The Effect of Red Ginger Powder (*Zingiber officinale var Rubrum*) Based on pH, Fat Content, Water Activity And L*a*b Color of Rabbit Jerky

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Abstract. This research aims to determine the effect of adding red ginger powder (*Zingiber officinale var Rubrum*) to rabbit meat jerky in terms of pH, fat content, Aw, and L*a*b color. This research method is a laboratory method using a Randomized Group Design (RAK) with 4 treatments and 6 replications. The treatments used were red ginger powder P0 (without adding red ginger powder), P1 (adding 5% red ginger powder), P2 (adding 10% red ginger powder), and P3 (adding 15% red ginger powder). The data obtained were analyzed using analysis of variance (ANOVA) and followed by Duncan's Multiple Range Test (DMRT) if there were differences between treatments. Based on research results, the addition of red ginger powder to rabbit jerky had a significant effect on the color L* (brightness) (33.61-35.22), and the color a* (redness) (5.21-6.62), but had no effect on pH (5.48-5.57), fat content (1.98-2.08%), water activity (0.70-0.76), and color b* (yellowness) (12.13-13 .30). The conclusion of the research is Red ginger powder addition to rabbit jerky had no significant effect on pH, fat content, water activity, or color b, but reduced brightness (L*) and increased redness (a*).

Keywords: jerky, rabbit meat, *Zingiber officinale var Rubrum*

1 Introduction

Rabbit meat has soft meat characteristics, low fiber, soft texture, and good nutrition that are better than other types of meat. Rabbit meat is prone to spoilage if not processed and stored properly. Therefore, the processing of rabbit meat is needed to extend its shelf life, utilize the potential of rabbit meat to create new food variations, and improve the quality of food products that use rabbit meat as a basic ingredient.

One of the efforts in food processing by adding other basic ingredients to add aroma, and taste and change the texture of the product is using curing techniques that apply and soak meat using certain ingredients such as sugar, salt, and other ingredients to prevent bacterial growth, add flavor, and help in the preservation process [1]. One of the food products that uses curing techniques in its manufacturing procedure is jerky.

I. Subagiyo et al. (eds.), *Proceedings of the 11th International Conference of Innovation in Animal Science (ICIAS 2024)*, Advances in Biological Sciences Research 49,
https://doi.org/10.2991/978-94-6463-880-6_4

Dendeng is an intermediate moisture food that is thin and made from fish or meat. Jerky contains a moisture content of around 15-40% so that it can be stored for a relatively long time; besides that, the texture is dry and crispy with a spicy and sweet flavor obtained from the spices and herbs added in jerky preparations [2].

Red ginger is a type of spice that is widely used as a medicine and food ingredient. The active substances contained in ginger function as antioxidants and anti-microbial that can help prevent the growth of bacteria and fungi and can ward off free radicals [3]. The use of ginger as a spice can bring out a strong spicy flavor. This is because ginger contains oleoresin and essential oils, namely gingeril, zingiberen, and zingiberol, which produce a spicy flavor in food. In addition, red ginger provides a distinctive spicy aroma and flavor without interfering with the main flavor of the product, and is safe, readily available, and more sensorially acceptable than other natural preservatives such as betel leaves or cloves. Based on the description above, it is necessary to research the addition of red ginger powder (*Zingiber officinale var Rubrum*) with a percentage of 0%, 5%, 10%, and 15% to rabbit meat jerky in terms of pH value, fat content, water activity, and L*a*b color.

2 Materials and Methods

The research was begun from August 2023 to September 2023 at the Animal Products Technology Laboratory, Faculty of Animal Science, Universitas Brawijaya, Malang. The materials used in making jerky consisted of New Zealand White rabbit meat, male sex, 4 months old and the body parts taken were the back, red ginger powder (*Zingiber officinale var Rubrum*), garlic, salt with cap kapal brand, galangal, coriander, pepper branded *Ladaku*, tamarind and brown sugar obtained from Blimbing Market Malang City while rabbit meat was obtained from Azhar Farm Batu. The research method used is an experimental experiment using a Randomised Group Design (RAK) with 4 treatments and 6 replicates, namely P0 P1 P2 P3 (red ginger powder 0, 5%, 10%, 15%). The tools used in the analysis are a pH meter branded pen type pH meter, a film pot, and a spatula for the pH test. Petri dish, scales, oven, pestle, mortal, filter paper, wool yarn for fat content test. Aw, meter branded Rotronic for water activity test, and color reader branded New CS-210 for L*a*b* color test.

