Occupational and Environmental Health Concerns of Unsafe Acts and Conditions in Selected Poultry Production Sites in Ido-Ekiti.

ABSTRACT

Aims: The aim of this research work is to establish the occupational and environmental burden of unsafe acts and conditions in poultry production sites in the area of study in order to validate the compliance level of poultry farmers to common safety regulations.

Place and Duration of Study: Department on Microbiology, Ekiti State University, Ado-Ekiti, from February, 2017 to December, 2019.

Methodology: A well-structured questionnaire was administered to farm managers and data on antibiotics treatment, age and species of birds, adherence to safety tips, waste disposal options, and poultry management practices were collected. The coordinates of the poultry sites, natural water bodies, source area and their relative distances were determined using the Geographical System Information Software, Mapit GIS.

Results: Majority of the poultry farms under survey (83 %) adopted intensive ranging system of farming and also commercialized their poultry products. Layers were the most reared (50 %) and 58 % of the birds were 6 months of age and above. There was no documented health, safety and regulatory protocols used on all the farms leading to variations in poultry management practices. Among the three waste disposal options adopted on the farms, disposal into open field was the most adopted (67 %). All the farms periodically disposed the waste generated between 3-4 days. Also, 42 % of the farmers applied the collected poultry droppings as farm yard manure and most of the farmers (92 %) engaged family members as workers on the farm. Eight percent of the farmers attended to clients during routine activities. External consultants were engaged by 83% of the farmers and well water was the main source of water used by 83 % of the farms. Coverall was used by 8 % of the farmers. Poultry feed was composed by few (25 %) farmers. From the socio-demographic characteristics of the poultry farmers the age range of majority (75 %) of the farmers was between 40-49 years old and 83 % of the entire poultry farmers were male. Also, 83 % had tertiary education and 92 % of the farmers were married. The relative distance of poultry farms to residential site is between 4 metres to 6 metres while the relative distance of poultry farms to natural water sources is from 160 metres to 4,596 metres. Five natural water bodies comprising 1 spring and 4 streams were found within the area under study. The water sources were used fo domestic (cooking, laundry, bathing, washing and drinking),religious rites, block moulding recreational/swimming, and agriculture/fish farming.

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Conclusion: The occurrence of unsafe acts and conditions with the potential occupational hazards inherent in poultry production sites are due to non-availability cum non-enforcement of documented health, safety and environment regulatory protocols in the area of study. Unsafe acts and conditions ranging from non-use of P.P.E, un-hygienic waste management options, proximity of poultry farms to places of residence and water bodies to indiscriminate use of poultry droppings as organic manure are common practices in poultry production sites increased the environmental burden of harmful M. A. R. B. and constitute occupational hazards to exposed poultry workers. Unguided human interaction with contaminated soil and water from the environment predisposes the public as potential victims of pathogenic bacteria from poultry waste.

Keywords: [Poultry, Safety, Unsafe Acts and Conditions, Waste]
Abbreviations: [P.P.E- personal protective equipment, M. A. R. B. - multiple antibiotic resistant bacteria]

1. INTRODUCTION

Most food animal production farms in Nigeria lack waste treatment facility and humans residing in the vicinity of livestock farms and animal waste dump sites may be exposed to antibiotic resistant bacteria normally present in poultry waste [1]. Animal feaces are alleged to be potential source of strains of bacteria that are antibiotic resistant and they can be a potential threat to human health when they contaminate water and different food sources that are consumed by man [2]. Antibiotics are used for prophylactic, metaphylactic and therapeutic benefits in food animal production farms such as poultry [3]. Poultry and other farm animals are the key reservoirs for multiple antibiotic resistant *E. coli* and the use of antibiotics in animal production sites is considered the most important factor that promotes the emergence, selection and spread of antibiotic resistant microorganisms [4]. Poultry birds can be colonized with antibiotic resistant bacteria.

