# The physical quality of corned goat meat using the addition of bay leaf (*Syzygium polyanthum*) flour

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**Abstract.** This study aimed to determine the effect of bay leaf (*Syzygium polyanthum*) flour, which contains flavonoids, tannins, and essential oils with antioxidant and antimicrobial properties, on the physical quality of corned goat meat. Four treatments were applied: 0% (BL0), 0.2% (BL1), 0.4% (BL2), and 0.6% (BL3) bay leaf flour, each with five replications in a completely randomized design. Physical parameters measured included pH, water-holding capacity (WHC), cooking loss, yield, texture, and color (L*, a*, b*). The addition of bay leaf flour significantly affected all parameters ($P < 0.05$). Increasing the concentration of bay leaf flour decreased pH and cooking loss while improving WHC, yield, texture firmness, and color intensity. The best results were observed at 0.6% addition. These findings indicate that bay leaf flour can be utilized as a natural functional ingredient to enhance the physical properties of corned goat meat.

## 1 Introduction

Goat meat is a nutrient-dense protein source with a fine muscle structure, low fat content, and a naturally darker color compared to beef and poultry. These characteristics make goat meat suitable for processed products with high nutritional value [1]. However, its processing is often challenged by low water-holding capacity (WHC), varying texture, and the presence of a distinctive "goaty" odor, which can reduce consumer acceptance. Improving the physicochemical stability of goat meat is therefore essential for developing high-quality processed products.

Corned meat is a restructured meat product prepared by grinding meat and combining it with binders, fillers, and seasonings to achieve a uniform matrix [2]. Although corned products are popular for their soft texture and ease of preparation, they commonly exhibit limitations such as low WHC, high cooking loss, and susceptibility to structural weakness during heating. Incorporating natural functional ingredients rich in antioxidants and bioactive compounds may enhance the quality, stability, and consumer appeal of corned meat.

Bay leaf (*Syzygium polyanthum*) contains flavonoids, tannins, and essential oils known

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for their antioxidant, antimicrobial, and protein-interacting properties. These compounds have been reported to influence meat product characteristics by modifying pH, reducing oxidative reactions, improving moisture retention, and enhancing texture and color [3]. Despite its potential, the application of bay leaf flour in corned goat meat has not been widely studied. Therefore, this research aimed to evaluate the effect of bay leaf flour addition on the physical quality of corned goat meat, focusing on pH, WHC, cooking loss, yield, texture, and color, to support the development of naturally enhanced meat products.

## 2 Materials and methods

### 2.1 Materials

Corned goat meat was prepared using the following formulation: 70% goat meat, 2% isolated soy protein, 3% skim milk powder, 3% egg yolk, 10% canola oil, 1% sugar, 2% salt, 0.5% nutmeg, 0.5% pepper, 3% shallots, 5% tapioca flour, and bay leaf (*Syzygium polyanthum*) flour according to the treatment levels. The goat meat was ground with salt until uniform before the remaining ingredients were added and mixed to form a homogeneous batter. The mixture was molded and steamed at 85°C for 10 minutes. The sample preparation process is summarized in Figure 1 to provide a clearer overview of the corned goat meat manufacturing procedure.

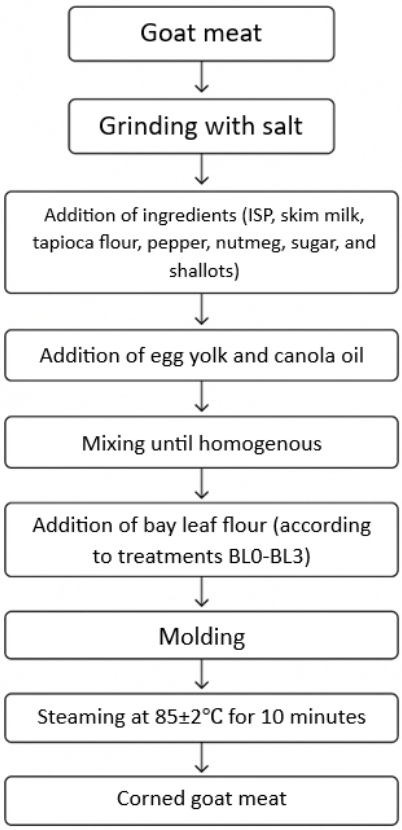


**Fig. 1.** Flowchart of corned goat meat preparation.

Bay leaf flour was produced by washing, drying, and grinding the leaves to a 100-mesh size. The pH of the product was measured using a digital pH meter. Water-holding capacity (WHC) was determined using the pressing method with Whatman No. 42 filter paper. Cooking loss was calculated from the difference in sample weight before and after cooking. Yield was determined as the percentage of cooked weight relative to raw formulation weight, following AOAC (2005). Texture was analyzed using a texture analyzer (measuring force in Newtons), and color values (L*, a*, b*) were measured using a colorimeter.

