

## Occurrence of *Escherichia coli* and *Salmonella* species in Some Livestock (Poultry) Feeds in Mando, Kaduna, Nigeria

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## Abstract

The study aimed at assessing the proximate composition, isolation, characterization of some *Enterobacteriaceae* from two (2) brands of poultry feeds marketed in Mando, Kaduna, Nigeria. A total of sixteen (16) samples of two (2) different poultry feeds (starter and finisher) from four (4) poultry farms in mando were collected and subjected to proximate and microbiological analysis. The proximate analysis was carried out using standard techniques and procedures. All the feed samples were cultured on separate media which include Eosin methylene blue (EMB), nutrient Agar (NA) and *Salmonella-Shigella* Agar (SSA) media using standard procedures. The antibiogram of the selected antibiotics were evaluated against the test isolates. The result of proximate analysis of the starter and finisher feeds indicated that the Dry matter of starter feed had the highest percentage composition of 95.02% and crude fiber of the finisher feed had the lowest composition of 3.78%. The highest number of bacterial load was recorded to be  $10.0 \times 10^4$  CFU/g for the feed sample A (starter feed) and  $12.0 \times 10^4$  CFU/g was recorded for the feed sample B (finisher feed) which had the highest number of bacterial load recorded among the two (2) different poultry feeds analyzed. The bacteria isolates were identified as *Salmonella* species and *Escherichia coli*. Total viable count (TVC) of *Salmonella* species and *E. coli* in the feed samples (starter and finisher) ranges from  $3.0 \times 10^4$  CFU/g to  $12.0 \times 10^4$  CFU/g. Both organisms (*Salmonella* species, *E. coli*) were found as 37.5% and 25% of the analyzed feeds (Broiler starter and broiler finisher) samples, respectively. There was no level of significant ( $p > 0.05$ ) difference between the level of contamination of *Salmonella* species and *E. coli* in the two different feeds analyzed, as  $p = 0.06$  and  $p = 0.13$  for *Salmonella* species, and *E. coli* respectively. Sample A and B (Starter and Finisher) feeds had the highest number of *Salmonella* species occurrence with six (6) positive samples while *E. coli* was recorded in four (4) samples of A and B (Starter and Finisher) feeds. The result of the antibiogram indicated that ciprofloxacin (30 µg), Gentamycin (30 µg), Perfloxacin (30 µg) and Tarvid (30 µg) was effective against *Salmonella* species and *Escherichia coli*. The significant of spread of the species of the *Enterobacteriaceae* in livestock feeds requires the need for effective quality assurance and control, good hygiene practices in production and proper handling of the poultry feeds.

**Keywords:** Livestock feeds, microbiological, techniques, proximate, isolates

## INTRODUCTION

All domesticated birds by man are referred to as poultry. These birds include domestic duck, fowl, geese, guinea fowl, turkey, ostriches and pigeons as reported by<sup>54</sup>. Livestock feeds can serve as a medium for a range of microbial contaminants such as bacteria (*Salmonella* sp., *Shigella* sp., *E. coli* etc) moulds (*Fusarium* sp., *Aspergillus flavus*, *Aspergillus paraciticus* etc) and their mycotoxins<sup>32</sup>. Many bacteria from the family enterobacteriaceae are mostly associated with environmental contaminations of feed ingredients. This poultry feeds contamination family include many genera and species of bacteria namely; *Salmonella*, *Enterobacter* and *Escherichia coli*<sup>26</sup>. The usual and common feeds compositions include soya beans, complete (whole) cereals, vitamins and vegetables such as tridax, *Amaranth* (*Amaranthus* sp.) and water leaf (*Talinum fruticosum*). Feeds in general has been implicated to be a major sources for transmission of bacteria and other microorganisms to the processing plant of the farm. Most animals

