# Effects of Dietary Inclusion of Clove (*Syzygium aromaticum*) Seed Powder as an Alternative to Antibiotic Growth Promoters on Carcass Characteristics and Physiological Parameters of Broiler Chickens

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## Abstract
*This study aimed to assess the effects of dietary inclusion of clove (syzygium aromaticum) seed powder as an alternative to antibiotic growth promoters on broiler chickens' carcass characteristics and physiological parameters. The experiment was conducted at the Poultry Unit of the Teaching and Livestock Research Farm, Bayero University, Kano, Nigeria. Clove seed powder purchased from Kurmi Market, Kano, was incorporated into the diet at different inclusion levels (0.6% and 0.8%). In an experiment that lasted for seven weeks, Ninety-day-old COBB-500 strain chicks were randomly assigned to three treatments, with each treatment consisting of three replicates per treatment of 10 birds in a completely randomized design (CRD). Data collected on carcass evaluation and physiological parameters were subjected to One-way Analysis of Variance, but none were significant (P>0.05) across the groups. The highest breast and thigh percentage value was obtained from broilers offered 0.6% of clove seed powder while the lowest values were obtained from those on 0.8% of clove seed powder. This same trend was also observed in the values obtained from the respiratory rate; however highest values of rectal temperature was observed at the control while lowest value was obtained from those offered 0.8% of clove seed powder. The study concluded that use of clove (syzygium aromaticum) seed powder as alternative to synthetic antibiotics should be promoted to prevent residual effect of antibiotics in the broiler chickens, contributing to the development of safer and more sustainable options to AGPs in the poultry industry.*

**Keywords:** Broiler chickens; Clove seed powder; Antibiotic alternative; Carcass characteristics; Physiological parameters

## Introduction
The poultry industry is a vital sector of global agriculture, providing an essential source of animal protein as consumer demand for poultry products continues to increase, hence the need for efficient broiler production (Choi *et al*., 2023). A common practice in enhancing broiler growth and feed efficiency has been using antibiotic growth promoters (AGPs), which improve performance by modifying gut microbiota, enhancing nutrient absorption, and preventing diseases (Gadde *et al*., 2017). However, concerns over the development of antibiotic-resistant bacteria and consumer preferences for antibiotic-free products have prompted a search for alternative growth promoters in poultry nutrition (Huyghebaert *et al.,* 2011). As a result, there has been growing interest in using natural feed additives derived from medicinal plants; among these, clove (Syzygium aromaticum) seed powder has shown promise as a natural feed additive due to the presence of bioactive compounds, including eugenol, which possesses antimicrobial, antioxidant, and anti-inflammatory properties (Cortés-Rojas *et al*., 2014). The bioactive properties of clove make it an attractive candidate for improving growth performance, carcass characteristics, and physiological parameters in broiler chickens. Studies have shown that the bioactive compounds in clove, mainly eugenol, improve carcass traits by reducing fat deposition and increasing muscle yield, influencing lipid metabolism and lowering fat accumulation in broiler chickens (El-Bahr *et al.,* 2020). The ability of clove to modulate physiological responses through enhancing the activity of endogenous antioxidant enzymes such as superoxide dismutase (SOD) and glutathione peroxidase (GPx), which help neutralize free radicals and protect cells from oxidative damage, makes it a promising alternative to antibiotics in poultry diets (Gülçin, 2011). In conclusion, using clove (Syzygium aromaticum) seed powder as a natural alternative to antibiotic growth promoters holds promise for improving broiler chickens' growth performance, carcass characteristics, and physiological parameters

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## Materials and Methods

**Experimental Site:** The study was conducted at the Poultry unit of Teaching and Livestock Research Farm (latitude 11°59'1.59" longitude 8°25'24.97") of the Department of Animal Science, Faculty of Agriculture, New Campus Complex, Bayero University, Kano, Nigeria. The area is characterized by a tropical dry and wet climate. The wet season usually occurs from May to September, while the dry season is from October to April. Annual rainfall and temperature range between 787mm and 960mm and $21^0$C and $39^0$C, respectively (Mohammed, 2019).

