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Original Research Article

Physical Characteristics of Spent Sentul Chicken Breast Marinated with Pineapple Peel Extract at Different Immersion Durations and Marination Levels

Lulu Raudatul Zannah[1], Dini Widianingrum[2], Rachmat Somanjaya[2]*, Oki Imanudin[2], Aaf Falahudin[2]

[1]Undergraduate Student, Study Program of Animal Husbandry, Faculty of Agriculture, Universitas Majalengka, Indonesia
[2]Study Program of Animal Husbandry, Faculty of Agriculture, Universitas Majalengka, Indonesia

***Corresponding author:** Rachmat Somanjaya

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Abstract: This study evaluated the effects of immersion duration and pineapple peel extract marination level on the physical characteristics of spent Sentul chicken breast. A completely randomized design with a 3 x 3 factorial arrangement was used. The first factor was immersion duration (10, 15, and 20 min), and the second factor was pineapple peel extract level (15%, 30%, and 45%), with two replicates per treatment combination. The observed variables were pH, water-holding capacity (WHC), instrumental tenderness response, and cooking loss. Data were analyzed using a General Linear Model, followed by Tukey and Duncan multiple-range procedures where appropriate. Immersion duration significantly affected pH, WHC, and the instrumental tenderness response ($p<0.05$). Marination level affected WHC and the tenderness response, while the duration x level interaction affected pH, WHC, and the tenderness response. Cooking loss was not significantly affected by either factor or their interaction ($p>0.05$). The reported pH values ranged from 5.77 to 6.01, WHC from 34.56% to 67.41%, the instrumental tenderness response from 13.99 to 39.86 instrument units, and cooking loss from 25.00% to 40.00%. The highest WHC was obtained after 10 min of immersion at a 30% extract level. Pineapple peel extract therefore modified several physical traits of spent Sentul chicken meat, although no single treatment combination optimized every response.

Keywords: Bromelain, Marination, Pineapple Peel Extract, Sentul Chicken, Spent Chicken, Water-Holding Capacity.

INTRODUCTION

Sentul chicken is an Indonesian local chicken originating from Ciamis, West Java, and is valued as a dual-purpose genetic resource for meat and egg production (Hayati *et al*., 2019). Its meat has a characteristic flavor and relatively lean composition, and previous work has described quality attributes of Sentul chicken meat (Ariyanti *et al*., 2019). However, meat from birds at the end of the productive cycle is less tender than meat from younger chickens because advancing age increases connective-tissue maturity and collagen cross-linking, thereby increasing resistance to tenderization (Bhat *et al*., 2018). This limits consumer acceptance and reduces the economic value of spent Sentul chickens despite their availability as a local animal-protein resource.

Marination is widely used to improve poultry-meat quality by introducing water, acids, salts, spices, and bioactive compounds into muscle tissue (Alvarado & McKee, 2007; Latoch *et al*., 2023). The effectiveness of a marinade depends on its formulation, concentration, contact time, temperature, and the intrinsic buffering and structural properties of the meat (Latoch *et al.,* 2023). In spent poultry, an appropriate marinade may alter pH, water retention, cooking yield, and texture-related responses (Alvarado & McKee, 2007; Okpala *et al*., 2022). Excessive acidification or proteolysis, however, can disrupt the protein matrix and adversely affect water-holding capacity and texture (Bhat *et al.,* 2018).

Pineapple-derived materials are promising natural marinade ingredients because they contain proteolytic enzymes, particularly bromelain, that can modify muscle structure (Ha *et al.,* 2012; Ketnawa &

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Rawdkuen, 2011). Bromelain is a cysteine protease capable of hydrolyzing myofibrillar and connective-tissue proteins (Ha *et al*., 2012). Pineapple-derived proteases have been used to tenderize beef and poultry in several forms, including bromelain extract, pineapple crown preparations, pineapple core extract, and pineapple juice (Ketnawa & Rawdkuen, 2011; Nadzirah *et al*., 2016; Hussain *et al.,* 2022; Senturk *et al.,* 2019). The response is dose- and time-dependent: insufficient exposure may have little effect, whereas excessive exposure may cause excessive softening or structural breakdown; therefore, concentration and immersion duration should be optimized together (Novita *et al*., 2019; Hussain *et al*., 2022; Susanti *et al*., 2024).

