Original Research Article

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

ABSTRACT

This research aimed to evaluate the possibility 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 to March 2022 at the Animal Products Technology Laboratory, Faculty of Animals Science and Biochemical Laboratory, Faculty of Mathematics and Natural Sciences, Brawijaya University, Malang, Indonesia. 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 results 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 beef jerky. 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: beef jerky, honey concentration, brown sugar, best quality

1. INTRODUCTION

Dendeng is a traditional Indonesian product [1] it is generally made of beef, thin and wide in shape, which combines spices and the drying process in its processing [2]. In the process of making beef jerky, brown sugar is usually used as a sweetener, but brown sugar has a high calories content, so it is necessary found and using a low-calorie sweeteners,like the honey. Based on [3], honey contains 328 kcal per 100 grams of honey, less than brown sugar, which contains 386 kcal.

Generally, honey has sensory properties such as a thinner texture, and the color of honey ranges from light yellow to dark yellow, and reddish yellow to black, and has a characteristic honey smell (4]. [5] added that honey has a higher sweetness. than sugar.

Honey is composed of several sugars, such as glucose and fructose [6]. Honey contains a number of compounds and has well-known antioxidant properties. Honey also contains non-enzymatic compounds such as ascorbic acid, tocopherol, carotenoids, amino acids, Maillard reaction products, flavonoids, and phenolic acids [7]. The presence of several vitamins, minerals, and phenolic compounds makes honey a good functional food for the public [8]. 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, this research aimed to evaluate the possibility of using honey as a substitute ingredient in beef jerky in terms of pH, water activity, moisture content, protein content, and fat content.

2. MATERIAL AND METHODS

2.1 Materials

The material used in this study is beef breast obtained from the Mergan market, Malang, Indonesia, honey (use real honey from bees) obtained from PT. Kembang Joyo, Malang, Indonesia, and brown sugar as well as supporting ingredients such as galangal, garlic, coriander, pepper, and salt obtained from Super Indo supermarket, Malang, Indonesia. The tools used in this research are food dehydrator (Wirastar FDH-6), knife, digital scale, glass and food processor (Philips Series 5000 - HR2222).

2.2 Methods

2.2.1 Technological method

The research method used was a laboratory experiment using a completely randomized design (CRD) with 6 treatments and 4 replications. The determination of treatment in this study was based on [9], which has been modified with a concentration of (P0) as a control, namely 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 next step is to determine the selection of beef jerky with the addition of the best concentration of brown sugar substitute with honey using the effectiveness index method [10].

The making of beef jerky refers to [11], which has been modified as follows. The beef (200 g) and spices are cleaned and then mashed using a food processor. The ground beef is mixed with spices (10% garlic, 2% coriander, 2.5% salt, 8.5% galangal, and 0.3% pepper) 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 to from 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 Analytical methods

pH value

The pH value was measured by using a pH meter Model (WalkLAB Microprocessor pH Tester Trans Instruments Ti 9000) [12]. 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.

Water Activity (aw)

The water activity was determined using a water activity meter Model (Water Activity Meter Rotronic HygroPalm 23-AW). Water activity measurement with an aw meter [13]. 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, indicating that the water activity measurement has been completed.

Proximate chemical composition:

The moisture content, protein content, fat content were determined according to AOAC [14].

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 value

The results of the substitution of brown sugar with honey with different concentrations gave no significant difference (P>0.05) to the pH of beef jerky (Table 1). The lowest pH value was in treatment P5 (5.32 ± 0.10) with a concentration of 30% honey, while the highest pH value was obtained by treatment P1 (5.62 ± 0.04) with a concentration of 24% brown sugar + 6% honey.

The resulting pH value tends to decrease as the concentration of honey added to beef jerky increases. This is because honey contains organic acids, amino acids, and flavonoid compounds. The dominant amino acid in honey is proline, while the dominant organic acid is gluconic acid. Organic acids possessed by honey include syringic acid (3,5-dimethoxy 4-hydroxybenzoic acid), methyl syringate (3,4,5-trimethoxybenzoic acid) and 2-hydroxy-3-phenylpropionic acid [15]. Beef jerky's pH will be affected by the acidic chemicals in honey. The higher the concentration of honey used, the more the acid content in the honey diffuses into the beef jerky, which is indicated by a decrease in the pH of the beef jerky [16]. The pH level of beef jerky is also strongly influenced by the water content contained in it. [17] reported that the low moisture content of honey causes spoilage microbes to not live.

3.2 Water Activity (aw)

The results of the substitution of brown sugar with honey with different concentrations gave no significant difference (P>0.05) in the water activity of beef jerky (Table 1). The average value in Table 1 can be seen that the average value of the water activity of beef jerky decreases as the concentration of honey increases. The lowest water activity value was in treatment P5 (0.56 ± 0.02) with a concentration of 30% honey, while the highest water activity value was obtained in treatment P1 (0.63 ± 0.05) with a concentration of 24% brown sugar + 6% honey.

