



**EFFECT OF USING GINGER AND TURMERIC FOR MARINATION ON  
THE MICROBIAL COUNT OF SPENT LAYERS MEAT**

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**ABSTRACT**

The study evaluates the effect of using ginger and turmeric for marination on the microbial count of spent layer meat. Sixteen (16) spent layers were used for the study and a total of four treatments: grilled control (no marination), grilled with ginger, grilled with turmeric, grilled with ginger and turmeric, fresh control (no marination), fresh with ginger, fresh with turmeric, fresh with ginger and turmeric, and four replications having one (1) spent layer in each replicate, were used for the study. Findings from the study showed that, meat without marination had a high microbial load, indicating vulnerability to spoilage and contamination. Ginger treatment reduced TBC to 1.50E+07 CFU/g, demonstrating its antimicrobial properties. Turmeric treatment recorded the highest TBC at 2.67E+07 CFU/g. This suggests that the addition of turmeric may create a condition for certain bacteria to thrive. The combination treatment yielded a total bacterial count (TBC) of 1.19E+07 CFU/g, suggesting a synergistic effect. The findings for total fungal count (TFC) showed significant differences ( $P < 0.05$ ), with ginger's efficacy against bacteria being limited. The combination treatment of turmeric and ginger showed the highest TFC at 2.30E+06 CFU/g. This suggests that the combination of turmeric and ginger as marinade may not effectively control fungal growth and could promote spoilage. The study recommends the combination of ginger and turmeric for marination due to their antimicrobial properties.

**Keywords:** Marination, Grilled, Antimicrobial, Turmeric, Ginger.

**INTRODUCTION**

Spent layer meat, typically considered lower in quality due to its age, muscle composition, and higher microbial loads, poses significant preservation challenges in the food industry. Microbial contamination in this meat can lead to spoilage and foodborne illnesses, making effective preservation methods essential (Chen *et al.*, 2016; Schwartz *et al.*, 2022). Marinating enhances meat's sensory attributes, such as tenderness, flavor, and juiciness, while also playing a critical role in microbial control. Natural antimicrobial agents in marinades have been shown to reduce microbial loads and improve food safety (Mudalal *et al.*, 2014). Acidic marinades, particularly those containing organic acids like acetic or lactic acid, effectively suppress microbial growth by lowering the pH of the meat, creating an environment unfavorable for spoilage bacteria while encouraging the growth of beneficial lactic acid bacteria (Mohan *et al.*, 2020; Bekhit *et al.*, 2014). Research indicates that marinades with a pH below 5.5 can significantly reduce the population of gram-negative bacteria, which are more sensitive to acidic conditions than gram-positive bacteria (Srinivasan, 2017). Ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*), both known for their antimicrobial properties, can be particularly effective in marination. Gingerol and shogaol, bioactive compounds in ginger, inhibit pathogenic bacteria and reduce microbial loads (Ibrahim *et al.*, 2021; Oyinlola *et al.*, 2024), while turmeric's curcumin offers both antioxidant and antimicrobial effects (Mohamedin *et al.*, 2018). Incorporating these spices into marinades for spent layer meat not only enhances microbial safety but also improves overall quality and consumer acceptance (Ahmed *et al.*, 2021; Moeini *et al.*, 2024). Unmarinated meat, especially during refrigerated storage, experiences a constant increase in microbial contamination (Knochel *et al.*, 2009). Therefore, the combination of ginger and turmeric in marinades could provide an effective method for improving the safety, quality, and acceptability of spent-layer meat, offering a promising approach to extending shelf life and enhancing consumer appeal.



The objectives of this study are to evaluate the effect of marination with ginger and turmeric in reducing microbial counts in spent layer meat and to identify and characterize the bacterial and fungal isolates present in spent layer meat.

## **MATERIALS AND METHODS**

A total of 16 spent layers were procured from Jema's poultry farm in Kafanchan for this study. Upon arrival at the laboratory, the birds were humanely slaughtered, following standard halal practices. The carcasses were then processed to remove feathers and entrails, after which they were divided into four treatments: grilled with control (no marination), marinated with ginger, marinated with turmeric, marinated with ginger and turmeric, and four (4) replications having one (1) spent layer in each replicate.