Information on the combined effects of pineapple peel extract level and immersion duration on spent Sentul chicken meat remains limited. Therefore, this study evaluated pH, water-holding capacity, instrumental tenderness response, and cooking loss of spent Sentul chicken breast subjected to three immersion durations and three extract levels. It was hypothesized that immersion duration and extract level would interact in modifying the physical characteristics of the meat.

MATERIALS AND METHODS

Research Location and Materials

The experiment was conducted from March to April 2026. Sample preparation, marination, and cooking-loss measurements were carried out in Gunungmanik Village, Talaga District, Majalengka Regency, West Java, Indonesia. Laboratory measurements of pH, water-holding capacity, and instrumental tenderness were conducted at the Microbiology Laboratory and the Animal Product Processing Technology Laboratory, Faculty of Animal Husbandry, Universitas Padjadjaran, Indonesia. The main materials were breast meat from spent Sentul chickens, pineapple peel, distilled water, and 70% alcohol for equipment sanitation. The birds were approximately 18-20 months old.

Experimental Design

A completely randomized design with a 3 x 3 factorial arrangement and two replicates was applied, producing 18 experimental units. Factor A was immersion duration: 10 min (W1), 15 min (W2), and 20 min (W3). Factor B was pineapple peel extract level: 15% (E1), 30% (E2), and 45% (E3). Each experimental unit consisted of 100 g of breast meat immersed in 100 mL of the assigned marinade solution.

Preparation of Pineapple Peel Extract and Marination

Fresh pineapples were peeled to obtain an approximately 0.5-cm-thick peel fraction. The peel was cut into pieces of approximately 2 cm, washed under running water, drained, blended, and filtered through sterile cloth. The filtrate was collected as pineapple peel extract and diluted with distilled water to prepare the assigned marination levels. Breast meat was portioned into 100-g samples, placed in labeled containers, completely immersed in 100 mL of marinade, and held for the assigned duration. After immersion, the samples were drained, placed in clip-seal plastic bags, and transported for physical-quality measurements.

Physical-Quality Measurements

Meat pH was measured using an electronic pH meter after the electrode had been rinsed with distilled water and calibrated to the neutral reference. Water-holding capacity was determined using a filter-paper press procedure consistent with the analytical principle described by Szmanko *et al*., (2021): a meat sample on Whatman filter paper was pressed between glass plates under a 35-kg load for 5 min, and the meat and wet areas were traced. Expressible water was estimated from the wet-area measurement and used with the sample moisture value to calculate WHC.

For the instrumental tenderness measurement, samples were standardized to approximately 3 cm in length and 1 cm in thickness, cooked to an internal temperature of approximately 70 degrees C, cooled to room temperature, and measured with a meat tenderness meter. The response was expressed as the maximum cutting force divided by the cross-sectional area (F/A). Values are reported as instrument units because the calibrated reporting unit was not documented in the laboratory record available for manuscript preparation. Cooking loss was determined from 10-g samples sealed in plastic, heated at 70 degrees C for 30 min, cooled under running water, surface-dried, and reweighed. Cooking loss was calculated as [(initial weight - cooked weight)/initial weight] x 100%.

Statistical Analysis

The data were analyzed using the General Linear Model for a two-factor completely randomized design. The main effects of immersion duration and extract level and their interaction were evaluated at the 5% significance level. Tukey tests were used for significant factor effects, and Duncan multiple-range tests were used for significant treatment-combination effects, consistent with the statistical procedure reported in the thesis. Results are presented as mean +/- standard deviation (n=2).

RESULTS AND DISCUSSION

pH Value

The pH of marinated spent Sentul chicken breast ranged from 5.77 to 6.01 (Table 1). Immersion duration significantly affected pH, while the main effect of extract level was not significant in the reported thesis analysis. A significant interaction indicated that the response to extract level depended on immersion duration. The lowest pH occurred at 15 min with 15% extract, whereas the highest value occurred at 10 min with 15% extract. The observed values are comparable with pH values commonly reported for marinated poultry meat (Gok & Bor, 2016; Okpala *et al*., 2022).

The reduction in pH at selected treatment combinations can be attributed to the diffusion of acidic components from pineapple-derived marinade into the muscle, a mechanism also reported for fruit- and vegetable-based marinades (Gok & Bor, 2016). Longer contact gives acidic compounds and proteolytic enzymes more time to interact with muscle proteins, while the buffering capacity of meat can moderate the magnitude of pH change (Latoch *et al.,* 2023). Similar physicochemical changes have been reported in marinated poultry products treated with natural marinades (Okpala *et al*., 2022). Moderate acidification may contribute to microbial control and product functionality, but excessive movement toward the isoelectric region of muscle proteins can reduce water retention (Alvarado & McKee, 2007; Huff-Lonergan & Lonergan, 2005).

