

Physicochemical, Microbiological, and Organoleptic Characteristics of IPB D1 Braised (Ungkep) Chicken at Different Storage Temperature and Different Storage Time

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ABSTRACT

Braised (Ungkep) chicken is one of the varieties of processed IPB D1 chicken that can be produced to increase consumer acceptance. The aim of this research was to analyze the physicochemical, microbiological and organoleptic characteristics of IPB-D1 braised chicken at refrigerator and freezer temperatures with storage times of 0, 7, and 14 days. A factorial completely randomized design was used in this study. The pH value and Total Plate Count (TPC) were significantly influenced by storage time ($P<0.05$). The storage temperature factor and the interaction between temperature and storage time did not have a significant effect on all variables. The TPC value up to the 14th day was still below the maximum limit, therefore it was still safe to consume.

Keywords: braised, IPB-D1 chicken, microbiology, organoleptic, physicochemical

ABSTRAK

Ayam ungkep adalah salah satu diversifikasi olahan ayam IPB D1 yang dapat diproduksi untuk meningkatkan penerimaan konsumen. Tujuan dari penelitian ini adalah menganalisis karakteristik fisikokimia, mikrobiologi, dan organoleptik ayam ungkep IPB-D1 pada suhu refrigerator dan freezer dengan lama penyimpanan 0, 7, dan 14 hari. Rancangan acak lengkap faktorial digunakan dalam penelitian ini. Nilai pH dan *Total Plate Count* (TPC) dipengaruhi secara nyata oleh lama penyimpanan ($P<0.05$). Faktor suhu penyimpanan dan interaksi antara suhu dan lama penyimpanan tidak berpengaruh nyata pada semua peubah. Nilai TPC sampai dengan hari ke-14 masih di bawah batas maksimum, oleh sebab itu masih aman dikonsumsi.

Kata kunci: ayam IPB-D1, fisikokimia, mikrobiologi, organoleptik, ungkep

INTRODUCTION

According to the Badan Pusat Statistik (2022), broiler chicken consumption in Indonesia reached 0.13 Kg/capita/ week in 2022. Meanwhile, broiler chicken production reached 3,765,573.09 tonnes in 2022 (BPS 2023). Overall, broiler chicken meat production had been successful in demand in 2022 considering there was a monthly surplus. Meanwhile, the average consumption of free-range (non-race) chicken meat per capita per week in 2022 was 0.018 kg (BPS 2023). Kampung chicken production in 2022 was 275,415.61 tons, and this production differed greatly from the production of meat from broiler chicken (BPS 2023).

Based on the data obtained, the consumption and production of kampung chicken is lower than that of broiler chicken. According to Padapi *et al.* (2021) the reason is because kampung chickens have limitations in cultivation. Kampung chickens grow slowly because there has not been much genetic development. As a result, crossbreeding native chickens or kampung chickens is required to boost the productivity and growth of local chickens (Lukmanudin *et al.* 2018). The IPB-D1 chicken is one of the crossbred local chickens. IPB-D1 chickens are a new family of composite local chickens established by the Ministry of Agriculture as a result of cross between Pelung, Sentul, Kampung chickens and broiler breeds (Falah *et al.* 2022). IPB-D1 chicken meat

has 18.18% protein content, 0.25% fat content, 4.23% carbohydrate content, 1.27% ash content, and 76.07% moisture content (Pangestu 2019). Broiler meat is a food with high nutritional value which contains around 75% water, 19% protein and 2.5% fat. Chicken meat also has a distinctive taste and is cheap (Edi *et al.* 2018).

However, the high nutritional content in meat provides an ideal environment for microbial growth, making chicken meat a perishable food. Deterioration in quality of chicken meat is usually caused by improper handling, which can lead to the growth of spoilage bacteria and reduce the quality and utility of the meat; consequently, processing or diversification of chicken products is required to preserve it (Jaelani *et al.* 2014). Diversifying chicken meat attempts to preserve its nutritional value, raise its quality, and increase its usefulness while also extending its shelf life.