harbour pathogens which are of food borne which serves as a good source of contamination, which is of significant in the spread of *Escherichia coli* and *Salmonella* species in humans<sup>7</sup>. These bacteria can survive for prolonged periods of time without multiplication on materials with low moisture contents therefore providing for the possibilities of the bacteria to be mechanically transmitted from one site to another through fomites, including contaminated feeds<sup>10</sup>. Feeds are formulated from different ingredients with different possible levels of *Salmonella* and *Escherichia coli* contamination. A research on cereal ingredients in the UK showed that animal feeds were contaminated with *Salmonella* and *Escherichia coli* at the farm level, whereas 92% of the meat and bone meal samples tested in the United States were contaminated with *Salmonella* and *Escherichia coli* and in the Netherlands 31% *Salmonella* contamination was recorded in fishmeal samples<sup>50</sup>. Feed manufacturing facilities are therefore considered as critical contamination points for

*Salmonella* and *Escherichia coli* entry into the food chain. The feeds and their ingredients are also a significant sources of extensive contaminations by antibiotic resistant bacteria along side multi-drug resistant strains of *Salmonella* sp.<sup>5</sup> Other bacteria such as *Escherichia coli* *Streptococcus* sp. and *Enterococcus* sp. have been isolated in feeds. The constant control of bacteria contaminations in feeds has shown to improve performances in production from poultry and it also reduces the occurrences of *salmonella* in farm environment breeding animals, and their products. The increase in chicken production has resulted in high demand of feeds, and consequently, proliferation of feed mills, some of which operates under substandard conditions. This may result into packaging of feed contaminated with pathogens and thereby spreading diseases to both humans and farms. Despite advances in medical science, infections due to *Salmonella* and *E. coli* strains remain the most important food borne diseases (FBDs) of human. Moreover, a majority of FBDs are implicated with the consumption of contaminated poultry eggs and meats. Though many approaches have been employed to counter these infections both in human and poultry, application of effective antibiotics (therapy) is the main control strategy<sup>40</sup>. The research aimed at assessing the occurrence of *Escherichia coli* and *Salmonella* species in some livestock feeds in Mando, Kaduna.

## MATERIALS AND METHODS

### Sample Collections

Sixteen (16) samples in total of two (2) different chicken feeds: (Broiler starter and finisher) were collected. Eight (8) samples each starter and finisher were collected from four (4) different poultry farms: four (4) per farm in Mando, Kaduna State. The feed samples were aseptically collected separately into sterile universal containers and were well labeled with regards to the feeds after seeking an informed consent from the poultry/livestock farmers. The feed samples were transferred to the Microbiology laboratory, Kaduna State University, Kaduna, Nigeria for proximate and bacteriological analysis.

### Proximate Analysis of Chicken Feeds

Proximate analysis of the some chicken feed samples were carried out for percentage total dry matter, crude protein, moisture, crude fat, ash,

crude fibre and carbohydrate content using the methods described by Bukar and Saeed MD<sup>9</sup>.

### Media Preparation

All culture media used in this research were prepared with regards to manufacturer's instructions. The media used include: NA, SSA, EMB and MHA.

### Isolation of Bacteria from Chicken Feeds

#### Total Viable Count (TVC)

Twenty five (25) grams of each feed sample were homogenized into 225ml of peptone water. One (1) ml of the homogenized sample was suspended in 9.0 ml distil water, then serial dilutions from  $10^{-1}$  to  $10^{-5}$  was carried out, One (1) ml of each two dilutions ( $10^{-3}$  and  $10^{-4}$ ) was inoculated into petri dishes containing nutrient agar for each respectively. The petri dishes was incubated at 37°C for 24 hours. Colonies that appeared on the plate were counted and recorded in CFU/g. The Total Viable Bacterial Count (TVC) was carried out as described by Atere et al<sup>6</sup>. Viable colonies from nutrient agar were inoculated into EMB and SSA agar for each bacterial isolates respectively. The plates were incubated at 37°C for 24 hours<sup>39</sup>.

