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# INFLUENCE OF SELECTED CHEMICAL ADDITIVES AND APPLICATION LEVELS ON BACTERIOLOGICAL SAFETY OF CHICKEN BREAST MEAT

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**ABSTRACT**------------------------------------------------------------------------------------------------------------
*The study was conducted to investigate the effects of selected chemical additives and their application levels on the bacteriological safety of chicken breast meat. A factorial experiment involving four widely used chemical additives (Monosodium glutamate, Sodium nitrate, Monosodium phosphate and Sodium chloride) and three application levels (1, 2 and 3% w/w) was laid in in a completely randomized design (CRD). A total of 15 average weight broiler chickens were slaughtered and cut into primal cuts. Chicken breast meat was collected and each fresh breast was divided into 10 average sized pieces making a total of 150 pieces. The pieces was randomly divided into 12 groups, containing 12 pieces representing the treatments for the study. Each group was administered its treatment specification and grilled using charcoal griller until the meat is cooked. The proximate, sensory and bacteriological data were collected and analyzed using the Analysis of variance (ANOVA) in the statistical packages for social sciences (SPSS) Version 17.0 at 5% using Tukey test. Monosodium glutamate treated samples at 2% had lower microbial load ($128 \times 10^5$) than all other samples. Total microbial load of chicken breast meat falls within the USDA safety limit for chicken products. The results revealed that despite chemical treatment, 36 bacteria were isolated from nine (9) genera of bacteria. According to prevalence, the bacteria include: Bacillus Cereus (22.22%), Staphylococcus aureus (19.44%), Pseudomonas auregenosa (16.67%), Streptococcus pneumonia (8.33%), Lacto bacillus (Strepto) (8.33%) Bacillus anthricia (8.33%), Wrella Shella pneumonae (5.56%), Bacillus subtilis (5.56%), Bacillus megaterium (2.78%) and Micro coccus (2.78%). The study concluded that Sodium chloride at up to 3% w/w should be used in the grilled beef industries since it ensures lower bacteriological load However, the presence of Streptococcus pneumonia is a human pathogenic bacterium and it is recognized as a major cause of pneumonia and meningitis in children and the elderly which may result to health challenges.*

**KEYWORDS**: *Chemical Additives, Bacteriological Load, Prevalence, Chicken Breast Meat*------------------------

## 1. INTRODUCTION

Chicken breast meat is an excellent source of protein, containing approximately 30-35 grams per 100 grams, chicken breast meat also it is relatively low in fat, with a favorable fatty acid profile USDA (2020). However it is a good source of various micro nutrients including niacin, vitamin B6, and selenium. From nutritional standpoint, meat could be regarded as a very valuable food and one of the main components of the daily diet of a significant human population (Bhawana et al., 2023). Since the dawn of human civilization. To address these concerns and produce high-quality, sustainable, and safe chicken breast meat products, the poultry industry can benefit from an understanding of consumer preferences and concerns *(*Harvey et al., 2017*).*

Chicken meat is cholesterol free without trans fats which were fingered to significantly contribute to coronary heart disease, unlike their high presence in beef and lamb. In Canada, values of 2 to 5 percent have been reported for beef and as high as 8 percent for lamb. The World Cancer Research Fund and others (Bingham, 2006) and Acuff (2006) clarified the difference between spoilage organisms and pathogens by stating, “spoilage organisms will not make you sick, as in instigating an infection and creating a real illness.” However, spoilage organisms make food undesirable.

The meat industry works diligently to prevent, reduce and eliminate both pathogenic and spoilage bacteria before meat are delivered to consumers for purchase.