One way to diversify chicken meat products is by braising them. The braising technique is a typical Indonesian way of cooking that has been done for a long time. Braising itself has the meaning of cooking ingredients that have been seasoned or marinated over low heat for a long time. By braising it, spices easily release enzymes which can give rise to a distinctive aroma and taste (Siswanti *et al.* 2018). Many people prefer braised chicken because it is simple to prepare, has no preservatives, tastes good, and has a soft texture (Pertiwi 2017). Braised (ungkep) chicken is also popular among the general public as an alternative to fast and convenient food choices kept in the refrigerator. Products that have been processed have a limited shelf life before degrading if kept at room temperature; consequently, a preservation method is required to extend the shelf life of the product. The goal of meat preservation is to prevent enzymatic, chemical, and physical damaging reactions. Packaging and storing it at freezing temperatures is one method of preservation (Lestarie 2018).

Proper packaging can prevent food spoiling by preventing the entry of oxygen and contaminated air. The packaging used in this study was a polypropylene plastic box/food box. Polypropylene (PP) packaging has the advantage of being able to endure high temperatures, with a melting point of 160 °C. Furthermore, PP plastic packaging is suitable for foodstuffs held at low temperatures because of its high density and low permeability of water vapour and gas, making it difficult for water vapour to penetrate (Mulyawan *et al.* 2019). As a result, polypropylene packaging is likely to preserve the quality of IPB-D1 braised chicken.

Refrigerator and freezer storage is the most simplest and widely used method of extending the shelf life of foodstuffs. Cooked chicken can be stored in the freezer at -17 °C for up to 4 months. Meanwhile, 7 days of refrigerator storage at 4 °C results in good quality (Kasih *et al.* 2012). However, the duration of storage can also have an impact on the quality of the meat; the longer it is held, the lower the quality. Physical and chemical conditions, the degree of microbiological contamination, and product sensory qualities can all be used to assess meat quality. Thus, the purpose of this study was to examine the quality of IPB-D1 braised (ungkep) chicken at various storage temperatures

(refrigerator and freezer) and storage times.

MATERIAL AND METHODS

Material

The equipment used in the test was a pH meter (pH55 lonix, China), a_w meter (Novasina MS1, Switzerland), oven (Mettler UM 400, Germany), petri dishes (K1004-J Sterile Disposable Polystyrene, USA), texture analyzer (Perten TVT, Australia), incubator, desiccator, beaker, sokhlet apparatus, hulls, Kjehdahl tube, forms for scoring organoleptic tests. The raw materials used were IPB D1 chicken meat. The age of IPB D1 chickens when slaughtered was 12 weeks, shallots, garlic, turmeric, candlenuts, lemon-grass, bay leaves, coriander, salt, sugar, and flavouring. The test materials used were buffer solutions pH 4 and 7, NaCl solution, PCA (plate count agar), distilled water, selenium, concentrated H_2SO_4 , H_3BO_3 , HCl, $HNO_{3(P)}$, hexane solvent, methanol, KOH, BF_3 , NaCl.

Methods

The chicken carcass was cut into four pieces and rinsed under running water. After that, marinate the meat for 30 minutes in lemon juice, covering the entire surface. The chicken meat was washed under running water after marinating to remove the sour taste. IPB-D1 chicken meat was seasoned with mashed spices, including shallots, garlic, turmeric, candlenuts, salt, sugar, flavouring, pounded ginger and lemon grass, as well as bay leaves. The chicken meat was added with the spices until evenly distributed and then set aside for 30 minutes. After that, place it in a pot with 2 litres of water. The cooking time was ± 45 minutes or until the spices were absorbed. The chicken was then chilled and wrapped in box packaging for storage in the freezer at -17 °C and the refrigerator at 4 °C. After 0, 7, and 14 days of storage, the braised (ungkep) chicken was analysed. The variables measured in this study are: pH value (AOAC 2005), a_w value (AOAC 2005), Texture (Indriani *et al.* 2022), Moisture Content (AOAC 2005), Total Plate Count (SNI 2008) and organoleptic test with scoring test method (SNI 2006).

Prior to analysis, the IPB-D1 braised (ungkep) chicken that had been stored and refrigerated was thawed. Prior to testing, samples stored in the refrigerator were thawed at room temperature for one hour. Meanwhile, the stored samples were refrigerated overnight or for 12 hours before being thawed at room temperature. Thawing transformed raw materials or products that were previously in a solid phase into a liquid phase.

