

The Effect of Sun-Drying Time on Water Content, Shrinkage, Tenderness, and Acceptability of Chicken Meat Urutan

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ABSTRACT: Traditional meat-based fermented processed products are very limited in Indonesia, one type of traditional fermented meat processed products typical of Indonesia is *urutan*. Considering that it is difficult to find processed *urutan* products because the basic ingredients used are meat, fat, and pork intestines, innovation is needed by using chicken meat in its manufacture. Sun-drying timer of the fermentation process occurs in the *urutan*. This study was conducted to determine the effect of sun-drying time on chicken meat *urutan* on water content, shrinkage, tenderness, and acceptability, and to determine the best sun-drying time. This research was conducted with experimental method using a Completely Randomized Design consisting of 3 treatments and 6 replicates, tested using Analysis of Variance and continued using the Duncan test. The results showed that differences in sun-drying time on the *urutan* of chicken meat had a significant effect ($P < 0.05$) on water content, shrinkage, and tenderness, but no significant effect ($P > 0.05$) on acceptability. The best sun-drying time on the chicken meat *urutan* was for 2 days with a water content of 63.45%, shrinkage of 13.55%, tenderness of 68.0 mm/gram/10 seconds, and a numerical scale on total acceptability of 5.00 (Like Moderately).

KEY WORDS: Chicken Meat, Sun-Drying Time, Urutan

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I. INTRODUCTION

The quality of food products can be improved by using fermentation as one of the types of food processing. Fermentation involves a complex microbial activity that includes bacteria, fungi, and yeast. These microorganisms change the characteristics and composition of meat, as well as the complex components in meat that can be broken down into simpler ones that are easier to digest. Fermentation can increase the nutritional value of food, extend its shelf life, and produce compounds that are beneficial to health, such as probiotics[16]. Fermentation can occur spontaneously in a natural way and non-spontaneously by adding a starter to the processing process. Traditional fermented meat products in Indonesia are very limited, one of which is *urutan*.

Urutan is a traditional fermented Balinese sausage, made from meat and pork fat mixed with spices, and inserted into the pig intestine as a natural casing and then fermented process, and can last up to 12 days when stored at room temperature[21]. The fermentation process of *urutan* occurs in the sun with a time of 2-4 days[23]. Spontaneous fermentation occurs in the *urutan* by utilizing natural microorganisms contained in the meat and seasonings used. The composition of lactic acid bacteria in the *urutan* is dominated by *Lactobacillus fermentum*, and the rest by *Pediococcus acidilactici* and *Pediococcus pentosaceus*[22].

This processed pork *urutan* product is still difficult to find, especially outside the Bali area. This is due to the limited consumption of *urutan* because it contains animal raw materials that can only be consumed by certain people, such as meat, fat, and pork intestines. Seeing that it is difficult to find processed *urutan* products because the basic ingredients used are meat, fat, and pork intestines, innovation is needed by using chicken meat in its manufacture. Based on data from the 2022 Trade Distribution Pattern of Broiler Chicken Meat Commodities, there was an increase in consumption of broiler chicken meat in Indonesia in 2021, with an average consumption of 6.048 kg per capita per year, an increase of 8.62% compared to the previous year[3].

Chicken meat is a popular choice for people for animal protein sources because it is easy to find and relatively affordable. Chicken meat *urutan* will be fermented spontaneously in the processing by sun-drying the meat.

The sun-drying process is carried out to reduce the water content in food ingredients, thus extending their shelf life and preventing damage. The smaller the water activity value, the more difficult it is for microorganisms to multiply, so that the shelf life of food ingredients is longer[11]. Chicken meat *urutan* as a whole will be affected by its water content. In addition, other factors such as shrinkage, tenderness, and acceptability also affect chicken meat *urutan*. It is necessary to study and analyze the test of water content, shrinkage, tenderness, and acceptability in this study with the aim of knowing the effect of sun-drying time and the best sun-drying time on chicken meat *urutan* on water content, shrinkage, tenderness, and acceptability.

II. MATERIAL AND METHODS

The research was conducted at the Laboratory of Livestock Product Processing and Laboratory of Biotechnology Research and Testing, Faculty of Animal Husbandry, Padjadjaran University. The ingredients used to make the chicken meat *urutan* in this study are chicken broiler strain cobb chest part of 2400 gram, chicken fat broiler cobb strain of 1600 gram, spices are 40 gram of salt, aromatic ginger 300 gram, turmeric 200 gram, ginger 200 gram, galangal 200 gram, red garlic 800 gram, garlic 600 gram, chili pepper 300 gram, red chili 300 gram, coriander 100 gram, pepper 100 gram, cumin 100 gram, shrimp paste 100 gram and collagen sausage cassings with a diameter of 23.55 mm. The tools used were bowl, tray, knife, cutting board, digital scale, analytical scale, chopper, plastic wrap, mattress thread, crucible porcelain, electric oven, desiccator, crucible pliers, penetrometer, stopwatch, refrigerator, plastic gloves, plastic plate, toothpick, label, questionnaire paper, and stationery writing tools.