The marination process involved preparing three different marinades: one with ginger, one with turmeric, and a third marinade combining both spices. For the ginger marinade, the dried ginger powder was mixed with water to form a paste, which was then diluted to the desired concentration to ensure effective antimicrobial properties. Similarly, dry turmeric was made into a paste with water and adjusted to the required concentration. The combined marinade consisted of equal parts of dry ginger and turmeric mixed with water. Each chicken cut was marinated for 24 hours at 4°C, allowing the meat to absorb the marinades.

Microbial analysis was conducted to assess the effectiveness of ginger and turmeric marinades in reducing microbial loads on spent layer meat. Samples from each treatment group was taken and analyzed for total bacterial counts using standard microbiological methods. Specifically, plate count agar (PCA) was used to culture aerobic bacteria, while selective media such as MacConkey agar was employed for coliforms and *Salmonella* spp. Counts was expressed in colony-forming units per gram (CFU/g) of meat

## **RESULTS AND DISCUSSION**

### **Effect of Marinating with Ginger and Turmeric on Fresh Spent Layer Meat**

Table 1 presented results of the effects of different marination treatments on the microbiological quality of spent layer meat. Total Bacterial Count (TBC) and Total Fungal Count (TFC), were analyzed, as these are key indicators of meat quality and safety. The results showed a significant difference in microbial loads between treatments ( $P < 0.05$ ), with varying effectiveness of the spices used. The control group, which had no marination, exhibited the highest TBC ( $1.14 \times 10^7$  CFU/g), indicating a significant microbial load. Ginger marination reduced the TBC to  $9.00 \times 10^6$  CFU/g, demonstrating its potent antibacterial properties. Turmeric alone did not reduce bacterial count effectively, with a TBC of  $1.46 \times 10^7$  CFU/g. The combination of ginger and turmeric, however, led to the highest TBC at  $1.78 \times 10^7$  CFU/g. For fungal counts, the control group had a TFC of 500100 CFU/g, while ginger marination reduced the count to 400200 CFU/g. Turmeric alone resulted in a higher TFC of 900250 CFU/g, and the combination of ginger and turmeric had the highest TFC at  $2.30 \times 10^6$  CFU/g.

Ginger was found to be the most effective in controlling fungal growth, while the combination of ginger and turmeric was the least effective in reducing microbial contamination. These findings align with studies by Samuel-Penu & Baridakara (2021), which demonstrated that ginger extracts, particularly the bioactive compounds gingerol and shogaol, possess strong antimicrobial properties, inhibiting the growth of foodborne pathogens by disrupting bacterial cell membranes and interfering with metabolic processes. The reduction in TBC in ginger-marinated meat is attributed to the antimicrobial effects of gingerol and other phenolic compounds, which alter cell permeability and inhibit enzyme activity, contributing to bacterial inhibition (Boakye *et al.*, 2016; Ghasemzadeh *et al.*, 2016).

**Table 1:** Effect of Marinating with Ginger and Turmeric on Fresh Spent Layer Meat

Treatments	TBC(CFU/g)	TFC(CFU/g)
Fresh spent layer meat (control)	1.14E+07 <sup>g</sup>	500100 <sup>de</sup>
Fresh spent layer meat with ginger	9.00E+06 <sup>h</sup>	400200 <sup>e</sup>
Fresh spent layer meat with turmeric	1.46E+07 <sup>e</sup>	900250 <sup>bc</sup>
Fresh spent layer meat with ginger and turmeric	1.78E+07 <sup>c</sup>	2.30E+06
SEM	70711	276.13

\*Values are presented as means  $\pm$  SEM. <sup>A, B, C, D, E, F, G, H</sup> were different ( $p < 0.05$ ) within the same row, TBC= Total bacterial count, TFC= Total fungal count

### Effect of Marinating with Ginger and Turmeric on Grilled Spent Layer Meat

Table 2 presented result of the effects of marination with ginger and turmeric on the microbiological quality of grilled spent layer meat. Significant differences ( $P < 0.05$ ) were observed across all treatments. The control group showed the highest Total Bacterial Count (TBC) at 1.88E+07 CFU/g, which was notably higher than the fresh spent layer meat. Ginger treatment reduced the TBC to 1.50E+07 CFU/g, while turmeric treatment resulted in an increased TBC of 2.67E+07 CFU/g, indicating that turmeric alone is less effective in reducing bacterial counts. However, the combination of ginger and turmeric led to the lowest TBC at 1.19E+07 CFU/g, suggesting a synergistic effect between the two spices. For Total Fungal Count (TFC), the control group had the lowest count at 360000 CFU/g, while ginger (500000 CFU/g) and turmeric (1.05E+06 CFU/g) treatments showed higher fungal growth. The combination of ginger and turmeric resulted in a TFC of 700250 CFU/g, indicating variable effects on fungal growth. The control group was more effective in controlling fungal growth, while turmeric alone was the least effective. These findings support the antibacterial efficacy of ginger, as highlighted by Ebrahimi *et al.* (2023), who demonstrated significant antimicrobial activity of ginger against foodborne pathogens like Salmonella and Escherichia coli.

