Antibiotic use, Abuse and their Public Health Implication: The Contributory role of management Flaws in the Poultry Industry in two Agro-Ecological Zones in Ghana

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Original Article

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Abstract

Fifty randomly selected registered commercial poultry farms in two agro-eccological zones in Ghana were investigated for contributory factors for antibiotic use and abuse and the public health implications thereof by means of questionnaires, interviews and on-the-spot inspections. Our results indicated that despite the good educational background of farm managers that should inform decisions and actions after veterinary advice, 31 drugs - antibiotics, coccidiostats and an antihelminthic - were being overly used to cover up husbandry and hygiene lapses and to make economic gains in terms of their constant use as growth promoters during the birds' lifetime. Taking advantage of the situation, manufacturers have produced and marketed poultry feed supplements loaded with tylosin, chloroamphenecol, tetracycline and neomycin, antibiotics that have been banned in feed for food-producing animals. From market-ready eggs from these farms, antibiotic residues to which *E. coli, S. aureus and B. subtilis* were susceptible to were detected. Antibiotic residues were generally more concentrated in the albumen than in the yolk. The study also found that Chronic Respiratory Disease (CRD) followed by coccidiosis were the major diseases against which medicines were used. Viral diseases were prevented with preventive vaccination in 60% of the farms but remainders of both antibiotics and vaccines were carelessly kept in 82% of the farms, a situation that could impact on their efficacies. It is suggested that the relevant government agencies like the Veterinary Services, Food and Drugs Board, Ministry of Health, Ghana Poultry Farmers Association and consumers make advocacy for enacting and enforcing regulations on food hygiene and use of antibiotics.

Key words: Antibiotic abuse, antibiotic residues in eggs, Ghana

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Introduction

The estimated protein consumption in Ghana is 53 g a day, which is lower than the recommended 65 g (Batsa, 1993). Poultry palys a significant role in the provision of protein in Ghana. The annual poultry production in Ghana is estimated at 14,000 metric tonnes of meat and 200 million eggs (FASDEP, 2000). The estimated poultry products consumption in Ghana is 12 eggs and 1.2 kg meat per annum. The world average is 154 eggs and 9.7 kg meat (WPS Year Book, 1999). Poultry has socio-economic and cultural roles in the country because of its 'safety net' impact on rural livelihoods (MOFA/DFID, 2002; FASDEP,2002). Having identified the potential of the poultry industry for protein supply and job creation, the government established an integrated poulty project in the country in 1960 and by the 1970 had removed customs duties on poultry drugs, vaccines and food additives and sought to improve veterinary and extension services. Thereafter, many people undertook poultry production on commercial basis either full or part-time (Aning, 1995). However, rearing of village poultry on extensive basis has been still widespread in the country. The projected poultry production in 2005 was 33,525,809 chicken, supplying 282,700 tonnes of meat and 251,500 tonnes of eggs (FAOSTAT, 2006). Curently the Central, Greater Accra and Ashanti Regions contribute 74% of commercial poutry production in Ghana. However, many disease outbreaks have always threathned increased poultry production (Aning, 1995). The situation has made the use of antibiotics for prophylaxis and treatment of diseases widespread, apart from the fact that antibiotics are found in commercially produced feed which is used as growth promotors. There has been worry about non-observance of withdrawal periods of antibiotics in the poultry industry, their consequent residues in poultry products and public health implications (Turkson, 2000; Donkor et al., 2011). Researchers have, therefore, endeavoured to develop methods to detect these residues (Bugyei et al., 1994; Bugyei et al., 2006). Because of the ease of access to antibiotics, farmers use and abuse them to compromise farm hygiene. Therefore, a periodic appraisal of management flaws that impact on poultry health and anitibiotic use becomes necessary in Ghana.

The aims of this study were to document the antibiotics used by poulty farmers in two important agro-ecological regions of Ghana, find out the management practices that necessitate the use and abuse of antibiotics and assess if market-ready eggs have antibiotic residues.