Data Analysis

The research design was carried out using a completely randomized design (CRD) factorial pattern (3x2) treatment with 3 replications. Factor A : storage time (A1 : 0 days, A2 : 7 days, A3 : 14 days). Factor B : storage temperature (B1 : refrigerator storage temperature, B2 : freezer storage temperature). The data obtained were then processed using analysis of variance based on a completely randomized design (CRD) (Gaspersz 1991). The linear model used is as follows:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijh}$$

where:

- Y_{ijk} = observation response variable
- I = treatment of duration storage time
- J = treatment of storage temperature
- K = repetition
- μ = the average value of the observations
- α_i = the effect of the level of treatment on the i th storage time
- β_j = effect of the j th storage temperature
- $(\alpha\beta)_{ij}$ = the effect of the interaction factor of the i th storage duration with the j th storage temperature on the research response
- ϵ_{ijh} = error

The acquired data were then analysed using analysis of variance (ANOVA). If the analysis of variance results shows a significant treatment effect ($P < 0.05$), then proceed with the Tukey test (Steel dan Torrie 1995). Organoleptic test results data were analyzed statistically non-parametric using the Kruskal-Wallis test.

RESULTS AND DISCUSSION

The pH value, a_w value, texture value, moisture content and TPC were not significantly influenced by the interaction between temperature and storage time.

pH Value

The effect of treatment on pH values is presented in Table 1. Measurements of pH values in this study showed significantly different results ($P < 0.05$) for 0, 7, and 14 days of storage, but the temperature used did not affect the pH value of processed braised chicken IPB-D1. According to Wala *et al.* (2016), the pH of processed chicken that has been stored at cold temperatures ranges from 6.09-6.56. In this study, the braised (ungkep) chicken with freezer and refrigerator storage and storage time of 0, 7, and 14 days had pH values between 6.19 and 6.43. According to the literature, the pH of the resulting braised (ungkep) chicken is not significantly different from the pH of other processed chicken. SNI has not yet regulated the quality requirements for cooked chicken meat in Indonesia.

Table 1. pH value of IPB D1 braised (ungkep) chicken at different storage temperature and different storage time

Storage Time (days)	Storage Temperature		Average
	Freezer	Refrigerator	
0	6.19 ± 0.08	6.19 ± 0.08	6.19 ± 0.00b
7	6.36 ± 0.07	6.42 ± 0.03	6.39 ± 0.02a
14	6.36 ± 0.03	6.43 ± 0.03	6.39 ± 0.02a
Rataan	6.30 ± 0.09	6.34 ± 0.13	

Note: different letters in the same column indicate significantly different ($P < 0.05$)

Storage time of 0, 7, 14 days had a significant effect ($P < 0.05$) on increasing the pH value. The increased pH value is caused by microbial activity in the meat which deaminates the amino acids in the meat to produce alkaline compounds (Wala *et al.* 2016). Refrigerator and freezer storage temperatures did not show significantly different results. Cold temperature storage can reduce chemical reactions, thereby inhibiting the activity of microorganisms and bacterial growth to be able to maintain the pH rate (Prabawa *et al.* 2021).

a_w Value

The changes in the a_w value during storage were not significant, showing that the IPB-D1 braised (ungkep) chicken's water activity tends to remain constant (Table 2). This is because the a_w value is associated with the relative humidity (RH) in the environment during storage, which tends to stay constant (Ismail *et al.* 2016). The relationship between a_w and humidity is an equilibrium relationship between the free water content in a material and the water content in the air. If the air moisture content is high, the material will absorb air water and vice versa if the free water content in the material is higher than in the air, the air will absorb the material water until an equilibrium state is reached.