**Table 2:** Effect of Marinating with Ginger and Turmeric on Grilled Spent Layer Meat

Grilled spent layer meat (control)	1.88E+07 <sup>b</sup>	360000 <sup>e</sup>
Grilled spent layer meat with ginger	1.50E+07 <sup>d</sup>	500000 <sup>de</sup>
Grilled spent layer meat with turmeric	2.67E+07 <sup>a</sup>	1.05E+06 <sup>b</sup>
Grilled spent layer meat with ginger and turmeric	1.19E+07 <sup>f</sup>	700250 <sup>cd</sup>
SEM	<b>132295</b>	<b>83964</b>

\*Values are presented as means  $\pm$  SEM. <sup>A, B, C, D, E, F, G, H</sup> were different ( $p < 0.05$ ) within the same row, TBC= Total bacterial count, TFC= Total fungal count

### Bacterial Isolate in Spent Layer Meat

The bacterial isolates from spent layer meat revealed a diverse microbial population, including Coagulase-negative *Staphylococci* (CoNS), *Micrococcus spp.*, *Klebsiella aerogenes*, *Bacillus spp.*, *Escherichia coli*, and *Streptococcus spp.* These findings align with previous studies on poultry products, particularly spent layers, which are often associated with lower quality (Xu *et al.*, 2023). Notably, the presence of *E. coli*, especially in turmeric-treated samples, is of great concern due to its association with foodborne illnesses and fecal contamination, as highlighted by Alfifi *et al.* (2022). The isolation of *Klebsiella aerogenes* and *Bacillus spp.* raises food safety concerns, as these bacteria can cause spoilage and foodborne diseases (Hu *et al.*, 2021; Todorov *et al.*, 2022). CoNS and *Micrococcus spp.*, while less virulent, may contribute to spoilage (Twomey *et al.*, 2024). These results highlight the potential microbial risks in spent layer meat, underscoring the importance of proper handling and cooking to ensure food safety.