Decomposition brought on by mold, air, bacteria, or yeast can be slowed by preservatives. Preservatives not only keep food fresh but also assist prevent contamination that can lead to foodborne illnesses like deadly botulism. (Lucy Bell Young, 2021). Of the various methods for food preservation, chemical food preservative is one. Humans have been preserving food since far before civilization was established. Evidence really points to the active usage of sun-drying methods for food preservation as early as 14,000 years ago in the Middle East and the Orient. It has long been practiced to chemically preserve food, especially by using salt to dry meats and fish. (Young Bell, 2021). Other preservation processes, such as cooking, pasteurization, and irradiation which applies heat, high energy, or ionizing radiation are carried out on the food product prior to the addition of chemical preservatives. The food product's shelf life can be increased by destroying germs and fungi by subjecting it to heat or high energy radiation (Lucy Bell Young, 2021).
Fresh chicken meat is a perishable and nutritious food. As a result of its high moisture content, it favors bacterial growth which leads to gradual deteriorative changes and spoilage. quality of chicken meat can be degraded due to bacterial contamination and lipid oxidation and ultimately result in social health concerns. The overuse of antibiotics in poultry production has contributed to the development of antimicrobial resistant bacteria, making it challenging to control microbial growth. (Kondjoyan and Portanguen, 2008). Therefore this study was carried out to assess the effect of chemical additives applied at different levels on microbial safety of chicken breast meat;

## 2. MATERIALS AND METHODS

### 2.1 Study area

The study was conducted in the Animal Science laboratory of the Kebbi State University of Science and Technology Aliero (KSUSTA). Aliero is a town Kebbi State, North west Nigeria. It is located in the southeast of the State between longitudes $12^0$16’42”N $4^0$27’6”E.

### 2.2 Study Plan

The study was conducted to determine the microbial safety of chicken breast meat processed with different chemical additives and their application levels. The objectives were to assess the microbial load, isolation and biochemical characterization to identify bacteria species present in the samples.

## 3. TREATMENTS AND EXPERIMENTAL DESIGN

The study was a factorial experiment involving four widely used chemical additives (Monosodium glutamate, Sodium nitrate, Monosodium phosphate and Sodium chloride) and three levels of application (1, 2 and 3% w/w) laid in a completely randomized design (CRD) giving 12 treatment combinations. The treatments were replicated 12 times.

## 4. PREPARATION OF SAMPLES

A total of 15 average weight broiler chickens were used, the birds were slaughtered and cut into primal cuts. Chicken breast meat was collected and each fresh breast was divided into 10 average sized pieces making a total of 150 pieces. The pieces were randomly divided into 12 groups, containing 12 pieces representing the treatments for the study. Each group was administered its treatment specifications and grilled using charcoal griller until the meat is cooked. The grilled meat samples were then kept separately for further analysis.

## 5. EXPERIMENTAL PROCEDURES

### Determination of Bacteriological Load

Determination of the total viable count (TVC) involved preparation of serial dilutions from 1 ml of each sample and 9 ml of tryptone water according to the methods of (APHA, 1992). From each dilution, 0.1ml taken and was surface plated onto a pre-prepared plate count agar medium, distributed using a plastic spreader. All the plates were thereafter incubated at 37 °C for 48 h using a laboratory incubator. After the incubation period, the bacteria colonies grown on plate count agar were counted with a colony counting chamber. The plates whose colony counts were between 30 and 300 CFU were considered reliable and representative for microbial load counting as reported by Eby (2021). The number of distinct colonies on each plate were counted as Colony-forming unit (CFU) per ml of sample volume. The CFU/ml was calculated using the dilution factor of its concentration expressed to log10 $CFU/cm^2$ values. Mean values of TVC in log10 CFU/ml of replicates were determined and reported as described by Swanson *et al*. (1992). To isolate and identify bacterial species, colony morphology on the plates was observed and colony sub-culturing was done to obtain pure colonies to run biochemical testing. Microscopy method was used for bacterial characteristics such as shape and color. Gram staining, lysine, Triple Sugar-Iron, catalase, motility, indole production, and citrate utilization, were performed following the standard protocol as described by Oyeleke and Magna (2008). The isolates were identified by comparing their morphological as well as biochemical characteristics against standard reference according to the Bergy's manual for determinative bacteriology Vos *et al*. (2009).