### Characterization and Identification of Bacteria from Chicken Feeds

The characterization and identification of bacteria isolates from samples of chicken feeds were based on Grams staining and selected biochemical tests which include Catalase, Indole production, Voges-Proskauer (VP), Methyl red, Citrate, Coagulase and Triple Sugar Iron Agar (TSI) test described by Grant et al<sup>22</sup> and Dougnon et al<sup>43</sup>.

### Antimicrobial Susceptibility Testing of Selected Antibiotics against the Bacteria Isolates

Mueller Hinton Agar was prepared according to the manufacturer's instruction. The bacteria suspension for each respectively was prepared and compared with the turbidity of 0.5 McFarland standard which is approx. cell density ( $1.5 \times 10^8$  CFU/mL) (standardization of inoculum), then 5 µl of the prepared bacteria suspension was placed on each of the series of plates with already different concentrations of the antimicrobial agent using a replicator device. The plate were incubated at 37°C for 24 hours as described by Mathew et al<sup>33</sup>.

### Statistical Analysis of Data

Data generated were statistically analyzed

using IBM - SPSS Statistics version 20 computer program. The student T-test and one way analysis of variance (ANOVA) was used to determine the prevalence of *Escherichia coli* and *Salmonella* species contaminations among the two different feeds (broiler starter feed and finisher feed) collected from four different farms. The significant difference were considered between and within variables.

**RESULTS**

Table 1 Showed the proximate composition of poultry feeds. The dry matter of broiler starter feed (A) was 95.02%, Dry matter of broiler finisher feed (B) was 94.86 %, Ash content of broiler starter recorded 7.89 %, the Ash content of broiler finisher feed was 7.85 %. The protein content of broiler starter feed was 22.54 %, 23.99 % was recorded for protein content of broiler finisher. Crude fat/Oil content indicated 5.99 % for broiler starter feed, 6.11 % was recorded for crude fat/oil content. The crude fiber content recorded for broiler starter was 4.92%, crude fiber content recorded for broiler finisher feed was 3.78 %. Nitrogen Free Extract recorded for broiler starter

feed was 57.22 % and 55.24 % was recorded for finisher. Table 2 Showed the estimation of total viable bacteria count of chicken feeds. The mean microbial load of broiler starter from AS<sub>1</sub> and AS<sub>2</sub> ranged between 3.0x10<sup>5</sup> to 5.0x10<sup>4</sup> CFU/25g . While the mean microbial load for broiler finisher feed from AF<sub>1</sub> and AF<sub>2</sub> ranged between 5.0x10<sup>5</sup> to 8.0 x10<sup>4</sup> CFU/25g. BS<sub>1</sub> and BS<sub>2</sub> mean microbial load for broiler starter feed ranged between 3.0 x10<sup>5</sup> to 4.0x10<sup>4</sup> CFU/25g. While BF<sub>1</sub> and BF<sub>2</sub> broiler finisher feed was recorded as 4.0 x10<sup>5</sup> and to 6.0 x10<sup>4</sup> CFU/25g. CS<sub>1</sub> and CS<sub>2</sub> broiler starter feed indicated the present of microbial load between 6.0x10<sup>5</sup> to 10.0 x10<sup>5</sup> CFU/25g. While CF<sub>1</sub> and CF<sub>2</sub> of the broiler finisher feed was recorded as 6.0x10<sup>5</sup> to 12.0 x10<sup>4</sup> CFU/g. DS<sub>1</sub> and DS<sub>2</sub> broiler starter feed ranges from 3.0 x10<sup>4</sup>, to 8.0 x10<sup>5</sup> CFU/25g and the DF<sub>1</sub> and DF<sub>2</sub> ranges from 3.0 x10<sup>4</sup> to 9.0 x10<sup>5</sup> CFU/25g for each of the two dilutions ( 10<sup>3</sup>, 10<sup>4</sup>) respectively. Table 3 showed characterization and identification of bacteria isolates. Isolate from AS<sub>1</sub> feed was Gram negative rod shape, methyl red positive ,catalase positive, citrate negative, indole positive, Voges–Proskauer negative and TSI (Acid production, no gas produced and buttom

