*FUDMA Journal of Sciences (FJS)*
*ISSN online: 2616-1370*
*ISSN print: 2645 - 2944*
*Vol. 10 No. 2, January, 2026, pp 167 – 174*
*DOI: https://doi.org/10.33003/fjs-2026-1002-4365*

# FROM KITCHEN TO COMMUNITY: DOSE-DEPENDENT PUBLIC HEALTH RISK REDUCTION OF MEAT-BORNE PATHOGENS AND SPOILAGE BACTERIA THROUGH CURRY POWDER-SALT CURING

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## ABSTRACT

Lack of refrigeration in many developing regions leads to economic and public health challenges from meat spoilage and foodborne pathogens. This research evaluates combinations of curry powder and salt as a public health intervention to reduce microbial load on beef stored at 4 ± 1 °C for 7 days. Two curing formulations were tested: a low-concentration range (0.5 - 3 g curry powder + 1 g salt/100 mL) and a high-concentration range (5 - 20 g curry powder + 5 g salt/100 mL), with untreated samples as controls. Total heterotrophic and coliform counts were measured. A significant dose-response was observed ($p < 0.05$): microbial loads decreased as curry concentration increased. The strongest suppression was achieved with Formulation Two (20 g curry + 5 g salt), reducing total heterotrophic bacteria count (THBC) to $3.00 \pm 2$ $\log_{10}$ CFU/g and significantly suppressed coliform growth by day 7 ($p < 0.05$ compared to control). Thirteen bacterial species were identified, including key pathogens, and their prevalence and diversity showed an inverse relationship with curry-salt concentration. The combination of salt-induced osmotic stress and curry's bioactive compounds effectively reduced microbial load and diversity. This study demonstrates that curry powder and salt act as preservatives and provide a scalable, culturally accepted solution for public health risk reduction. By defining concentration thresholds, this approach can help small-scale processors in low-resource settings extend meat shelf-life and reduce foodborne illness risks, particularly among vulnerable populations. Further studies are needed to assess sensory acceptance and storage stability.

**Keywords**: Curry Powder, Salt Curing, Meat Preservation, Dose-Response Modelling, Foodborne Pathogens, Microbial Diversity, Public Health Intervention

## INTRODUCTION

Meat is a nutrient-rich food that is highly susceptible to spoilage due to microbial activity, lipid oxidation, and enzymatic degradation. In many low-resource settings, where access to reliable refrigeration is limited due to unreliable power supply, spoilage can occur rapidly, leading to economic losses and potential public health risks (FAO, 2023). Traditionally, salt has been used as a preservative for meat because it dehydrates tissues, creates an osmotic environment unfavourable for microbial growth, and extends shelf life (Purriños *et al*., 2011). Spices, such as curry powder, are valued not only for their sensory enhancement but also for their potential antimicrobial and antioxidant properties (Gottardi *et al*., 2016; Wani *et al*., 2022). The combination of salt and spices offers a culturally relevant and potentially more effective preservation strategy for meat (Tajkarimi *et al*., 2010). This is consistent with earlier findings by Okon *et al*. (2020), who demonstrated that the synergistic application of *Citrus aurantifolia* (lime) and NaCl provided superior bacterial reduction in the bivalve clam, *Galatea paradoxa*, compared to using either agent alone

Previous studies have explored various meat preservation techniques including thermal treatment, drying, vacuum packaging, and refrigeration (Gómez *et al*., 2020; Lee and Yoon, 2024). These methods, while effective, can alter sensory qualities, require expensive infrastructure, or fail under an inconsistent power supply. Spices have been investigated for their role in inhibiting microbial growth and delaying lipid oxidation in foods (Hyldgaard *et al*., 2012; Rubió *et al*., 2013). Essential oils from spices such as oregano, clove, rosemary, and turmeric have demonstrated antimicrobial activity against *Escherichia coli*, *Listeria monocytogenes*, and *Staphylococcus aureus* in both in vitro and in vivo food models (Tajkarimi *et al*., 2010). However, most of these studies focused on individual spice extracts or essential oils rather than complex spice blends such as curry powder.

