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The Effect of Marinating Jungga Citrus (*Citrus jambhiri lush*) on Physical and Organoleptic Quality of Goat Meat

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ABSTRACT

Goat meat is very popular in Indonesia. Goat meat is very popular in Indonesia. One method of preserving goat meat is by treating it with acid, a process known as rarit. This study aims to determine the effect of using Jungga citrus on the physical and organoleptic quality of goat meat rarity. The experimental design used in this study was a Completely Randomized Design (CRD) with 4 treatments and 5 replications, resulting in a total of 20 experimental units: P0=0%, P1=6%, P2=12%, P3=18%. The parameters were physical quality tests, including pH and yield of goat meat, and organoleptic tests for color, aroma, taste, and texture. The results of this study indicate that marinating goat meat with Jungga citrus solution produces significantly better organoleptic results, including texture, aroma, taste, and pH. However, there were no significant differences in color and yield between treatments. The best treatment with good results was found at a dose of 18 ml of Jungga citrus (P3) with the addition of 82 ml of mineral water. This indicates that the use of Jungga citrus in marinating goat meat effectively improves organoleptic quality such as texture, aroma, and taste. However, it does not affect the color of the meat or yield, thus maintaining the color of the meat. In conclusions Jungga citrus are good for preserving goat meat into rarit.

Keywords: Goat Meat, Preserving, Physical, Rarit, Organoleptic

1. Introduction

Goat meat is one of the animal-based food sources consumed by all segments of society due to its high nutritional value [1]. In 100 g of goat meat, there are 27 g of protein, 3 g of fat, 143 kcal of energy, and 75 mg of cholesterol [2]. The production level of goat meat in North Sumatra in 2023 reached 861.80 tons. [3].

One of the processed goat meat products is a Lombok specialty called rarit, which is quite easy to make. Rarit goat meat is a processed food consisting of slices of goat meat that are dried and only require a few spices such as tamarind, sugar, and salt [4]. Some people consider processed goat meat products to have an unpleasant aroma or a distinctive smell and tough texture. The aroma of goat meat is a key factor in the acceptance of goat meat products. The primary cause of the distinctive aroma in goat meat is the presence of two volatile acids (4-methyl octanoic acid), which are one of two types of fatty acids that are easily oxidized. The content of volatile acids in goat meat is higher compared to other livestock [5].

Efforts to reduce the distinctive odor of goat meat are generally carried out by marinating it before cooking using enzymes from fruit plants or acid solutions[6]. Acid-based marinating can enhance flavor,

improve the physical properties of meat, and also extend shelf life [7]. Marinating with organic acids such as citric acid can increase tenderness because citric acid can break the peptide bonds in meat fiber proteins during the tenderization process [8].

The marinade ingredient that can be used is Jungga citrus (*Citrus jambhiri lush*). Jungga citrus (*Citrus jambhiri lush*) is known as sundai citrus, sundai tamarind, or sundai lime. Jungga citrus it has the same appearance as kaffir lime with a taste similar to lime and a distinctive aroma [9]. Jungga lime has an acid content that can be used as a meat tenderizer. Citric acid is naturally found in fruits such as citruss, pineapples, pears, and so on [10]. Acid can break down proteins in meat, and by breaking down proteins, it creates space for flavor and water to penetrate, thereby enhancing the texture of the meat [11].

The use of Jungga citrus (Citrus jambhiri lush) in processing is often used in the production of dakke naniura, a typical Toba dish. Jungga citrus (Citrus jambhiri lush) in dakke naniura is useful for removing the fishy smell and making the fish more tender. The use of Jungga citrus (*Citrus jambhiri lush*) for the development of processed goat meat products has not been extensively studied; therefore, further research is needed on the use of jungga citrus (*Citrus jambhiri lush*) in goat meat products and its effects on both physical and organoleptic quality.

2. Method

This research was conducted at the Livestock Production Laboratory of the Animal Science Study Program, Faculty of Agriculture, University of North Sumatra, over a three-month period from May to October 2024.

2.1. Materials

The materials used in this study were goat meat as the main ingredient (4 kg), Jungga citrus (4 kg), salt, sugar, cooking oil, and mineral water.