Table 1: pH of spent Sentul chicken breast marinated with pineapple peel extract

Immersion duration	15% extract	30% extract	45% extract	Duration mean
10 min	6.01 +/- 0.03	5.99 +/- 0.03	5.89 +/- 0.00	5.96 +/- 0.06
15 min	5.77 +/- 0.03	5.79 +/- 0.03	5.89 +/- 0.00	5.82 +/- 0.06
20 min	5.90 +/- 0.11	5.90 +/- 0.03	5.89 +/- 0.00	5.90 +/- 0.02
Level mean	5.89 +/- 0.11	5.89 +/- 0.09	5.89 +/- 0.00	5.89 +/- 0.08

Factor effects: *immersion duration, p<0.001; extract level, p=0.840; interaction, p<0.001. Values are mean +/- SD (n=2). Values are presented for the nine factorial treatment combinations.*

Water-Holding Capacity

Water-holding capacity displayed a strong interaction between immersion duration and extract level (Table 2). The highest WHC was obtained with 10 min of immersion at a 30% extract level (67.41%), whereas the lowest value occurred with 10 min at 45% extract (34.56%). This non-linear pattern shows that increasing extract concentration did not consistently improve water retention. A moderate level may have promoted limited proteolysis and muscle swelling, while the highest level during short immersion may have caused rapid acidification or structural disruption that increased expressible water.

WHC reflects the ability of the protein matrix to retain water during pressure, cutting, storage, and cooking. Postmortem pH, myofibrillar spacing, protein denaturation, and structural changes are major determinants of this property (Huff-Lonergan & Lonergan, 2005). Controlled proteolysis can alter muscle structure and water distribution, whereas extensive protein degradation may weaken the structural network that retains water (Bhat *et al*., 2018; Ha *et al.,* 2012). The marked interaction in the present study therefore emphasizes the need to optimize concentration and time together rather than selecting either factor independently.

Table 2: Water-holding capacity (%) of spent Sentul chicken breast marinated with pineapple peel extract

Immersion duration	15% extract	30% extract	45% extract	Duration mean
10 min	46.95 +/- 0.91	67.41 +/- 0.86	34.56 +/- 0.79	49.64 +/- 14.85
15 min	47.02 +/- 0.86	43.64 +/- 0.76	51.05 +/- 0.77	47.23 +/- 3.37
20 min	35.57 +/- 0.80	55.93 +/- 0.74	63.30 +/- 0.84	51.93 +/- 13.36
Level mean	43.51 +/- 5.42	55.66 +/- 10.65	49.60 +/- 12.91	49.60 +/- 10.82

Factor effects: *immersion duration, p<0.001; extract level, p<0.001; interaction, p<0.001. Values are mean +/- SD (n=2). Higher values indicate a greater capacity to retain water under the stated press-test conditions.*

Instrumental Tenderness Response

The instrument-measured tenderness response increased with both immersion duration and pineapple peel extract level, and the interaction was significant (Table 3). The lowest value was observed at 10 min with 15% extract, while the highest value was observed at 20 min with 45% extract. This progressive response is consistent with reports that increasing pineapple-derived protease exposure through concentration and/or marination time can markedly alter poultry-meat texture (Hussain *et al*., 2022; Novita *et al*., 2019; Susanti *et al*., 2024).

Bromelain can hydrolyze myofibrillar proteins and connective-tissue components, reducing structural resistance in meat (Ha *et al*., 2012; Ketnawa & Rawdkuen, 2011). Studies using pineapple juice, pineapple core extract, pineapple crown-derived bromelain, and other pineapple preparations have similarly reported substantial tenderizing or textural effects in meat (Senturk *et al*., 2019; Hussain *et al*., 2022; Nadzirah *et al*., 2016). However, interpretation of the absolute values requires confirmation of the meat tenderness meter calibration and whether higher readings represent greater tenderness or greater cutting resistance. For this reason, the present manuscript reports the source values as an instrumental response rather than converting them to kg/cm2 or Newtons without documentary support.

