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PORK JERKY USING SUGAR ANTS NIRA AND NaCl SALT DURING STORAGE

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Abstract

This study was conducted to determine the effect of palm sugar and NaCl salt on pork jerky stored at room temperature. In this study, the Split Plot design was used in a time design that was arranged as follows: Factor A was the concentration of palm ant sugar + NaCl salt (divided into 3 combinations), namely A1 = Palm ant sugar 15% + NaCl 5%, A2 = Palm sugar 10 % + 10% NaCl salt, A3 = 5% palm sugar + 15% NaCl salt and factor B is storage duration at room temperature (20-25°C) (divided by 3 different time durations) as follows B1 = 10 days, B2 = 20 days, B3 + 30 days, with three replications. The variables observed were water content, pH and microbial count and peroxide value. The results showed that the use of palm sugar + NaCl gave a very different effect (P <0.01) on the water content and the number of microbes in pork jerky and peroxide value but not (P>0.05) on the pH of pork jerky. Storage time at room temperature had a significantly different effect (P<0.01) on water content, pH, and the number of microbes and peroxide numbers. In short, the use of palm sugar 5% + NaCl 15% can extend the shelf life of pork jerky up to 30 days.

Key words*: palm sugar sap, pork jerky, salt.*

INTRODUCTION

In Indonesia, especially the province of North Sulawesi, the availability of pork is quite a lot and the price is relatively cheaper than beef. In meeting the needs of animal protein, pork has a high nutritional content with a chemical composition of 60-70% water content, 6-10% fat and 20-28% protein (USDA, 2009). Meat preservation is a way of storing meat for a long period of time so that the quality and cleanliness is maintained. One way of preservation is to make beef jerky which is a traditional processed product from meat which is the result of a combination curing and drying processes. Pork jerky is a plate-shaped food product made from sliced fresh pork from healthy pork that has been seasoned and dried. Jerky is a semi-wet food (intermediate moisture food) with a moisture content of 20 to 40% (Said & Ahmad, 2007). Curing seasoning is table salt, saltpeter (nitrate salt and/or nitrite), sugar is the main ingredient, while pepper, laos, coriander, and garlic are additional spices that can increase the palatability of beef jerky (Suharyanto et al., 2008). The problem faced in making pork jerky is the use of saltpeter as a coloring agent which can be detrimental to health, so palm ant sugar is used. The maximum limit for the use of nitrites according to Permenkes No. 722/MENKES/Per/IX/1988 is 50 ppm for corned beef (single/mixed with KNO_2), if it exceeds the standard it will cause poison to the human body (Ministry of Health RI, 1998). Humectants that are often used are from the sugar, polyol and salt groups which can be used singly or can be combined to produce semi-wet food. Palm sap is a liquid produced from palm types such as palm sugar and is used as an ingredient for making palm sugar and can then be made into powdered ant sugar. Ant sugar is produced with a yield of 11.48-11.50% and a water content of 3.57-4.05% (Inayatul et al*.,* 2019), ash content 0.19%-1.24%, and sucrose content 90.77%-97.24% with favorable organoleptic properties (Nurjanna et al., 2020). Palm sugar has a distinctive taste so that its use cannot be replaced by other types of sugar, besides having a function as a natural sweetener and giving the impression of a brown color to food (Said & Ahmad, 2007). NaCl salt is one of the complementary needs for food and a source of electrolytes for the human body (Purbani,

2000). In the processing industry, salt is generally used to improve the taste, appearance, and functional properties of the resulting product. serves as a preservative, as well as to improve the appearance of the texture (Assadad and Utomo, 2011). Most of the beef jerky is stored at room temperature, which is 26-27 °C with a relative humidity of 70%. Another opinion states that beef jerky is a semi-wet food ingredient with a moisture content of 15 to 50% (Purnomo, 1995) As an area with a large pig farming industry, processing pork into beef jerky is not well known and pork jerky products are not widely circulated in Manado city. And the problem is how far the use of palm sugar + NaCl salt in pork jerky during its storage period at room temperature.