Comment [B4]: Check the use of the word 'facility' which i suggest should take a plural form. Also consider reconstructing the whole sentenence, paying attention to your punctuations. Sentence can be broken into to two sentences instead of one.

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During indiscriminate waste disposal, these bacteria can be directly discharged with feacal material from animal sources into water and soil in the environment. Antibiotic resistant bacteria and their genes are pollutants to human environment and are transmissible to man via interaction with environmental reservoirs such as soil, water and animal [5]. Resistant bacteria have been found in many water sources such as drinking wells, rivers and effluents from waste-water treatment plants. These bacteria can cause and spread bacterial diseases such as typhoid fever through contaminated water [6], [7]. Antibiotic resistant bacteria may reach humans indirectly along the food chain through consumption of contaminated food, direct contact with infected animals or biological substances such as blood, urine, feces, saliva released to the environment. Besides, consumption of food contaminated with bacteria may directly lead to infection such as diarrhea caused by *Salmonella typhi, Campylobacter* spp. and pathogenic strains of *E. coli* (EHEC) [8]. The resistant bacteria can potentially cause infections and spread to man [9], [10]. Poultry farmers and their families are occupationally exposed and at risk of infection with the multiple antibiotic resistant bacteria from their animals [11], [12] and [13].

Comment [B7]: Check the spelling of 'faeces' and be consistent with it.

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2. MATERIAL AND METHODS

Research tools

A well-structured questionnaire was administered to farm managers and data on antibiotics treatment, age and species of birds, adherence to safety regulatory measures, waste and poultry management practices were collected

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Provenance/determination of the source area

The coordinates of the source area (poultry sites), natural water bodies, human residence and their relative distances were determined using the geographical system information software Mapit GIS as described by [14].

Study population and site

The study population comprises 12 poultry farms with their managers. Poultry birds such as broilers, turkeys and free range birds were reared in the selected poultry farms in Ido Ekiti and Usi Ekiti, Ekiti State. Five natural water sources were also identified.

Collection and culturing of samples

Fresh feacal droppings from poultry birds were randomly sampled with a sterile swab stick and transferred into a freshly procured, sealed, factory-packed polythene bag. Farm feed, water and soil from disposal sites were also collected in sterile universal containers and immediately transferred to the Microbiology Laboratory, Ekiti State University, Ado-Ekiti for bacteriological analysis[15], [1]. The samples were cultured within 2 hours of collection.

Statistical Analysis

Statistical analysis was carried out using SPSS version 20.0 for the analysis of percentages and frequency.

3. RESULTS AND DISCUSSION.

The poultry farming type and management attitudes of the poultry farmers in Ido-Ekiti is shown in Table 1. Data obtained from this research on commercialization of poultry product by majority (83.3 %) of the farmers show that poultry farming is an agro-business. Intensive ranging system of farming was adopted on most farms that sold their poultry products. Intensive farming system was adopted to limit the exposure of birds to pathogens and predators normally present in the environment. It avails periodic attention and care from farm managers, protection of birds from harsh environmental conditions, regular supply of feeds, and routine examination. Poultry farming may be more profitable when practised on a large scale as a result of the huge turnover derivable from regular supply of products to meet consumers' demand. Layers (the most reared) husbandry affords periodical sales of eggs and meat which can constantly improve the economy of poultry farmers. This is in agreement with the assertions of [16] on profitability assessment of laying hens production. Family members were the major type of labour engaged on the farms (91.7 %). Family members used as labour though considered cheaper were constantly exposed to multiple antibiotic resistant bacteria from poultry and they stand a higher risk of contracting infection from them. Workers such as veterinarians, poultry farmers, abattoir workers and those directly in contact with animal products are occupationally exposed and at risk of contracting infection from multiple antibiotic resistant bacteria [17]. Well water was majorly used on the farms and it was free from feacal contamination. Though well water is rich in minerals, it may be liable to contamination with agro-chemicals (herbicides, insecticides) and lethal pathogens associated with flooding. Contaminated source of water can serve as a reservoir of pathogens and source of infection in poultry birds.