### 2.2 Methods

This research aims to determine how adding bay leaf powder affects the physical characteristics of processed goat meat. The research examines the pH level, the ability to retain moisture, the amount of weight lost during cooking, the resulting yield, the firmness, and the color, which includes measuring lightness (L), redness (a), yellowness (b), and an additional b value. The discoveries from this research will support the creation of meat products processed using natural methods that have improved physical qualities:
BL0: no addition (control)
BL1: addition of 0.2% bay leaf powder
BL2: addition of 0.4% bay leaf powder
BL3: addition of 0.6% bay leaf powder

## 3 Results and discussion

### 3.1 pH Value

The amount of hydrogen ions ($H^+$) present in a substance is indicated by its pH value. Its importance stems from its influence on a product's stability,shelf life, and inherent physical and chemical attributes. To determine the pH, a pH meter was employed. The average pH measurements of goat meat that had undergone the corning process using bay leaf powder are detailed in Table 1.

**Table 1.** Average pH Analysis.

| Treatment | pH ± SD |
|---|---|
| BL0 | $6.91 \pm 0.03^{d}$ |
| BL1 | $6.72 \pm 0.03^{c}$ |
| BL2 | $6.49 \pm 0.01^{b}$ |
| BL3 | $6.24 \pm 0.03^{a}$ |

Note: $^{a,b,c,d}$ A notable disparity ($P<0.01$) is represented by distinct superscript notations inside the column.

The pH values of corned goat meat decreased progressively with the increasing concentration of bay leaf flour. This decline is associated with the presence of phenolic acids and organic acids naturally found in *Syzygium polyanthum*, which may contribute hydrogen ions to the meat matrix, thereby lowering pH [5]. Phenolic compounds can also influence protein surface charge and ion distribution, resulting in a slight acidification of the product. Similar trends reported on research of corned chicken showed that adding 5% beetroot powder increased the pH to 7.63 [6].

### 3.2 Water Holding Capacity (WHC)

The term water-holding capacity describes how proteins prevent liquid from escaping from a product. Table 2 displays the average WHC values of goat meat that has been corned with bay leaf powder added.

**Table 2.** Average WHC value.

| Treatment | WHC (%) ± SD |
|---|---|
| BL0 | $51.94 \pm 0.06^{a}$ |
| BL1 | $53.01 \pm 0.05^{b}$ |
| BL2 | $55.00 \pm 0.04^{c}$ |
| BL3 | $57.03 \pm 0.06^{d}$ |

Note: $^{a,b,c,d}$ A notable disparity ($P<0.01$) is represented by distinct superscript notations inside the column.

The addition of bay leaf flour significantly increased the WHC of corned goat meat ($P<0.01$). This enhancement is attributable to the tannins and flavonoids present in bay leaf flour, which are known to interact with muscle proteins through hydrogen bonding and hydrophobic interactions. These interactions can stabilize the protein matrix, reduce protein denaturation during processing, and improve water binding capacity.

Several studies have documented similar mechanisms. Flavonoid-rich Syzygium extracts strengthen protein–water interactions, polyphenols stabilize myofibrillar proteins, thereby increasing WHC in meat systems [3]. The higher WHC observed in this study is therefore consistent with previously described polyphenol–protein interaction mechanisms.

Improved WHC contributes to better juiciness, tenderness, and overall palatability, suggesting potential benefits for consumer acceptance of corned goat meat products. Meat products often have WHC levels between 20% and 60%. Therefore, when compared to previous research, the WHC levels in our study are within the normal range. Research on chicken corned meat containing 10% rice bran oil showed that WHC increased by 55.79% [7].

### 3.3 Cooking Loss

Calculating weight loss during cooking requires an understanding of cooking loss. Heat causes protein denaturation during cooking, leading to cooking loss. This process reduces the ability of water and protein molecules to bond. Table 3 presents the average cooking losses for corned goat meat with added bay leaf powder.

**Table 3.** Average cooking loss value.

| Treatment | *Cooking loss* (%) ± SD |
|---|---|
| BL0 | $12.81 \pm 0.06^{d}$ |
| BL1 | $10.80 \pm 0.06^{c}$ |
| BL2 | $9.89 \pm 0.02^{b}$ |
| BL3 | $6.75 \pm 0.05^{a}$ |

Note: $^{a,b,c,d}$ A notable disparity ($P<0.01$) is represented by distinct superscript notations inside the column.

