Original Research Article

The Effect of Substitution Brown Sugar with Honey on Making Beef Jerky

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ABSTRACT

The aim of this research was to determine the best method of using honey as a substitute ingredient in beef jerky in terms of pH, water activity, moisture content, protein content, and fat content. This research was conducted from January 2022 to March 2022 at the Animal Products Technology Laboratory, Faculty of Animas Science and Biochemical Laboratory, Faculty of Mathematics and Natural Sciences, Brawijaya University, Malang. The research material used was beef, with supporting ingredients such as salt, onions, spices, and honey concentrations of 6, 12, 18, 24, and 30%. The research method used an experimental design with six treatments and three replications. The treatments were (P0) 30% brown sugar, (P1) 24% brown sugar + 6% honey, (P2) 18% brown sugar + 12% honey, (P3) 12% brown sugar + 18% honey, (P4) 6% brown sugar + 24% honey, and (P5) 30% honey. The data was analyzed using Analysis of Variance (ANOVA), and if there was a significant influence, Duncan's Multiple Range Test Method (DMRT) was used to test it. The result showed that substituting brown sugar with honey had a highly significant difference (P 0.01) on pH, water activity, moisture content, protein content, and there was a significant difference (P<0.05) in the addition of honey to the fat content of dried beef. The addition of 24% honey produced the best quality beef jerky with a pH of 5,36%, water activity of 0,57%, moisture content of 10,68%, protein content of 28,25%, and fat content of 4.25%.

Keywords: brown sugar, beef jerky, honey, substitution

1. INTRODUCTION

Currently, many food products have been developed that combine nutrition and health functions, commonly referred to as functional food products. An example of a functional food product is beef jerky. Jerky is one of the oldest meat products and has been sold for many years in the form of snack foods [1]. In the process of making beef jerky, brown sugar is usually used as a sweetener, but brown sugar has a high calorie content, so it is necessary to have an alternative to a low-calorie sweetener, namely honey.

Honey is composed of several sugars, such as glucose and fructose as a sweetener in honey [2]. Honey contains a number of compounds and has well-known antioxidant properties. Honey also

contains non-enzymatic substances such as ascorbic acid, tocopherol, carotenoids, amino acids, proteins, Maillard reaction products, flavonoids, and phenolic acids [3]. The presence of several vitamins, minerals, and several phenolic compounds makes honey a good functional food for public [4]. Processing of beef jerky with the use of honey as a substitute for sugar and other supporting materials such as spices and salt is expected to produce good quality beef jerky as a functional food. Based on the description above, the analysis of pH, water activity, moisture content, protein content, and fat content was carried out to evaluate the best quality of beef jerky based on its physicochemical properties.

2. MATERIAL AND METHODS

2.1 Materials

The materials used in this study were beef, brown sugar, and honey with flavors such as galangal, garlic, pepper, and salt. The tools used in this research are a food dehydrator, knife, digital scale, glass, and food processor.

2.2 Methods

The research method used was a laboratory experiment using a completely randomized design (CRD) with 6 treatments, with concentration (P0) as control, namely 30% brown sugar, (P1) 24% brown sugar + 6% honey, (P2) 18% brown sugar + 12% honey, (P3) 12% brown sugar + 18% honey, (P3) 6% brown sugar + 24% honey, and (P5) 30% honey with 3 replications.

2.2.1 Making Beef Jerky

The making of beef jerky refers to [5], which has been modified as follows. The beef and spices are cleaned and then mashed using a food processor. The ground beef is mixed with spices and then honey is added according to the treatment, namely 6, 12, 18, 24, and 30%. After that, it is stirred until it becomes a dough. Then the dough is flattened with a glass edge so that it forms a thin sheet with a thickness of 2-3 mm. Furthermore, drying was carried out using a food dehydrator at a temperature of 60 ºC for 4 hours.

2.2.2 pH

The pH was tested using a pH meter [6]. The pH meter was calibrated in advance by using a buffer of pH 4 and pH 7. The electrode into the sample to be tested was inserted at room temperature. After that, the numbers printed on the pH meter screen after a constant state were recorded.

2.2.3 Water Activity (aw)

Water activity measurement with an aw meter [7]. The sample is inserted into a special tube and then inserted into the AW meter. The screen will show the measurement progress. After the value is stable, the instrument will sound, which indicates the water activity measurement process has been completed.