Materials and Methods

Sampling

The study was conducted in two agro-ecological regions in Ghana namely: Ashanti Region (deciduous forest zone) and Central and Greater Accra Regions (in the Coastal Savannah zone). The regions were purposively chosen, because they have the largest number of small and large scale poultry farms in Ghana and contributing to about 74% of poultry production in Ghana (FAOSTAT, 2006; LPIU, 2006). The sampling frame for the questionnaire was on commercial farms with flock sizes above 500 and whose owners were active members of the Ghana Association of Poultry Farmers. A total of 50 farms were investigated, 20 each from Ashanti and Greater Accra Regions and 10 from Central Region.

Instrument

Structured inspection schedule/questionnaire with categorical variables and continuous questions was used to interview farm staff and make on-the -spot inspections of farms. The objectives of the inspection schedule/questionnaire were to collect data on structure, management and understanding of issues surrounding antibiotic use in the poultry industry.

Agar diffusion antibiotic sensitivity testing

From each farm, 15 market-ready eggs were randomly collected without prior information to the farmers and regardless of the total number of eggs laid at the time of sampling. The sampling was based on the assumption that since mass treatment was the method of choice, antibiotic residue, if any, should be equally present in all the eggs in the house at a specific time. In all, 150 eggs were collected, labelled and stored in a fridge at 15^{o} C till the antibiotic sensitivity tests were carried out.

The egg samples were broken into sterilised Petri dishes. The yolk was separated from the albumen and 3 ml of the yolk was then transferred aseptically into the 5 ml clean, sterilised centrifuge tubes. The yolk was then centrifuged at 7000 rpm for 20 minutes at 25^0C.

Nutrient Agar (Oxoid Ltd., Basingstoke, Hampshire, England) was prepared according to the manufacturer's instructions and its pH's adjusted to 7.4 ± 0.2 using the pH buffers. It was poured into Petri dishes and dried at 37^0C. A sterilised 8 mm cork borer was used to create 4 wells in each of the four quarter segments of the Nutrient Agar in the Petri dishes. Into the wells created in the Nutrient Agar, 0.15 ml of the albumen and 0.15 ml of the yolk supernatant were placed in duplicate. The samples were then allowed to diffuse into the agar for about 4-6 hrs at room temperature of 25^0C.

Cultures of *E. coli, S. aureus and B. subtilis* (supplied by the Food Research Institute, Ghana) were resuscitated in Nutrient Broth (Oxoid Ltd, Basingstoke, Hampshire England) at 37^0C. Into 10 ml of sterilised semi-solid Nutrient Agar (Oxoid Ltd, Basingstoke, Hampshire, England) in test tubes, 0.1 ml each of the bacterial cultures was individually and aseptically inoculated. The contents of the inoculated tubes with the Nutrient Agar were stirred using a vortex mixer. Onto the Nutrient Agar, whose wells contained the egg samples, the semi-solid Nutrient Agar containing the bacterial cultures were poured and allowed to set for 30 min.

The agar wells that had been overlaid with *E. coli* were incubated for 24 hours at 44^0C. Those with *S. aureus* were incubated for 24 hours at 37^0C and those with of *B. subtilis* were incubated for 24 hours at 30^0C.

The plates were observed for inhibition zones after the incubation periods. The inhibition zones were then measured with a calliper. The Johnson and Case (1995) standard, which measures the extent of zone of inhibition was used in assessing the susceptibility of the test microorganisms to suspected antibiotic residues in the eggs, that is, 10 mm or less (Resistant); 11-15 mm (Intermediate); 16mm or more (Susceptible).

Results and Discussion

Table 1 suggests that since majority of the managers of investigated farms and their farm hands had been generally formally educated, some with tertiary education, and have had training in poultry production, they should be able to understand the necessity for enforcing farm hygiene and making informed decisions on choice, administration, storage and withdrawal periods of antibiotics upon veterinary advice and prescriptions and also keep farm records, including antibiotic use. Our findings on farm staff educational backgrounds and their implications agrees with the findings of Turkson (2008). However, the finding that as much as 95% of the farm staff had never been medically examined before in relation to their jobs, gave the impression that they did not care for being possible agents for transmission of zoonotic diseases, for example *Salmonella*.

