MYCOTOXICOLOGY SOCIETY OF NIGERIA

In Collaboration With

AFRICA CENTRE OF EXCELLENCE FOR
MYCOTOXIN AND FOOD SAFTY
FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

BOOK OF PROCEEDINGS

CONFERENCE THEME:

EMERGING SOLUTIONS TO MYCOTOXIN AND FOOD SAFETY CHALLENGES: THE ROLE OF ARTIFICIAL INTELLIGENCE

12th - 15th
NOVEMBER, 2024.

MYCOTOXICOLOGY SOCIETY OF NIGERIA

In collaboration with

AFRICA CENTRE OF EXCELLENCE FOR MYCOTOXIN AND FOOD SAFETY, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

17TH MYCOTOXICOLOGICAL SOCIETY OF NIGERIA CONFERENCE

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INFLUENCE OF AQUEOUS TURMERIC (*CURCUMA LONGA*) EXTRACT ON THE BACTERIAL COUNT IN BROILER CHICKEN MEAT

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ABSTRACT
This study investigates the potential of turmeric (*Curcuma longa*) aqueous extract as a natural alternative to synthetic growth promoters in broiler chicken production, focusing on its impact on meat bacterial count. One hundred and sixty broiler chicks were divided into four groups receiving varying concentrations of turmeric extract in their drinking water (0, 1, 2, and 3 g/L). Bacterial counts in meat samples were analysed. While no statistically significant differences ($P>0.05$) in bacterial load were observed across treatment groups, a numerical trend showed decreasing bacterial counts with increasing turmeric concentrations, ranging from 6.20 CFU/g (control) to 5.20 CFU/g (3 g/L turmeric). Although not statistically significant, this trend suggests a potential antimicrobial effect, warranting further research with higher turmeric concentrations and longer experimental durations to fully explore its potential as a natural feed additive for improving gut health in broiler chickens.

Keywords: *Curcuma longa*, broiler chicken meat, antimicrobial activity

INTRODUCTION
Turmeric (*Curcuma longa*) has a long history of use in both human and animal medicine. It is recognized for its diverse properties, functioning as a nematocide, antibacterial, antifungal, antiprotozoal, antiviral, and antioxidant agent (Chattopadhyay *et al.*, 2004; Kiuchi *et al.*, 1993). Beyond these, it also exhibits immunomodulatory and hypocholesteremic effects (Ammon *et al.*, 1993; Anthony *et al.*, 1999; Chattopadhyay *et al.*, 2004). In recent years, the poultry industry has experienced a surge in interest in medicinal plants. This shift is largely driven by growing consumer concerns regarding synthetic additives and antibiotic residues in meat products (Kirkpinar *et al.*, 2014). Prior research has already demonstrated some of turmeric's positive impacts on broiler chickens, including improvements in growth performance, feed conversion ratio, antioxidant status, and immune response (Al-Sultan, 2003; Emadi and Kermanshahi, 2006; Arslan *et al.*, 2017; Hosseini-Vashan *et al.*, 2012).

While the global benefits of turmeric are well-established, consumer demand for leaner meat, specifically options with lower intra-muscular fat, is on the rise. (Yang et al., 2009; Yang et al., 2015). In Nigeria, various locally available species of turmeric are commonly used in traditional medicine for treating a range of diseases. Given this widespread local use, it's crucial to specifically assess the effects, both positive and negative, of these local turmeric varieties on the carcass traits and sensory evaluation of broiler chickens.

This research is fundamentally driven by the necessity to explore the potential of turmeric as a natural and readily available substitute for synthetic growth promoters in antibiotic-free poultry production systems. It seeks to provide valuable insights into how an aqueous extract of turmeric might influence broiler production, with a particular focus on its impact on the bacterial count present in the meat and on the overall quantitative phytochemical profile of the turmeric itself. Ultimately, this investigation will contribute to developing more scientifically grounded and sustainable practices within the poultry industry. Therefore, the core aim of this study is to rigorously examine the effect of an aqueous extract of *Curcuma longa* (turmeric) on the bacterial count found in broiler chicken meat.

MATERIALS AND METHODS
Experimental Site and Bird Management
The experimental work was conducted at the Poultry section of the Teaching and Research Farm, Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Gidan Kwano Campus, Minna, Nigeria.