**Table 1.** Average Proximate Composition of Selected Poultry Feeds

Parameters/ Ingredient (%)	Sample:		t-cal	P value
	A	B		
Dry matter	95.02±23.12	94.86± 24.13	0.008	0.994
Ash content	7.89±3.123	7.85±2.153	0.018	0.986
Protein content	22.54±4.512	23.99±4.419	0.398	0.711
Crude fat/Oil content	5.99±1.912	6.11±1.841	0.078	0.941
Crude fiber content	4.92±0.988	3.78±0.671	1.653	0.174
Nitrogen Free Extract (NFE)	57.22±14.67	55.24±13.68	0.171	0.873

Sample A: Broiler starter feed, Sample B: Broiler finisher feed

**Table 2.** Total Viable Bacterial Count of Chicken Feeds from Mando, Kaduna

	Starter feed (CFU/25g)		Finisher feed (CFU/25g)		t-cal	p value
	Range of Count	Average Count	Range of Count	Average Count		
A	3.0 -5.0	4.00±1.01	5.0 - 8.0	6.50±72	2.171	0.091
B	3.0 - 4.0	3.50±0.75	4.0 - 6.0	5.00±1.02	2.052	0.109
C	6.0 - 10.0	8.00±1.98	6.0 -12.0	9.00±2.17	0.589	0.587
D	3.0 - 8.0	5.50±2.01	3.0 -9.0	6.00±2.42	0.275	0.797

Keys: Sample codes: A: Mando Market, B: Neco , C: Sarki Lane, D: Jibril Close: L:Location

yellow) which confirmed probably the presence of *Escherichia coli* while isolate from AS<sub>2</sub> was Gram negative rod, methyl red positive, citrate positive, catalase positive, voges-proskauer negative, indole negative and TSI positive ( red slant, yellow butt, gas positive, blackbutt (H<sub>2</sub>S produced) which confirmed probably the presence of *Salmonella* species. Isolate from BS<sub>1</sub> also confirmed probable presence of *Salmonella* species and isolate from BS<sub>2</sub> feed also indicated the probable presence of *Salmonella* species. The other probable bacteria shows that BF<sub>1</sub> isolate showed the presence of *Escherichia coli*. The CS<sub>1</sub> isolate indicated the

presence of *Escherichia coli* while CS<sub>2</sub> isolate indicated the presence of *Salmonella* species while CF<sub>1</sub> isolate was positive for *Salmonella* species. Further more, the DS<sub>1</sub> isolate indicated the presence of *Escherichia coli* while DS<sub>2</sub> isolate was positive for *Salmonella* species. Table 4 Showed the percentage occurrence of *Salmonella* sp and *E. coli* isolated from two (2) different brands of poultry feeds (Broiler starter and finisher feeds) from ABC and D. This showed *Salmonella* had 6 positive occurrence from the four (4) farms with 37.5% in the two different feeds as the most predominant pathogen, and *E. coli* having