Cooking loss decreased significantly with the increasing concentration of bay leaf flour ($P<0.01$). This reduction is directly related to the observed increase in WHC. A strengthened protein matrix with greater water-binding ability minimizes moisture and nutrient loss during thermal processing. Accordingly, the correct relationship—consistent with meat science principles—is that an increase in WHC results in a decrease in cooking loss. This finding is

supported that improved moisture retention in processed meats leads to reduced thermal shrinkage and lower cooking loss [7].

### 3.4 Yield

The yield percentage is inversely related to cooking loss; when the yield percentage is high, the cooking loss decreases, and vice versa. The yield values of corned goat meat with the addition of bay leaf powder are presented in Table 4.

**Table 4.** Average yield value.

| Treatment | Yield (%) ± SD |
|---|---|
| BL0 | 93.01 ± 0.04[a] |
| BL1 | 95.11 ± 0.06[b] |
| BL2 | 98.41 ± 0.05[c] |
| BL3 | 102.53 ± 0.05[d] |

Note: [a,b,c,d] A notable disparity (P<0.01) is represented by distinct superscript notations inside the column.

The results showed that product yield increased significantly with higher concentrations of bay leaf flour (P<0.01). This improvement is primarily associated with the reduction in cooking loss, which indicates better water retention during thermal processing. The presence of fiber and polyphenol compounds in bay leaf flour may enhance protein matrix stabilization, reducing heat-induced shrinkage and moisture expulsion. Similar mechanisms have been reported in meat systems enriched with plant-derived functional ingredients, where improved WHC and reduced cooking loss directly contribute to higher processing yield [8].

In addition to the biophysical explanation, increased yield also presents potential industrial advantages. Higher yield contributes to improved production efficiency, better product consistency between batches, and reduced raw material loss. From an economic perspective, maintaining greater product mass after cooking can reduce manufacturing costs per unit and increase profitability. Furthermore, improved moisture retention may support better shelf-life stability, as water activity distribution and structural integrity are key factors influencing microbial and oxidative changes in processed meats. These industrial implications warrant consideration in future development and scaling-up processes.

### 3.5 Texture

Texture assessment is a test that measures the elasticity, hardness, resilience, and adhesiveness of a product. Good corned meat texture is elastic and tender. The texture values of corned goat meat with the addition of bay leaf powder are presented in Table 5.

**Table 5.** Average texture value.

| Treatment | Texture (N) ± SD |
|---|---|
| BL0 | 9.16 ± 0.06[a] |
| BL1 | 10.66 ± 0.06[b] |
| BL2 | 11.13 ± 0.03[c] |
| BL3 | 12.58 ± 0.06[d] |

Note: [a,b,c,d] A notable disparity (P<0.01) is represented by distinct superscript notations inside the column

The addition of bay leaf flour significantly increased the texture values of corned goat meat (P<0.01). The improvement in texture may be attributed to the phenolic compounds and

fiber content within bay leaf flour, which can enhance protein–protein and protein–water interactions during heating. These interactions promote the formation of a more cohesive and elastic gel matrix, resulting in firmer structural integrity. Previous studies have demonstrated that polyphenol-rich or fiber-containing plant-based additives can improve hardness, cohesiveness, and gel stability in processed meat matrices due to enhanced cross-linking and water retention. This is reinforced by findings from a study on the addition of fermented red beet bulbs to chicken patties, which showed that this supplementation enhanced the patties' consistency [9].

From an industrial and consumer standpoint, firmer texture offers advantages such as better sliceability, reduced crumbling, and improved handling stability. However, the present study did not evaluate sensory acceptability. Because consumer perception of firmness varies depending on preference, future research should incorporate sensory testing to determine the relevance of these textural changes for product acceptability and marketability.

### 3.6 Color L a*b*

The L a* b* color values of corned goat meat with the addition of bay leaf flour are presented in Table 6.

**Table 6.** Average L a*b* color value.

| Treatment | *Lightness* (L) ± SD | *Redness* (a*) ± SD | *Yellowness* (b*) ± SD |
|---|---|---|---|
| BL0 | $53.06 \pm 0.07^{d}$ | $16.03 \pm 0.07^{d}$ | $7.94 \pm 0.05^{a}$ |
| BL1 | $49.03 \pm 0.08^{c}$ | $14.04 \pm 0.07^{c}$ | $9.01 \pm 0.08^{b}$ |
| BL2 | $45.99 \pm 0.06^{b}$ | $11.98 \pm 0.08^{b}$ | $9.98 \pm 0.05^{c}$ |
| BL3 | $42.96 \pm 0.06^{a}$ | $10.01 \pm 0.08^{a}$ | $10.96 \pm 0.06^{d}$ |

Note : $^{a,b,c,d}$ A notable disparity ($P<0.01$) is represented by distinct superscripts notations inside the column

The incorporation of bay leaf flour significantly affected the color characteristics of corned goat meat ($P<0.01$). The decreased L* value suggests a darker appearance, likely caused by chlorophyll pigments present in bay leaves. The reduction in a* value indicates lower redness due to pigment masking, whereas the increase in b* value reflects the contribution of carotenoid compounds that shift the meat color toward yellow [10]. These pigment-induced changes align with findings reported in prior studies involving herb- or plant-extract-enriched meat products [11].