Table 2 shows that majority of farmers constantly used antibiotics as prophylaxis and more intesively during disease outbreaks for treatments. Although majority of the farmers purchased medicines on prescription, it was evident that 30% of farmers, in spite of their formal education, made their own diagnosis and prognoses of diseases that were occuring or about to occur and formed their own opinions on what antibiotics to buy. Liberalisation of antibiotic imports in Ghana has made them (antibiotics) easily availiable. It seemed that veterinary drug sellers did not insisit on certified veterinary prescriptions before sales. They could even suggest the diagnoses of diseases to farmers so that they could sell their drugs. The situation could lead to unnecessary use and overuse of antibiotics, their wrong combinations, quick changeover to other drugs and improper dosage (Khan, 1975). The result would be the production of antibiotic resistant strains of bacteria (Khachatourians, 1998) and cross resistance with other bacteria (Baker-Austin et al., 2006). It is worrying from Table 2 that 82% of the investigated farms did not have any storage facilities for left-over antibiotics. They were left at ambient temperatures and even in sunshine, a situation that could impact on the antibiotic potency.

From Table 3 it is inferable that the 31 drugs used in the farms that were investigated could be grouped into antibiotics, formulations with low doses of antibiotics to be used as growth promoters, coccidiostats and an antihelminthic. Our results recorded that some of the antibiotics that were used neither gave information about their active ingredients nor their withdrawal periods. This usually occured with imitated antibiotic products which could enter the country by unapproved routes to escape Veterinary Services, Food and Drugs Board and Standards Board's approval and customs duties. Our investigation found that labelling of such drugs was incomplete and also some of them had expired but were being used.

Table 1: Educational status of staff of farms*

Factors	Central n=10	Greater Accra n=20	Ashanti n=20	Tallies n=50
Farm managers/caretakers				
Illiterate	0(0)	0(0)	0(0)	0(0)
Basic Education	6(60)	10(50)	7(35)	23(46)
Secondary/Vocational	2(20)	2(10)	5(25)	9(18)
Tertiary	2(20)	8(40)	8(40)	18(36)
Farm hands				
Illiterate	2(20)	1(5)	3(15)	6(12)
Basic Education	7(70)	13(65)	9(45)	29(58)
Secondary/Vocational	1(10)	5(25)	6(30)	12(24)
Tertiary	0(0)	1(5)	2(10)	3(6)
Training on poultry farming				
Trained	5(50)	15(75)	18(90)	38(76)
Untrained	5(50)	5(25)	2(10)	12(24)
Medical examination				
Medically examined	1(10)	2(10)	1(5)	4(8)
Medically unexamined	19(90)	18(90)	19(95)	46(95)

*Percentages are in parenthesis

Table 3 shows that although there were inter-zonal differences in the use of different antibiotics, Tylodox, TCN and Amprolium powder were mostly used. Tylosin is a macrolide antibiotic and the active ingredient of Tylodox. The soluble salt Tylosin tartrate is approved for poultry as a drinking water medication because Tylosin has a wide spectrum of activity against gram positive bacteria including *Staphylococci* and *Streptococci*, but narrow against gram negative bacteria like *Campylobacter* and *Pasteurella multocida* and against *Mycoplasma gallisepticum*, the causative agent of Chronic Respiratory Disease in poultry. However, resistance to Tylosin has been observed. Cross-resistance to other members of the macrolide group has been reported especially to erythromycin, which is used extensively in human treatments (BAM, HACCP Manual). Although Tylosin is added to feed to promote increased rate of weight gain and improved feed efficiency, it is not approved for use as a feed medication for poultry in Canada and European countries. (BAM, HACCP Manual; Philips, 1999). It has been suggested that there are no or minimal benefits using antibiotics as growth promoters (Engster et al., 2002; Emborg et al., 2001, WHO, 2003). Further, USDA (2009) asserts that the assumed economic and production benefits of antibiotics in animal feed can largely be improved by improved cleanliness of animal houses and improved testing for diseases. Flake & Ashitey (2008) had also noted that poultry farmers adopted antibiotics as preventive medication to compensate for biosecurity measures. However, WHO (2000) advises that under no circumstances should antibiotics be used as an alternative to high-quality animal hygiene. For, overuse and abuse of antibiotics lead to the emergence of resistant strains in both the birds and man, delay desirable exposure and immunity destruction of useful gastrointestinal microflora (Ladefoged, 1996), result in allergy in man (O'Brien & Campbell, 1984) and affection of his teeth and cartilage (Booth & McDonald, 1986; Blaser, 1996).