**Experimental Birds, Diets, and Design:** The experimental birds were sourced from a reputable dealer. Ninety (90) day-old broiler chicks of the COBB-500 strain were used in the experiment. The clove was purchased from Kurmi Market, Kano. It was then milled into a fine powder using a spice milling machine. The clove powder was added to the formulated standard diets at 0.6% and 0.8% inclusion levels. The chicks were divided into three treatment groups. Each treatment comprised 30 chicks and was randomly subdivided into 3 replicates, with 10 chicks per replicate. Each treatment group was assigned to each of the diets as follows: 0% clove seed powder (T1, control), 0.60% clove seed powder (T2), and 0.80% clove seed powder (T3) in a completely randomized design (CRD).

**Management of Experimental Birds:** Before the chicks arrived, the poultry house was cleaned and disinfected, and routine medication and vaccination of the birds were done as soon as they were due. The chicks were raised on deep litter for brooding at the starter and finisher phases. Tables 1 show the composition of Broiler starter and finisher diet Supplemented with Clove (*Syzygium aromaticum*) Seed Powder.

**Table 1: Composition of Broiler starter and finisher diet Supplemented with Clove (*Syzygium aromaticum*) Seed Powder**

| | STARTER DIET | | | FINISHER DIET | | |
|---|---|---|---|---|---|---|
| | **T1** | **T2** | **T3** | **T1** | **T2** | **T3** |
| **Clove** | 0 | 0.6 | 0.8 | 0 | 0.6 | 0.8 |
| **Maize** | 39.79 | 39.79 | 39.79 | 52.04 | 52.04 | 52.04 |
| **Soya Bean Meal** | 41.01 | 41.01 | 41.01 | 28.56 | 28.56 | 28.56 |
| **Wheat Offal** | 12 | 11.4 | 11.2 | 12 | 11.4 | 11.2 |
| **Salt** | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| **Bone meal** | 2.5 | 2.5 | 2.5 | 4 | 4 | 4 |
| **Vitamin/Mineral Premix** | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| **Limestone** | 2 | 2 | 2 | 0.2 | 0.2 | 0.2 |
| **Lysine** | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| **Methionine** | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| **Vegetable oil** | 2 | 2 | 2 | 2.5 | 2.5 | 2.5 |
| **Total** | **100** | **100** | **100** | **100** | **100** | **100** |
| **Calculated Analysis** | | | | | | |
| **ME (Kcal/kg DM)** | 2659.1 | 2547.8 | 2644.1 | 2772.6 | 2761.4 | 2757.7 |
| **Crude Protein (%)** | 22.99 | 22.91 | 22.89 | 19 | 18.91 | 18.88 |
| **Crude Fiber (%)** | 4.88 | 4.83 | 4.81 | 4.44 | 4.38 | 4.37 |
| **Ether Extract (%)** | 5.79 | 5.78 | 5.57 | 4.93 | 4.91 | 4.89 |
| **Lysine (%)** | 1.43 | 1.43 | 1.42 | 1.11 | 1.1 | 1.09 |
| **Methionine (%)** | 0.43 | 0.43 | 0.43 | 0.38 | 0.38 | 0.37 |
| **Phosphorus (%)** | 0.76 | 0.76 | 0.76 | 1.58 | 1.57 | 1.57 |
| **Calcium (%)** | 1.67 | 1.67 | 1.67 | 1.55 | 1.55 | 1.55 |

**Table 3: Carcass characteristics of broiler chicken fed dietary Inclusion of Clove (*Syzygium aromaticum*) Seed Powder**