MATERIALS AND METHODS

This research was conducted at the Laboratory of Livestock Technology, Faculty of Animal Husbandry, Sam Ratulangi University, Manado for 40 days. Materials and tools this research uses materials such as ground pork, NaCl, palm sugar, PCA, Physiological NaCl, distilled water, 70% alcohol, and tools such as pH meter, oven, analytical scale, blender, weighing bottle, desiccator, autoclave, incubator, coloni counters and glassware. Design and Variables The research design was split plot in time on the basis of RAL with three replications. Factor A combination of palm sugar + NaCl consists of: A1 = Pork + (15% palm sugar-NaCl 5%), A2 = pork + (10% palm sugar-NaCl 10%), A3 = pork + (palm sugar 5%-NaCl 15%) and Factor B storage time at room temperature (26-27^{0}C) consisted of: B1 = 10 days, B2 = 20 days, B3 = 30 days.

The composition of the treatment as listed in Table 1.

Table 1. Treatment Composition

Material	Treatment		
	1	2	3
Palm ant sugar	15	10	5
Salt NaCl	5	10	15
Garlic	0.5	0.5	0.5
Galangal	0.2	0.2	0.2

How to make pork jerky:

1. The pork is washed and drained, then Ground;
2. Mixed with materials according to treatment;
3. Shaped flat round/rectangle;
4. Dry at 70 °C for 6 hours;
5. Stored at room temperature according to treatment and analyzed (Figure 1).

Pork

Fresh Pork

Pork Jerky

Figure 1. Experimental design

Research Variables

1. Moisture content (AOAC, 2005)

Measurements were carried out using the heating method. The material is heated at a temperature (100-10°C) for 6 hours, then weighed until a constant weight of.

2. pH is obtained (AOAC, 2005). Measurement using a pH meter where the material is blended with distilled water is then measured and read when the pointer shows a constant scale.

3. Number of microbes (BSN, 2000) Measurement of Total Plate Count (TPC) with PCA tools and media was autoclaved and diluted with physiological NaCl, then the material was blended with distilled water and incubated at 37°C for 48 hours. The calculation of the number of microbes was carried out using a handtally counter.

4. Peroxide Number (Ketaren, 2005)

The sample is put into a funnel which is given ammonium chloride, shaken until the fat is clumped and separated with hexane. Then evaporated until the fat is left behind. Then put it in the erlemeyer, add acetic acid and chloroform, then heat it and add indicator and titrate with 0.1 N thiosulfate until the yellow color disappears.

Data Analysis

The data obtained from the test (moisture content, pH, number of microbes) were analyzed for variance in Split plot in time and if the results were significantly different, then continued with the BNJ test (Steel and Torrie, 1991).

RESULTS AND DISCUSSIONS

Water Content of Pork Jerky

The average water content of pork jerky using palm sugar (GSA) + NaCl during storage at room temperature can be seen in Table 2. The average value is in the range of 14.47-38.86%, not much different from the study of Saleh et al (2012) the water content of chicken jerky soaked in betel leaf juice ranged from 49.83% and the soaking time factor ranged from 55.23%. and is in the range of 15-50% semi-wet food moisture content (Purnomo, 1995). Based on the Indonesian National Standard on the quality of beef jerky, the maximum water content is 12% (w/w). Thus, the water content obtained in this study is still high (>12%).

The results of the analysis of diversity showed that the combination of GSA+NaCl had a highly significant (P<0.01) effect on the water content of pork jerky, as well as the length of storage at room temperature. The BNJ follow-up test showed that pork jerky using the combination of GSA+NaCl A1 and A2 had the same water content but significantly different (P<0.01) higher than A3 (Table 2). It can be concluded that the best one is the one using the GSA+NaCl combination A3, this is because NaCl salt can extract meat protein and can bind more water because of its hygroscopic nature which is stronger than palm sugar. Salting can remove water from the surface of the meat. The higher salt concentration can remove more water from the meat (Desniar et al., 2009). Furthermore Syarief and Halid (1993) added that dissolved sugar causes a lower vapor pressure so that water evaporates more easily from the dried material. Inayatul et al (2019) stated that the more salt and sugar concentration in beef jerky, the water content tends to decrease. This reduction in water content can be achieved by using high processing temperatures and/or using preservatives (Saleh et al., 2012). BNJ follow-up tests showed that the storage time at room temperature B1 was significantly different (P<0.05) with lower water content with B2 and B3, then B2 had a significantly (P<0.05) lower water content than B3 (Table 2). It can be concluded that B1 is the best because of the lowest water content. The low initial water content is very decisive and increases the absorption of moisture from the environment in pork jerky. In line with Dewi and Ratna (2008), Ikhsan et al, 2016 stated that the water content of beef jerky had increased during storage at room temperature by ± 2% from its initial water content. Delviani et al. (2021) stated that jerky with vacuum packaging has a significant effect on water content and storage time of 0 days to 9 days can affect quality and shelf life. The results of the research by Istihastuti et al (1998) showed that eel fish jerky with different packaging (vacuum and non-vacuum) each contained 20.33% and 20.54% moisture after being stored for 8 weeks, increasing to 22.61% and 20.79% (Istihastuti et al., 1998). Dewi and Ratna (2008), stated that jerky packed in plastic bags after 30 days of storage had a higher water content than jerky packaged in a vacuum manner.