The manufacturing procedure begins with chicken meat and fat were chopped into cubes and mixed in a ratio of 60:4. Adding spices that have been roughly cut into the meat and fat mixture according to the composition of spices in the formulation. Putting the mixture of chicken meat, fat, and spices into the collagen sleeve. The fermentation process occurred spontaneously according to the conditions under sunlight. The chicken meat *urutan* was tested for water content, shrinkage, tenderness, and acceptability. This research was conducted using experimental methods and the research design used was Completely Randomized Design (RAL). There were three treatments where each treatment was replicated as many as six replicates. The treatment was carried out with different sun-drying times on the chicken meat *urutan*, including P1 (2 Days Sun-Drying *Urutan*), P2 (4 Days Sun-Drying *Urutan*), P3 (6 Days Sun-Drying *Urutan*).

The variables observed in this study included water content, shrinkage, tenderness, and acceptability. The measurement of each variable uses the following methods and formulas:

1. Water content (%), obtained using the Gravimetric method, which involves heating the chicken meat sausage until all the water evaporates, and then weighing it again to obtain a constant weight.
2. Shrinkage (%), obtained by weighing the initial chicken meat sausage weight and the final sausage weight, then calculating the shrinkage based on the percentage.
3. Tenderness (mm/gram/10 seconds), obtained objectively using a penetrometer gauge by looking at the depth of entry of the penetrometer needle into the sausage for 10 seconds.
4. Acceptability, including color, taste, aroma, texture, and consumer acceptance. Acceptability value testing was carried out by 20 moderately trained panelists who gave an assessment on a questionnaire given based on a hedonic scale, namely 1 (very dislike), 2 (dislike), 3 (dislike moderately), 4 (neutral), 5 (like moderately), 6 (like), 7 (very like).

Data from the test results of water content, shrinkage, and tenderness of each treatment of differences in the sun-drying time of chicken meat *urutan* in this study were tested using Analysis of Variance. If the results of the analysis showed a significant difference between treatments, it was continued with the Duncan Test. Tests on acceptability values (color, taste, aroma, texture, and total consumer acceptance) used the Kruskal-Wallis Test, a non-parametric statistical method.

III. RESULTS AND DISCUSSIONS

The drying process in food processing will involve a reduction in product water content which aims to maintain product quality and avoid spoilage[2]. Based on the observations presented, it can be seen that the average water content of the highest order was obtained by P1 then successively followed by P2 and P3. The results of the analysis of variance showed that different sun drying duration gave a significant effect on water content ($P < 0.05$) so that it was further analyzed with Duncan's multiple range test in Table 1.

Table I. Water Content of Chicken Meat *Urutan*

Treatment	Water Content (%)
P1	63,449 ^c ± 1,905
P2	50,149 ^b ± 3,120
P3	17,202 ^a ± 2,099

Note: The numbers followed by different letters in the Duncan test indicate significant differences (P<0,05).

The water content of *urutan* with a sun-drying time of 2 days, 4 days, and 6 days is still within normal limits, and in accordance with the percentage of water content of meat sausages according to SNI 2015, which is a maximum of 67%. The longer sun drying and fermentation time will result in a decrease in the water content of the sausage, this is due to the growth of microorganisms in the fermented sausage. This is in line with the statement of Sari et al. (2017) that the longer the fermentation time and the higher the drying temperature will cause the water content to decrease. The decrease in water content will be faster if the drying temperature and initial fermentation are high[10]. Water in a product will be evaporated during the drying process so that the water content is reduced and the growth of microorganisms will be inhibited[9].

Based on the results of Duncan's multiple range test of *urutan* water content, it can be concluded that the best chicken meat sausage water content is P1 with a sun-drying time of 2 days. This is because if the water content of the *urutan* is too low, it will produce *urutan* with a dry and hard texture due to the lack of water content in the *urutan*. Water will react with fat, protein, and polysaccharides which will affect the texture of the product[25].

Shrinkage is a physical change that causes changes in shape, volume reduction, increased hardness, surface cracking, and will affect the overall quality of dry food ingredients[18]. Based on the observations presented, it can be seen that the lowest average *urutan* shrinkage was obtained by P1 then successively followed by P2 and P3. The results of the analysis of variance showed that the difference in drying time had a significant effect on shrinkage (P <0.05) so that it was further analyzed with Duncan's multiple range test in Table 2.