One hundred and sixty (160) day-old Ross 308 broiler chicks were randomly assigned to four treatment groups in a Completely Randomized Design (CRD). Each treatment group was replicated four times, with ten birds per replicate

(40 birds per treatment). The birds were housed in a poultry pen with two-sided openings for ventilation, using a deep litter system. Routine management and standard vaccination programme schedules were strictly followed.

Experimental Materials and Diet Formulation

The experimental test ingredient, turmeric, was procured from Kure ultra-modern market, Minna, Niger State. A single-phase feeding method was employed. The treatment groups were as follows:

- **Treatment 1 (T1):** 0 g turmeric/litre of water (Control)
- **Treatment 2 (T2):** 1 g turmeric/litre of water
- **Treatment 3 (T3):** 2 g turmeric/litre of water
- **Treatment 4 (T4):** 3 g turmeric/litre of water

Turmeric Extract Preparation

Fresh turmeric rhizomes were obtained from Kure ultra-modern market, Minna. The rhizomes were washed, sliced, and sun-dried for four days. The dried turmeric was then ground into a powder using a hammer mill. The turmeric aqueous extract was prepared by dissolving the weighed turmeric powder in water, stirring, allowing it to stand for 30 minutes, and then filtering it through a muslin cloth. The filtrate was collected and used as the aqueous extract, administered to the birds via their drinking water.

Bacterial Count Analysis

Total aerobic mesophilic counts (CFU/g x 10^5) were determined following the procedures of AOAC (2005). Dilutions of meat samples were plated on plate count agar and incubated aerobically at 37°C for 24 hours. After incubation, bacterial colonies were counted and averaged. The result was expressed as the total number of colonies multiplied by the dilution factor and inoculum volume, yielding colony-forming units per gram (CFU/g x 10^2).

Data Analysis

All data was analysed using a one-way analysis of variance (ANOVA) in SPSS software (version 23.0). Significant differences between treatment means were determined using the same software.

RESULTS

The analysis of bacterial counts in broiler chicken meat, following the administration of varying levels of turmeric aqueous extract, revealed no statistically significant differences (P>0.05) among the treatment groups. The bacterial loads ranged from 6.20 CFU/g in the control group (T1) to 5.20 CFU/g in the group receiving the highest concentration of turmeric extract (T4). While statistical significance was not achieved, a numerical trend of decreasing bacterial load was observed with increasing concentrations of turmeric aqueous extract. The specific bacterial counts for each treatment group, presented as colony-forming units per gram (CFU/g), are visually represented in Figure 1.

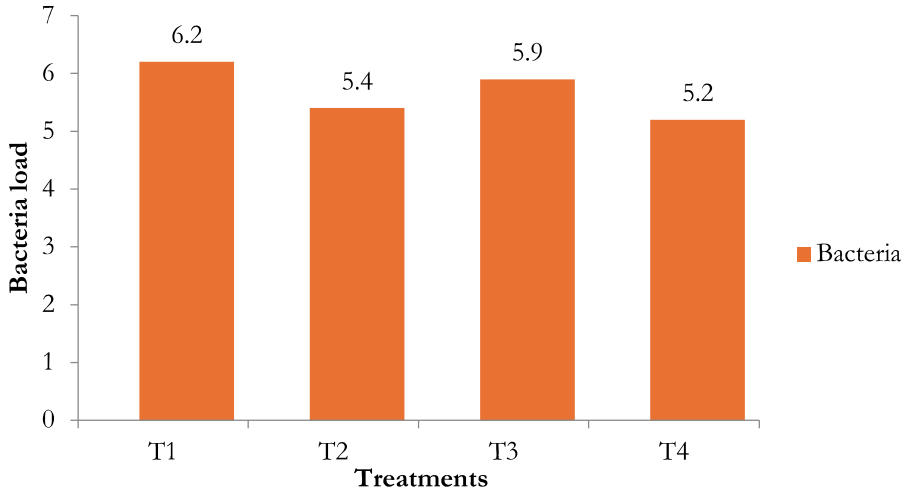


Figure 1: Bacterial Count of Broiler Chicken Administered Turmeric Aqueous Extract.