**Table 3.** Characterization and Identification of Bacterial Isolates from Chicken Feeds

Sample Code	Gram Reaction	Catalase	Methyl Red	Indole	VP	Citrate	TSI Slant	H <sub>2</sub> S	Butt	Probable Organisms
AS1	-rod	+	+	+	-	-	AA	NG	Yellow	<i>E. coli</i>
AS2	-rod	+	+	-	-	+	AL	G	Red	<i>Salmonella</i> sp.
AF1	-	-	-	-	-	-	NA	NG	-	-
AF2	-	-	-	-	-	-	NA	NG	-	-
BS1	-rod	+	+	-	-	+	AL	G	Red	<i>Sal. sp.</i>
BS2	-rod	+	+	-	-	+	AL	G	Red	<i>Sal.sp.</i>
BF1	-rod	+	+	+	-	-	AA	NG	Yellow	<i>E. coli</i>
BF2	-	-	-	-	-	-	NA	NG	-	-
CS1	-rod	+	+	+	-	-	AA	NG	Yellow	<i>E. coli</i>
CS2	-rod	+	+	-	-	+	AL	G	Red	<i>Sal. sp.</i>
CF1	-rod	+	+	-	-	+	AL	G	Red	<i>Sal. sp.</i>
CF2	-	-	-	-	-	-	NA	NG	-	-
DS1	-rod	+	+	+	-	-	AA	NG	Yellow	<i>E. coli</i>
DS2	-rod	+	+	-	-	+	AL	G	Red	<i>Sal. sp.</i>
DF1	-	-	-	-	-	-	NA	NG	-	-
DF2	-	-	-	-	-	-	NA	NG	-	-

AS: Mando market Broiler Starter feed, AF: Mando market Broiler finisher feed, BS: Neco Broiler starter feed, BF: Neco Broiler finisher feed, CS: Sarki lane Broiler starter feed, CF: Sarki lane Broiler finisher feed, DS: jubril close Broiler starter feed, DF: jibril close Broiler finisher feed, -ve: gram negative, +ve: gram positive, *E. coli*: *Escherichia coli*, *Salmonella/Sal. sp*: *Salmonella* species, Slant-AA: Acid, AL: Alkaline, H<sub>2</sub>S-NG: No Gas, G: Gas produced, Butt.: Bottom.

**Table 4.** Percentage Occurrence of Some *Enterobacteriaceae* in Broiler Starter and Finisher Feeds Collected from Different Farms in Mando, Kaduna

Locations	No of Samples collected	<i>Salmonella</i> sp present	<i>E. coli</i> present	t- cal	p value
A	4	1.00±0.01	1.00±0.02	0.000	1.000
B	4	2.00±0.02	1.00±0.01	71.611	0.000
C	4	2.00±0.03	1.00±0.02	45.656	0.000
D	4	1.00± 0.02	1.00±0.03	0.000	1.000
Total	16	37.5%(p=0.13)	25%(p=0.06)		

A= Mando market Broiler stater feed/finisher, B=NECO Broiler stater feed/finisher, C= Sarki lane Broiler stater feed/finisher, D=Jibril close Broiler stater feed/finisher

**Table 5.** Antibacterial Susceptibility Profile of *Salmonella* species and *Escherichia coli* to Selected Antibiotics

Antibiotics (dose)	Zones of Inhibition against <i>Salmonella</i> sp. (mm)	Zones of Inhibition against <i>Escherichia coli</i> (mm)
Spt(30µg)	R	R
Chlo (30µg)	MS	MS
Spf (10µg)	R	S
Cpf(30µg)	MS	S
Amp(30µg)	R	S
Aug(10µg)	R	R
Gen (30µg)	MS	MS
Pef(30µg)	S	MS
Tar (10µg)	S	MS
Str (10µg)	R	MS

Spt: Septrin, Chlo: Chloramphenicol, Spf: Sparfloxacin, Cpf: Ciproflaxacin, Amp: Ampicillin, Aug: Augmentin, Gen: Gentamycin, Pef: Pefloxacin, Tar: Tarvid, Str: Streptomycin, S:Sensitive:MS: Moderately sensitive, R:Resistant.

4 positive occurrence with 25% in the two feeds analyzed from the four farms as the less predominant pathogen. Table 5 shows the result of antibacterial susceptibility test of *Salmonella* species and *Escherichia coli* to the antibiotic disc which indicated that *Salmonella* sp. and *E.coli* were either sensitive (R), moderately sensitive (MS) and resistant (R) at different concentrations (ranging from 10 to 30 µg) respectively.