Table 2: Antibiotic usage and handling*

Factors	Central n=10	Greater Accra n=20	Ashanti n=20	Tallies n=50
Rationale for usage				
In disease outbreak	4(40)	5(25)	7(35)	16(32)
Prophylactic use	0(0)	3(15)	2(10)	5(10)
Prophylactic and curative	6(60)	12(60)	11(55)	29(58)
Reasons for choice				
Cost	0(0)	0(0)	0(0)	0(0)
Availability	0(0)	0(0)	0(0)	0(0)
Potency	0(0)	0(0)	0(0)	0(0)
Veterinary prescription	8(80)	11(55)	16(80)	35(70)
Farmer prescription	2(20)	9(45)	4(20)	15(30)
Post usage storage				
Warehouse	2(20)	4(20)	3(15)	9(18)
No storage facility	8(80)	16(80)	17(85)	41(82)
Sales of produce within of antibiotic withdrawal for eating	6(60)	12(60)	9(45)	27(54)
No sales of produce within antibiotic withdrawal period for eating	4(40)	8(40)	11(55)	23(46)

*Percentages in parenthesis

The use of TNC powder presents two problems. The first is that it is mixture of oxytetracyclines, chloramphenicol and neomycin. The use of chloramphenicol in veterinary medicine has been restricted to non-food animals. The United States has banned nitrofurans, chloramphenicol and ampicillin in animal feed. Germany and the Netherlands have forbidden penicillin and tetracycline in feed. Neomycin can worsen kidney disease in man (Wongtavatchai et. al, 2004). The second issue is that TCN and Tylosin have withdrawal periods of 21 days and 10 days respectively. That makes it difficult for farmers who use them to wait for withdrawal periods before the sale of eggs or meat, more so as commercial poultry production in Ghana is strategically targeted to meet festive occassions like Christmas, Easter and Idul Fitir. Eggs are, however, sold all year round. As many as 54% of farms sold their produce within the withdrawal periods.

In any case, Table 5 suggests that CRD followed by coccidiosis were the major diseases during the period of study. The finding accounts for why Tylodox and Amprolium were the most used antimicrobials. It is suggested that when deep litter is the system of choice, overcrowding must be avoided, since it aggravates CRD.

The other diseases are of viral aetiology and do not need antibiotics but rather vaccination. Table 6 suggests that 40% of the farms did not adhere to preventive vaccination schedules. In fact, it was also established that as many as 11 farms kept vaccines for more than 24 hrs after collection from the veterinary outfits without a cold chain. That is a problem that Hunter (2003) also identifies with developing countries.

For farms that maintained disinfection barriers and foot baths, the following disinfectants were being most popular: HI-BI (chloroxenol), Omicide and Quincide (quaternary ammonium compound), Izal and Dettol (phenols) and Virkon (potassium peroxymonosulphate). On-going investigation (Annan-Prah et al., 2012) using Johnson and Case agar diffusion tests (1995) suggests that, at the manufacturers' recommended dilutions, *S. aureus* is susceptible to Quincide and HI-BI but not to Izal and Virkon. *E. coli* was found susceptible to Quincide but not to HI-BI, Virkon, and Izal. That also raises a concern about the antibiotic spectra and effectiveness of disinfectants that were being used on farms. If health records were meticulously kept (Table 6), the trend of use and the effectiveness of antibiotics and vaccines and chemical disinfectants could be monitored.