## 6. DATA ANALYSIS

The data collected for bacteriological analysis were analyzed using the Analysis of variance (ANOVA) in the statistical packages for social sciences (SPSS) Version 17.0. Significant means were separated at 5% using the Tukey test. Bacteriological results were expressed as CFU/g.

## 7. RESULTS AND DISCUSSION

**Total Viable bacterial count from Chicken Breast Meat Cured with Different Levels of Chemical Additives**

The result in Table 1 shows the total viable bacterial count indicate that all microbiological test carried out indicated that there is significant difference ($p<0.05$) in the chicken breast meat. However, monosodium glutamate was found to have higher log ($128x10^{-5}$) followed by monosodium phosphate ($124x10^{-5}$) and sodium nitrate has the least with ($15x10^{-5}$). However all the microbial load of chicken breast meat falls within the USDA safety limit for chicken breast meat. However, Asmara *et al.* (1994) who reported TVC in raw chicken meat in the range of 6.55 -7.15.log10cfu/g. The recommended microbiological standard for raw meat was in the range of $10^{-5} – 10^{-7}$ log10cfu/g. The results of the study are in agreement with Chaiba *et al*. (2007) who reported the presence of Staphylococcus spp. and Salmonella spp. in raw chicken meat. The presence of such high microbial counts can be attributed to improper handling of raw chicken products and inadequate storage conditions (Jay *et al, 2005)*.

**Prevalence of Bacterial Isolates Identified from Chicken Breast Meat Cured with Different levels of Chemical Additives**

Table 2 shows the result for prevalence of bacterial isolates identified from chicken breast meat treated with different levels of chemical additives. Results shows that a total of 36 bacteria were isolated from nine (9) genera of bacteria including *Bacillus Cereus* (22.22%), *Staphylococcus aureus* (19.44%), *Pseudomonas auregenosa* (16.67%), *Streptococcus pneumonia* (8.33%), *Lacto bacillus (Strepto)* (8.33%) *Bacillus anthricia* (8.33%), *Wrella Shella pneumonae* (5.56%), *Bacillus subtilis* (5.56%), *Bacillus megaterium* (2.78%) and *Micro coccus* (2.78%).

The presence of Bacteria spp in chicken breast meat identified from all chicken breast meat sample were 36 bacteria which Bacillus cereus 22.44% with frequency of 8, Staphylococcus aureus 19.44% with frequency of 7, *Pseudomonas auregenosa* 16.67% with frequency of 6, Streptococcus pneumonia 8.33% with frequency of 3, *Lacto bacillus* (strepto) 8.33% with frequency of 3, Bacillus anthricia 8.33% with frequency of 3, Wrella shella pneumonia 5.56% with frequency of 2, *Bacillus subtilis* 5.56% with frequency of 2, *Bacillus megaterium* 2.78% with frequency of 1 and lastly Micro coccus 2.28% with frequency of 1. Ten (10) bacteria isolates identified from chicken breast meat cured with different chemical additives and twelve samples were contaminated with a total of ten (10) bacteria spp. From the result obtained from the experiment Bacillus cereus was found to have the highest prevalence of bacteria accounting for (22.22%) of the bacterial population isolated. This has indicated a higher prevalence of bacterial contamination from the study area. Followed by Staphylococcus aureus (19.44%), *Pseudomonas auregenosa* (16.67%), and Streptococcus pneumonia (8.33%) each. However, Beli, *et al.* (2001) have revealed a low prevalence of Salmonella in turkey meat in Albania (8.2%). In Ireland, Jordan, *et al*. (2006) have found (3.1%).which the report show a significance differences with the current studies.

