International Journal of Agricultural and Biosystems Engineering
2017; 2(6): 48-53
http://www.aascit.org/journal/ijabe

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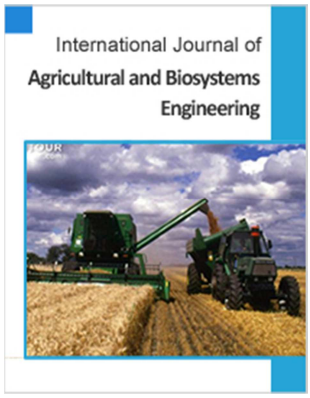

Keywords
Poultry Feeds,
Bacteria,
Antibiotics,
Broilers,
Layers,
Wukari

Received: September 5, 2017
Accepted: November 8, 2017
Published: December 6, 2017

Identification and Anti-biogram Profile of Bacteria Associated with Poultry Feeds Used in Wukari, Taraba State, North East, Nigeria

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Citation
Imarenezor Edobor Peter Kenneth, Iyamu Mercy Itohan, Dosa James Martha, Olofinlade Olamide Gloria, Yakubu Abdulkarim. Identification and Anti-biogram Profile of Bacteria Associated with Poultry Feeds Used in Wukari, Taraba State, North East, Nigeria. *International Journal of Agricultural and Biosystems Engineering.* Vol. 2, No. 6, 2017, pp. 48-53.

Abstract
A total of seven (7) different feeds samples were collected from three (3) different poultry sites meant for different purposes; Layers and Broilers for investigation in the laboratory using standard microbiological techniques. The aim of the study was to determine the microbial loads, antibiogram profile of the different types of bacteria contaminating poultry feeds sold and used in Wukari metropolis, Nigeria. The results clearly show bacteria isolated from both layers and broilers to include *Streptococcus* species (17), *Salmonella* species (7), *Escherichia coli* (16), *Bacillus* species (8) and *Staphylococcus* species (15). Isolates from layers feeds shows *Streptococcus* species 7 (26%), *Salmonella* species 2 (7.4%), *Escherichia coli* 11 (40.7%), *Bacillus* species 3 (11.1%) and *Staphylococcus* species 4 (14.8%) and isolates from the broiler feeds shows *Streptococcus* species 10 (27.7%), *Salmonella* species 5 (13.8%), *Escherichia coli* 5 (13.8%), *Bacillus* species 5 (13.8%) and *Staphylococcus* species 11 (30.6%). In comparison, this study demonstrated that broiler feeds have the highest percentage 36 (57.1%) of bacteria isolates than the layer feeds 27 (42.8%), these may be attributed to the high protein contents of the marshes in the broiler feeds which also serve as growth factor for the contaminating bacteria. It is also worth noting that *Streptococcus* species (17) has the highest frequency of occurrence while *Salmonella* species (7) has the lowest frequency of occurrence. In terms of susceptibility pattern of the various isolates to antibiotics used in these study, the isolates clearly demonstrated various degrees of sensitivity and resistance patterns to the antibiotics. In conclusion, poultry feeds (layers and broilers feeds) used in Wukari metropolis had bacterial contaminants. Hence, in – cooperation of antibiotics to poultry feeds and in the management program of poultry farming is recommended. Also, the hygienic production of poultry feed is of public health concern, therefore, the control of bacterial infections should be approached through cleanliness, disinfection and intensive supportive nursing care, proper treatment of feed ingredients and application of hygienic measures starting from harvesting of feed ingredients to storage, processing of feeds, packaging, transporting and eventual marketing of the bagged feeds.