T1 = Control (administered 0 g of turmeric/litre of water); T2 = administered 1 g of turmeric/litre of water; T3 = administered 2 g of turmeric/litre of water; T4 = administered 3 g of turmeric/litre of water; CFU = Colony forming unit; SEM = Standard error of mean; P-value = Probability value; LS = Level of significance; NS = Not significant.

DISCUSSION

The results of this study, focusing on the bacterial count in broiler chickens administered varying concentrations of turmeric aqueous extract, revealed no statistically significant differences ($p>0.05$) across the treatment groups. As presented in Figure 1, the bacterial load, measured as colony-forming units per gram (CFU/g), ranged from 6.20 CFU/g in the control group (T1) to 5.20 CFU/g in the group receiving the highest concentration of turmeric extract (T4). While the absence of statistical significance might initially suggest a lack of effect, the consistent numerical decrease in bacterial load observed with increasing turmeric concentration warrants careful consideration.

The numerical trend, with bacterial counts decreasing from 6.20 CFU/g (T1) to 5.4 CFU/g (T2), 5.9CFU/g, then to 5.20 CFU/g (T4), strongly suggests a potential antimicrobial effect of the turmeric aqueous extract. This observation aligns with a growing body of literature highlighting the antimicrobial properties of turmeric and its bioactive components. Kumar *et al.* (2017) reported on the antimicrobial activity of turmeric against common foodborne pathogens, supporting the potential for turmeric to contribute to a reduction in bacterial load. Furthermore, Sarker *et al.* (2018) specifically demonstrated the antimicrobial effects of turmeric against poultry pathogens, including *E. coli* and *Salmonella*, two bacteria of significant concern in poultry production and food safety.

The active compound primarily responsible for turmeric's antimicrobial activity is curcumin. Tyagi *et al.* (2015) demonstrated that curcumin inhibits both bacterial growth and biofilm formation, a crucial mechanism by which bacteria establish themselves and resist antimicrobial agents. The observed numerical decrease in bacterial load in our study, while not statistically significant, could be attributed to the action of curcumin and other bioactive compounds present in the turmeric aqueous extract.

Several factors could explain why the observed trend did not reach statistical significance. One possibility is the dosage of turmeric aqueous extract used in the study. The concentrations (1 g/L, 2 g/L, and 3 g/L) might have been too low to elicit a statistically significant reduction in bacterial load. Future research should explore higher concentrations of turmeric extract to determine if a more pronounced and statistically significant effect can be achieved.

Another factor to consider is the duration of the experiment. The length of time the birds were exposed to the turmeric extract might have been insufficient to allow for a statistically significant change in bacterial load to manifest. A longer experimental period could potentially reveal a more substantial and statistically significant impact.

The method of administration, via drinking water, also warrants consideration. While convenient, this method might have resulted in variations in the actual intake of turmeric extract by individual birds, potentially contributing to the lack of statistical significance.

Despite the absence of statistical significance in this specific study, the findings contribute to the broader discussion surrounding the use of natural alternatives to antibiotics in poultry production. The numerical decrease in bacterial load, coupled with the existing literature on turmeric's antimicrobial properties, suggests that turmeric aqueous extract holds promise as a potential feed additive to promote gut health and potentially reduce the reliance on antibiotics. This is particularly relevant given the growing concerns about antibiotic resistance and the need for alternative strategies to manage bacterial populations in poultry (Lillehoj *et al.*, 2018). Further research, employing higher doses, longer experimental periods, and potentially different administration methods, is needed to fully elucidate the potential of turmeric aqueous extract as a natural antimicrobial agent in broiler chicken production.

CONCLUSION AND RECOMMENDATIONS

In this study, it was established that the inclusion of turmeric aqueous extract in the drinking water of broiler chickens, at the concentrations tested, did not significantly alter the bacterial count in the meat. However, a consistent numerical decrease in bacterial load was observed with increasing concentrations of the extract, suggesting a potential, albeit non-significant, antimicrobial effect.

Based on the findings of this study, although the tested levels of turmeric aqueous extract didn't statistically confirm its impact, the numerical trend encourages that furthur research should explore higher concentrations and longer experimental periods to fully understand the dose-response relationship.

It is therefore recommended that further research should be conducted, to explore higher concentration of Turmeric aqueous extract, this will help validate its potential as a natural feed additive for improving gut health and potentially reducing bacterial load in broiler chicken meat. This research should also investigate different period of administering the extract to chicken.

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