## 8. CONCLUSION

The results revealed that Monosodium glutamate treated samples at 2% had lower microbial load ($128 \times 10^5$) than all other samples Total microbial load of chicken breast meat falls within the USDA safety limit for chicken breast meat, which indicated it was acceptable with in the consumer. However, despite chemical treatment, 36 bacteria were isolated from nine (9) genera of bacteria. According to prevalence, the bacteria include: *Bacillus Cereus* (22.22%), *Staphylococcus aureus* (19.44%), *Pseudomonas auregenosa* (16.67%), *Streptococcus pneumonia* (8.33%), *Lacto bacillus (Strepto)* (8.33%) *Bacillus anthricia* (8.33%), *Wrella Shella pneumonae* (5.56%), *Bacillus subtilis* (5.56%), *Bacillus megaterium* (2.78%) and *Micro coccus* (2.78%). The presence of *Streptococcus pneumonia* is a human pathogenic bacterium and it is recognized as a major cause of pneumonia and meningitis in children and the elderly which may result to health challenges. The research finding revealed *Bacillus cereus* was found to be more prevalent in all the total chicken breast meat samples collected and also the presence of *Streptococcus pneumonia* is a human pathogenic bacterium and it is recognized as a major cause of pneumonia and meningitis in children and the elderly which may result to health challenges, Bacillus cereus was found to be more prevalent in all the total chicken breast meat samples collected. There should be enlightenment and awareness to the public as regarding the quantity of all the chemical additives that we use in our foods and meat so that adequate and right proportion of the chemicals should be used in order not to exceed the recommended standard set by World Health Organization (WHO) and United State Department of Agriculture (USDA) for guarantee safety of both food and meats for consumptions.

## 9. TABLES

**Table 1 Total Viable Bacterial Count from Chicken Breast Meat Cured with Different Chemical Additives**

| Meat samples | Tvc/g $10^{-4}$ | Tvc/g $10^{-5}$ | Total | Mean | Cfu/g | USDA |
|---|---|---|---|---|---|---|
| MSG 1% | NA | 95X$10^{-5}$ | 95 | 95 | 95.0 × $10^5$ | Acceptable |
| MSG 2% | NA | 128X$10^{-5}$ | 128 | 128 | 128-× $10^5$ | Acceptable |
| MSG 3% | 200X$10^4$ | 100X$10^{-5}$ | 300 | 150 | 150-× $10^5$ | Acceptable |
| SNT 1% | NA | 63X$10^{-5}$ | 63 | 63 | 630 × $10^5$ | Acceptable |
| SNT 2% | NA | 21X$10^{-5}$ | 21 | 21 | 21.0 × $10^5$ | Acceptable |
| SNT 3% | 175X$10^4$ | 15X$10^{-5}$ | 190 | 95 | 95.0 × $10^5$ | Acceptable |
| MSP 1% | NA | 31X$10^{-5}$ | 31 | 31 | 31.0 × $10^5$ | Acceptable |
| MSP 2% | NA | 48X$10^{-5}$ | 48 | 48 | 48.0 × $10^5$ | Acceptable |
| MSP 3% | 87X$10^{-4}$ | 124X$10^5$ | 211 | 105.5 | 105.5 × $10^5$ | Acceptable |
| SCL 1% | NA | 68X$10^{-5}$ | 68 | 68 | 68 × 01$0^5$ | Acceptable |
| SCL 2% | NA | 55X$10^{-5}$ | 55 | 55 | 55.0- × $10^5$ | Acceptable |
| SCL 3% | 203X$10^4$ | 76X$10^{-5}$ | 279 | 139.5 | 139.5- × $10^5$ | Acceptable |

MSG = Monosodium glutamate MSP = Monosodium phosphate
SCL = Sodium chloride SNT = Sodium Nitrite

**Table 2: Prevalence of Bacterial Isolates Identified from Chicken Breast Meat Treated with Different Chemical Additives and their Concentration**

| Bacteria Isolates | Prevalence Frequency | Percentage (%) |
|---|---|---|
| *Bacillus Cereus* | 8 | 22.22 |
| *Staphylococcus aureus* | 7 | 19.44 |
| *Pseudomonas auregenosa* | 6 | 16.67 |
| *Streptococcus pneumonia* | 3 | 8.33 |
| *Lacto bacillus ( Strepto)* | 3 | 8.33 |
| *Bacillus anthricia* | 3 | 8.33 |
| *Wrella Shella pneumonae* | 2 | 5.56 |
| *Bacillus subtilis* | 2 | 5.56 |
| *Bacillus megaterium* | 1 | 2.78 |
| *Micro coccus* | 1 | 2.78 |
| Total | 36 | 100 |