Table 2. a_w value of IPB D1 braised (ungkep) chicken at different storage temperature and different storage time

Storage Time (days)	Storage Temperature		Average
	Freezer	Refrigerator	
0	0.85 ± 0.01	0.85 ± 0.01	0.85 ± 0.00
7	0.85 ± 0.00	0.86 ± 0.00	0.85 ± 0.00
14	0.86 ± 0.00	0.86 ± 0.00	0.86 ± 0.00
Rataan	0.85 ± 0.00	0.85 ± 0.00	

According to Fatiha (2018) the a_w produced in processed *pepes* chicken ranges from 0.83-0.8, while the a_w value resulting from this study ranges from 0.85-0.86. Referring to the literature, the a_w value of IPB-D1 braised (ungkep) chicken was not much different from the a_w value of other processed chickens. A high a_w value can cause braised (ungkep) chicken to be easily damaged, because it can be a medium for the growth of spoilage microbes and certain chemical reactions such as oxidation reactions and enzymatic reactions (Fatiha 2018). More bacteria can develop when the a_w value is close to 1. The a_w values above 0.7 are favourable for mould growth, above 0.75 for yeast growth, above 0.8 for bacterial growth, and above 0.91 for pathogenic bacteria that can cause disease (Leviana and Paramita 2017).

Texture Value

The texture is one of the test variables for food quality that can assess the hardness, softness and crispiness of a food product. The texture value observed in this study is the hardness value. The hardness values obtained in this study

Table 3. Texture value (g/force) of IPB D1 braised (ungkep) chicken at different storage temperature and different storage time

Storage Time (days)	Storage Temperature		Average
	Freezer	Refrigerator	
0	1975.46 ± 42.29	1975.46 ± 42.29	1975.46 ± 0.00
7	1934.81 ± 88.23	1943.55 ± 61.90	1939.18 ± 6.18
14	1885.81 ± 14.81	1953.30 ± 40.71	1919.56 ± 47.72
Rataan	1932.03 ± 44.88	1957.43 ± 16.35	

range from 1885.81 to 1975.46 g/force (Table 3). Research conducted by Indiarito *et al.* (2021) the hardness value produced for smoked chicken was 1031.68-2385.23 g/force. Thus, when referring to the literature, the texture value of IPB-D1 braised (ungkep) chicken was not much different from the texture value of other processed chicken. Based on the texture value results, the texture of braised chicken is in the hard category. The results of the analysis of variance showed that the storage time and temperature were not significantly different ($P>0.05$).

The moisture content and pH value of the meat can both alter its textural value. High moisture content can degrade a product's texture and promote the growth of microbes, causing the product to decay faster (Nugroho 2019). The texture value was found to be the lowest in samples stored in the freezer for 14 days, with a value of 1885.81 g/force. This is due to the freezing process, which causes ice crystals to form, which might disrupt the structure of the meat tissue. Hardness can also be affected by the cooking process, storage time, and storage techniques. Product quality is affected by storage time; the longer the meat is stored, the softer the texture will be since the pH of the meat has decreased. The decrease in pH is caused by protein denaturation which results in a decrease in water holding capacity and a decrease in texture.

Mositure Content

Mositure content in a food product is one of the variables in testing its physical properties which states the amount of water in a material. The effect of the treatment on the water content value was presented in Table 4. The results of the analysis of variance showed no significant difference and between the two treatments, there was no interaction. Based on the research results, the water content of IPB-D1 braised (ungkep) chicken ranged from 62.42-64.86%. According to Nugroho (2019), the moisture content in braised chicken has a value of 59.89-60.19%.

Table 4. Mositure content (%) of IPB D1 braised (ungkep) chicken at different storage temperature and different storage time

Storage Time (days)	Storage Temperature		Average
	Freezer	Refrigerator	
0	62.42 ± 1.80	62.42 ± 1.80	62.42 ± 0.00
7	63.65 ± 1.14	63.82 ± 5.23	63.73 ± 0.12
14	63.99 ± 0.90	64.86 ± 2.29	64.42 ± 0.61
Rataan	63.35 ± 0.82	63.70 ± 1.22	

The moisture content of the IPB-D1 braised (ungkep) chicken was higher as compared to the literature. The ability of a material to bind water, also known as water holding capacity (WHC), can cause a material's moisture content to increase (Atmojo 2014). Changes in moisture content can also be influenced by room humidity during food ingredient storage due to the process of absorbing water vapour from the air, which causes the water content to rise. As a result, high permeability packaging, such as PP plastic, is required to ensure that the product is not easily contaminated by water and other types of damage (Afrianti *et al.* 2013). Another factor that causes the water content of braised chicken to be higher was because the cooking technology was different.

