The influence of different drying methods on cowhide crackers at PT Java Mandiri's Partner on protein content, expandability, and organoleptic quality

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Abstract. The aim of this research is to determine the best protein content, expandability, and organoleptic quality among three different drying treatments for cowhide crackers. The material used in this research is cowhide cowhide crackers. Three drying treatments were used in this study, which are drying in an oven for 4 hours (P1), sunlight drying for 2 days (P2), and a combination of both, with sunlight drying for 2 days and oven drying for 30 minutes. The research employs a Completely Randomized Design (CRD) and a Randomized Block Design (RBD) Subsampling for the organoleptic test with three treatments and six replications, and the De Garmo method was used to determine the best treatment. The results of this research were analyzed using Analysis of Variance (ANOVA), and if differences were found, Duncan's test was employed. The findings revealed that the drying treatments significantly ($P<0.01$) affected protein content, expandability, and organoleptic evaluation. The average value of protein content 65.87%-83.20%, expandability 179.53%-530.42%, color rating 3.26-4.01, crunchiness 3.32-4.11, and taste rating 3.03-4.02. The conclusion derived from the De Garmo method is that the best treatment is drying in an oven (P1) with a protein content of 65.87%, expandability of 530.42%, color rating of 4.01, crunchiness rating of 4.11, and taste rating of 4.02.
Keywords: cowhide, cowhide crackers, drying, protein content, expandability, organoleptic

1 Introduction

The cattle slaughter industry plays a crucial role in meeting the protein needs of the Indonesian population. The increasing population growth leads to a higher demand for beef to meet protein requirements. Consequently, many cattle slaughter industry are overwhelmed by the handling of waste generated from animal slaughtering, especially cattle hides. One

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way to solve this issue is by processing the waste into cowhide crackers, which can be resold at a high market value. This approach aims to harness the diversification of by-products from livestock processing, enhancing the economic value of hides, and creating new job opportunities.

Crackers is a popular snack enjoyed by many Indonesians [1]. It has led to a significant number of Indonesians engaging in crackers processing businesses, which can be found in nearly every region. Ready-to-eat crackers can be found in roadside eateries as well as large restaurants. People of all backgrounds can enjoy this famous snack.

Cowhide crackers is a traditional Indonesian food known to exist since the 9th or 10th century and is native to the island of Java, as recorded in the Batu Pura inscription [2]. Cowhide crackers is typically made from cattle or buffalo hides that undergo various processes to become crispy and popular snack in Indonesia. In processing, industries commonly prefer using cattle hides because they are readily available. The cowhide, as a byproduct of livestock slaughter, has significant potential to be processed into leather crackers [3]. One initiative that can be undertaken to harness this potential is the establishment of a cowhide cracker processing factory.

PT Java Mandiri is a food industry that produces cowhide crackers. The company operates from Monday to Friday, half a day on Saturday, and is closed on Sunday. On a typical day, they can produce approximately 20 sheets of cowhide crackers. However, during peak seasons like approaching Eid al-Adha, the company can produce 30 to 40 sheets of cowhide crackers from cattle hides.

The procedure for handling hides to be processed into cracker is similar to the standard method. However, what sets it apart from others is that lime is not mixed during the boiling process. According to an interview with the company owner, the use of lime can lead to environmental pollution. Another reason is that the company is not yet equipped to handle the waste generated by the cowhide cracker industry. Therefore, this becomes a compelling reason to conduct research by applying different drying methods to observe the resulting protein content, expandability, and organoleptic quality (color, crispiness, and flavor).

2 Material and Methods

This research was conducted from August 9 to October 9, 2023, and was carried out by a group of five researchers. The research took place at three different locations. The sampling and frying of cowhide crackers were performed at PT Java Mandiri, located on Mendalanwetan Street, Wagir District, Malang Regency. Protein content analysis was conducted at the Food Testing and Quality Assurance Laboratory, Faculty of Agricultural Technology, Brawijaya University. Organoleptic testing was carried out in the Livestock Product Technology Reading Room, Faculty of Animal Science, Brawijaya University.