Table 3: Instrumental tenderness response of spent Sentul chicken breast marinated with pineapple peel extract

Immersion duration	15% extract	30% extract	45% extract	Duration mean
10 min	13.99 +/- 0.83	21.36 +/- 0.79	24.38 +/- 0.82	19.91 +/- 4.82
15 min	15.92 +/- 0.87	27.65 +/- 0.77	35.99 +/- 0.83	26.52 +/- 9.04
20 min	17.86 +/- 0.93	31.27 +/- 0.80	39.86 +/- 0.90	29.66 +/- 9.94
Level mean	15.92 +/- 1.80	26.76 +/- 4.52	33.41 +/- 7.20	25.36 +/- 8.80

Factor effects: *immersion duration, $p<0.001$; extract level, $p<0.001$; interaction, $p<0.001$. Values are mean +/- SD (n=2) and are reported as instrument units (F/A) because the final calibrated unit was not documented in the available laboratory record.*

Cooking Loss

Cooking loss ranged from 25.00% to 40.00%, and neither immersion duration, extract level, nor their interaction had a significant effect (Table 4). The absence of a significant response may reflect the relatively short immersion periods, the small number of replicates, and high within-treatment variation in some combinations. Cooking loss is influenced by heat-induced protein denaturation, pH, water distribution, and structural shrinkage of muscle during heating (Huff-Lonergan & Lonergan, 2005; Alvarado & McKee, 2007).

The lack of significance does not mean that the marinade had no technological relevance. WHC measured under pressure responded strongly, whereas thermal loss did not. These tests represent different stresses on the muscle system, and their results need not move in parallel. A formulation that retains water during pressing may still release water during heating if protein denaturation and muscle shrinkage dominate (Huff-Lonergan & Lonergan, 2005). Future studies should use more replicates, a non-marinated control, standardized sample geometry, and precise internal-temperature monitoring to confirm the cooking-yield response.

Table 4: Cooking loss (%) of spent Sentul chicken breast marinated with pineapple peel extract

Immersion duration	15% extract	30% extract	45% extract	Duration mean
10 min	35.00 +/- 7.07	30.00 +/- 0.00	30.00 +/- 0.00	31.67 +/- 7.53
15 min	30.00 +/- 14.14	40.00 +/- 0.00	25.00 +/- 7.07	31.67 +/- 9.83
20 min	30.00 +/- 0.00	35.00 +/- 7.07	35.00 +/- 7.07	33.33 +/- 5.16
Level mean	31.67 +/- 7.53	35.00 +/- 7.75	30.00 +/- 6.32	32.22 +/- 6.47

Factor effects: *immersion duration, $p=0.450$; extract level, $p=0.884$; interaction, $p=0.357$. Values are mean +/- SD (n=2). Values were calculated from the validated replicate observations used in the factorial analysis.*

Practical Implications and Study Limitations

The results demonstrate that pineapple peel extract can modify several physical properties of spent Sentul chicken meat within only 10-20 min. The strong interactions for pH, WHC, and the instrumental tenderness response show that treatment selection should be based on a desired processing endpoint. A 10-min immersion at 30% extract maximized WHC, while the strongest instrumental response occurred at 20 min and 45% extract. Because cooking loss did not differ significantly, a single universally optimal combination could not be identified from the four physical traits.

The experiment was limited by two replicates per treatment combination, the absence of an untreated control, and the lack of a reported bromelain-activity assay. The calibrated unit of the tenderness instrument was not available in the laboratory record used for manuscript preparation. These limitations should be addressed before commercial recommendations are made. Sensory evaluation, microbiological quality, storage stability, color, lipid oxidation, and economic feasibility should also be examined.

CONCLUSIONS

Immersion duration and pineapple peel extract level interacted in modifying the pH, water-holding capacity, and instrumental tenderness response of spent Sentul chicken breast, while cooking loss remained unaffected. The highest water-holding capacity (67.41%) was obtained after 10 min of immersion at a 30% extract level. Increasing both immersion duration and extract level produced progressively larger instrumental tenderness readings, with the highest value at 20 min and 45% extract; the practical meaning of this value must be confirmed against the instrument calibration. Pineapple peel extract is therefore a promising locally available marinade ingredient, but the preferred treatment should be selected according to the targeted physical-quality attribute and validated through expanded trials.

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Conflict of Interest: The authors declare that they have no known conflict of interest related to this manuscript.