1. Introduction

Poultry are chickens, ducks, geese, guinea fowls, turkeys and other related birds reared for the purpose of meat and egg production [1]. In Nigeria, the poultry population is estimated to be over 140 million [2]. They are the most commonly reared livestock and over 70% of those rearing livestock are reported to rear chickens [3]. Broilers are a type of chicken (apart from cockerels and layers) reared for meat production and by implication a source of protein [4]. There are many facets of production, and hence many areas that are potential concern for the welfare of the animals involved. These areas may include, among others, housing of laying hens, beak trimming, toe clipping, spent hen disposal, molting of laying hens, feed restriction, lighting programs, growth rates and resulting effects of chicken and turkey broilers, transportation, pre-slaughter management, slaughter, and handling [5]. While research is actively being conducted in methods to improve welfare in most if not all of these areas, recommendations for present management schemes is to have producers ensure they are making the most of the research that has already been completed, using the best management practices that are possible. The nature of poultry outcomes is surprisingly growing with rise in number of people and this is because of good quality and actual price [6]. The large blowout of human consumption of poultry meat and eggs caused the control of microbial contamination. The defense of poultry outcomes raises the importance of efforts that should be applied towards estimation and detection of microbial hazard, which represents an ample risk to the consumer [1, 5, 6]. Poultry feed is considered as one of the essential sources of contamination of poultry products. The safety and quality of poultry feeds are recently of major interest in developed countries, that safety of feed is a principal demand for all birds. Contaminated feeds may lead to great economic disaster in case of destroying an infected flock of birds [7]. The world feed manufacture and stock industries have faced serious food safety problems throughout the last two decades such as the commencement of epidemic like bovine encephalopathy (BSE) and Belgium dioxin crisis, that take place in 1999 because of contaminated fat provided to stock feed manufacture [5]. These occurrences showed the importance of feed safety in guarantying the safety of human food. One of the greatest areas of interest in the bacterial contamination of poultry feed come from the stock feed, raw materials and farms [8]. There was an expanded focus on food as origin of bacterial contamination of livestock production units, and their accepted measures that every feed factory or industry should follow and produce great quality, adequacy and microorganisms free feed. Industry must accept larger share of responsibility for the quality and safeness of poultry feed production. Advances had been done to decrease the contamination of poultry materials as well as finished product, with some invasive *Salmonella*, the greatest important cause of infection in poultry [9]. Studies from around the world have documented the presence of *Salmonella enterica* in a wide variety of animal feeds [9, 10]. Various other microbes such as *Bacillus* species*, Staphylococcus species, Escherichia coli, Campylobacter and Clostridium perfringens* can contaminate poultry feed either from ingredients via farms workers, equipment's, air, handling, used bags or raw materials. There is a reasonable proof that poultry feed is often contaminated with food-borne bacterial pathogens [11]. Risk estimation data for largest poultry-borne hazards are lacking, but these types of data are fundamental in developing food safety approaches. There is a requirement to assay poultry production, processing, handling and preparation procedure to decide their impact on the risk of food-borne illness. Fully understanding the hazards associated with poultry consumption is the key to establish effective sampling, detection and identification procedures that in turn can be applied to design control strategies [12]. Poultry industry in developing countries such as South Africa can be categories into two sub-sectors, namely commercial and traditional sub-sectors [12, 13]. Each of them has its own characteristics that make them distinctive to national food security. The commercial sub-sector contains mainly of exotic breeds of layer and broiler chickens with high egg and meat production, accordingly [12]. Occasionally, they are enclosed in the urban and peri-urban areas where the infrastructure necessary for the production and market of goods exists. However, the traditional sub-sector on the contrary, consists mainly of indigenous birds inclusive of different breeds and or lines such as the Venda chickens. This sub-sector is very important source of income of most rural households as it is mostly found in the rural areas [13, 14]. This sub-sector, presently, constitutes about 80% of the country's rural poultry flock and is a main source of readily available protein in the form of eggs and meat as well as for cash money for 90% of the rural households [14]. However, when compared to commercial layer and broiler chickens, the home-grown chickens produce fewer eggs and have smaller body weights [15]. Furthermore, it has been shown that the home-grown chickens tend to have lower feed efficiency [16]. Improved home-grown poultry production in Limpopo province offers a viable approach to improving nutritional and economic status of the rural households. Improvement in genetic potential of the home-grown chicken should be accompanied by a simultaneous improvement in the standard of management with particular attention to their nutrient requirements in order to enhance food sufficiency and economic empowerment of the rural people [16, 17]. Hence, improved nutritional management is necessary to assist in achieving optimal performance in terms of diet intake, growth rate, feed conversion ratio, live weight, high meat yield and low mortality, especially when commercialization of the breed is of utmost importance. Such approach may help the farmers to improve productivity of their chickens [17]. This study was therefore carried out to determine the microbial load, antibiogram and types of bacteria contaminating poultry feeds sold and used in Wukari metropolis, Nigeria.

2. Materials and Methods

2.1. Study Area

The study was carried out in three (3) poultry farms at Wukari, Nigeria which lies between latitude 7°55'42" North and longitude 9°47'59" East. It has an area of 4,308 km^2 and population of over 8,000 who re mainly farmers and traders. Wukari is home to Federal University Wukari and Kwararafa University. The major languages spoken are Jukun, Kutep, Tiv, Hausa and Fulani [18].