Table 2. Average effect (palm sugar + NaCl salt) and storage time at room temperature on the moisture content (%) of pork jerky

Palm ant sugar concentration + NaCl salt	Storage Time			Average
	B1(10 days)	B2(20 days)	B3(30 days)	
A1 (GSA 15% and NaCl 5%)	27.59±0.44	27.35±1.69	38.29±1.27	31.08[a]
A2 (GSA 10% and NaCl 10%)	20.96±1.80	26.86±1.34	38.86±1.83	28.89[a]
A3 (GSA 5% and NaCl 15%	14.47±2.06	24.72±1.96	24.72±2.01	21.30[b]
Average	36.93[a]	26.31[b]	26.31[b]	27.09

Note: Different superscripts (abc) in the same row and column show differences (P<0.01)

The pH of Pork Jerky

The average pH of pork jerky can be seen in Table 3 ranging from 4.43 to 5.26. Almost the same as the results of research from Miwada et al (2015), that the average pH of pork jerky with drying and seasoning concentrations ranged from 5.29-6.64 and using liquid smoke 5.94-6.4. Analysis of variance showed that the use of the glycerol-NaCl combination had no significant effect ($p>0.05$) on the pH of pork jerky while storage time at room temperature had a significantly different effect ($P<0.01$) on the pH of pork jerky (Table 3).

Table 3. The average effect of palm sugar + NaCl salt and storage time at room temperature on the pH of pork jerky

Concentration palm ant sugar + NaCl salt	Storage Time			Average
	B1(10 days)	B2(20 days)	B2(20 days)	
A1 (GSA 15% and NaCl 5%)	4.94±0.22	5.13±0.28	5.26±0.18	5.11
A2 (GSA 10% and NaCl 10%)	4.76±0.18	4.97±0.18	5.16±0.16	4.96
A3 (GSA 5% and NaCl 15%)	4.43±0.11	4.87±0.11	5.03±0.11	4.78
Average	4.71[a]	4.99[a]	5.15[b]	4.95

Note: Different superscripts (abc) on the same line indicate differences ($P<0.01$)

Furthermore, the BNJ test showed that B1 and B2 were the same but significantly different ($P<0.01$). B3 had a higher pH of pork jerky (Table 3). This is because during storage protein decomposition occurs resulting in changes in hydroxyl groups and hydrogen groups which causes an increase in the pH of pork jerky. An increase in meat pH can also occur due to changes in meat chemical proportions (Rotinsulu et al., 2019). The magnitude of the pH is related to the formation of alkaline compounds during storage and will affect microbial growth (Hadiwiyoto, 1993) and low H+ concentrations indicate higher pH and vice versa low pH indicates high H+ concentrations.

In addition, microbes can grow in the pH range of 6.0-8.0, usually they are destructive and yeast and lactic acid bacteria grow well in the pH range of 3.0-6.0 (Sutrisna et al*.,* 2015).

Pork Jerky Microbes

The average number of pork jerky microbes can be seen in Table 4, which is in the range of 4.18-4.93 log cfu/g, much lower than Rotinsulu et al (2019) study on beef jerky using glycerol-Nacl salt, namely 6.04-6, 60 log cfu/g. Meat starts to spoil if the microbial count exceeds log 6.69 cfu/g (Wilson et al, 1981).

The BNJ test showed the number of pork jerky microbes using palm sugar (GSA) –NaCl salt showed that A1 was different from A2 and A3, then A2 was different from A3 (Table 4). It can be concluded that the best was the A3 treatment with the smallest microbial count, namely 4.34 log cfu/g. This is because NaCl salt has a stronger ability to inhibit microbial growth than sugar palm ants. Salt can cause plasmolysis and Ci_ ions are toxic to microbes and can cause microbial dehydration due to osmotic forces (Madigan et al, 2011).