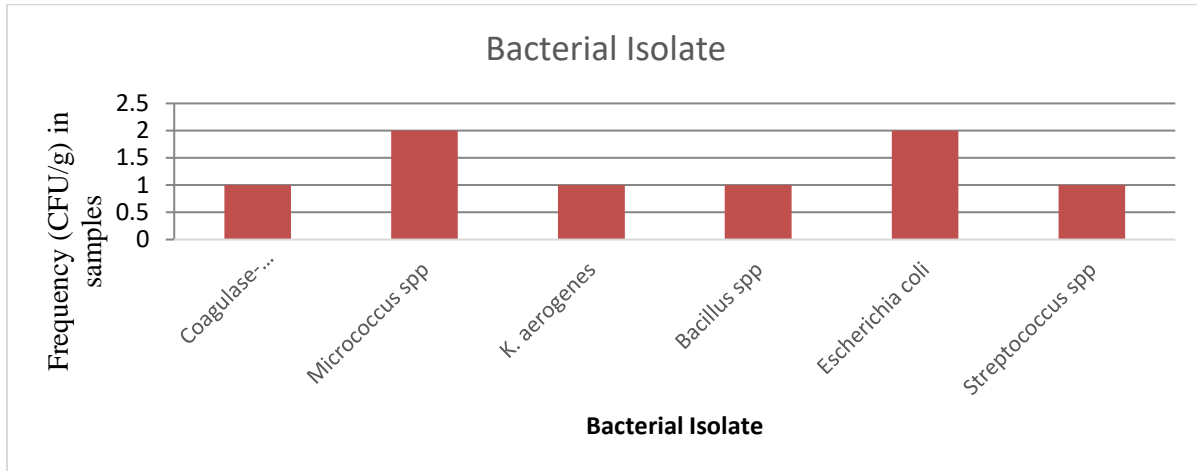


Figure 1: Bacterial Isolate in Spent Layer Meat

### Fungal Isolate in Different Marinated Spent Layer Meat

Figure 2 showed the fungal isolates from marinated spent layer meat, revealing the presence of *Candida spp.*, *Aspergillus niger*, and *Mucor spp.* These fungi are associated with spoilage and food safety concerns. *Candida spp.* was found in several samples, indicating that yeasts thrive in marinated environments, contributing to off-flavors and texture changes (Ren *et al.*, 2024). The presence of *Aspergillus niger* raises concerns due to its potential to produce mycotoxins, which pose health risks (Gupta and Sharma, 2017). *Mucor spp.* was also isolated, highlighting the potential for spoilage in high-moisture marinated meat (Snyder *et al.*, 2019; Zelenakova *et al.*, 2022). These findings suggest that while marination enhances flavor and tenderness, it can also facilitate fungal growth if storage conditions are not properly managed (Fadhel *et al.*, 2016; Ehsanur Rahman *et al.*, 2023).

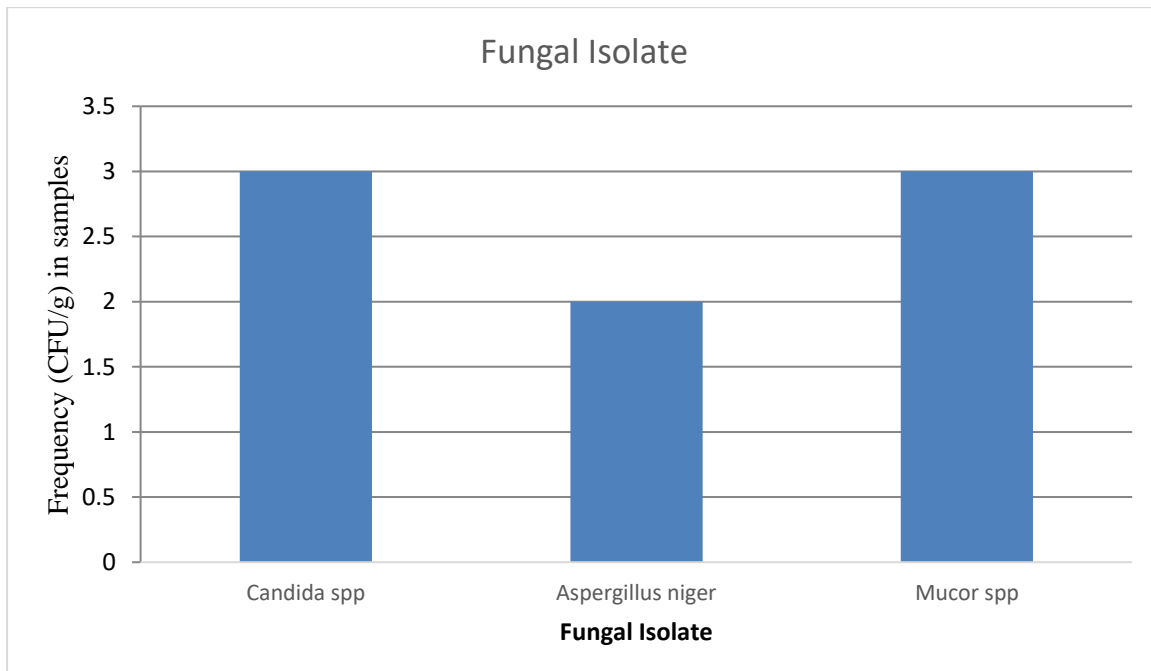


Figure 2: Fungal isolate in spent layer meat

### CONCLUSION AND RECOMMENDATION

The study concluded that marination using ginger and turmeric significantly influences the microbial counts in spent layer meat. The combination of ginger and turmeric emerged as the most



effective treatment for reducing total bacterial counts (TBC), showcasing the strong antimicrobial properties of this combination. However, grilled meat with no marination was found to have the lowest population of fungi, while grilled spent layer meat with turmeric was least effective in total fungal count (TFC), compared to ginger and the combination of ginger and turmeric treatment.

Based on the findings of this study, the following are recommended:

Incorporating the combination of ginger and turmeric in marination processes is recommended due to their significant antimicrobial properties, which effectively reduces bacterial counts.

Maintaining appropriate storage conditions, such as optimal temperature and humidity helps to minimize fungal contamination and spoilage in marinated products.

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