2.2. Tools

The tools used in this study included: a blender, knife, cutting board, analytical scale, tray, 250 ml beaker, plastic bowl, frying pan, strainer, spatula, spoon, plastic plate, oven, plastic, container, label paper, questionnaire paper, writing instruments, pH meter, and other supporting equipment.

2.3. Study design

The design used in this study was a completely randomized design (CRD) with 4 treatments and 5 replicates. Thus, there were a total of 20 experimental units. Each experimental unit used 10 g of goat meat with a marinating time of 30 minutes for all treatments [7]. A marinating time of 30 minutes allows the added seasoning to penetrate deeper into the meat, resulting in a flavor that is acceptable to the panelists. The treatments to be used are:

P0: (Control) marinade without using Jungga citrus + 100 ml mineral water.
P1: Marinade using 6 ml of Jungga citrus + 94 ml of mineral water
P2: Marinade using 12 ml of Jungga citrus + 88 ml of mineral water
P3: Marinade using 18 ml of Jungga citrus + 82 ml of mineral water
Sample weight per treatment was 10 g.

2.3 Research Parameters

2.3.1 Potential of Hydrogen (pH)

This pH test was conducted using a pH meter in the Central Laboratory of the Faculty of Agriculture, Universitas Sumatera Utara. The pH measurement of the meat was performed according to the Association of Official Analytical Chemists method. The meat was weighed at 5 g, then the marinated meat was placed in a beaker glass and added with 10 ml of distilled water. The calibrated pH meter was then inserted into the meat, and the measurement and recording of the results were performed.

2.3.2 Organoleptic

Color

Color is the first parameter that determines panelists' acceptance of a product

Table 1. Organoleptic test of color

Specifications	Value
Color	
Light Brown	9
Brown	8
Brownish Black	7
Black	6
Black on the surface	5
Black with a few white spots	4
Black with quite a few white spots	3
Black with many white spots	2
Black with very many white spots	1

Texture

Texture is one of the determining factors of the quality of a food product that needs to be considered.

Table 2. Organoleptic test of texture

Specifications	Value
Texture	
Elastic and chewy	9
Somewhat elastic and chewy	8
Slightly elastic and chewy	7
Slightly elastic and less chewy	6
Less elastic and somewhat soft	5
Less elastic and slightly soft	4
Less elastic and soft	3
Less elastic, soft, and somewhat watery	2
Very inelastic, very soft, and Watery	1

Aroma

Aroma is one of the determining factors in whether a product is accepted or not, where scent can be used as an indicator of damage to the product if the scent in the product is no longer normal.

Table 3. Organoleptic test of aroma

Specifications	Value
Aroma	
Not fishy, fresh, with a distinctive aroma	9

Not fishy, with a distinctive aroma	8
No fishy smell, slightly reduced specific rarity	7
No fishy smell, reduced specific rarity	6
Slightly fishy, slightly rancid, less fresh smell	5
Slightly fishy, slightly rancid, unpleasant odor	4
Slightly fishy, slightly rotten, rancid	3
Fishy, rotten, rancid	2
Very fishy, very rotten, and very rancid	1

Taste
Taste is a factor that influences consumer acceptance and determines the appeal of a product.

Table 4. Organoleptic test of taste

Specifications Taste	Value
The taste of goat meat is dominant.	9
The taste of goat meat is quite dominant.	8
The taste of goat meat is slightly reduced.	7
Somewhat pleasant, reduced goat meat flavor	6
Unpleasant, reduced goat meat flavor, dominant seasoning	5
Unpleasant, no goat meat flavor, dominant seasoning	4
Not good, no goat meat flavor, spices slightly dominant	3
Not good, no goat meat flavor, spices Dominant	2
Very bad, no goat meat flavor, spices very dominant	1

3. Result and discussion

3.1. Potential of Hydrogen (pH)

One of the most important factors affecting the durability and quality of meat as a food ingredient is its pH value [11]. The pH value affects meat quality because it is related to color, tenderness, water-holding capacity, flavor, and shelf life [12]. The average pH values of goat meat marinated with jungga citrus solution are shown in Table 5.