Table 4. The average effect of palm sugar + NaCl salt and storage time at room temperature on pork jerky microorganisms (log cfu/g)

Palm ant sugar concentration + NaCl salt	Storage time			Average
	B1 (10 days)	B2 (20 days)	B3 (30 days)	
A1 (GSA 15% and NaCl 5%)	4.57± 0.02	4.87±0.02	4.93±0.02	4.80[a]
A2 (GSA 10% and NaCl 10%)	4.36±0.03	4.54±0.02	4.61±0.00	4.52[b]
A3 (GSA 5% and NaCl 15%)	4.18±0.06	4.42±0.03	4.45±0.01	4.34[c]
Average	4.37[a]	4.66[b]	4.74[c]	4.55

Note: Different superscripts (abc) in the same row and column show a difference ($P<0.01$)

Sugar has a high solubility which can reduce the relative humidity (RH). In addition, salt and sugar which are humectants can reduce water activity and water content thereby inhibiting microbial growth, because metabolic activities require water (Purnomo, 1995). The BNJ test showed that the storage time at room temperature B1, B2 and B3 was highly

significant (P<0.01) on the number of microbes (Table 4). The longer the storage, the increased the number of microbes. This is due to the availability of nutrients and water for microbial growth. In addition, there is degradation of nutrients in pork jerky by microbes which can cause spoilage over time. Microbes need nutrients such as carbon, nitrogen, non-metal elements such as sulfur and phosphorus, metal elements such as Ca, Zn, Na, K, Cu, Mn, Mg and Fe, vitamins, water and energy (Cappucino, 2014). Microbial growth is relatively fast if nutrition is good and enzymes are formed to break down the substrate and then adapt to the environment (Madigan et al, 2011).

Pork Jerky Peroxide Numbers

The average peroxide value of pork jerky can be seen in Table 5, which is in the range of 2.56-12.13 milliequivalence/kg of material.

Analysis of variance showed that the use of the glycerol-NaCl combination and storage time at room temperature as well as the interaction between the two factors had a significantly different effect (p<0.01) on the peroxide value of pork jerky. The BNJ test showed that the peroxide value of pork jerky using palm ant sugar (GSA) – NaCl salt showed that A1 was different from A2 and A3, then A2 was different from A3.

Table 5. The average effect of palm sugar + NaCl salt and storage time at room temperature on the peroxide number (milli equivalent / kg of ingredient) of pork jerky

Combination of ant sugar-Nacl	Storage time			Average
	B1	B2	B3	
A1	2.86^{g}±0.04	5.03^{e}±0.11	8.26^{c}±0.18	5.38^{a}
A2	3.66^{f}±0.04	6.23^{d}±0.11	9.13^{b}±0.11	6.34^{b}
A3	6.40^{d}±0.07	9.03^{b}±0.16	12.13^{a}±0.18	9.18^{c}
Average	4.30^{a}	6.76^{b}	9.84^{c}	

Note: Different superscripts (abc) on the same line indicate differences (P<0.01)

It can be concluded that the best was treatment A1 with the smallest peroxide value, namely 5.38 milliequivalence/kg beef jerky. This is because the ant sugar salt has a stronger ability to prevent oxidation than NaCl. Sugar has a high solubility can dissolve in beef jerky. Antioxidants from palm sugar added to the product are able to inhibit or prevent auto-oxidation reactions and act as donors of hydrogen atoms for lipid radicals. The stability of derivatives of antioxidant radicals is better than free radicals (Kosim et al., 2015). In addition, salt and sugar which are humectants also have the ability as antioxidants to reduce peroxide numbers (Purnomo, 1995). The BNJ test shows the storage time at room temperature B1, B2 and B3 were highly significant (P<0.01) on the jerky peroxide value (Table 4). With longer storage there is an increase in peroxide value. This is due to the longer storage at room temperature the more fat jerky oxidized by oxygen.

Under these conditions, the fat content affects the rate of oxidation (Purnamasari et al., 2012).

CONCLUSIONS

The combination of GSA+NaCl had a highly significant (P<0.01) effect on the water content of pork jerky, as well as storage time at room temperature. And the combination of GSA+NaCl on pork jerky pH gave no significant effect (P>0.05) while storage time at room temperature had a significantly different effect (P<0.01) on pork jerky pH. The number of pork jerky microbes using palm sugar (GSA + NaCl salt) showed a very significant difference (P<0.01) and The BNJ test shows the storage time at room temperature B1, B2 and B3 were highly significant (P<0.01) on the jerky peroxide value. It was clear that using 5% palm sugar + 15% NaCl could extend the shelf life of pork jerky up to 30 days.

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