2.2.4 Moisture Content

The moisture content of beef jerky was analyzed using the oven method [8]. The empty cup was dried in an oven at a temperature of 105 °C. The cup was taken and cooled in a desiccator for 30 minutes, then the cup was weighed. A total of 2 g of beef jerky was put into an empty cup, then put in an oven at 105 °C for 24 hours. The cup containing the sample that no longer contained moisture was taken and put into a desiccator for 30 minutes and weighed.

2.2.5 Protein Content

The protein content of beef jerky was analyzed using the Kjeldahl method [9]. A total of 0.5 g of the sample was put into a Kjeldahl flask. One grain of selenium is put into a Kjeldahl flask and 3 ml of H2SO4 is added. The flask containing the solution was then put into a heating

device with a temperature of 410, and 10 ml of water was added. The destruction process is carried out until the solution becomes clear. The clear solution was cooled and added to 50 ml of distilled water and 20 ml of 40% NaOH, then distilled. The distillation results were accommodated in a 125 ml Erlenmeyer containing 25 ml of boric acid (2% H_3BO_30 containing 0.1% bromocresol green and 0.1% methyl red indicator in a ratio of 2:1. Distillation was carried out by adding 50 ml of NaOH-Na_2S2O_3 solution to the distillation apparatus until 40 ml of the distillate was accommodated in an Erlenmeyer with a bluish green distillate result. Then the distillate is titrated with 0.09 N HCL until the first pink color changes and the blank is determined.

2.2.6 Fat Content

The fat content of ground beef jerky was analyzed using the Soxhlet method [9]. A sample of 1-2 g was weighed and put on filter paper lined with cotton. The filter paper containing the sample was then put into a Soxhlet tube and then extracted with a fat solvent such as 250 ml of petroleum ether for 6 hours. After being extracted with a solvent, the fat was filtered, and the filter paper containing the sample was removed, then dried in an oven at 105 °C for 24 hours. The fat extract was then cooled in a desiccator for 30 minutes and weighed.

2.3 Statistical Analysis

Data were analyzed using Analysis of Variance (ANOVA), and if a significant difference was found, it was tested using the Duncan's Multiple Range Test (DMRT).

3. RESULT AND DISCUSSION

3.1 pH

The results of the analysis of variance showed that the substitution of brown sugar with honey gave a very significant difference ($P<0.01$) to the pH of beef jerky. The average value in Table 1 can be seen that the average pH value of beef jerky decreases with the addition of honey concentration. The lowest average pH value was found in treatment P5, which was 5.32 ± 0.10, and the highest average value was found in treatment P1, which was 5.62 ± 0.04. The decrease in the average pH value of beef jerky was due to honey containing organic acids and flavonoids.

The content of acidic compounds will affect the pH decrease of beef jerky. The higher the concentration of honey used, the more it causes the acid content in the solution to increase and diffuse into beef jerky. The acidity of beef jerky increases, as indicated by a decrease in the pH of beef jerky. The pH level of beef jerky is also strongly influenced by the water content contained in it. [10] reported that the low moisture content of honey causes spoilage microbes to not live.

3.2 Water Activity (aw)

The results of the analysis of variance showed that the substitution of brown sugar with honey gave a very significant difference ($P<0.01$) to the water activity of beef jerky. From the average value in Table 1, it can be seen that the average value of the water activity of beef jerky increases along with the increase in the concentration of honey. The lowest mean value of beef jerky was found in treatment P1, which was 0.57 ± 0.02, and the highest average value of aw was found in the P5 treatment, which was 0.68 ± 0.02.

The decrease in the average water activity value of beef jerky is thought to be due to the osmotic effect produced by honey. Osmosis is the transfer of substances or chemical compounds from low concentrations to high concentrations, which can reduce the water and water activity content in the meat. The water molecules react strongly with the sugars in honey, leaving less water for microorganisms to live in. Osmotic pressure causes the bacteria to be

hydrated so that they cannot live. The decrease in the mean water activity value due to the addition of honey concentration also occurred, presumably because honey has a low water activity value [11].

3.3 MOISTURE CONTENT

The results of the analysis of variance showed that the substitution of brown sugar with honey gave a very significant difference (P<0.01) to the moisture content of beef jerky. The average value in Table 1 of the research results can be seen that the average value of moisture content decreases with the addition of honey concentration. The lowest mean water content was found in the P5 treatment, at 10.63 ± 0.82, and the highest average value was found in the P1 treatment, at 11.63 ± 0.82.