Total Plate Count (TPC)

The results of analysis of variance showed that TPC was significantly ($P<0.05$) affected by storage time, but not significantly ($P>0.05$) by storage temperature (Table 5). Based on the data that has been obtained, total microbes in IPB-D1 braised (ungkep) chicken with different storage periods and storage temperatures have values ranging from 1.67 to 4.46 log cfu/g.

Table 5. Total Plate Count (TPC) (log cfu/g) of IPB D1 braised (ungkep) chicken at different storage temperature and different storage time

Storage Time (days)	Storage Temperature		Average
	Freezer	Refrigerator	
0	1.67	1.67	1.67b
7	3.82	4.32	4.07a
14	4.03	4.46	4.24a
Rataan	3.17	3.8	

Note: different letters in the same column indicate significantly different ($P<0.05$)

SNI (2009) states that the maximum limit of microbial contamination in food was 5.00 log cfu g⁻¹. As a result, braised (ungkep) chicken that had been stored at low temperatures for up to 14 days was still safe for public consumption. Total microbes were significantly affected by time storage treatment. The longer the storage, the more base is created due to increasing microbial activity, which finally leads to deterioration. The decomposition process will be followed by microbial growth, increasing the overall number of microorganisms collected. (Edi and Rahmah 2018). According to Fardiaz (1992), bacterial growth is also influenced by water supply or water content contained in a food ingredient. The amount of high water content can

cause the bacterial population to increase because the water contained in food is used by bacteria as a place for their growth.

Because it contains antimicrobial spices such as turmeric, shallots, garlic, and coriander, IPB-D1 braised (ungkep) chicken can be stored for up to 14 days. For storage of more than 14 days, further investigation is needed. The essential oil contained in turmeric can be used as an antibacterial because it contains hydroxyl and carbonyl functional groups which are phenol derivatives. These phenol derivatives will interact with the bacterial cell wall before being absorbed and penetrating the bacterial cell, inducing precipitation and protein denaturation, resulting in membrane lysis. Turmeric, in addition to possessing antibacterial effects, is also an antioxidant (Septia and Simanjuntak 2015). Allicin chemicals found in onions and garlic can decrease bacterial activity. Shallots have a broad spectrum of antibacterial activity because they can inhibit the growth of both gram-positive and gram-negative bacteria. Coriander has an essential oil level ranging from 0.4-1.1% of the total weight of coriander seeds, according to Hasanah and Dori (2019). Essential oils and coriander seed extract can inhibit the growth of Gram-positive and Gram-negative.

Organoleptic Test : Scoring Method

The average results of the IPB-D1 braised (ungkep) chicken scoring method at different temperatures and storage times with the quality criteria tested in the form of colour, aroma, taste and texture are presented in Table 6. However, the panelists were not evaluated on the taste and texture of the fried chicken samples stored in the refrigerator. According to Kasih *et al.* (2012), food stored at 4 °C has a 7-day shelf life, whereas food stored at -17 °C has a 4-month shelf life.

Colour

Based on the results of the scoring test on the colour quality criteria of IPB-D1 braised (ungkep) chickens with different time storage treatments and storage temperatures did not show significantly different results (P>0.05). According to the data, the value of braised (ungkep) chicken ranges between 2.15-3, which is brownish yellow to light brown. The yellow colour of the braised (ungkep) chicken

is due to the spice used, turmeric. Turmeric includes the colour curcumin, which causes it to turn yellow to orange (Sundari 2016). The brown colour created by the braised (ungkep) chicken is owing to the frying procedure, which creates a non-enzymatic browning reaction with the Maillard reaction. Non-enzymatic Maillard reactions occur as a result of heating-induced interactions involving reducing sugar groups and freeing amino acid groups from amino acids or proteins (Miranti 2020).

The browning process, also known as the Maillard reaction, is induced by the frying temperature and the viscosity of the oil. The fried ingredients will turn a dark brown or burnt colour if the temperature is too high. Because of the increased oil viscosity, the colour of the oil adheres to the fried products more easily. The condition of the frying oil is particularly important, as the fried food should have a visually appealing appearance (Rahman *et al.* 2016). Cooking oil that is used regularly can degrade the quality of the oil and potentially represent a health risk. It not only degrades the quality of oil used repeatedly, but it can also degrade the quality of fried products. Physical changes in food ingredients, as well as a drop in the nutritional value content of food ingredients, can result in a reduction in quality (Zahra *et al.* 2013). The research carried out produced a non-uniform colour because the oil used for frying was used repeatedly (3 times of frying), so the results obtained had different colour values. According to Zahra *et al.* (2013), cooking oil may be used repeatedly for up to 1-4 frying times, after which it is recommended to replace it with new oil.

