10 ml of distilled water, and stirred until homogeneous. The pH value of the sample was measured with a pH meter calibrated with phosphate buffer pH 7 (Bouton and Harris, 1972).

Tenderness. Tenderness was tested by using warner-bratzler meat shear (Soeparno, 2009). Sample with a width of 1.5 cm, and a thickness of 0.67 cm and a length adapted to the meat fiber direction was cut with Warner-Bratzler shear force test. The tenderness was measured on three places of sample.

Analysis data

Data were analyzed by analysis of variance of one way classification of Completely Randomized Design. The mean differences were tested by Duncan New Multiple Range Test (Steel and Torrie, 1980)

RESULTS AND DISCUSSION

Chemical Characteristics

Accordings to the results of the study, the chemical characteristics of ground beef jerky with sun drying were not affected by kinds of sugar. The chemical characteristics of ground beef jerky included moisture, protein, and fat contents. The average moisture, protein, and fat contents of ground beef jerky with sun drying were presented in Table 1.

Table 1. The average of moisture, protein and fat contents of ground beef jerky made with three kinds of sugar and dryed with sun drying

Variables	Kinds of sugar		
	Sugar cane	Coconut sugar	Palm sugar
Moisture (%)^{ns}	11.60±0.55	12.60±1.52	11.60±1.14
Protein (%)^{ns}	28.96±0.42	30.22±0.80	29.99±1.43
Fat (%)^{ns}	5.29±0.91	5.96±0.83	6.08±0.99

^{ns}Not significant

Moisture content. Suratmo (1993) stated that drying is the reduction of moisture content of a material to a certain extent by evaporation pathway without damaging the original tissue. Food drying aims for preservation, because the microorganisms that cause food to become damaged will not grow and develop in a dry material. Soeparno (2009) added that cooking can cause changes in water binding capacity due to protein solubility, high temperatures during cooking cause the moisture content to decrease.

The results of this study showed that kinds of sugar did not significantly affect the moisture content of the ground beef jerky dried with sun drying ($P<0.05$) The average of moisture content was not much different between coconut sugar, palm sugar, and sugar cane jerky. The average of moisture content of ground beef jerky with the addition of coconut sugar, palm sugar, and sugar cane was 12.6, 11.6, and 11.6%, respectively. The moisture content of ground beef jerky with palm sugar and sugar cane showed the same. BSN (1992) stated that maximum moisture content of ground beef jerky is 12%. The average of moisture content of ground beef jerky was below 12%, but the jerky with coconut sugar was higher than 12%, but was still within the normal range of Indonesian National Standard (SNI).

Factors that affect the decrease of moisture content are during the drying process and the addition of spices. Drying aims to reduce moisture content and the addition of salt in this product will bind some water. Suharyanto (2007) stated that drying causes a decrease of the moisture content of meat causing the content of other ingredients such as proteins, carbohydrates and fats in higher concentrations.

Other factors because the moisture content of coconut sugar, palm sugar, and sugar cane, were not much different so the ability to bind water was almost the same. The sucrose content of sugar also affects the moisture content. The moisture content of sugar had a little effect on the jerky products. This was in accordance with Rumokoi (1990) stated that moisture content of palm sugar 9.16% and sugar cane 10.32%. Kurniasari and Yuwono (2015) stated that moisture content of coconut sugar was 11.67%.

Sugar cane consists of 94.8% sucrose and 0.2% composed of other compounds, whereas coconut sugar consists of 92% sucrose and 8% other compounds such as protein (Buckle *et al.*, 1987). Rukomoi (1990) stated that palm sugar contains 84.31% sucrose. Lawrie (2003) stated that moisture content of beef jerky is influenced by temperature and duration of drying, the higher temperature and the longer soaking time, leads to lower moisture content of the beef jerky.

Protein content. The statistical analysis showed that kinds of sugar did not significantly affect the protein content of the ground beef jerky with sun drying ($P>0.05$). The average of protein content did not differ between coconut sugar beef jerky, palm sugar beef jerky, and sugar cane. The average of protein content of coconut sugar jerky, sugar palm jerky, and sugar cane jerky was 30.22, 29.99, and 28.96%, respectively. The highest protein content was obtained from coconut sugar, while the lowest protein content was obtained from sugar cane beef. The level of protein content of beef jerky was still in normal range according to SNI. BSN (1992) stated that protein content of the beef jerky was at least 30%.

Naruki and kanoni (1992) stated that drying treatment can cause chemical and physical reactions, namely protein denaturation, degradation, microbial and enzymatic destruction, loss of some nutrients and reaction between sugar and protein or amino acids. Lawrie (2003) stated that addition of vegetable proteins into animal food protein sources of animal protein leads to cause a deficiency of essential amino acids of proteins that are fulfilled by excessive amino acids in other proteins, so the nutrient quality of the mixture will be higher than one of the proteins .