2.1 Research Material

The materials used in this research included cowhide crackers without the addition of lime in the manufacturing process. The cowhide used was from male cattle (with no distinction regarding breed and age) sourced from three different locations: Batu, Surabaya, and Malang. The frying oil used was of the "Kunci Mas" brand, with a total 800 liter for 120 kg of dried cowhide.

2.2 Research Equipment

The equipment used for the production of cowhide crackers included an oven made by PT Java Mandiri, two large gas stoves made by PT Java Mandiri, two large stoves made by PT Java Mandiri, four LPG gas tanks, two large-sized pans, a cowhide cutter made by PT Java Mandiri, two large-sized sieves, an analytical scale of SF-400 brand, a temperature gauge of Benetech brand, and plastic clips. The tools used for sample testing included Kjeldahl flasks, a set of destruction and distillation apparatus, 100 ml measuring flasks, dropper pipets, distillation flasks, measuring glasses, 100 ml Erlenmeyer flasks, Snowman brand pens, Sinar Dunia brand millimeter blocks (for expansion testing), organoleptic assessment questionnaires, and De Garmo test questionnaires.

2.3 Research Method

The method employed in this research involved experiments conducted using a Completely Randomized Design (CRD) with three treatments, each repeated six times, and a Randomized Block Design (RBD) Subsampling for Organoleptic Testing. Samples were collected over a period of 6 days and subjected to different drying methods. The drying treatments were named as follows: P1 (oven drying for 4 hours), P2 (sun drying for 2 days), and P3 (sun drying for 2 days followed by 30 minutes in the oven).

2.4 Research Procedure

The research procedure carried out at PT Java Mandiri, based on previous research and modified accordingly, begins with the cleaning of newly arrived cowhides. Initially, the hides are washed with flowing water, followed by the removal of any remaining fat and meat still adhering to the skin. The cleaned hides are then boiled twice: the first boiling lasts for 10 minutes, and the second for 10-15 minutes, depending on whether the skin is old or young (up to 30 minutes at most) at a temperature 88.8°C. This process makes it easier to remove hair from the cowhide. After boiling, the cowhide is cleaned of hair using a hair scraper knife (if hair remains, burning is done to facilitate scraping). The cleaned cowhide, free from hair, meat, and fat, is then cut according to the order (2x2 cm in this study) to facilitate the drying process. The cut hides are then oven-dried for 4 hours, sun-dried for 2 days, and a combination of sun drying for 2 days and oven drying for 30 minutes. The sun-dried hides enter the degreasing stage or are steamed using oil for 5 hours at a temperature of 225.5°C. If the hides bubble up and rise, turn off the stove and let the hides shrink and go back under the oil. Repeat this process to obtain quality kerupuk rambak. Lift and let the steamed kerupuk cool completely. Then fry the kerupuk until it becomes crispy. The kerupuk is fried twice, with the first frying using low heat at 187°C and the second frying using high heat at 245°C. The aim is to achieve perfectly bloomed cowhide cracker [4].

2.5 Variable Test

The variables used in this research include the protein content, expansibility, and organoleptic quality of cowhide crackers, which are assessed as follows:

1. Protein content testing of cowhide crackers using the Kjeldahl method [5].
2. Expandability testing by calculating the surface area of the crackers by tracing them onto grid paper [6].

3. Organoleptic color using hedonic scale from 1-5 (1 = slightly brownish, 2 = slightly yellowish, 3 = somewhat white, 4 = white, 5 = very white) of the cowhide crackers from the three different drying treatments
4. Organoleptic cunchiness using hedonic scale 1-5 (1 = not crunchy, 2 = somewhat crunchy, 3 = sufficiently crunchy, 4 = crunchy, 5 = very crunchy) of the cowhide crackers from the three different drying treatments
5. Organoleptic taste using hedonic scale 1-5 (1 = unpleasant, 2 = somewhat pleasant, 3 = moderately pleasant, 4 = pleasant, 5 = very pleasant) of the cowhide crackers from the three different drying treatments. This hedonic test is performed by 20 untrained panelists [7].