Despite the long history of curry powder use in cooking, limited research exists on its direct role in meat preservation when combined with salt. There is a paucity of empirical data regarding optimal concentrations, antimicrobial efficacy against a range of spoilage and pathogenic microorganisms (Santiesteban-López *et al*., 2020; Seleshe *et al*., 2022; Ehsanur Rahman *et al*., 2023; Fernandes *et al*., 2024). Moreover, there is insufficient evidence on how curry powder performs in real-world storage conditions relevant to low-resource environments (Seleshe *et al*., 2022; Sulieman *et al*., 2023). This knowledge gap limits the ability of food processors and households to effectively utilize curry powder as a functional preservative.

This study was designed to address these gaps by evaluating the microbial load, diversity, and of organisms in cured meat treated with varying concentrations of curry powder in combination with salt. We specifically studied how different doses affect the overall microbial load, total coliforms, and the variety of isolated bacteria, including spoilage and pathogenic species, over seven days of refrigerated storage. We hypothesized that there would be a significant inverse correlation between the concentration of the curry-salt curing solution and the diversity of the microbial community on the meat. Specifically, we predicted that higher doses of the treatment would not only reduce the total microbial load but also selectively inhibit a broader spectrum of species, leading to a less diverse residual microbial population dominated by more resistant organisms. The findings contribute to the growing body of literature on natural food preservation

strategies and offer a culturally appropriate, low-cost intervention for meat safety in developing countries. Additionally, understanding the impact of curry powder on microbial communities may support broader public health objectives aimed at reducing reliance on synthetic preservatives and improving food safety in resource-limited settings (Chouhan *et a*l., 2017; FAO, 2023) By combining microbiological measurements with biochemical analysis, this research offers a complete evaluation of how curry powder-salt curing can serve as a method for extending shelf life. It also presents a culturally acceptable, low-cost public health solution to improve food safety and possibly reduce the spread of resistant pathogens in resource-limited settings.

## MATERIALS AND METHODS

### Study Area and Sample Collection

The study was conducted in Uyo, Akwa Ibom State, Nigeria, a humid tropical zone with limited refrigeration access. Fresh beef samples were purchased from Anua Offot Market, aseptically packaged, and transported on ice to the Department of Microbiology Laboratory, University of Uyo, for immediate analysis.

### Preparation of Cured Meat Samples

Meat was washed in cooled sterile water and cured with two formulations:

***Formulation 1:*** curry powder (0.5 g, 1 g, 2 g and 3 g) + 1 g salt + 100 mL sterile water. This formulation represents a lower concentration range, suitable for testing subtle preservative and sensory effects, as used in studies evaluating minimal intervention strategies (Seleshe *et al*., 2022; Ehsanur Rahman *et al*., 2023).

***Formulation 2:*** curry powder (5 g, 10 g, 15 g and 20 g) + 5 g salt + 100 mL sterile water. This formulation represents a higher concentration range, consistent with methodologies designed to test the robust antimicrobial efficacy of plant extracts and their synergistic effects with salt in marinades and curing solutions (Sulieman *et al*., 2023).

Untreated samples served as controls. Twenty-five (25)g of the cured meat was wrapped in aluminium foil, placed in sterile beakers, and refrigerated (4 ± 1 °C) overnight. Microbiological analysis was conducted on days 1, 3, 5, and 7.

### Microbiological Analysis

Serial dilutions were prepared according to Cheesbrough (2006), and total heterotrophic bacterial counts (THBC) and total coliform counts (TCC) were enumerated using pour-plate techniques on Nutrient Agar and MacConkey Agar, respectively (Horrigan and MacCance, 1990; Prescott, 2004). The analyses were performed in triplicate (n = 3). Plates were incubated at 28 °C for 24 h, which is the average ambient temperature in the study region, allowing for the simultaneous enumeration of three key physiological groups: true psychrotrophs capable of slow growth at 4°C, mesophilic pathogens (such as *Salmonella* species and pathogenic *E. coli*), and the native tropical spoilage microflora that may exhibit optimum growth at moderate temperatures. This approach ensures a comprehensive assessment of the total viable microbial community and the potential public health risk, rather than focusing exclusively on the subpopulation active during refrigeration (Juneja *et al*., 2012), and counts were expressed as CFU/g. Representative colonies were purified by repeated streaking on Nutrient Agar and stored on agar slants at 4 °C. Morphological, cultural, and biochemical tests were performed for bacterial identification following ‘’Bergey’s Manual’’ (1994). Furthermore, selective and differential media like Mannitol salt agar, Eosine methylene blue agar, Salmonella/Shigella agar and Blood agar were used to identify bacterial isolates. Tests included Gram staining, catalase, coagulase, oxidase, urease, citrate utilisation, starch hydrolysis, motility, MR-VP, indole, and sugar fermentation (glucose, lactose, sucrose, maltose, fructose, mannitol) were also carried out.