| | Clove (*Syzygium aromaticum*) Seed Powder Inclusion level (%) | | | | |
|---|---|---|---|---|---|
| **PARAMETERS** | **0** | **0.6** | **0.8** | **SEM** | **P Value** |
| LIVE WT | 3323.3 | 2600.2 | 3303.3 | 237.78 | 0.132 |
| DRESS WT | 2545.1 | 1976.7 | 2360.1 | 167.38 | 0.14 |
| DRESS WT% | 85.63 | 85.4 | 84.8 | 0.25 | 0.32 |
| **Primal parts (% of live body weight)** | | | | | |
| HEAD | 1.96 | 2.37 | 1.92 | 0.15 | 0.77 |
| WING | 7.27 | 7.76 | 6.41 | 0.39 | 0.35 |
| NECK | 3.71 | 4.17 | 2.88 | 0.38 | 0.06 |
| BACK | 8.18 | 6.35 | 5.55 | 0.78 | 0.06 |
| SHANK | 3.31 | 3.65 | 3.23 | 0.13 | 0.47 |
| BREAST | 26.83 | 28.20 | 24.32 | 1.14 | 0.34 |
| RIBS | 5.72 | 5.51 | 6.36 | 0.25 | 0.05 |
| THIGH | 10.68 | 11.15 | 10.29 | 0.25 | 0.19 |
| DRUMSTICK | 10.38 | 9.68 | 9.48 | 0.27 | 0.06 |
| **Organs (% of live body weight)** | | | | | |
| GIZZARD | 1.30 | 1.35 | 1.31 | 0.013 | 0.13 |
| HEART | 0.55 | 0.51 | 0.51 | 0.014 | 0.28 |
| SPLEEN | 0.12 | 0.32 | 0.30 | 0.063 | 0.17 |
| LIVER | 2.41 | 1.99 | 1.76 | 0.19 | 0.16 |
| OMENTAL FAT | 0.66 | 0.90 | 1.06 | 0.16 | 0.6 |
| ABDOMINAL FAT | 0.90 | 1.47 | 0.86 | 0.20 | 0.44 |
| SI | 2.71 | 2.95 | 2.62 | 0.10 | 0.39 |
| LI | 0.90 | 0.90 | 1.01 | 0.07 | 0.24 |
| CROP | 0.45 | 0.64 | 0.66 | 0.066 | 0.47 |

*[ab] mean value in the column bearing different superscript are significantly different ($p<0.05$) **Live body weight was used as covariate.*

**Results and Discussion**

The results on Carcass characteristics of broiler chicken fed dietary Inclusion of Clove (*Syzygium aromaticum*) Seed Powder presented in Table 3, showed that the dietary Inclusion had no significant (P>0.05) effect on carcass characteristics of broilers. Carcass quality traits (live weight, dressed weight), Primal parts (Head, wing, neck, ribs, back, thigh, breast, drumstick, and shank), and organs (Gizzard, heart, Spleen, Liver, Abdominal Fat, Omental Fat, Small Intestine, Large Intestine, Crop) recorded in the study did not differ significantly (P>0.05) among the control and Clove Seed Powder treated groups. The live weight and dressing weight of broiler chickens were slightly affected by clove seed powder inclusion. Chickens who received 0.6% clove showed a notable reduction in live weight (2600.2 g) compared to the control group (3323.3g) and the 0.8% group (3303.3g). This reduction was not statistically significant (P>0.05), suggesting that including clove seed powder at the tested levels does not substantially affect live body weight. Research by Ahmed *et al*. (2023) indicated that clove supplementation in broilers can positively influence growth performance due to its antioxidant properties, which help mitigate oxidative stress and promote better feed conversion. However, the findings in this study suggest that more than the dosage used may have been required to elicit a significant growth effect on broiler chickens. The result of this study also buttressed the opinion of Marcincak *et al*., 2011 who reported that dietary Inclusion of Clove seed powder did not have a significant (P>0.05) effect on the live weight and carcass yield of broiler chickens; however, this does not corroborate the findings of Suliman *et al.* (2020) who reported that dietary Inclusion of Clove seed powder significantly (P<0.05) influenced the final live weight, carcass weight and dressing percentage of broiler chickens.

The highest percentage value of primal parts was observed on broiler chicken offered 0.6% Inclusion level of Clove (*Syzygium aromaticum*) Seed Powder. The breast yield was highest in chickens receiving 0.6% clove (28.20%) and lowest in the 0.8% group (24.32%). Despite these differences, the inclusion of clove seed powder did not have a significant effect (P>0.05) on broiler chickens. Similarly, the thigh weight showed no significant impact across all the treatment groups. These findings align with a study by Yousaf *et al*. (2022), who reported that clove inclusion improved carcass characteristics slightly and did not have a significant effect. The observed result on neck, back, and drumstick weights showed slight variations in values, particularly at the 0.6% inclusion level, which suggests that clove might have some minor effects on the allocation of body mass in certain parts of the bird; further studies with higher doses of clove inclusion might reveal more pronounced effects on broiler chickens.