Waste generated on farms were frequently disposed and used as organic manure by some farmers (58.3 %). The waste disposal option widely adopted on the farms was disposal into open field (66.7 %). This observation is in agreement with the findings of [1] that wastes generated on food animal production farms in Nigeria were dumped in heaps on farmlands or remote locations inside or close to water bodies. Frequent packing and disposal of poultry dropping is necessary to prevent accumulation of gases that are harmful to poultry birds. Un-hygienic waste management options, proximity of poultry farms to places of residence and indiscriminate use of poultry droppings as organic manure can predispose human immediate environment to gross contamination with feacal material.

Comment [B10]: How did you test for antimicrobial resistance of baceria and what was your standard?

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These multiple antibiotic resistant bacteria haboured in poultry droppings can also spread into water and soil. Man may acquire these bacteria from the environment through consumption of contaminated water, food (vegetable), during recreational activities such as swimming and while performing religious rites. It was observed that less attention was paid to bio-safety issues that may affect human health on the farms. Agencies that promote bio-safety friendly regulations and policies that prohibit unsafe acts and conditions in poultry production sites should be established in order to prevent spread of zoonotic infection of bacterial origin from farm to man.

The socio-demographic characteristics of the poultry farmers in the area of study are shown in Table 2. The data show that the business of poultry farming was mainly practised by a population of married men (83 %) with tertiary education (75 %). The age category of majority of the farming population was between 40-49 years old. This underscores the importance of energy, commitment and education in effective poultry management operations. Disease prevention and control in poultry demand education, training and regular surveillance of the poultry farm. The status of marriage directly confers the responsibility of co-managing poultry farms on family members via delegation of duties. The findings of this result is consistent with that of [18] who recorded 72 % male and 71 % poultry farming population with tertiary education.

The antibiotic consumption profile of the birds under study is shown in Table 3. Administration of antibiotics by dissolution in water was a usual practice in the examined poultry farms with record of antibiotic treatment. They were administered majorly for therapeutic purpose (64 %). Antibiotics were also administered for disease prevention and enhancement of egg production in laying birds. Antibiotics administered on the farms were enrofloxacin, erythromycin, tetracycline, gentamycin, streptomycin, neomycin, colistin, cotrimoxazole, metronidazole and chloramphenicol. Anticoccidiostat was also administered across 50 % of the farm. The crude use of antibiotics in poultry management can select for resistant strain of multiple antibiotic resistant bacteria. The antibiotics percentage resistant profile of *E. coli* isolated is shown in Table 4. M.A.R.B. were isolated from 4 poultry waste disposal sites comprising both land and water sources. M.A.R.B. were also isolated from poultry across 12 farms.

The proximity of poultry sites to natural water sources and human residence in the area of study is shown in Table 5. All the sampled poultry farms (100 %) were located in close proximity to residential sites. Natural water sources located within the area of study and their uses is shown in Table 6. The water bodies comprises spring and streams used for religious, domestic, recreational, fish farming and construction activities. These factors coupled with poor waste disposal options can increase the level of human exposure to soil and water contaminated with M.A.R.B. from poultry. The geographical system positioning coordinates of the area of study is shown in Table 7. The proximity of the poultry farms to one another coupled with periodical disposal of poultry waste attests to the increased microbial load of land and water in human environment. This finding is consistent with that of [8] that antibiotic resistant bacteria may reach humans along the food chain through consumption of contaminated food and contact with infected animals or infected biological substances.