### Determination of Dose-Dependent Public Health Risk Reduction

The quantitative microbiological data from the curing experiments was used to create a theoretical model for reducing public health risks. This process had two main steps. First, we established a dose-response relationship for microbial inhibition. Second, we applied this relationship to measure population health risk.

### Dose-Response Modelling of Microbial Inhibition

We collected primary data for Total Heterotrophic Bacterial Count (THBC) and Total Coliform Count (TCC) across two formulations (F1: 0.5-3 g curry + 1 g salt; F2: 5-20 g curry + 5 g salt) and various storage days. For each treatment group, we calculated the average THBC at Day 7, which represents the end of the recommended storage period. We applied a non-linear regression to fit the data to a log-linear dose-response model described in equation 1:

$$\Delta Log10CFU = \alpha * \ln(C) + \beta \quad (1)$$

In this equation, ΔLog10CFU represents the reduction in microbial load compared to the control, C is the concentration of curry powder (g/100mL), and α and β are model parameters. We assessed the goodness-of-fit using the $R^2$ statistic.

### Extrapolation to Theoretical Relative Risk (RR)

We transformed the microbial load data into a theoretical Relative Risk (RR) of foodborne illness, based on the principle that the chance of getting sick from contaminated food depends on the number of pathogens ingested (FAO and WHO, 2022). We calculated the RR for each treatment group in relation to the untreated control (RR = 1.0) using a simplified exponential dose-response relationship for infection (Buchanan *et al*., 2000) as in equation 2:

$$RR\_theoretical = 10^{(k * \Delta Log10CFU)} \quad (2)$$

In this equation, ΔLog10CFU is the average reduction in log10 CFU/g for the treatment group compared to the control, and k is a scaling constant (set at k = -0.5 for model illustration) that represents the specific infectivity of the pathogen. This model directly connects the amount of microbial reduction achieved by each curry-salt dose to a proportional decrease in health risk for the population.

For this proof-of-concept study, we employed a simplified dose-response relationship: (Equation 2). While true dose-response models for bacterial pathogens use pathogen-specific parameters (typically α and β for the beta-Poisson model or r for the exponential model), our simplified approach with k = -0.5 serves as an illustrative scaling factor to demonstrate the directional relationship between microbial reduction and theoretical risk. This simplification is justified for comparative purposes within a single study system, though we acknowledge that actual risk reduction would be pathogen-dependent.

### Formulation of Public Health Application Bands

Based on the resulting dose-risk curve, we categorised the treatment formulations into specific Public Health

***Application Bands:***

***Band 1 (Baseline Risk Reduction):*** This includes Formulation One (0.5-3 g curry) and is recommended for general household use to improve meat safety.

***Band 2 (High-Risk Mitigation):*** This includes Formulation Two (15-20 g curry) and is aimed at high-risk populations (immunocompromised, children, elderly) or during peak seasons for diarrheal disease, where maximum pathogen suppression is necessary.

All analyses were performed using R statistical software (v4.3.1) along with the drc package for fitting dose-response curves.

**Statistical Analysis**

All experiments were performed in triplicate (n = 3), with each replicate representing an independent experimental run using separate meat samples and freshly prepared curing solutions. Data were analysed using SPSS version 20.0 (IBM Corp., Armonk, NY, USA). Microbial counts (THBC and TCC) were $\log_{10}$-transformed to achieve normality and homogeneity of variance before analysis. Differences in mean microbial counts between treatment groups (different curry powder concentrations) and across storage days were assessed using a one-way analysis of variance (ANOVA). Where ANOVA indicated significant differences ($p < 0.05$), post-hoc multiple comparisons were conducted using Tukey's Honestly Significant Difference (HSD) **test** to identify which specific treatment groups differed significantly from each other. All results are presented as mean ± standard deviation (SD). A p-value < 0.05 was considered statistically significant.