3 Results and Discussion

3.1 pH

The result of pH in rabbit jerky is shown in Table 1. Analysis of variance showed that rabbit jerky with the addition of red ginger powder (*Zingiber officinale var Rubrum*) with different percentages did not affect the pH value. The treatment with the addition of red ginger powder as much as 15 grams, P3, produced the lowest pH value of 5.48 while the treatment without the addition of red ginger powder produced the highest pH value of 5.57. The pH value of beef jerky with the addition of lemongrass powder

(*Cymbopogon citratus*) ranged from 5.11-5.47 [4] but the addition of red ginger powder to beef jerky produces a pH value between 5.79-6.08 [3]. Adding more red ginger powder will decrease the pH value by 0.05 in rabbit jerky. Red ginger contains proteolytic enzymes that can restrain the glycolysis process in meat and produce lactic acid so that the pH of the meat will decrease. The proteolytic enzyme in red ginger, zingibain, works by breaking down muscle proteins into peptides and free amino acids, which can indirectly affect the post-mortem glycolysis process. This protein breakdown changes the muscle cell environment, increases the availability of metabolic substrates and can accelerate the activity of endogenous glycolytic enzymes such as phosphofructokinase and lactate dehydrogenase. As a result, lactic acid production increases, meat pH decreases faster, and this contributes to the textural quality and microbial resistance of rabbit jerky.

Table 1. The result of pH in rabbit jerky

Treatment	pH ± SD
P0	5.57 ± 0.15
P1	5.55 ± 0.12
P2	5.53 ± 0.19
P3	5.48 ± 0.08

In addition, flavonoid compounds found in red ginger can also affect the glycolysis process in meat [5]. The addition of natural ingredients containing antioxidant compounds, such as red ginger, can cause a decrease in pH to inhibit the growth of spoilage bacteria in meat [6]. In addition, the reduction in pH value in rabbit jerky is caused by the addition of tamarind as one of the spices in jerky. Tamarin d has an acidic pH so it can reduce the pH value and increase the acidity level [7].

3.2 Fat Content

The result of fat content in rabbit jerky is shown in Table 2. Analysis of variance showed that rabbit jerky with the addition of red ginger powder (*Zingiber officinale var Rubrum*) with different percentages did not affect the fat content. The addition of red ginger powder as much as 15 grams with P3 treatment produced the highest average of 2.08% and the addition of red ginger powder as much as 10 grams with P2 treatment produced the lowest average of 1.98%.

Table 2. The result of fat content rabbit jerky

Treatment	Fat Content (%) ± SD
P0	2.03 ± 0.23
P1	2.03 ± 0.22
P2	1.98 ± 0.15
P3	2.08 ± 0.09

The fat content in this study has met the standard of fat content in beef jerky according to SNI 2908: 2013. Good fat content, according to SNI, is a maximum of 3%. This fat content is lower when compared to the fat content of goat jerky with the immersion of betel leaf juice (*Piper betle L.*) which is 2.05-2.70% [8] but higher when compared to the addition of red ginger to the cut meat of native chickens produces fat content of 0.09-0.20% [9]. This is thought to be because native chicken meat and red ginger have low fat content. Red ginger contains a relatively low amount of fat, about 4%, and is usually used in small amounts in research formulations. In addition, red ginger is better known for its essential oil content and active compounds such as zingiberol, gingerol, and shogaol that have activities as antioxidants and proteolytic enzymes. The proteolytic properties of these compounds function in the meat tenderization process by breaking down protein structures, but do not directly affect fat content. However, the antioxidant properties of red ginger play a role in maintaining the stability of fat in meat by inhibiting the oxidation process, not by increasing or decreasing the fat content.

3.3 Water Activity

The result of Aw in rabbit jerky is shown in Table 3. Analysis of variance showed that rabbit jerky with the addition of red ginger powder (*Zingiber officinale var Rubrum*) with different percentages did not affect the value of water activity. The addition of red ginger powder as much as 10 grams with P2 treatment produces the highest average of 0.76 and the lowest average obtained from P3 is 0.71, which is the addition of 15% red ginger powder to jerky.

Table 3. The result of Aw in rabbit jerky

Treatment	Aw ± SD
P0	0.70 ± 0.08
P1	0.75 ± 0.07
P2	0.76 ± 0.05
P3	0.71 ± 0.04

The value of the results of this study is lower when compared to the Aw value of baralok beef jerky, which is 0.79-0.86 and higher than the Aw value of jerky on the market, which is 0.40-0.50 [10]. In the P3 treatment, the addition of 15% ginger powder to jerky produced the lowest Aw value. The addition of red ginger powder will reduce the Aw value by 0.05. This is thought to be because red ginger powder fills the air cavity in the dough so that the jerky dough becomes dense and causes a lack of space available for water [3].

3.4 L*a*b Color

The result of L*a*b Color in rabbit jerky is shown in Table 4.