Internal organs, which include the gizzard, heart, spleen, liver, omental fat, Small Intestine, and Large Intestine, were not significantly (P>0.05) affected by the dietary Inclusion of Clove seed powder. Clove inclusion did not significantly affect the weight of the gizzard, heart, spleen, and liver. The liver weight, in particular, showed a slight decrease with increasing clove levels (from 2.41% to 1.76%), but the P-value indicates that this change is not statistically (P>0.05) significant. This result is consistent with findings from Khalil e*t al*. (2021), who observed that clove's antioxidant properties can reduce liver inflammation, but this effect is more prominent at higher doses or extended feeding periods. This study also corroborates the findings of Dalkilic and Guler. (2009) who reported that dietary clove extract inclusion had no significant (P>0.05) effect on the liver, gizzard, heart, small intestine and large intestine of broiler chickens. The abdominal fat percentages increased slightly at 0.6% inclusion but reduced again at 0.8%. The P-values obtained indicated no significant differences across all treatments. The result obtained is similar to the findings by Suliman *et al.* (2020), who reported that clove's potential to affect lipid metabolism in broilers was not pronounced at low inclusion levels.

The result showed that different levels of clove (*Syzygium aromaticum*) seed powder inclusion have significant effects on various physiological parameters in broiler chickens. The inclusion levels of clove seed powder tested were 0% (control), 0.6%, and 0.8%, with measurements taken for pulse rate, respiratory rate, and rectal temperature. The pulse rate in broiler chickens decreased slightly with increasing inclusion levels of clove seed powder, from 198.33 bpm in the control group (0%) to 195.89 bpm in the group receiving 0.8% clove seed powder. However, the change was not statistically significant (P>0.05). The slight reduction in pulse rate might suggest that clove has a mild calming or sedative effect, likely due to its high content of bioactive compounds such as eugenol. However, this study did not show significant changes in heart rate with the levels tested. This is consistent with findings by Iqbal *et al*. (2023), who observed minor reductions in heart rate in poultry with clove supplementation but emphasized that other cardiovascular parameters, such as blood pressure, were more notably affected.

The respiratory rate also showed minor variations, increasing from 46.22 bpm at 0% inclusion to 47.11 bpm at 0.6%, but decreasing to 45.78 bpm at 0.8%. The changes in respiratory rate were not statistically significant (P>0.05). Nonetheless, the absence of significant changes in this study aligns with research by Yousaf *et al*. (2022), who found that while clove oil may influence respiratory function, significant effects are typically observed at higher doses or with prolonged administration. Rectal temperature decreased slightly with the inclusion of clove seed powder, from 40.53°C at

0% to 40.16°C at 0.8%. Similar to the other parameters, this change was not statistically significant (P>0.05). The slight reduction in rectal temperature may indicate a minor effect of clove on thermoregulation. Clove's anti-inflammatory properties could play a role here, as inflammation typically elevates body temperature. The findings are consistent with those reported by Khalil *et al*. (2021), who observed minor reductions in body temperature with clove supplementation, likely due to its ability to reduce systemic inflammation. However, the lack of statistical significance in this study suggests that the clove dosage was insufficient to induce pronounced effects on body temperature.

## CONCLUSION

While the study found that dietary inclusion of clove seed powder did not produce statistically significant effects on broiler carcass quality or physiological parameters, this absence of a clear effect is itself an important finding. The most plausible explanation lies in the experimental design: the chosen inclusion rates (0.6% and 0.8%) may have been below the minimum threshold required to elicit a measurable biological response, or the seven-week trial period might have been too short for the subtle growth-promoting or physiological effects of clove's active compounds (such as eugenol) to manifest and be detected. Therefore, these results do not necessarily invalidate clove's potential as an antibiotic alternative. Instead, they highlight specific pathways for future research. To conclusively determine its efficacy, subsequent studies should investigate higher inclusion levels to establish an effective dosage and consider extending the duration of the feeding trial. Such adjustments are crucial to fully understand clove's potential and to provide clear, evidence-based recommendations for its use in sustainable poultry production.

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