2.2. Sample Collection and Media Used

Two (2) samples each of poultry feed of broilers and layers were collected from three (3) different poultry farms namely; Banbich farm, Aga farm and Federal University Wukari farm all in Wukari metropolis, Taraba state, Nigeria. Sample collection was done using sterile universal container (bottle). All samples were aseptically transported to the Department of Microbiology laboratory, Federal University Wukari, Nigeria for further microbiological laboratory investigations. The media used were nutrient agar and MacConkey agar.

3. Result

A total of seven (7) samples were collected from two different types of poultry feeds which are Layers and Broilers. The samples were inoculated into Nutrient agar and MacConkey agar. Table 1. Shows the overall characteristics of isolated bacteria from poultry feeds. Table 2. Shows the average bacterial count of different poultry feeds according to feed type. Table 3. Shows the percentages and frequencies of occurrence of bacterial isolates (layers). Table 4. Shows the percentage and frequencies occurrence of bacterial isolates (broilers). Table 5. Shows the antibiotic susceptibility tests for isolated bacteria from poultry feed. Figure 1. Shows the percentages representation of the bacterial isolates (layers). Figure 2. Shows the percentages representation of the bacterial isolates (broilers).

Table 1. *Overall characteristics of isolated bacteria from poultry feeds.*

S/N	Morphological characteristics	Gram stain	Coagulase	Catalase	Citrate	Oxidase	Indole	Glucose
1.	Yellowish, round colonies	+ rod	_	+	+	_	_	+
2.	Pink or red, flat colonies	- rod	_	+	_	_	+	+
3.	Milky, round, moist colonies	+ cocci	_	_	_	_	_	+
4.	Milky, round, moist colonies	+ cocci	+	+	+	_	_	+
5.	Orange, round, raised, moist	- rod	_	+	_	_	+	_

Table 1. *Continued.*

S/N	Morphological characteristics	Gram stain	Sucrose	Galactoses	Gas	H_2S	Isolates
1.	Yellowish, round colonies	+ rod	_	+	_	_	*Bacillus* species.
2.	Pink or red, flat colonies	- rod	+	+	+	_	*Escherichia coli*
3.	Milky, round, moist colonies	+ cocci	+	+	_	_	*Streptococcus* species.
4.	Milky, round, moist colonies	+ cocci	+	_	_	_	*Staphylococcus* species.
5.	Orange, round, raised, moist	- rod	_	_		+	*Salmonella* species.

Keys
= Negative, + = Positive

Table 2. *Average bacterial count of different poultry feeds.*

S/N	TYPES OF FEED	BACTERIAL COUNT
1.	Layers	27
2.	Broilers	36
	Total	63

Table 3. *Percentages and Frequencies of occurrence of bacterial isolates (layers feeds).*

S/N	Isolates	Number of colonies	Percentage of occurrence
1.	*Escherichia coli*	11	40.7
2.	*Salmonella* species	2	7.4
3.	*Bacillus* species	3	11.1
4.	*Staphylococcus* species	4	14.8
5.	*Streptococcus* species	7	26.0
	Total	27	100.0

Table 4. *Percentages and Frequencies of occurrence of bacterial isolates (broilers feeds).*

S/N	Isolates	Number of colonies	Percentage of occurrence
1.	*Escherichia coli*	5	13.8
2.	*Salmonella* species	5	13.8
3.	*Bacillus* species	5	13.8
4.	*Staphylococcus* species	11	30.6
5.	*Streptococcus* species	10	28.0
	Total	36	100.0