The average of protein content of ground beef jerky with kinds of sugar was relatively the same, because it was influenced by protein content of coconut sugar, palm sugar, and sugar cane. The protein content of sugars were not much different, Addition of sugars at small level on the processed meat products will not affect the protein content of processed meat. This was in accordance to Sutrisno and Susanto (2014) stated that protein content of coconut sugar was 64%, while Rumokoi (1990) stated that protein content of palm sugar and sugar cane was 2.28 and 0.06%, respectively.

Fat content. The statistical analysis showed that kinds of sugar did not significantly affect the fat content of ground beef jerky with sun drying ($P>0.05$). The average of fat content showed did not vary much between coconut sugar jerky, palm sugar jerky, and sugar cane jerky was 5.96, 6.08, and 5.29%, respectively.

The average of fat content was relatively the same, it can be due to the fat content of, coconut sugar, palm sugar and sugar cane were almost the same and the relationships

between the water and protein content of the sugar. Higher moisture content will affect the level of fat content. This was explained by Rumokoi (1990) stated that sugar content of palm sugar and cane sugar was 0.11 and 0.15%, respectively. According to Sutrisno and Susanto 2014) the fat content of palm sugar was 10%. Judge *et al.* (1989) stated that fatty meat was closely related to its moisture content. The greater the fat content the water content the less. Lawrie (2003) also added that fat content has a negative correlation with moisture content. The greater fat content will lead to less of moisture content.

Physical Quality

According to the results of study, the physical quality of ground beef jerky with sun drying were not affected by kinds of sugars. The physical characteristics of ground beef jerky consisted of pH value and tenderness. The average of pH value and tenderness of ground beef jerky with sun drying was presented in Table 2.

Table 2. The average of pH value and tenderness of ground beef beef jerky made with three kinds of sugar with sun drying

Variabel	Kinds of sugar		
	Sugar cane	Coconut sugar	Palm sugar
pH value^{ns}	5.68±0.10	5.61±0.01	5.70±0.08
Tenderness (kg/cm^2)^{ns}	0.20±0.03	0.21±0.04	0.20±0.03

^{ns}Not significant

pH value. The statistical analysis showed that kinds of sugar addition had no significant effect on the physical quality of ground beef jerky with sun drying including pH value (P>0.05.). The average of pH value of ground beef jerky was not much different between coconut sugar beef jerky, palm sugar beef jerky, and sugar cane beef jerky. The average of pH value of coconut sugar jerky, palm sugar jerky and sugar cane jerky was 5.61, 5.70, and 5.68, respectively.

The pH value of ground beef jerky with sun drying had an average of pH value of 5.89±0.05 (Bastoni, 2013). Compared to the previous studies, the results of the study were still fairly large for pH value of ground beef jerky. The pH value was due to the acid-producing bacteria causing the pH value to decrease.

The duration of storage time at room temperature increased the pH value of ground beef jerky. The increase of pH value of beef jerky during the storage time at room temperature was because of the moisture that bound to protein started out so that amount of free water increased. It mean the meat becomes alkalis and its pH rises (Soputan, 2004). Zuliana *et al*. (2016) stated that according to surveys on the market, coconut sugar has pH ranges from 6.10 to 8.40. Soerparno (2009) stated that normal pH value of meat is about 5.3 to 5.8, and the pH value of jerky ranges from 4.5 to 5.1. Judge *et al*. (1989) stated that treatment during the meat processing can change the pH value.

The process of meat grinding leads to break down the meat protein. The destruction of meat proteins may lead to increase activity of acid-producing bacteria, taht decrease pH value. Treatment of meat grinding, mixing and dough making allows reaction with microorganisms so that the degree of acidity decreases (Judge *et al*., 1989). The decrease of moisture content does not affect the pH value so drying does not affect the pH value. The differences of moisture content may be due to the influence of factors affecting drying such as weather, long drying, and uneven heat penetration (Mulyani, 1984).

Tenderness. The statistical analysis showed that kinds of sugars did not significantly affect the tenderness of ground beef jerky with the sun drying (P>0.05). The average of tenderness of ground beef jerky was not much different between coconut sugar jerky, palm sugar jerky, and sugar cane jerky. The average of tenderness of coconut sugar jerky, palm sugar jerky, and sugar cane jerky was 0.21, 0.20, and 0.20 kg/cm^2,

Meat processing, characteristics of the meat, fillers, spices and additives added also affect the tenderness of the product (Judge *et al*., 1989). Soeparno (2009) stated that cooking can increase or decrease the tenderness of meat and these cooking effects depend on duration or temperature of cooking. The duration of cooking time affects the softening of collagen, while the cooking temperature is more influential on the myofibrils. The myofibrils protein almost coagulates or denatures the perfect protein at 60^{0}C and at higher temperatures can lead to the toughness of coagulated myofibrils protein.

CONCLUSSION

The clonclussion of this study are these three kinds of sugar can be usefull as an ingreedient of making ground beef jerky with out any changes in chemical and physical quality.

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