Unsafe acts, conditions and potential occupational hazards inherent in poultry production sites are traceable to non-availability cum non-enforcement of documented health, safety and environment regulatory protocols in the area of study. Unsafe acts and conditions ranging from non-use of P.P.E., un-hygienic waste management options, proximity of poultry farms to places of residence and water bodies, to indiscriminate use of poultry droppings as organic manure are common practices in poultry production sites. They increased the environmental burden of harmful M. A. R. B. bacteria and constitute occupational hazards to exposed poultry workers. Unguided human interaction with contaminated soil and water from the environment predisposes the public as potential victim of pathogenic bacteria from poultry waste.

Table 1: Poultry farming types and management attitudes of the poultry farms in Ido-Ekiti

Characteristics		Frequency (%)
Ranging style of bird	Intensive	10 (83.3)
	Extensive	2 (16.7)
Types of bird	Pullet/Layer	6 (50)
	Turkey	2 (16.7)
	Broiler	2 (16.7)
	Cockerel	1 (8.3)
	Local breed	1 (8.3)
Age of birds (months)	>6 months	7 (58.3
	2- 5 month	4 (33.3)
	1 month	1 (8.3)
Scale of production	Commercial	10 (83.3)
	Subsistence	2 (16.7)
Predominant waste disposal options	Open field	8 (66.7)
	Buried	3 (25)
	Into running water	1 (8.3)
Droppings used as farm yard manure	No	7 (58.3)
	Yes	5 (41.7)
Period of disposing litters	3-4 days	12 (100)
Attendance to client during activities	No	11 (91.7)
	Yes	1 (8.3)
Use of glove as personal protective equipment	No	10 (83.3)
	Yes	2 (16.7)
Personal protective equipment used	Coverall	1 (100)
Major type of labour engaged on farm	Family members	11 (91.7)
	Others	1 (8.3)
Employment of services of consultant	No	10 (83.3)
	Yes	2 (16.7)
Water source	Regular	10 (83.3)
	Not regular	2 (16.7)
Major source of water on farm	Well	10 (83.3)
	Borehole	2 (16.7)
Major source of feed consumed	Purchased	9 (75)
	Self-composed	3 (25)
Name of purchased feed	Brand A	1 (11.1)
	Brand B	8 (88.9)
Use of documented safety regulations	No	12 (100)

* Intensive (caged)
* Extensive (free range), numbers in parenthesis are percentage values.

Table 2: Socio-demographic characteristics of the poultry farmers

Characteristics		Frequency	Percentage (%)
Age of poultry farmers	30-39	1	8.3
	40-49	9	75
	50-59	1	8.3
	60 and above	1	8.3
Gender	Male	10	83.3
	Female	2	16.7
Level of education	Primary/ below	1	8.3
	Secondary	1	8.3
	Tertiary	10	83.3
Marital status	Single (widow)	1	8.3
	Married	11	91.7

Table 3: Antibiotic consumption profile of poultry birds examined

Characteristics		Frequency (%)
Exposure to antibiotics	Yes	11 (91.7)
	No	1(8.3)
Purpose of usage	Disease prevention	3 (27.3)
	Treatment	7 (63.6)
	Enhance egg production	1 (9.1)
Method of administration	Water	11 (100)
	Feed	0 (0)
	Injection	0 (0)
Age of birds when first exposed	2 weeks	5 (45.5)
	1 month	3 (27.3)
	2 months	2 (18.2)
	3 months plus	1 (9.1)
Routine chart for antibiotic use	Yes	3 (25)
	No	9 (75)
Frequency of administration of antibiotics	Cotrimoxazole	6 (50)
	Tetracycline	5 (41.7)
	Gentamycin	3 (25)
	Enrofloxacin	2 (16.7)
	Erythromycin	2 (16.7)
	Streptomycin	2 (16.7)
	Neomycin	2 (16.7)
	Colistin	2 (16.7)
	Metronidazole	1 (8.3)
	Chloramphenicol	1 (8.3)
	Tylosine	1 (8.3)
Frequency of administration of classes of antibiotics	Sulphonamide	6 (50)
	Tetracycline	5 (41.7)
	Aminoglycoside	5 (41.7)
	Fluoroquinolone	2 (16.7)
	Macrolide	2 (25)
	Polymyxin	2 (16.7)
	Nitroimidazole	1 (8.3)
	Amphenicol	1 (8.3)
Product availability from market survey	Tetracycline	2 (100)
	Cotrimoxazole	1 (50)
	Neomycin	2 (100)
	Gentamycin	2 (100)
	Erythromycin	2 (100)
	Penicillin	1 (50)
	Enrofloxacin	1 (50)
	Streptomycin	1 (50)
	Colistin	1 (50)
	Chloramphenicol	1 (50)
	Tylosine	1 (50)