**RESULTS AND DISCUSSION**

**Microbial Counts in Cured Meat - Formulation One**

In Formulation One (0.5-3 g curry powder + 1 g salt + 100 mL), microbial counts declined with increasing curry powder concentration. On Day 1, total heterotrophic bacterial counts (THBC) were highest in the control (4.54 ± 2 $\log_{10}$ CFU/g) and lowest in 3 g curry samples on Day 3 (3.65 ± 2 $\log_{10}$ CFU/g). In Formulation Two (5-20 g curry powder + 5 g salt/100 mL), microbial inhibition was more pronounced. The highest THBC was recorded in the control at Day 3 (4.54 ± 2 $\log_{10}$ CFU/g), whereas the lowest was observed in 20 g curry-treated meat at Day 7 (3.00 ± 2 $\log_{10}$ CFU/g), which aligns with the peak microbial activity observed across all control groups.

For Total coliform counts (TCC) followed a similar trend as THBC for formulation one, peaking in the control at Day 5 (3.94 ± 2 $\log_{10}$ CFU/g) and reaching their lowest in 3 g curry-treated meat on Day 3 (3.42 ± 2 $\log_{10}$ CFU/g). These results indicate that even low curry concentrations, when combined with salt, can significantly suppress microbial proliferation within the first three days of storage. For TCC of formulation two, control samples peaked at Day 1 (3.94 ± 2 $\log_{10}$ CFU/g), while 20 g curry significantly suppressed coliform growth by Day 7 (2.60 ± 2 $\log_{10}$ CFU/g). The sustained reduction in microbial load with higher curry concentrations suggests prolonged antimicrobial activity, possibly due to synergistic effects between curry powder's bioactives and salt (Zhang *et al*., 2016; Sulieman *et al*., 2023).

**Table 1: Total Heterotrophic Bacterial Count of Cured Meat Samples**

| Category | Curry Concentration | Bacterial count ($\log_{10}$ CFU/g) | | | |
|---|---|---|---|---|---|
| | | Day 1 | Day 3 | Day 5 | Day 7 |
| Total Heterotrophic Bacterial Counts (THBC) for F1 | Control | 4.54 ± 2 | 4.51 ± 2 | 4.48 ± 2 | 4.30 ± 2 |
| | 0.5 g | 4.39 ± 1 | 4.18 ± 2 | 4.27 ± 1 | 4.25 ± 2 |
| | 1 g | 4.04 ± 2 | 4.00 ± 1 | 4.12 ± 2 | 4.09 ± 2 |
| | 2 g | 3.92 ± 2 | 3.85 ± 2 | 3.97 ± 2 | 3.94 ± 2 |
| | 3 g | 3.73 ± 1 | 3.65 ± 1 | 3.79 ± 2 | 3.81 ± 2 |
| Total Heterotrophic Bacterial Counts (THBC) for F2 | Control | 4.39 ± 2 | 4.54 ± 2 | 4.48 ± 2 | 4.37 ± 2 |
| | 5 g | 3.75 ± 2 | 3.53 ± 2 | 3.83 ± 2 | 3.76 ± 2 |
| | 10 g | 3.08 ± 2 | 2.78 ± 2 | 3.53 ± 2 | 3.65 ± 2 |
| | 15 g | NG | NG | 3.36 ± 2 | 3.48 ± 2 |
| | 20 g | NG | NG | NG | 3.00 ± 2 |

Key: F1: Formulation one; F2: Formulation two; NG: (No growth) as being below the detection limit (< 1 $\log_{10}$ CFU/g); g = gram