The consequences of overuse, abuse and non-observance of withdrawal periods are evident in Table 3 and 4. Eggs from 32% of the investigated farms contained antibiotic substances, though they (antibiotics) were not characterised in this study. The antibiotic substances in the eggs meant for market were generally more concentrated in the albumen than in the yolk for *E. coli*, *S. aureus* and *B. subtilis*. However, the yolk of eggs from the Cental Region had equally high amount of antibiotic residue. Kan and Petz (2000) had noted that drug residues will appear in both egg white and yolk after administration of drugs although poultry eggs contain a natural antibiotic substance, lysozyme, against most gram positive bacteria (Beuchat & Golden, 1989). However, if lysozyme presence was the cause of of the inhibition zones observed, then the zones should have been equal in extent and observable in all the eggs. Therefore, the inhibition zones might not be the result of lysozyme in the eggs but from antibiotics that entered the eggs and possibly the birds' tissues. Mohammad et al. (1997) suggest that among the factors responsible for the occurence of anbiotic residues in food are: failure to observe withdrawal periods, extended usage or excessive dosages, poor records of treatment, off-label use of antibiotics, over-the-counter purchases of drugs, lack of consumer awareness of hazards of antibiotic residues in food and lack of enforcement of legislation. Our investigation came out with similar findings that heavy doses of antibiotics were being used and withdrawal periods were not observed for eggs going into the market. Farmers gave the following reasons for non-observance of withdrawal periods: we cannot throw the eggs away because we are in for profit; clients have been eating these eggs for a long time and nothing happens to them; the drugs do not have any effects on eggs; nobody is practising that in Ghana; the high cost of production makes this unpracticable; there is no compensation from government for destroying farm produce etc. However, such farmers lose sight of the fact that the government has got the moral obligation to protect consumers from potential dangers arising from unacceptable practices likely to endanger food safety and public health. What may have contributed to so much use of antibiotics and their consequent presence in eggs is suggested to be traceable to compromising the general guidelines and rules that regulate the poultry farm facilities, hygiene, their operations and personnel involved. Antibiotics seem to be used to cover up, strategically or tactically, poor farm hygiene. Also feed manufacturers, percieving the improper hygiene on farms in developing countries, add antibiotics, not merely as growth promotors, but also to put birds under constant medication against bacterial diseases.

The credence given for the above-mentioned perception lies in the analyis of Table 6, which tabulates factors that may contribute to thr transmission of pathogens. Farms that were located in residential areas could be easily affected by cross-transmission from residential units and from unrestricted human and surrounding domestic animal traffic to the premises of farms. The ease of such cross pathogen transmission becomes serious when farms have no disinfection barriers for people and vehicles entering the farms and maintained footbaths for entering into pens. Farmers were improperly burying their carcasses. They used their raw litter for manure in their farms or sold it to surrounding neighbours. Both situations contribute to the spread of pathogens. Our results show that the deep litter is the system of choice (74%) with continuous production (80%) over battery cage system (10%). This agrees with Turkson (2008) that the continuous production system is popular with the farms because it allowed all-year round use of facilities rather than 'down times' of the 'all-in, all out' system. Yet the preference of deep litter method of production lets birds be in direct contact with their droppings, effects complete disease cycle