## DISCUSSION

The ingredient percentage composition of broiler starter feed was higher than that of broiler finisher feed. This could be attributed to the chicks needs for higher amount of nutrient to enable them grow. The broiler finisher feed has less percentage composition of the feed ingredients as compared to broiler starter feed. This might be as a result of the chicken having the ability to have acquired the essential nutrients for their growth and so do not need more nutrients for growth but need just enough nutrient to keep them healthy. Dry matter has the highest ingredient percentage composition of the feed of 95.02 % for broiler starter feed and 94.86 % for broiler finisher feed making. This is to enable the chicken pick the feed easily. Nitrogen Free Extract (NFE) has the second high value of percentage composition of the feed ingredient. This shows the sugar and starch content of the feed which are essential for the meat content of the chicken. Ash content recorded the lowest % composition of the

feed ingredient. This is because it is trace minerals which are needed only in a small quantity<sup>54</sup>. Crude fat, protein content and crude fiber were present in small quantities. Crude fat provide essential fatty acids and energy, protein content that maintains the growth in the chicken while fiber is associated with the reduced energy availability. This is similar to the research conducted in Zaria Kaduna State by Bukar et al<sup>9</sup> who reported proximate composition of chicken feed for crude fiber content with the lowest composition of 1.70 while dry matter recorded was with the highest percentage composition of 90.02. The statistical analysis of the ingredient for broiler starter and finisher feeds, indicates that there were no significant difference ( $p>0.05$ ) between broiler starter and finisher feeds in all the proximate percentage compositions. Total viable count of the isolates showed the  $10^3$  dilution samples with higher colony forming unit and  $10^4$  dilution having less colony forming unit. This could be because colonies of microorganism varies with the dilution factor as reported by Pattabhiramaiah and Mallikarjunaiah<sup>42</sup>. The  $CF_1$  feed recorded the highest number of colonies of 12 CFU/g while  $CS_1$  feed recorded the second highest colony of 10 CFU/g The possible reason why  $CF_1$  feed indicated the highest number of colonies could be due to the fact that it contains higher nutrient composition as compared to other feeds.  $BS_1$  feed recorded the least number of colonies of 3CFU/g which could also be as a result of low nutritional composition of the feed. The statistical analysis indicated

that there was no significant difference ( $p>0.05$ ) between the total viable count of broiler starter feeds and broiler finisher feeds in farm A and D but occurred significantly in farm B and C from the four different locations. The bacteria isolated were *Escherichia coli* and *Salmonella* species which are commonly associated with disease of the poultry and has resulted in the death of the poultry birds. It can also result in food borne infections. This study is similar to the study conducted by Leaumont et al<sup>32</sup> were they reported isolates such as *Escherichia coli* and *Salmonella* species in poultry feeds. Similarly, Keddy et al<sup>29</sup> reported the presence of *Salmonella* species, *Escherichia coli*, *Staphylococcus* species, *Streptococcus* species and *Bacillus* species in poultry feeds. The occurrence of *Salmonella* species and *Escherichia coli* in the feed samples may be as a result of fecal contamination during the preparation of the feeds or from the product's retailers. These is possible because no any form of sterilization is usually carried out by the farmers during compounding of the feeds which enhances the growth and survival of these bacteria<sup>50</sup>. The prevalence of *E. coli* and *Salmonella* sp. contaminations in this study was 62.5% which was less than the prevalence of 71.43% reported in a study on poultry feeds from farms and markets in Bangladesh, as reported by Chowdhury et al<sup>14</sup> but higher than 22.2% prevalence recorded in a study from feed outlets in Nigeria as reported by Nourmohamadi and Shokrollahi<sup>39</sup>. A much lower prevalence of 3.6% was reported by Nigra et al<sup>38</sup> from broiler feeds in Iran. Detection of *E. coli* and *Salmonella* and in feeds is a common study which have been reported from different countries. The statistical analysis between the four farms revealed no significant difference between the occurrence of *Salmonella* species and *E. coli* in farm A and D ( $p>0.05$ ) while location B and C recorded significant occurrence of *Salmonella* species and *E. coli*. The percentage prevalence of *Salmonella* sp. and *E. coli* from the two different feeds (broiler starter and broiler finisher) was 25%, and 37.5%, respectively. This findings partially agrees with the work of Nourmohamadi and Shokrollahi<sup>39</sup> who reported a prevalence of 40%, for *Salmonella* species and 25%, for *E. coli* in broiler starter, and broiler finisher feeds respectively. Although *Salmonella* showed a slightly higher contamination rate in both starter