Color is a critical quality attribute that strongly influences consumer perception and purchase intention. Although the darker greenish tones may indicate the use of natural ingredients, they may also reduce familiarity for consumers accustomed to the typical appearance of corned meat. Since the present study did not include sensory evaluation, future research should assess consumer responses to these color modifications to determine their impact on acceptability and potential market feasibility.

## 4 Conclusion

This study demonstrated that the addition of bay leaf flour up to 0.6% effectively improved key physical quality parameters of corned goat meat, including water holding capacity, cooking loss, texture, color characteristics, and product yield. These results indicate that bay leaf flour has potential as a natural functional ingredient capable of enhancing processing stability and product performance.

Nevertheless, the study has several limitations. Sensory attributes such as taste, aroma, texture acceptability, and color perception were not evaluated, and the shelf-life characteristics of the product were not examined. Future research should incorporate sensory testing, storage-stability analysis, and safety assessments to provide a more comprehensive understanding of product feasibility. Additionally, studies on large-scale production are recommended to determine industrial applicability, potential economic benefits, and scalability of bay leaf flour as an ingredient in commercial corned meat formulations.

## References

1 M. Gawat, L. Kaur, J. Singh, M. Boland, Physicochemical and quality characteristics of New Zealand goat meat and its ultrastructural features. Food Res. Int. **161,** 111736 (2022). https://doi.org/10.1016/j.foodres.2022.111736

2 M.H. Shakil, A.T. Trisha, M. Rahman, S. Talukdar, R. Kobun, N. Huda, W. Zzaman, Nitrites in cured meats, health risk issues, alternative to nitrites: a review. Foods. **11**, 21 (2022). https://doi.org/10.3390/foods11213355

3 E. Rohaeti, F. Karunina, M. Rafi, FTIR-Based fingerprinting and chemometrics for rapid investigation of antioxidant activity from *Syzygium polyanthum* extracts. Indonesia Journal of Chemistry, **21**(1), 128-136 (2021). https://doi.org/10.22146/ijc.54577

4 AOAC, Official methods of analysis of the association of official analytical chemists. Published by the Association of Official Analytical Chemist, (Maryland, USA, 2005)

5 M. Sella, E.J. Guntoro, B.P. Utama, Pengaruh pemberian rendaman tepung daun salam terhadap kualitas daging sapi bali ditinjau dari warna, pH, dan daya ikat air. Stock Peternakan, **4**(2), 9-17 (2022)

6 S.A.P. Dewi, E.S. Widyastuti, H. Evanuarini, The quality of corned chicken with the addition of red beet (*Beta vulgaris* L.) flour as natural food coloring. Atlantis Press, **28**(1), 272-279 (2023). https://doi.org/10.2991/978-94-6463-116-6_34

7 A.H. Aththoriq, A. Susilo, H. Evanuarini, Impact on physicochemical quality and antioxidant activity chicken corned using rice bran oil as potential antioxidant. AFSJ, **24**(6), 37-43 (2025). https://doi.org/10.9734/afsj/2025/v24i6793

8 S.H. Lee, H.J. Kim, S.T. Jung, The effects of various dietary fiber additions on quality characteristics of blended pork meat. ICoMST, **1**(1), 1-3 (2016)

9 H. Evanuarini, A. Susilo, D. Amertaningtyas, Improving the physicochemical and microstructural qualities of chicken patties with the addition of red beet peel flour (*Beta vulgaris* L) as a filler. JIIP, **33**, 1 (2023). https://doi.org/10.21776/ub.jiip.2023.033.01.07%20

10 M.N.B.A. Rahman, S.N. Aziz, K. Rovina, N.M. Hayati, K. Mury, A.J. Aziz, N. Huda, Physicochemical analysis of bay leaf (*Syzygium polyanthum* (Wight) Walp.) and its effect on healthy adults' blood glucose. Food Research, **9**(4), 336-346 (2025). https://doi.org/10.26656/fr.2017.9(4).148

11 Y. Rahman, A.R.A. Aziz, H.M. Nor, Emerging challenges and efficacy of poluphenols-protein interaction in maintaining meat safety during thermal processing. FCA, **1**(1), 15-21 (2024)