The decrease in beef jerky's average water activity value is thought to be due to the osmotic effect of honey [18]. Osmosis is the transfer of substances or chemical compounds from low concentrations to high concentrations, which can reduce moisture content and water activity in meat [19]. 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 [20]. [9] added that honey can bind water in foodstuffs, causing reduced water activity in foodstuffs. The more the honey is added, the lower the water activity value.

3.3 MOISTURE CONTENT

The results of the substitution of brown sugar with honey with different concentrations gave a very significant difference (P<0.01) in the moisture content of beef jerky (Table 1). The average value in Table 1 of the research results can be seen that the average value of water content decreases with the addition of honey concentration P1 (6%), P2 (12%), P3 (18%), P4 (24%), and P5 (30%), resulting in 11.79%, 11.77%, 11.31%, 10.68%, and 10.63%. The lowest water content was in treatment P5 (10.63 ± 0.82) with a concentration of 30% honey, while the highest water activity value was obtained by treatment P1 (11.79 ± 0.23) with a concentration of 24% brown sugar + 6% honey.

The decrease in beef jerky's average moisture content is due to the gradual increase in the concentration level of

honey, which causes osmotic pressure so that water comes out of the meat. The water content of honey itself, based on [21], is a maximum of 22%, while the water content of beef jerky, based on [22], is a maximum of 12%. Therefore, the moisture content of beef jerky in all treatments of this study met the standard.

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 [23].

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 protein 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 protein content was found in treatment P1 (26.16±0.48) with a concentration of 24% brown sugar + 6% honey, and the highest average value in treatment P5 (28.39 ± 0.36) with the addition of 30% honey concentration.

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. The increase in protein content in beef jerky was evidenced by the higher concentration of adding honey in P1 (6%), P2 (12%), P3 (18%), P4 (24%), and P5 (30%), resulting in 26.16%, 26.80%, 27.33%, 28.25%, and 28.39%. This is in line with the opinion of [24], 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.

The drying process carried out will also cause an increase in the protein content of beef jerky products. This is due to an increase in the concentration of nitrogen ions, where during drying there is a release of water molecules by meat protein, so that the concentration of meat protein increases due to a decrease in the weight of the material [25]. [26] added that drying beef jerky using an oven can increase the protein content produced because the temperature in the oven is more stable than drying beef jerky in the sun.

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	0.68±0.02	11.98±0.55[b]	26.06±0.56[a]	4.92±0.85[b]
P1	5.62±0.04	0.63±0.05	11.79±0.23[a]	26.16±0.48[b]	3.57±0.14[a]
P2	5.56±0.14	0.62±0.03	11.77±0.20[a]	26.80±0.17[b]	3.92±0.50[a]
P3	5.52±0.10	0.58±0.05	11.31±0.21[a]	27.33±0.12[c]	3.99±0.80[a]
P4	5.36±0.19	0.57±0.02	10.68±0.30[a]	28.25±0.24[c]	4.25±0.53[b]
P5	5.32±0.10	0.56±0.02	10.63±0.82[a]	28.39±0.36[d]	5.65±0.62[b]

3.5 Fat content

The results of the substitution of brown sugar with honey with different concentrations gave a significant difference ($P<0.05$) to the fat content of beef jerky (Table 1). The lowest mean value of fat content was in treatment P1 (3.57 ± 0.14%) with a concentration of 24% brown sugar + 6% honey, and the highest average value was in treatment P5 (5.65 ± 0.62%) with the addition of a concentration of 30 % honey.

The increased fat content in beef jerky is due to the higher concentration of honey used. It is suspected that the protein content of beef jerky increases as the concentration of honey increases. This is in line with the explanation of [27], which states that variations in the chemical composition between fat and protein content in meat mutually influence one another; 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.

The Directorate of Nutrition, Ministry of Health, Republic of Indonesia [28] in [29], requires that the fat content in beef jerky be 9%. Therefore, the fat content of beef jerky in all treatments in this study met the standards of the Indonesian Directorate of Nutrition.

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 [10] 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

[10] reported that in determining the best treatment using the effectiveness index method, the product's value will be obtained, where the treatment with 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 6:24% was the best treatment with a pH value of 5.36%, water activity of 0.57%, moisture content of 10.68%, protein content of 28.25%, and fat content of 5.25%. The increasing concentration of honey can reduce pH, water activity, moisture content and increase the protein and fat content of beef jerky.

DISCLAIMER

The products used for this research are commonly and predominantly used products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company, rather it was funded by the personal efforts of the authors.

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