Table 5. Effect of Jungga citrus marinade on pH levels in goat meat

Treatment	Replication					Mean ± SD
	I	II	III	IV	V	
P0	6,31	6,04	6,19	6,05	6,57	$6,23^{a} \pm 0,219$
P1	5,85	5,77	5,73	5,49	5,95	$5,76^{b} \pm 0,171$
P2	5,26	5,05	5,12	5,20	5,33	$5,19^{c} \pm 0,110$
P3	4,78	4,89	4,55	4,71	4,63	$4,71^{d} \pm 0,131$

Note: Different superscripts indicate significant differences between treatments (P<0.05).

The results shown in the table above indicate that the highest average pH value of goat meat marinated with Jungga citrus was found in P0, which was 6.23, while the lowest average pH value of goat meat marinated with Jungga citrus was found in P3, which was 4.71. The results of the ANOVA analysis indicate that marinating with Jungga citrus produces a significant difference (P<0.05) in the pH value of goat meat. The analysis results show that each treatment has a very significant difference from the other treatments. Based on the research results regarding the pH value of goat meat, it was found that the highest average pH value of goat meat was found in P0 (6.23), followed by P1 (5.76), then P2 (5.19), and P3 (4.71).

Next, a Duncan Multiple Range Test (DMRT) was conducted on four treatments of goat meat rarity in jungga citrus marinade. The results showed that the higher the concentration of jungga citrus in the treatment, the lower the pH value of the rarity. Based on the Duncan test results, it was found that there was a very significant effect (P<0.05) between treatments. Treatment P0 had a significant effect (P<0.05) on P1, P2, and P3. Treatment P1 had a significant effect (P<0.05) on P2 and P3. Treatment P2 had a significant effect (P<0.05) on P3.

3.2. Organoleptic

3.2.1 Color

Color is the first parameter that determines panelists' acceptance of a product. If the color of a product is not attractive, it will affect the panelists' assessment of the product. The results of the statistical analysis of the color quality of rarit marinasi asam jungga can be seen in Table 6.

Table 6. Effect of jungga citrus marinade on the organoleptic test of the color of rarit goat meat

Treatment	Replication					Mean^{tn} ± SD
	I	II	III	IV	V	
P0	7,10	6,97	6,84	6,55	6,81	6,85 ± 0,205
P1	6,61	6,35	6,52	6,65	6,52	6,53 ± 0,115
P2	6,23	6,52	6,58	6,55	6,29	6,43 ± 0,161
P3	6,87	6,58	5,90	6,42	6,35	6,43 ± 0,354

Note: tn = no significant difference between treatments (P>0.05)

Based on the results of data analysis using the Kruskal-Wallis test, it was found that marinating with Jungga citrus did not significantly affect (P>0.05) the color score of goat meat rarity. As can be seen in the Table 6, the average color score of goat meat rarity was marinated using jungga citrus, the highest score was at P0, which was 6.85 (dark brown), and the lowest average score was at P3, which was 6.43 (dark brown). Since the test results were not significantly different, no further testing was necessary. [13] also found that the colour of dendeng was dark brown.

Based on Table 6, it appears that the treatment of goat rarity color tends to show no significant difference at an average of 6.43–6.85 (dark brown). The factor that affects the color of rarity so that it is not noticeable is the temperature used during the cooking/heating process, which will affect the color of the meat.

3.2.2 Texture

The effect of jungga acid marinade treatment on panelists' assessment of goat meat rarity texture can be seen in the following Table 7.

Table 7. Effect of jungga citrus marinade on organoleptic testing of goat meat rarity texture

Treatment	Replication					Mean ± SD
	I	II	III	IV	V	
P0	5,45	5,48	5,65	5,16	5,03	$5,35^{a} \pm 0,252$
P1	5,81	5,29	5,68	5,55	5,45	$5,55^{a} \pm 0,201$
P2	6,39	5,84	6,26	6,55	6,35	$6,28^{b} \pm 0,266$
P3	6,81	6,35	6,71	6,59	6,68	$6,63^{c} \pm 0,174$

Note: Different superscripts indicate significant differences between treatments (P<0.05).