Table 4. The result of L*a*b Color in Rabbit Jerky

Treatment	Variable		
	L*	a*	b*
P0	35.22 ± 0.41^{ab}	5.21 ± 0.50^{a}	11.60 ± 1.09
P1	33.89 ± 1.06^{a}	5.73 ± 0.98^{ab}	11.06 ± 1.14
P2	33.82 ± 1.42^{a}	5.81 ± 0.68^{ab}	10.97 ± 1.33
P3	33.61 ± 0.93^{a}	6.62 ± 0.46^{b}	11.80 ± 1.04

Notes: Different notations (ab) in the same column indicate significant differences ($P<0.05$).

Color L* (brightness). Analysis of variance showed that rabbit jerky with the addition of red ginger powder (*Zingiber officinale var Rubrum*) with different percentages gave a significantly different effect on L* color. The highest mean L* value was obtained in P0 with treatment without the addition of red ginger powder, which was 35.22. The lowest L* average value was obtained by P3 with the addition of 15% red ginger powder, which amounted to 33.61. The L* value in this study is lower when compared to the addition of palm sugar to tilapia jerky, which is 26.6-32.37 [11]. The L* value in this study has met the jerky color standard according to SNI 2908:2013. A good jerky color, according to SNI, is a normal color typical of meat and does not look foreign. Good jerky has the characteristics of not having greenish-white spots caused by mold and a blackish-brown color [12]. The lower the L* value, the color of the product tends to lead to black. The decrease in L* (brightness) value of 0.21 in rabbit jerky with the addition of red ginger powder is thought to be due to the presence of pigments that give red color to red ginger. The more the use of red ginger, the brightness of the product will decrease, this is because the pigment of red ginger is orange-reddish. The color that appears in a food product is influenced by the raw materials used. Seasonings and spices used in jerky, such as garlic, brown sugar, coriander, and pepper, give a dark color to the final product. In addition, the drying process influences the color change in jerky.

The longer the drying time on jerky will produce a darker jerky color [13]. Stated in their research on broiler jerky with a drying process for 7 hours produced a blackish brown color and was preferred by panelists. Brownish color changes in jerky are caused by the reaction of heated sugar which will produce a dark product color. The level of color brightness in jerky is influenced by sugar, the Maillard reaction, and the sugar caramelization process.

Color a* (redness). Analysis of variance showed that rabbit jerky with the addition of red ginger powder (*Zingiber officinale var Rubrum*) with different percentages gave a significantly different effect on the color a*. The highest average value of a*

was obtained in P3 with the addition of 15% red ginger powder, which amounted to 6.62. The lowest a* average value was obtained by P0 with the treatment without the addition of ginger powder, which amounted to 5.21. This figure is lower than the the a* color of rabbit jerky fermented with Lactobacillus plantarum ranged from 13.72-14.63 [14]. The addition of red ginger powder produces a redder jerky color. The addition of red ginger flour as much as 7 grams in goat meatballs produced a red color in the meatballs [15]. The higher the a* value, the redder the color of the resulting product. The increase in a* value (redness) of 0.8 in rabbit jerky with the addition of red ginger powder is due to the high anthocyanin pigment content in red ginger.

Anthocyanin is a flavonoid compound contained in red ginger (*Zingiber officinale var Rubrum*) which is the highest phenol compound which is 90-96% of the total phenol compounds. Anthocyanins are water-soluble pigments and provide color depending on the level of acidity around them which is generally found in plants [16].

Color b* (yellowness). Analysis of variance showed that rabbit jerky with the addition of red ginger powder (*Zingiber officinale var Rubrum*) with different percentages did not affect the color b*. The highest average value of b* was obtained in P3 with the addition of 15% red ginger powder, which amounted to 13.30. The lowest b* average value was obtained by P2 with 10% red ginger powder addition treatment, which amounted to 12.13. The color b* in beef jerky with the addition of strawberries ranges from 5.45 to 10.07 [17]. Based on the color degree parameter, the b* value indicates blue and yellow colors, a negative b* value indicates that the product is blue, and a positive b* indicates yellow. The higher the b* value indicates that the product is yellow. The increase in b* value (yellowness) of 0.83 in rabbit jerky with the addition of red ginger powder is due to the browning process caused by the processing and drying of the jerky. In addition, ginger has curcumin compounds that affect the yellow color of a product and contain antioxidant properties.

Curcumin is a phenolic compound that gives a yellow color derived from the rhizome of the ginger plant [18]. The addition of red ginger can increase the yellow color caused by oleoresin compounds that are yellow to dark brown. Red ginger has the highest oleoresin content of 5.8-6.3% when compared to other types of ginger such as elephant ginger and emprit ginger [19].

4 Conclusion

Red ginger powder addition to rabbit jerky had no significant effect on pH, fat content, water activity, or color b, but reduced brightness (L*) and increased redness (a*).

Disclosure of Interests. The authors have no competing interests to declare that are relevant to the content of this article.

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