Aroma

Aroma is a critical indicator in the food industry since it may immediately determine whether or not a product is acceptable. The scoring test results on the quality criteria of IPB-D1 braised (ungkep) chicken aroma with different time storage treatments and storage temperatures revealed no significant differences (P>0.05). According to the data, the value of braised (ungkep) chicken ranges from 3.20 to 3.55, indicating that it is slightly odour to the odour of chicken meat. According to Muliady *et al.* (2016), odour can be produced by the presence of volatile chemicals found

Table 6. IPB-D1 braised chicken scoring test at different storage temperature and different storage time

Treatments	Quality Criteria			
	Colour	Aroma	Taste	Texture
KH0	2.15 ± 1.08	3.55 ± 1.09	2.95 ± 0.82	3.30 ± 0.92b
RH7	2.55 ± 0.94	3.20 ± 1.00	-	-
FH7	2.40 ± 0.94	3.40 ± 1.09	3.60 ± 0.82	4.10 ± 0.71a
RH14	2.25 ± 1.11	3.20 ± 1.28	-	-
FH14	3 ± 1.25	3.35 ± 0.93	3.45 ± 1.14	3.40 ± 0.99a

Note: different letters in the same column indicate significantly different (P<0.05)

KH0 = control fried chicken with storage H0, RH7 = refrigerated storage chicken on the 7th day, FH7 = freezer storage chicken on the 7th day, RH14 = refrigerator storage chicken on the 14th day, FH14 = storage fried chicken freezer on 14th day. Color 1 = yellow, 2 = brownish yellow, 3 = light brown, 4 = brown, 5 = dark brown. Aroma 1 = not very smelly of chicken meat, 2 = not smelly of chicken meat, 3 = slightly smells of chicken meat, 4 = smells of chicken meat, 5 = very smelly of chicken meat. Taste 1 = very no taste of spices, 2 = no taste of spices, 3 = slightly taste of spices, 4 = taste of spices, 5 = very taste of spices. Texture 1 = very tough, 2 = very tough, 3 = a little tough, 4 = not very tough, 5 = very not very tough

in foodstuffs and can evaporate throughout the heating process.

Taste

Taste is a critical indicator of the value of product acceptance and taste from food product quality. The scoring test results on the quality criteria of IPB-D1 braised (ungkep) chicken aroma with varied time treatments and storage temperatures revealed no significant differences ($P>0.05$). According to the data, the value of braised (ungkep) chicken ranges from 2.95 to 3.60, with a slightly spicy to spicy taste. The value of the taste parameter rises after the braised chicken is stored, which could be due to spice absorption throughout the storage process.

Texture

The scoring test on the IPB-D1 broiler aroma quality criteria with different storage times and temperature treatments yielded significantly varied results ($P>0.05$). According to the study findings, the value of braised (ungkep) chicken ranges from 3.30 to 4.10, indicating a slightly tough to not tough level. The texture of the fried chicken is affected by storage time. The freezing process is responsible for textural changes that occur during storage. The texture value was at its highest level, namely not tough, on the 7th day of storage, however, it reduced to a slightly tough level on the 14th day of storage. Differences in texture values are also caused by different carcass sizes in each sample used.

CONCLUSION

The pH value, a_w value, texture value, moisture content and TPC were not significantly influenced by the interaction between temperature and storage time. The results showed that the storage time of IPB-D1 braised (ungkep) chicken affected the pH and TPC values. Freezer and refrigerator storage temperatures did not affect the physicochemical and microbiological characteristics of IPB-D1 braised (ungkep) chicken. Organoleptic test results, temperature and storage time affect the texture quality criteria of IPB-D1 braised chicken. IPB-D1 braised (ungkep) chicken with a TPC value less than the maximum limit can be stored for up to 14 days and is still safe to eat.

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