**Table 2: Total Coliform Count of Cured Meat Samples**

| Media | Curry Concentration | Bacterial count ($\log_{10}$ CFU/g) | | | |
|---|---|---|---|---|---|
| | | Day 1 | Day 3 | Day 5 | Day 7 |
| Total Coliform Counts (TCC) for F1 | Control | 3.86 ± 2 | 3.80 ± 2 | 3.94 ± 2 | 3.79 ± 2 |
| | 0.5 g | 3.12 ± 2 | 3.70 ± 2 | 3.87 ± 2 | 3.76 ± 2 |
| | 1 g | 3.77 ± 2 | 3.62 ± 2 | 3.80 ± 1 | 3.76 ± 1 |
| | 2 g | 3.71 ± 2 | 3.57 ± 2 | 3.84 ± 2 | 3.69 ± 2 |
| | 3 g | 3.62 ± 2 | 3.42 ± 2 | 3.76 ± 2 | 3.51 ± 2 |
| Total Coliform Counts (TCC) F2 | Control | 3.94 ± 2 | 3.88 ± 2 | 3.81 ± 2 | 3.72 ± 2 |
| | 5 g | 3.67 ± 2 | 3.63 ± 2 | 3.53 ± 2 | 3.60 ± 2 |
| | 10 g | NG | 3.11 ± 2 | 3.53 ± 2 | 3.58 ± 2 |
| | 15 g | NG | NG | NG | 3.00 ± 2 |
| | 20 g | NG | NG | NG | 2.60 ± 2 |

Key: F1: Formulation one; F2: Formulation two; NG: (No growth) as being below the detection limit (<1 $\log_{10}$ CFU/g)

**Microbial Characterisation, Identification, Diversity and Distribution**

A total of 13 bacterial species were identified, including *Bacillus subtilis*, *Micrococcus* sp., *Streptococcus* sp., coagulase-negative *Staphylococcus*, *Proteus* sp., *Enterococcus* sp., *Staphylococcus aureus*, *Salmonella* sp., *Enterobacter* sp., *Escherichia coli*, *Shigella* sp., *Citrobacter* sp., and *Bacillus cereus* (Tables 3). Control samples harboured the highest microbial diversity, whereas higher curry concentrations reduced both the number and variety of isolates. This reduction aligns with earlier studies showing that spice-derived antimicrobials can target a broad spectrum of Gram-positive and Gram-negative bacteria in food systems (Table 4) (Tajkarimi *et al*., 2010; Rubió *et al*., 2013).

The presence of pathogens such as *E. coli*, *S. aureus*, and *Salmonella* sp. in untreated meat underscores the need for effective preservation methods in low-resource settings (Gizaw, 2019). The significant microbial load reduction in treated samples suggests that curry powder salt curing could serve as a culturally acceptable, low-cost intervention to extend meat shelf life while reducing foodborne pathogen risk (Seleshe *et al*., 2022; Sulieman *et al*., 2023)

The observed synergy mirrors findings in spice-salt preservation studies where combinations produced stronger antimicrobial outcomes than individual treatments (Lv *et al*., 2011). The addition of salt may enhance these effects by creating osmotic stress and reducing water activity, further limiting microbial growth (Purriños *et al*., 2011). The antimicrobial properties of curry powder are likely due to phenolic compounds, curcuminoids, and essential oils (e.g., from turmeric, cumin, coriander) that disrupt cell membranes, inactivate enzymes, and interfere with nutrient uptake (Hyldgaard *et al*., 2012); as noted in the study of *Galatea paradoxa* by Okon et al.(2020), the acidic nature of lime combined with osmotic pressure of NaCl creates an environment that facilitates the rapid leakage of intracellular components in enteric pathogens.