2.6 Data Analysis

The data obtained from the three tests mentioned above are then analyzed using Analysis of Variance (ANOVA) with the Microsoft Excel 2019 application. If there are differences, the analysis is further continued with the Duncan's Multiple Range Test (DMRT). The data obtained is then analyzed to find the best treatment using the De Garmo method [8]

3 Results and Discussion

3.1 Protein Content

The analysis of variance results shows that the drying methods significantly affect the protein content of cowhide crackers with a very significant impact ($P<0.01$). The average protein content of cowhide crackers can be seen in Table 1. The table shows that the protein content of cowhide crackers ranges from 65.87% to 83.20%. The highest protein content is found in treatment P2, which is 83.20% with sun drying, while the lowest average is obtained from treatment P1, which is 65.87% with oven drying. The protein content in this study is relatively high when compared to the other research which reported a protein content of 6.10% for cowhide crackers, water content of 0.11%, calcium content of 1.88%, expansion power of 372.12%, crispness score of 5.38, and taste score of 6.89 [9].

The average protein content of cowhide crackers is influenced by several factors. The first factor is the use of raw materials from cowhide. Cowhide crackers contain 83 grams of protein, 4 grams of fat, 1 gram of minerals, 5 milligrams of calcium, 10 milligrams of phosphorus, 12 grams of water, and an energy content of 268 calories per 100 grams. The high protein content is affected by the drying and frying processes [10]. There are differences between treatment P1, P2, and P3. P1 has the lowest value due to the drying method that uses an oven with a higher temperature than sun drying. Higher temperatures and longer processing times lead to increased protein damage in the material [11]. Higher cooking temperatures lead to a decrease in protein content in food products [12].

Table 1. The average protein content, expandability, organoleptic quality, and de garmo on cowhide cracers with different drying method.

Treatment	Protein Content (%)	Expandability (%)	Organoleptic		
			Color	Crunchiness	Taste
P1	65.87^{a}±3.22	530.42^{b}±89.24	4.01±0.85	4.11±0.78	4.02±0.82
P2	83.20^{b}±1.00	179.53^{a}±35.10	3.26±0.82	3.32±1.22	3.03±1.11
P3	81.51^{b}±2.00	223.95^{a}±112.08	3.44±0.99	3.56±0.99	3.23±1.06

Note: Superscripts $^{a-b}$ in the same column indicate highly significant differences ($P < 0.01$)

3.2 Expandability

The analysis of variance results show that the different drying methods have a highly significant effect ($P<0.01$) on the expandability of cowhide crackers. The average expandability of cowhide crackers can be seen in Table 1. The data demonstrates that the expandability of cowhide crackers ranges from 179.53% to 530.42%. The highest expandability is observed in treatment P1, which is 530.42% with oven drying, while the lowest expandability is found in treatment P2, which is 179.53% with sun drying. The expandability of all three treatments is notably high compared to the other research with the expandability of commercial crackers ranged from 38% to 145% [13]. The higher the expandability of the crackers, the better the quality of the final product [14].

The expandability of cowhide crackers is related to the protein content contained within them. The higher the protein content in cowhide crackers, the lower the expandability, and conversely, the lower the protein content, the higher the expandability. The higher the protein content in cowhide crackers, the lower the expandability [15]. High protein content can reduce the expandability of crackers, leading to smaller air pockets due to the density of air pockets filled with protein [16]. In addition to protein content, there are other factors influencing the expandability of crackers, such as moisture content. The moisture content of raw crackers significantly affects the bloom value produced when the crackers are fried, with an optimal moisture content ranging from 9-10% [13].

3.3 Organoleptic Quality

The sensory evaluation of crackers was carried out to determine the effect of different drying treatments on the sensory characteristics of the product, including color, crunchiness, and taste. The method used to determine the sensory quality was the hedonic test. The analysis of variance results shows that the different drying methods have a highly significant effect ($P<0.01$) on the sensory quality of crackers. The average values of the sensory evaluation of cowhide crackers can be found in Table 1.

Color. The analysis of variance results shows that the different drying treatments for cowhide crackers have a highly significant effect ($P<0.01$) on color evaluation. Based on the data presented in Table 1, the organoleptic color values range from 3.26 to 4.01 (somewhat white to white). This indicates that the color of the tested cowhide crackers is acceptable to the panelists. The lowest value for color in the sensory evaluation is 3.26 for P2, which involves sun drying, while the highest value is 4.01 for P1, which involves oven drying. However, both P2 and P3 have lower average color evaluation scores compared to P1. Based on this data, the panelists tend to prefer cowhide crackers dried using the oven method (P1) due to the color being less yellowish or brownish, which can occur with excessive frying.