Table 2. Shrinkage of Chicken Meat *Urutan*

Treatment	Shrinkage (%)
P1	13,546 ^a ± 1,609
P2	25,641 ^b ± 3,471
P3	30,081 ^c ± 2,191

Note: The numbers followed by different letters in the Duncan test indicate significant differences (P<0,05).

The shrinkage of *urutan* with 2 days, 4 days, and 6 days of drying is still within normal limits, this is in line with the opinion of Soeparno (2015) that the amount of meat shrinkage varies in the range of 15-40% with a range of 1.5-54.5%. The longer the fermentation process, the more water is released by the protein which causes greater shrinkage. Shrinkage will be lower if the water content is higher, this is because the water that comes out in shrinkage is free water. The decrease in pH is one of the consequences of the fermentation process that occurs due to the accumulation of lactic acid as the main product of lactic acid bacteria activity[13]. The use of complex spices and one of them is salt in sausage making not only to improve the flavor, but can reduce Aw by accelerating the release of water so that the product becomes drier[14].

Based on the results of Duncan's multiple range test of *urutan* shrinkage, it can be concluded that the best chicken meat *urutan* shrinkage is P1 with 2 days of sun-drying. The lower shrinkage indicates that the *urutan* has better quality, because meat or processed meat products with high shrinkage will cause high loss of food substances during the cooking or processing process[20].

Tenderness is related to food texture, namely the roughness of the meat surface and describes chewiness[24]. Based on the observations presented, it can be seen that the highest average *urutan* tenderness was obtained by P1 then successively followed by P2 and P3. The results of the analysis of variance showed that the difference in sun-drying time had a significant effect on tenderness (P <0.05) so that it was further analyzed with the Duncan multiple range test in Table 3.

Table 3. Tenderness of Chicken Meat *Urutan*

Treatment	Tenderness (mm/gram/10 seconds)
P1	68,017 ^a ± 7,518
P2	55,383 ^b ± 3,268
P3	48,033 ^a ± 1,792

Note: The numbers followed by different letters in the Duncan test indicate significant differences (P<0,05).

The tenderness of chicken meat *urutan* is influenced by sun-drying which is interspersed with fumigation. This is in line with the opinion of Soeparno (2015) that the length of fumigation can increase the tenderness of meat depending on time and temperature, this is due to the amount of protein myofibrils that are denatured. The longer sun-drying time will cause the tenderization value to be lower. This is because tenderness is influenced by the amount of water that comes out in the shrinkage process, during sun-drying if more water comes out, the value of tenderness will be smaller. This is in line with the opinion of Baldassini et al. (2021) that water content, temperature and cooking time of meat, and intramuscular fat greatly affect meat tenderness. Water content in meat plays an important role in determining the texture of meat, including its tenderness[20].

Based on the results of Duncan's multiple range test on *urutan* tenderness, it can be concluded that the best chicken meat *urutan* tenderness is P1 with 2 days of sun-drying. This is because tenderness is related to food texture, which describes the elasticity or roughness of the meat surface[24]. The longer sun-drying, the lower water content and high shrinkage, both of which result in a decrease in the tenderness of the sausage so that the texture becomes hard.

The acceptability test is conducted to determine the acceptance of food products in consumers of the tested products so that it can be used to evaluate product quality and determine innovations that need to be made to improve the quality of these. The results of the study on color, taste, aroma, texture, and total acceptance of chicken meat *urutan* with different duration of sun-drying are presented in Table 4.

Tabel 4. Acceptability of Chicken Meat *Urutan*

Acceptability Assessment	Treatment			Mean	Description
	P1	P2	P3		
Color	5,40	5,50	5,55	5,48	dark yellowish brown
Taste	4,05	3,55	3,85	3,81	sour typical of fermentation
Aroma	5,40	5,50	5,55	5,48	acid an smoke
Texture	4,85	4,90	5,05	4,93	solid
Total Acceptance	4,60	4,45	4,50	4,51	acceptable

Note: The results of the Kruskal-Wallis test of chicken meat *urutan* with different duration of sun-drying did not significantly affect the acceptability value.

The sun-drying time of 2 days, 4 days, and 6 days on chicken meat *urutan* did not give a significant effect ($P > 0.05$) on the color of chicken meat *urutan*. This result was due to the fact that chicken *urutan* treated with different sun-drying durations displayed a slightly yellowish dark brown color and based on the hedonic scale tended to still be preferred by panelists. The fumigation process also affects the color of the *urutan* which is relatively the same in all treatments.