**Table 3: Biochemical Characterization and Identification of Bacterial Isolated from Cured and Uncured Meat Samples**

| S/N | Gram Reactions | Shape | Catalase | Coagulase | Motility | Starch hydrolysis | Citrate | Urease | MR | VP | Oxidase | Spore formation | Indole | Haemolysis | Glucose | Maltose | Lactose | Fructose | Sucrose | Mannitol | Probable organisms |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | +ve | Rod | + | - | + | + | - | - | - | + | - | + | - | - | AG | A | - | A | A | - | *Bacillus subtilis* |
| 2. | +ve | Cocci in chains | + | - | - | + | - | - | + | - | - | - | - | + | A | A | A | A | - | - | *Streptococcus* sp. |
| 3. | +ve | Cocci in pairs | + | - | - | + | + | + | + | - | + | - | - | - | - | A | - | A | - | A | *Micrococcus* sp. |
| 4. | +ve | Cocci in clusters | + | - | - | - | + | - | - | + | - | - | - | - | A | A | - | A | A | AG | Coagulase-negative *Staphylococcus* sp. |
| 5. | -ve | Rod | + | - | + | - | - | + | + | - | - | - | - | - | AG | A | AG | AG | AG | - | *Proteus* sp. |
| 6. | +ve | Cocci in short chains | - | - | - | + | - | + | - | + | - | - | - | - | A | AG | AG | AG | - | AG | *Enterococcus* sp. |
| 7. | +ve | Cocci in clusters | + | + | - | - | + | - | - | + | - | - | - | + | AG | A | - | A | A | AG | *Staphylococcus aureus* |
| 8. | -ve | Rod | + | - | + | - | + | - | + | - | - | - | - | - | A | A | - | - | - | AG | *Salmonella* sp. |
| 9. | -ve | Rod | + | - | + | - | - | - | - | + | - | - | - | | AG | AG | - | - | - | AG | *Enterobacter* sp. |
| 10. | -ve | Rod | + | - | + | - | - | - | + | - | - | - | + | + | AG | AG | AG | A | AG | - | *Escherichia coli* |
| 11. | -ve | Rod | + | - | + | - | - | - | + | - | - | - | - | - | AG | - | - | A | - | AG | *Shigella* sp. |
| 12. | -ve | Short rod | + | - | + | - | + | - | + | - | - | - | - | + | AG | AG | AG | AG | - | - | *Citrobacter* sp. |
| 13. | +ve | Rod | + | - | + | + | - | - | - | + | - | + | - | - | AG | A | - | AG | A | - | *Bacillus cereus* |

Key: +ve = Positive; -ve = Negative; A = Acid; G = Gas

**Table 4: Distribution of Different Microorganisms Isolated from Control and Cured Meat Samples**

| Organisms | Controls | | Bacterial from cured meat using Formulation One | Bacterial from cured meat using Formulation Two |
|---|---|---|---|---|
| | Control for Formulation One | Control for Formulation Two | | |
| *Bacillus subtilis* | + | + | + | + |
| *Streptococcus sp.* | + | - | - | - |
| *Micrococcus sp.* | + | + | + | + |
| Coagulase negative *Staphylococcus sp*. | + | + | - | - |
| *Proteus sp.* | + | - | - | - |
| *Enterococcus sp.* | + | + | - | - |
| *Staphylococcus aureus* | + | + | + | - |
| *Salmonella sp.* | + | + | - | - |
| *Enterobacter sp.* | + | - | + | - |
| *Escherichia coli* | + | + | - | - |
| *Shigella sp.* | + | + | - | - |
| *Citrobacter sp.* | + | - | + | - |
| *Bacillus cereus* | + | + | + | + |

Key: + = Present; - = Absent

**Summary of Key Findings**

i. Microbial counts declined with increasing curry powder concentration, with the greatest effect observed in 20 g curry + 5 g salt (Formulation Two).
ii. High curry concentrations sustained inhibition through Day 7 of storage.
iii. Curry powder reduced both microbial load and diversity, including spoilage and pathogenic species.

The findings align with prior research on spice-based antimicrobials and support their application in meat preservation.

**Dose-Dependent Public Health Risk Reduction**

Figure 1 models the direct public health implications of the core finding of this study: that higher concentrations of curry powder with salt produce a dose-dependent reduction in the microbial load on meat. Theoretical relative risk (RR) of foodborne illness associated with consumption of beef cured with varying concentrations of curry powder and salt, stored at 4 ± 1 °C for 7 days. Relative risk was calculated based on the reduction in Total Heterotrophic Bacterial Count (THBC) at Day 7 compared to untreated controls, using the relationship in equation 2, with k = -0.5. Control represents untreated meat (RR = 1.0). F1(0.5g) = Formulation One with 0.5 g curry powder + 1 g salt/100 mL; F1(3g) = Formulation One with 3 g curry powder + 1 g salt/100 mL; F2(5g) = Formulation Two with 5 g curry powder + 5 g salt/100 mL; F2(20g) = Formulation Two with 20 g curry powder + 5 g salt/100 mL. Values are mean ± SD (n = 3). A log-linear dose-response model ($\Delta Log_{10}CFU = \alpha \cdot \ln(C) + \beta$) was fitted to the full dataset (all concentrations from 0.5 to 20 g/100mL), yielding an $R^2 = 0.94$, indicating that 94% of the variance in microbial reduction is explained by curry powder concentration. The progressive reduction in RR from 1.0 (Control) to 0.22 (F2-20g) demonstrates a clear dose-dependent public health benefit, with the highest concentration achieving an estimated 78% risk reduction. This idea is consistent with applying targeted interventions to maximise public health impact with limited resources, a key consideration for food safety in developing regions, as pointed out by Grace (2015). For example, lower concentrations of Formulation One may suffice for general household use, providing a base level of improvement to food safety. In contrast, the robust suppression achieved by Formulation Two (20g curry + 5g salt) presents a critical strategy in protecting those most vulnerable, including children, the elderly, and immunocompromised populations, who suffer disproportionately severe outcomes from pathogens such as *E. coli* and *Salmonella*.