## 10. REFERENCES

1. *Acuff, G. (2006). Thought Leader, Microbe Manager. Meeting place, pp 28*
2. *APHA, "American public Health association" (1992). Compendium of methods and Microbiological examination of food. 3rd ed., Washington DC, USA.*
3. *Asmara, A., Badou, M., Faid, M., and Bouzoubaa, K. (1994). Microbial contamination of poultry slaughtered in traditional shops in Morocco. MAN Micro biologies, aliments, nutrition, 12(3), 323-327.*
4. *Atlas R, Parks C, Brown E (1995) Laboratory manual to accompany microbes in our world. Mosby- yearbook Inc, St. Louis, pp 16–18*
5. *Bingham, S. (2006). The fibre – folate debate in colo-rectal cancer. Proceedings of the Nutrition Society 65(1):19–23.*
6. *Beli, E., Telo, A. and Duraku, E. (2001). Salmonella serotypes isolated from turkey meat in Albania. International Journal of Food Microbiology, 63(1-2), 165-167*
7. *Chaiba, A., Rhazi, F. F., Chahlaoui, A., Soulaymani, B. R., and Zerhouni, M. (2007). Microbiological quality of*

*poultry meat on the Meknès market (Morocco). International Journal of Food Safety, 9, 67-71.*

8. *P. Ferranti and F. Villani, (2009 Eby,B., (2010).Enumerationofmicroorganisms.Availableat https://www.sas.upenn.edu/LabMannuals/biol275/Table.../24-Diluton.pdf. (Accessed on 8 Nov 2016).*
9. *Ercolini D, Russo F, Nasi A. (2024). Mesophilic and psychotropic bacteria from meat and their spoilage potential in vitro and in beef. Journal of Applied and Environmental Microbiology National Population Commission NPC.*
10. *Harvey, D. (2017). Consumer attitudes towards animal welfare and sustainability in the poultry industry. Journal of Agricultural and Environmental Ethics, 30 (2), 257-276.*
11. *ISO/TS (2009) 11133–1. Microbiology of food and animal feeding stuffs. General guidelines on preparation and quality assurance of culture media in the laboratory.*
12. *Jay,J.M., Loessner, M .J. and Golden, D.A. (2005). Modern Food Microbiology, 7th edition, Springer Science and Business media, Inc., New York, USA.*
13. *Jordan, E., Egan, J., Dullea, C., Ward, J., McGillicuddy, K., Murray, G., Murphy, A., Bradshaw, B., Leonard, N., Rafter, P. and McDowell, S. (2006) Salmonella surveillance in raw and cooked meat and meat products in the Republic of Ireland from 2002 to 2004. International Journal of Food Microbiology, 112(1), 66-70*
14. *Kondjoyan, A. and S. Portanguen. (2008). Effect of superheated steam on the inactivation of Listeria innocua surface inoculated onto chicken skin. Journal of Food Engineering. 87:162-171.*
15. *Lucy Bell-Young , (2021). Chemical Methods of Food Preservations*
16. *Oyeleke, S. and S. Magna, (2008). Essential of Laboratory Practicals in Microbiology to best publisher, Minna.Nigeria, pp: 36–75.*
17. *Swanson, K., F. Busta, Peterson and M. Johnson, (1992).Colony counting methods. In the "Compendium of E. Methods for the Microbiological examination of foods, 3rd ed. American public Health Association. Washington DC.,pp: 75–77.*
18. *USDA (United State Department of Agriculture) (2020). National Nutrient Database for Standard Reference United State Department of Agriculture.*
19. *Vos P, Garrity G, Jones D, Krieg N, Ludwig W, Rainey F, Schleifer K, Whitman W (2009) Bergey's Manual of Systematic Bacteriology 2nded. Springer-Verlag, New York, pp 13– 15.*