Based on Table 7, it can be seen that treatment P3 on the texture of goat meat rarity was more preferred by the panelists with the highest average score of 6.63. The average level of panelist preference for the texture of beef rarity was highest at a score of 6 (slightly elastic and less chewy) and lowest at a score of 5 (less elastic and somewhat hard). The texture of goat meat rarit is obtained by adding Jungga citrus which contain citric acid during the marinating process. The differences in texture are influenced by the amount of citric acid solution used in the marinating process and the duration of the marinating process, which affects the texture of the rarit. Marinating meat with acid can enhance flavor, soften texture, and encourage consumer acceptance of processed products [7].

3.2.3 Aroma

Aroma is one of several organoleptic quality parameters used to determine the acceptability of a processed product, and it can serve as an indicator of product deterioration. The results of the statistical analysis of rarit aroma quality using gelugur acid during storage in this study are shown in Table 8.

Table 8. Effect of jungga citrus marinade on the organoleptic test of rarit aroma in goat meat

Treatment	Replication					Mean ± SD
	I	II	III	IV	V	
P0	6,03	6,32	6,58	6,03	6,19	$6,23^{a} \pm 0,230$
P1	6,68	7,03	6,71	6,45	6,68	$6,71^{b} \pm 0,207$
P2	7,00	7,03	6,94	7,06	7,29	$7,06^{c} \pm 0,133$
P3	6,94	7,84	6,84	7,10	6,84	$7,11^{c} \pm 0,420$

Note: Different superscripts indicate significant differences between treatments (P<0.05).

Based on the results of the Kruskal-Wallis analysis, it was found that marinating with Jungga citrus fruit produced a very significant difference (P<0.05) compared to P3. From the results of the study, it was found that the higher the level of treatment used, the higher the aroma score of the goat meat. The highest average aroma score in the organoleptic test of goat meat rarity was achieved with treatment P3 (18 ml), which tended to be higher. [14] also found that that acid treatment affects the aroma. The panelists liked it, with the highest average score of 7.11 based on the criteria (not fishy, slightly reduced goat meat specificity) and the lowest score of 6.3 for P0 (not fishy, reduced goat meat specificity).

3.2.4 Taste

Taste is a factor that influences consumer acceptance and determines consumer receptivity to a product. The results of statistical analysis of the taste quality of rarit using Jungga citrus during marinade in this study can be seen in Table 9.

Table 9. The effect of Jungga citrus marinade on the organoleptic test of goat meat flavor

Treatment	Replication					Mean ± SD
	I	II	III	IV	V	
P0	5,71	5,61	5,81	5,90	5,68	$5,74^{a} \pm 0,113$
P1	6,61	6,84	6,87	6,97	6,61	$6,78^{b} \pm 0,162$
P2	6,87	6,97	7,16	7,00	7,16	$7,03^{c} \pm 0,126$
P3	6,61	7,16	6,71	7,68	7,23	$7,08^{c} \pm 0,432$

Note: Different superscripts indicate significant differences between treatments (P<0.05)

Based on Table 9, it appears that the P3 treatment for the rarity of goat meat tends to be more preferred by panelists, with the highest average score of 7.68. The average level of panelist preference for the rarity of goat meat in P3 was 7.08 (delicious, slight reduction in the rarity of goat meat), while the lowest average score for the rarity of goat meat was in P0 at 5.74 (less delicious, insufficient rarity of goat meat, dominant seasoning). The flavor obtained in the rarit is derived from the marinade of tamarind and spices. The differences in flavor are influenced by the amount of tamarind and spices added during the marinating process. In agreement with [7], who opined that the taste of the meat, added ingredients, drying effects, and frying of processed products are factors influencing the rarit taste.

4. Conclusion

4.1 Conclusion

1. The use of Jungga citrus solution on goat meat can improve, among other things, texture, aroma, taste, and pH. However, there were no significant differences between treatments in terms of color and yield weight.

2. The best treatment with good results was found at a dose of 18 ml of jungga acid (P3) with the addition of 82 ml of mineral water.

4.2 Recommendations

1. In future studies, ensure even cutting and heating of the meat, and increase the concentration of jungga citrus during the marinating process.

2. Conduct further research on the chemical and microbiological quality of the meat.

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