The color changes to dark brown due to the sun-drying and fumigation process. This is in accordance with the opinion of Martiyanti & Vita (2018) that high temperatures in the heating process produce a darker color of chicken meat *urutan* (fermented sausage), and the higher the temperature and duration of heating, the more the water content decreases. Chicken meat *urutan* that shows a slightly yellowish color is influenced by the base spices (base genep) used, especially turmeric. The dark brown and slightly yellowish color change in chicken meat *urutan* is due to the curcumin pigment contained in the spices and is sensitive to light during sun-drying. The color of curcumin will darken due to the decomposition of the structure in the form of curcumin cyclization[8].

The sun-drying time of 2 days, 4 days, and 6 days on chicken meat *urutan* did not have a significant effect ($P > 0.05$) on the taste of chicken meat *urutan*. This is because the ingredients used in making chicken meat *urutan* in each treatment are the same. The flavor of processed meat is influenced by meat, spices, and processing methods coupled with the fermentation process[20]. Chicken meat *urutan* treated with different duration of sun-drying displays a sour taste due to the fermentation process and based on the hedonic scale tends to be liked by panelists.

The sour taste of chicken meat *urutan* will be more dominant than the taste of chicken meat because it is influenced by the fermentation process. Lactic acid bacteria found in meat cause the sour taste of chicken meat *urutan*. Lactic acid is able to reduce carbohydrates or glucose which causes a decrease in pH resulting in a sour taste[13]. The fumigation process carried out in each treatment also causes the sour taste obtained in each treatment to be similar. The fumigation process contains acetic acid, formic acid, fentic acid, butyric acid, vanillic acid, and ovallic acid[1].

The sun-drying time of 2 days, 4 days, and 6 days on chicken meat *urutan* did not have a significant effect ($P > 0.05$) on the aroma of chicken meat *urutan*. The sour aroma and strong smoke aroma caused the chicken meat *urutan* to produce aromas that tended to be the same and had no significant difference in aroma. The similar sour aroma of chicken meat *urutan* was due to the same ingredients used, as well as the similar smoking process in each treatment.

The sour aroma of the chicken meat *urutan* was similar because the ingredients used were the same, and the smoking process was similar in each treatment. Spices have an important role in creating food flavor and are enhanced by the fumigation process[6]. This is in line with Pascual et al.'s (1997) statement that the aroma produced comes from spices, proteins, and flavor-giving fats, as well as lactic acid bacteria and yeast that affect the aroma and sensory quality of fermented sausages. The sour aroma of fermented sausage is caused by lactic acid produced by the metabolism of lactic acid bacteria.

The sun-drying time of 2 days, 4 days, and 6 days on chicken meat *urutan* did not have a significant effect ($P>0.05$) on the texture of chicken meat *urutan*. The dense texture of chicken meat *urutan* is caused by the use of salt, thus increasing the osmosis pressure. This resulted in the water content in the chicken meat *urutan* decreasing as the drying time increased. Reduced water content causes the texture of the product to become denser and more compact due to increased activity of the enzyme pectin methylesterase and the formation of concentrated calcium[26].

Chicken meat thickness and fat content also affect the texture of chicken meat *urutan*. The addition of salt and the fermentation process will cause biochemical changes so that the texture of chicken meat will change as the fermentation time increases. The texture of chicken meat *urutan* is dense and compact compared to sausage in general due to the fermentation process which causes fat and carbohydrates to be denatured by lactic acid bacteria. The texture of fermented sausage is also influenced by the fat added to the dough and aims to add calories, improve texture, and enrich flavor in food ingredients[25].

The sun-drying time of 2 days, 4 days, and 6 days on chicken meat *urutan* did not have a significant effect ($P>0.05$) on the total acceptance of chicken meat *urutan*. Total acceptance showed that all treatments had the same effect with a hedonic scale of somewhat like. The results on total acceptance were not significantly different because the level of preference for color, taste, aroma, and texture showed results that were not significantly different, so the total acceptance also gave the same effect. This is in line with the opinion of Chapman & Chapman (1980) that other assessment components, such as taste, aroma, color, and texture are influenced by total acceptance. Total acceptance is the final decision of consumers in accepting a new product[19].

IV. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the research and discussion, it can be concluded that different lengths of sun-drying in the process of making chicken meat *urutan* affect the water content, shrinkage, and tenderness, but have no effect on the acceptability test. Duration of sun-drying chicken meat *urutan* for 2 days is the best length of sun-drying on the water content of chicken meat *urutan* at 63.45%, shrinkage at 13.55%, tenderness at 68.0 mm/gram/10 seconds, and acceptability at 5.00 (Somewhat Like) which can still be accepted by panelists. A sun-drying time of 2 days can be used in making chicken meat *urutan*. Further research on the sequence considering packaging and storage is required.

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