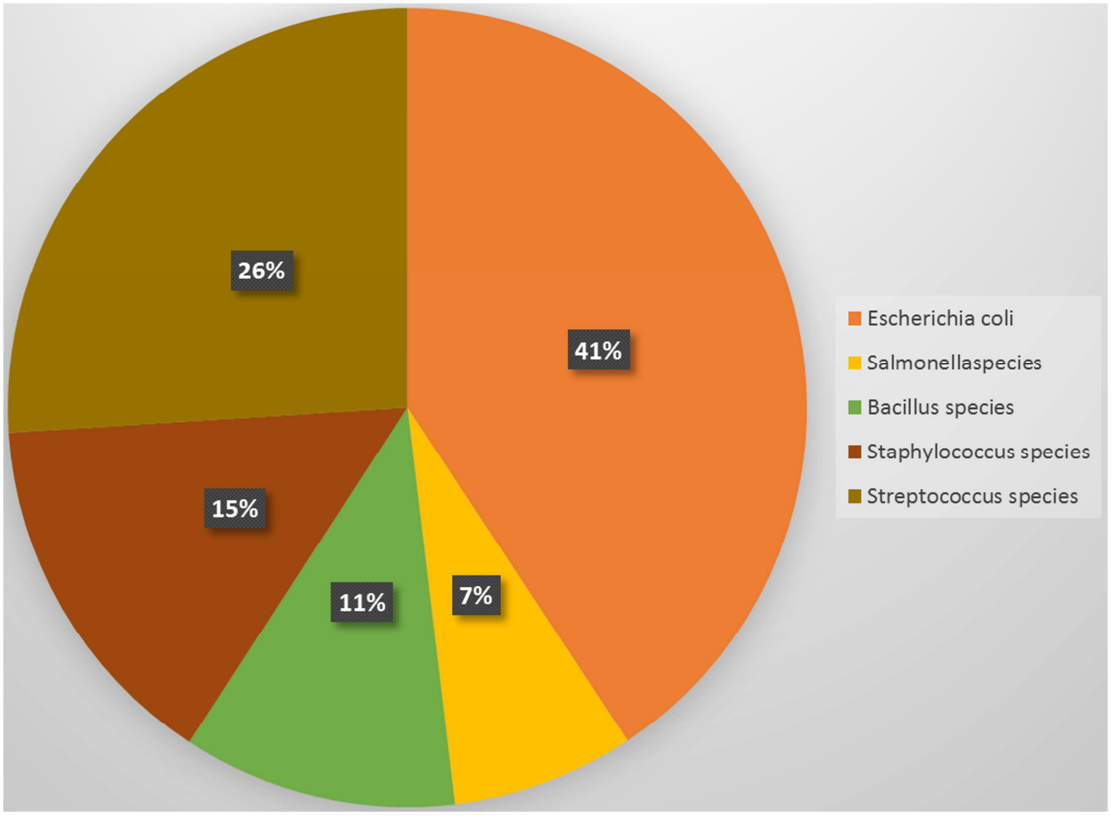

Figure 1. *Pie chart showing the percentages of isolated bacteria from layers feeds.*

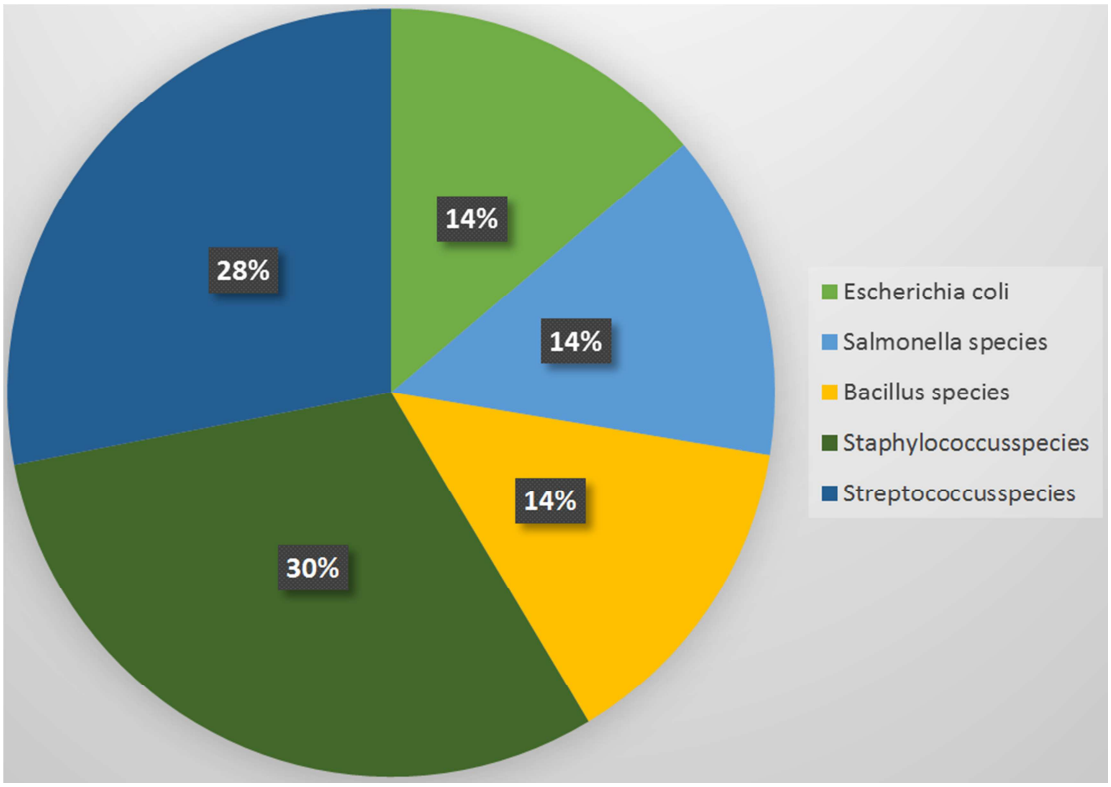

Figure 2. *Pie chart showing the percentages of isolated bacteria from broilers feeds.*