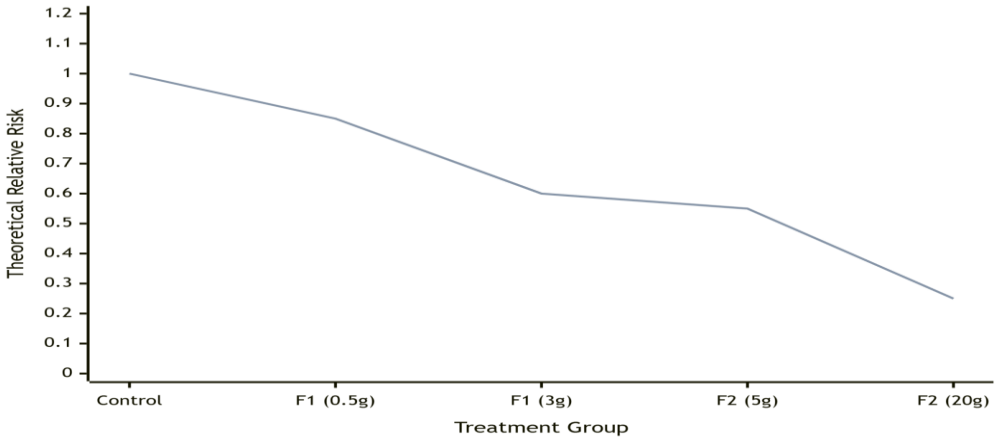


Figure 1: Dose-Dependent Public Health Risk Reduction Based on the Observed dose-Dependent Microbial Inhibition ($R^2 = 0.94$)

This strategy becomes all the more critical in resource-limited settings where infrastructural weaknesses example, fragile cold chains represent a perennial determinant of outbreaks of foodborne disease (Gizaw, 2019). By offering a graduated, approachable intervention, the curry-salt technique enables communities to resist these systemic imperils. Deploying the high-dose regimen during seasonal peaks of diarrheal diseases or in areas with known contamination could function as a form of passive, community-wide prophylaxis, decreasing the incidence of infection and the linked burden on fragile healthcare systems. Thereby, this dose-response relationship transforms the preservative from being a mere kitchen practice into a scalable and adaptable tool for epidemiological control.

## CONCLUSION

This study demonstrated that curry powder, when combined with salt, effectively reduces microbial load and diversity in cured meat, including both spoilage organisms and foodborne pathogens. As hypothesized, an inverse correlation exists between treatment dose and microbial variety. Formulation Two (20 g curry + 5 g salt) achieved the most pronounced suppression, reducing theoretical relative risk (RR) by approximately 78%—representing one of the first dose-response models for curry-based preservation in this cultural context.

The findings provide evidence for a low-cost, scientifically validated, and culturally acceptable preservation strategy for low-resource settings. This scalable model can be deployed via community-based workshops to improve food safety and reduce the incidence of foodborne illness in households lacking reliable refrigeration.

## RECOMMENDATIONS

i. Promote the use of curry powder- salt curing in households and small-scale meat processing enterprises in low-resource settings.
ii. Conduct sensory evaluation studies to assess consumer acceptance of various curry concentrations.
iii. Investigate the long-term storage stability and efficacy of curry-salt curing under ambient conditions.
iv. Explore the antimicrobial spectrum of different curry formulations to optimise preservation effects.

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