The decrease in the average moisture content of beef jerky is due to the addition of increasing honey concentration, which causes osmotic pressure so that water comes out of the meat. The moisture content of beef jerky is also influenced by fat content and protein content. The protein content of beef jerky is inversely proportional to the moisture content, so the higher the protein content of beef jerky, the lower the moisture content. Moisture content is also related to meat protein, namely the hydrophilic nature of meat protein in increasing water molecules [12].

3.4 PROTEIN CONTENT

The results of the analysis of variance showed that the substitution of brown sugar with honey gave a very significant difference (P<0.01) to the moisture content of beef jerky. The average value in Table 1 of the research results can be seen that the average value of protein content increases with the addition of honey concentration. The lowest mean value of water content was found in the P1 treatment, which was 26.06 ± 0.56, and the highest average value was found in the P5 treatment, which was 28.39 ± 036.

The increase in the average protein content of beef jerky is determined by the quality of the basic raw materials used. The higher the protein content in honey, the higher the protein content produced by beef jerky. This is in line with the opinion of [13], which states that the protein content in the final product is the total protein content of beef jerky after processing. This condition of protein content is influenced by several things, such as the type of processing carried out, the protein content of the ingredients, and the source of protein added to the product. This is also in line with the opinion of [14], which states that oven drying causes protein levels to be higher than sun drying because the temperature is uniform and stable, so that it takes less time than sun drying, where the temperature is not controlled.

Table 1. The average test results of pH, Water activity, Moisture Content, Protein Content, Fat Content

Treatment	Analysis				
	pH	Water activity	Moisture Content	Protein Content	Fat Content
P0	5.74±0.02[b]	0.68±0.02[b]	11.98±0.55[b]	26.06±0.56[a]	4.92±0.85[b]
P1	5.62±0.04[a]	0.63±0.05[a]	11.79±0.23[a]	26.16±0.48[b]	3.57±0.14[a]
P2	5.56±0.14[a]	0.62±0.03[a]	11.77±0.20[a]	26.80±0.17[b]	3.92±0.50[a]
P3	5.52±0.10 [a]	0.58±0.05[a]	11.31±0.21[a]	27.33±0.12[c]	3.99±0.80[a]

P4	5.36±0.19[a]	0.57±0.02[a]	10.68±0.30[a]	28.25±0.24[c]	4.25±0.53[b]
P5	5.32±0.10[a]	0.56±0.02[a]	10.63±0.82[a]	28.39±0.36[d]	5.65±0.62[b]

3.5 FAT CONTENT

The results of the analysis of variance showed that the substitution treatment of brown sugar with honey gave a significant difference ($P<0.05$) to the fat content of beef jerky. The average value in Table 1 of the research results can be seen that the average value of fat content increases with the addition of honey concentration. The lowest mean value of fat content was found in treatment P1, which was 3.57 ± 0.14% and the highest average value in treatment P5 was 5.65 ± 0.62%. The increase in fat content in beef jerky is due to the higher concentration of honey used. [15] reported that variations in chemical composition between fat and protein content in meat influence each other; if the protein content is low, the fat content will be high and vice versa. The increasing fat content in meat processed by drying, heating, and low-temperature cooking methods will cause the water content to decrease while the fat content and protein content will increase.

3.6 BEST TREATMENT

The determination of the best concentration of brown sugar substitution with honey was carried out by the effectiveness index method according to [15] using quantitative data parameters, namely pH, water activity, moisture content, protein content, and fat content. The value of the product can be seen in Table 2.

Table 2. Best Value of Beef Jerky Products

No	Treatment	Total Value of Each Parameter
1.	P0	0.29
2.	P1	0.15
3.	P2	0.18
4.	P3	0.51
5.	P4	0.72
6.	P5	0.50

[16] reported that in determining the best treatment using the effectiveness index method, the value of the product will be obtained, where the treatment that has a high product value is better. In contrast, a treatment that has a low product value is the worse. Thus, the treatment that has the highest product value will be the best treatment. Based on these criteria, obtained beef jerky with the addition of honey by 24% (P4) to be the best treatment with a product value of 0.72.

4. CONCLUSION

The substitution of brown sugar with honey with a concentration of 6:25% was the best treatment with a pH value of 5.36%, water activity of 0.57%, water content of 10.68%, protein content of 28.25%, and fat content of 5.65%.

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