Table 5. *Antibiotics susceptibility pattern of isolates.*

S/NO	Isolates	Selected Antibiotics					
		Ciprofloxacin	Erythromycin	Septrin	Gentamycin	Amoxicillin	Streptomycin
1.	*Escherichia coli*	S	R	R	S	S	R
2.	*Salmonella* species	S	R	S	S	R	S
3.	*Bacillus* species	R	S	R	S	R	S
4.	*Staphylococcus* species	R	S	R	S	S	S
5.	*Streptococcus* species	S	R	S	R	R	S

Keys:
R = Resistant, S = Susceptible

4. Discussion

Poultry feed is a major vector for the transmission of bacterial infections to poultry birds in poultry farms and processing plan [18]. Bacterial contamination of poultry feed is a significant potential pathway for the entry of bacteria pathogens into human food supply [19]. Feeds from seven (7) feed samples examined for bacteriological contamination shows that *Streptococcus* species (17) was the leading etiological agents of poultry feed infections while *Salmonella* species (7) was the least. This disagree with the earlier observation that *Candida* species was the major contaminants of poultry feeds [20]. Other bacteria isolates obtained were *Escherichia coli* (16), *Bacillus* species (8) and *Staphylococcus* species (15). The isolation of *Escherichia coli* may be attributed to faecal contamination during the preparation of these feeds or from the products retailers while *Staphylococcus* species in feed suggests recent contamination most probably from the market sellers [21]. In this study broiler feeds grew the highest percentage 36 (57.1%) of bacteria isolates than the layer feeds 27 (42.8%); this may be attributed to the high protein contents of these marshes which also serve as growth factor for the contaminating organisms. Although, this do not agree with previous work which found layer feeds to contain higher bacteria isolates [21, 22]. Thus, the study has shown a relatively high level of bacterial contamination of poultry feeds in both the boiler and layer feeds in the studied areas [23]. This result is inconsistence with the number of isolates from these sources and is not unexpected; it could be attributed to the level of contamination in the environment of poultry farms and feed storage condition which agree with previous work that environment and handling process during manufacturing and marketing play a major role in feed contamination by bacteria [15, 24]. Therefore, it is good to carry out routine microbiological examination on poultry feed in other to improve production, performance in poultry management. On the antibiotics susceptibility pattern, the result shows that *Escherichia coli, Salmonella* species, *Bacillus* species, *Staphylococcus aureus* are susceptible to gentamycin except *Streptococcus* species. *Staphylococcus aureus, Bacillus* species, *Salmonella* species, and *Streptococcus* species were susceptible to streptomycin except *Escherichia coli.* Also, *Salmonella* species, *Escherichia coli* and *Streptococcus* species were susceptible to ciprofloxacin while *Salmonella* species, *Escherichia coli* and *Streptococcus* species are resistance to erythromycin. Likewise, *Escherichia coli, Bacillus* species and *Staphylococcus aureus* are resistance to septrin. *Escherichia coli, Salmonella* species and *Streptococcus* species are resistance to erythromycin and lastly *Bacillus* species, *Salmonella* species, and *Streptococcus* species are resistance to amoxicillin. The susceptibility pattern of this various isolates is in line with most previous work on the susceptibility pattern of bacteria isolated from poultry [25]. The resistance pattern of some of the isolates to septrin and amoxicillin is worrisome as this are major antibiotics use by most poultry farmers in this locality.

5. Conclusion

Poultry feeds are contaminated with pathogenic bacteria such as *Escherichia coli, Bacillus* species, *Staphylococcus aureus, Streptococcus* species and *Salmonella* species. These organisms may contaminate poultry products and constitute a real hazard to public health. The broiler feeds in this study which were found to contain more contaminated microbial load with bacteria when compared to layer feeds need more attention as this will serve as a major rout for transfer of pathogenic bacteria which can endanger public health in this locality. The hygienic production of poultry feed is of public health concern, therefore, the control of bacterial infections should be approached through cleanliness, disinfection and intensive supportive nursing care, proper treatment of feed ingredients and application of hygienic measures, such as HACCP standard, starting from harvesting of feed ingredients to storage, processing of feeds, packaging, transporting and eventual marketing of the bagged feeds.

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