REFERENCES

- Alvarado, C., & McKee, S. (2007). Marination to improve functional properties and safety of poultry meat. Journal of Applied Poultry Research, 16(1), 113-120. https://doi.org/10.1093/japr/16.1.113
- Ariyanti, R., Ulupi, N., Suryati, T., & Arifiantini, R. I. (2019). Meat quality on Sentul cocks with different immunoglobulin yolk concentrations. Jurnal Ilmu Ternak dan Veteriner, 24(2), 76-81. https://doi.org/10.14334/jitv.v24i2.1861
- Bhat, Z. F., Morton, J. D., Mason, S. L., & Bekhit, A. E.-D. A. (2018). Applied and emerging methods for meat tenderisation: A comparative perspective. Comprehensive Reviews in Food Science and Food Safety, 17(4), 841-859. https://doi.org/10.1111/1541-4337.12356
- Gok, V., & Bor, Y. (2016). Effect of marination with fruit and vegetable juice on some quality characteristics of turkey breast meat. Brazilian Journal of Poultry Science, 18(3), 481-488. https://doi.org/10.1590/1806-9061-2016-0225
- Ha, M., Bekhit, A. E.-D. A., Carne, A., & Hopkins, D. L. (2012). Characterisation of commercial papain, bromelain, actinidin and zingibain protease preparations and their activities toward meat proteins. Food Chemistry, 134(1), 95-105. https://doi.org/10.1016/j.foodchem.2012.02.071
- Hayati, S. N., Mulyono, S., & Roesdiyanto. (2019). Carcass weight and percentage of different types of male Sentul chicken in the early period. Jurnal Peternakan Indonesia, 21(3), 240-246. https://doi.org/10.25077/jpi.21.3.240-246.2019
- Huff-Lonergan, E., & Lonergan, S. M. (2005). Mechanisms of water-holding capacity of meat: The role of postmortem biochemical and structural changes. Meat Science, 71(1), 194-204. https://doi.org/10.1016/j.meatsci.2005.04.022
- Hussain, N., Weng, C. H., & Munawar, N. (2022). Effects of different concentrations of pineapple core extract and maceration process on free-range chicken meat quality. Italian Journal of Food Science, 34(1), 124-131. https://doi.org/10.15586/ijfs.v34i1.2086
- Ketnawa, S., & Rawdkuen, S. (2011). Application of bromelain extract for muscle foods tenderization. Food and Nutrition Sciences, 2(5), 393-401. https://doi.org/10.4236/fns.2011.25055
- Latoch, A., Czarniecka-Skubina, E., & Moczkowska-Wyrwisz, M. (2023). Marinades based on natural ingredients as a way to improve the quality and shelf life of meat: A review. Foods, 12(19), 3638. https://doi.org/10.3390/foods12193638
- Nadzirah, K. Z., Zainal, S., Noriham, A., & Normah, I. (2016). Application of bromelain powder produced from pineapple crowns in tenderising beef round cuts. International Food Research Journal, 23(4), 1590-1599.
- Novita, R., Sadjadi, S., Karyono, T., & Mulyono, R. (2019). Pineapple fruit extract level and immersion duration on the quality of spent duck meat. Jurnal Peternakan Indonesia, 21(2), 143-153. https://doi.org/10.25077/jpi.21.2.143-153.2019
- Okpala, C. O. R., Juchniewicz, S., Leicht, K., Korzeniowska, M., & Guine, R. P. F. (2022). Antioxidant, organoleptic and physicochemical changes in different marinated oven-grilled chicken breast meat. Foods, 11(24), 3951. https://doi.org/10.3390/foods11243951
- Senturk, P. K., Karakaya, M., Unal, K., & Babaoglu, A. S. (2019). Technological and textural properties of spent chicken breast, drumstick and thigh meats as affected by marinating with pineapple fruit juice. British Poultry Science, 60(4), 381-387. https://doi.org/10.1080/00071668.2019.1621990
- Susanti, S., Rizqiati, H., & Adlina, M. S. (2024). Physical characteristics, moisture content and organoleptic properties of spent laying-hen meat with different marination durations in pineapple crown extract. Jurnal Ilmiah Sains, 24(2). https://doi.org/10.35799/jis.v24i2.55076
- Szmanko, T., Lesiow, T., & Gorecka, J. (2021). The water-holding capacity of meat: A reference analytical method. Food Chemistry, 357, 129727. https://doi.org/10.1016/j.foodchem.2021.129727