The color of cowhide crackers is influenced by the boiling and frying process. The color of crackers is influenced by the original ingredients of the crackers, such as protein and carbohydrates, and is affected by the frying process [17]. The desirable color for crackers is a natural, unobtrusive color that arises from the composition of the ingredients used. The resulting color depends on the duration and temperature of frying and the chemical composition of the surface of the food, while the type of oil used has a minimal effect on the color change of the food [18].

Crunchiness. The analysis of variance results shows that different drying methods for cowhide crackers have a highly significant effect ($P<0.01$) on crunchiness evaluation. According to the data presented in Table 1, the organoleptic crunchiness values range from 3.32 to 4.11 (somewhat crispy to crispy). This suggests that the crunchiness produced by the tested cowhide crackers is acceptable to the panelists. The lowest value for crunchiness in

the sensory evaluation is 3.32 for P2, involving sun drying, while the highest value is 4.11 for P1, involving oven drying. However, both P2 and P3 have lower average crunchiness evaluation scores compared to P1. According to this data, the panelists tend to prefer cowhide crackers dried using the oven method (P1). This occurs because cowhide crackers dried using the oven are easier to break apart compared to the other two treatments.

Crunchiness is closely related to the expandability of cowhide crackers. Crunchiness is influenced by the expandability; the higher the expandability, the higher the preference for crunchiness [19]. The crunchiness of cowhide crackers is also influenced by the protein content. High protein content can reduce crunchiness and the expandability of crackers [20].

Taste. The analysis of variance results shows that the different drying treatments for cowhide crackers have a highly significant effect ($P<0.01$) on the taste evaluation. Based on the data presented in the table, the organoleptic taste values range from 3.03 to 4.02 (fairly delicious to delicious). This suggests that the taste produced by the tested cowhide crackers is acceptable to the panelists. The lowest value for taste in the sensory evaluation is 3.03 for P2, involving sun drying, while the highest value is 4.02 for P1, involving oven drying. However, both P2 and P3 have lower average taste evaluation scores compared to P1.

Based on this data, the panelists tend to prefer cowhide crackers dried using the oven method (P1). This is because cowhide crackers dried using the oven have a milder skin flavor compared to the other two drying methods. The preference level of the panelists, ranging from 3.03 to 4.02, is influenced by several factors. The first factor is related to cowhide crackers from PT Java Mandiri, which underwent three different drying treatments and did not use flavorings, allowing the panelists to experience the natural taste of cowhide. The quality of crackers, including their taste, can be influenced by the quantity of raw materials, the type of raw materials, and the amount of seasoning used [21]. The second factor is related to the oven treatment, which imparts a better taste than the other two treatments. This occurs because the protein contained in the crackers undergoes hydrolysis during the cooking process, producing amino acids and glutamic acid, which enhance the umami taste of the crackers [22].

3.4 The Best Treatment

The selection of the best treatment aims to make informed decisions by comparing the research variables with the treatments that have been implemented. The best treatment can be determined using the De Garmo method. Parameters used include protein content, crispiness, color, taste, and crunchiness. The results of the best treatment analysis using the De Garmo method are selected based on the highest productivity value. The calculation data using the De Garmo method can be seen in Table 2.

Table 2. The productivity value using De Garmo

Treatment	Productivity Value
P1	0.74
P2	0.26
P3	0.33

Note: * Indicates the best treatment, which is cowhide crackers dried using the oven drying method for 4 hours

Based on the calculation of treatment values using the Effective Index method, the best treatment is found in P1 with a protein content of 65.87%, crispiness of 530.42%, color rating of 4.01, crunchiness rating of 4.11, and taste rating of 4.02.

4 Conclusions

Based on the research results, it can be concluded that the different drying treatments significantly affect the protein content, expandability, and organoleptic qualities of cowhide crackers. Drying the cracker in an oven for 4 hours yielded the best results with a protein content of 65.87%, expandability of 530.42%, color score of 4.01, crunchiness score of 4.11, and a taste score of 4.02.

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