feed and finisher feed (37.5%,  $p=0.13$ ) than *E. coli*, (25%,  $p=0.06$ ), there was no significant difference between the data obtained.

Heeraman<sup>24</sup> reported that cereal ingredients for animal feeds were contaminated with *Salmonella* and *Escherichia coli* at the farm level, whereas 92% of the meat and bone meal samples tested in the US were contaminated with *Escherichia coli* and *Salmonella* sp., and 31% of *Salmonella* contamination was recorded in fishmeal samples in the Netherlands<sup>50</sup>. The poultry feeds from the four (4) farms showed higher contamination with *Salmonella* species than with *E. coli* even though there was no significant different ( $p>0.05$ ) between them. A possible explanation for this may be due to the increased use of antibiotics in the feed for treatment which made poultry feed a major reservoir of antimicrobial resistant *Salmonella* and *E. coli*. This agrees with the work of Atere et al<sup>6</sup> and Brown et al<sup>8</sup> who reported the increased use of antibiotics in feed result in the contamination of feed by *Salmonella* and *Escherichia coli* that develop antibiotic resistance due to transposons. The sensitivity, moderate sensitivity and resistant of *Salmonella* sp. and *E. coli* at different concentrations of the antibiotics ( ranging from 10 to 30  $\mu\text{g}$ ) respectively which could be attributed to the efficacy of the antibiotics on bacterial and/or resistant genes that are possessed by the bacterial genome as the case may be towards some of the antibiotics. due to the indiscriminate use of antibiotics by farmers This antibacterial susceptibility pattern is similar to reports of Alabi et al<sup>2</sup> who conducted a research in Abeokuta, Nigeria and reported a higher prevalence and antibacterial susceptibility pattern of *salmonella* isolates from chicken carcasses while Atere et al<sup>6</sup> and Silva et al<sup>48</sup> both also reported isolation and antibiotic susceptibility pattern of *Salmonella* and *E. coli* from livestock feeds.

## CONCLUSION

The result of proximate analysis indicated dry matter having the highest percentage and crude fiber having the least percentage. The isolation and identification of the collected chicken feeds indicated *Salmonella* species having high number (6 positive samples) of contaminations in broiler starter and broiler finisher feeds than

*E. coli* having lesser number (4 positive samples) of contaminations. Antibiogram of the bacteria carried out indicated ciprofloxacin, Gentamycin, Perfloxacin and Tarvid to be effective against *Salmonella* species and *Escherichia coli* isolated from the chicken feeds analyzed.

#### Recommendations

1. The application of Hazard Analysis and Critical Control Points (HACCP) in poultry feed production should be paramount in the industries and to local feed producers.
2. Disinfection of ingredients before addition to the pool of the feed is highly recommended.
3. Addition of probiotics to the prepared poultry feeds is also highly recommended, this will reduce indiscriminate use of antibiotics which usually result to antibiotic resistance by microorganisms that attacks the feeds.
4. Adhering to Surveillance, Good Manufacturing Practices (GMP) and personal hygiene by the feed producers will reduce or eliminate contamination of the feeds.

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#### CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

#### AUTHORS' CONTRIBUTION

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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#### DATA AVAILABILITY

All datasets generated or analyzed during this study are included in the manuscript.

#### ETHICS STATEMENT

This article does not contain any studies with human participants or animals performed by any of the authors.

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