***** Numbers in parenthesis are percentage values

Table 4: Antibiotics percentage resistant profile of *E. coli* isolated

		Cephalosporin			Fluoroquinolone		Aminoglycoside	Caberpenem	Sulfonamide	Tetracycline	
Source code	N	CRO (%)	CAZ (%)	AMC (%)	CIP (%)	OFX (%)	CN (%)	MEM (%)	SXT (%)	TET (%)	n (%)
A	5	0	0	5 (100)	4 (80)	3 (60)	4 (80)	0	3 (60)	4 (80)	4 (80)
B	3	1 (33.3)	1 (33.3)	3 (100)	1 (33.3)	1 (33.3)	1 (33.3)	0	1 (33.3)	3 (100)	3 (100)
C	3	1 (33.3)	1 (33.3)	3 (100)	1 (33.3)	2 (66.7)	3 (100)	0	2 (66.7)	2 (66.7)	3 (100)
D	5	1 (20)	1 (20)	5 (100)	4 (80)	5 (100)	5 (100)	0	2 (40)	3 (60)	5 (100)
E	6	0	0	5 (83.3)	5 (83.3)	5 (83.3)	3 (50)	2 (33.3)	4 (66.7)	5 (83.3)	6 (100)
F	5	1 (20)	1 (20)	5 (100)	5 (100)	5 (100)	1 (20)	3 (60)	4 (80)	4 (80)	5 (100)
G	8	5 (62.5)	5 (62.5)	2 (25)	8 (100)	6 (75)	3 (37.5)	3 (37.5)	6 (75)	7 (87.5)	8 (100)
H	11	9 (81.9)	8 (72.7)	7 (63.6)	11 (100)	9 (81.9)	8 (72.7)	1 (8.7)	11 (100)	11 (100)	11 (100)
I	13	13 (100)	12 (92.3)	9 (69.2)	11 (84.6)	12 (92.3)	13 (100)	9 (69.2)	10 (76.9)	10 (76.9)	12 (92)
J	12	11 (91.7)	10 (83.3)	7 (58.3)	12 (100)	10 (83.3)	7 (58.3)	7 (58.3)	10 (83.3)	11 (91.7)	12 (100)
K	14	9 (64.3)	10 (71.4)	10 (71.4)	12 (85.7)	12 (85.7)	12 (85.7)	7 (50)	11 (78.6)	10 (71.4)	12 (86)
L	5	5 (100)	4 (80)	4 (80)	5 (100)	5 (100)	4 (80)	4 (80)	5 (100)	1 (20)	5 (100)
F/W	-	-	-	-		-	-	-	-	-	-
DS	4	4 (100)	3 (75)	3 (75)	3 (75)	3 (75)	4 (100)	2 (50)	4 (100)	2 (50)	4 (100)
Total	94	60 (63.8)	56 (60)	68 (72.3)	82 (87.2)	78 (83)	68 (72.3)	38 (40.4)	73 (77.7)	73 (77.7)	90 (95.7)

Keys: n=number of isolates, N- Number of isolates showing multiple antibiotic resistance, F/W- isolates from feed and water, DS-number of isolates from disposal site, OFX-Ofloxacin; CIP-Ciprofloxacin, GN-Gentamycin; AMC-Amoxycillin-clavulanate, CRO-Cefriaxone; MEM-Meropenem, CAZ= Ceftaxidime TET= Tetracycline, SXT= Trimethroprim/Sulfamethoxazole. Source A- pullets, B- layers, C- broilers, D- broilers, E-,turkeys, F-,turkey, G-layers, H-layers, I-layers, J-cockerels, K-local birds, L-layer

Table 5: Proximity of poultry sites to natural water sources and human residence

Farm code	human residence	Distance of poultry sites to: natural water bodies				
		OGS	IGS	APL 1	APL 2	IJK
A	10	2458.8	2995.1	3231.9	1144.5	4595.9
B	10.5	1566.8	596.1	1156.2	1867.6	1442.4
C	10.5	1566.8	596.1	1156.2	1867.6	1442.4
D	6.0	859.3	1090.9	2054.9	1628.2	2643.6
E	5.0	1396.5	1717.8	800.35	1715.2	2836.9
F	4.3	1516.8	974.6	1900.2	3007.2	625.5
G	8.0	1663.1	1110.4	2161.3	3449.6	815.3
H	8.0	999.2	990.9	379.4	1942.6	2155.8
I	4.0	1807.1	1464.7	1814.2	3626.0	989.0
J	4.5	389.7	565.7	1164.2	785.1	1442.4
K	4.6	473.4	159.5	1141.6	2153	1530.5
L	12	958.8	369.2	1529.6	2714.7	1233.2

Key: A-L (farm code), OGS 1- Ogudu stream, IGS - Igemo spring,, APL1- Apalogbo I stream, APL2-Apalogbo II stream, IJK-Ijokole stream, * distance recorded in metres

Table 6: Natural water sources located within the area of study and their uses.

No	Water bodies	Types	Percentage of use of the water bodies (%)						
			Fishing	Domestic	Farming	Recreational	Construction	Religious	None
1	Ogudu	Stream	-	10	30	20	20	20	-
2	Igemo	Spring	-	10	-	-	-	-	-
3	Apalogbo I	Stream	20	10	30	-	30	-	10
4	Apalogbo II	Stream	10	30	10	50	-	-	-
5	Ijokole	Stream	-	30	50	-	-	-	20

Key: A-L (farm code),
1-Ogudu stream, 2-Igemo spring, 3-Apalogbo I stream, 4-Apalogbo ii stream, 5-Ijokole stream**.**

Table 7: Geographical system positioning coordinates of the area of study

Poultry sites	Latitude	Longitude
A	7.8927	5.1688
B	7.8668	5.1659
C	7.8667	5.1658
D	7.8667	5.1658
E	7.8740	5.1802
F	7.8566	5.1778
G	7.8547	5.1761
H	7.87234	5.1792
I	7.85408	5.1833
J	7.86719	5.1736
K	7.86588	5.1738
L	7.86148	5.1749

Source A- pullets, B- layers, C- broilers, D- broilers, E-,turkeys, F-,turkey, G-layers, H-layers, I- layers, J-cockerels, K-local birds, L-layers

4. CONCLUSION

The occurrence of unsafe acts, conditions and the potential occupational hazard inherent in poultry production sites are traceable to non-availability cum non-enforcement of documented health, safety and environment regulatory protocols in the area of study. Unsafe acts and conditions ranging from non-use of P.P.E., un-hygienic waste management options, proximity of poultry farms to places of residence and water bodies, to indiscriminate use of poultry droppings as organic manure are common practices in poultry production sites. They increased the environmental burden of harmful M. A. R. B. bacteria and constitute occupational hazards to exposed poultry workers. Unguided human interaction with contaminated soil and water from the environment predisposes the public as potential victim of pathogenic bacteria from poultry waste.

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CONSENT (WHERE EVER APPLICABLE)

Not applicable

ETHICAL APPROVAL (WHERE EVER APPLICABLE)

Not applicable

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