Table 3: Antibiotics used in investigated farms

Antibiotics used	Active ingredients	Withdrawal period	Region				Percentage (n = 50)
			Central	Greater Accra	Ashanti	Total	
Pen – strep plus	Streptomycin as sulphate 133 mg , Procaine pennicillin G 45mg	3 days for meat	1	6	4	11	22%
Tylodox extra wsp	Tylosin		5	5	7	17	34%
Keprocel			7	2	0	9	18%
Amprolium			2	5	8	15	30%
Neooxyvital eggs formula wsp			5	3	1	9	18%
Alta – oxy- eggs formula wsp	Oxytetracycline and vitamins		4	3	2	9	18%
Vitacox wsp			3	0	0	3	6%
Procox wdp			1	0	0	1	2%
Hipraoxyvit egg formula			1	0	0	1	2%
Superhipracox			1	0	1	2	4%
Hipralona Enro – S	Enrofloxacin		1	1	1	3	6%
Atceryl			2	3	4	7	14%
Pharmacox			2	0	1	3	6%
TCN powder	Oxytetracycline HCL 50mg Chloramphenicol 50mg Neomycin sulphate 25mg	21 days	3	4	4	11	22%
Crotadona			1	2	1	4	8%
Oxyfuravit			1	1	1	3	6%
Doxycol	Doxycline hyclate		1	2	1	4	8%
Norfloxacin 20%			0	1	1	2	4%
Oxytetracycline 50%	Oxytetracyclin HCl 500mg/g	eggs 10 days and 5 days for meat	0	1	1	2	4%
Super egg formula plus	Oxytetracycline 60mg	5 days	5	0	3	8	16%
Neomycin wsp	Neomycin		0	4	3	7	14%
Drinkmix Tiamulin 10%	Tiamulin Hydrogen fumurate 100g	eggs 10 days and 3 days for meat	0	1	0	1	2%
Sulphadimidine	Sulphur		2	1	1	4	8%
Bidox			2	1	1	4	8%
Colimicina	Colistin 300mil I.U, Neomycin 60mg, and Tylosin	7 days	0	1	1	2	4%
Dioxin			0	1	0	1	2%
ENROCOCCI	Enrofloxacin 10mg, Colistin 500mil I.U	4 days	1	2	2	5	10%
Trisul 80/400			2	4	3	9	18%
Tetraneovit	Tetracycline, neomycin and vitamins		0	1	4	5	10%
Enrofloxacin	Enrofloxacin		0	1	7	8	16%
Piperazine	Piperazine Dihyrochloride 100%	1 day	0	1	0	1	2%

*Percentages are in parenthesis

Table 3: Farms that had eggs testing positive for antibiotic residues in eggs

Region	N	*E. coli*	*S. aureus*	*B. subtilis*	Regional Totals (%)
Central	30	0(0)	7(23.3)	1(3.3)	8(26.7)
Greater Accra	60	4(6.7)	6(10)	5(8.3)	15(25)
Ashanti	60	3(5)	3(5)	6 (10)	12(20
Totals(%ages)	150	7(4.7)	16(10.7)	12(8)	35(23.3)

*Percentages in parenthesis

Table 4: The mean inhibition zone for the samples from the three regions

	MEAN INHIBITION ZONE (mm)						
	E. COLI		STAPH. AUREUS		B. SUBTILIS		n
REGION TYPE	YOLK	ALBUMEN	YOLK	ALBUMEN	YOLK	ALBUMEN	
CENTRAL REGION	0.00	10.80	13.00	16.80	1.60	12.40	30.00
GREATER ACCRA REGION	3.10	16.10	4.20	14.30	3.30	15.50	60.00
ASHANTI REGION	1.90	12.70	1.20	10.90	3.00	15.70	60.00

[Legend: 10mm or less = Resistant, 11mm – 15 mm = Intermediate and 16mm or more = susceptible (Johnson and Case, 1995)]

Table 5: Common diseases recorded on investigated poultry farms

Disease	Central n=10	Greater Accra n=20	Ashanti n=20	Tallies n=50
Chronic Respiratory Disease	5(50)	12(60)	10(50)	27(54)
Coccidiosis	8(80)	8(40)	7(35)	23(46)
Gumboro	6(60)	4(20)	7(35)	17(34)
Infectious coryza	4(40)	6(30)	7(35)	17(34)
Newcastle	6(40)	1(5)	8(40)	15(30)
Fowl pox	3(30)	6(30)	2(10)	11(22)
Enteritis	0(0)	1(5)	2(10)	3(6)
Diarrhoea (unknown cause)	1(10)	0(0)	0(0)	1(2)
Fatty liver	0(0)	1(5)	0(0)	1(2)

*Zonal and overall percentages in parenthesis

and consequent overuse of antibiotics. For instance, unabsorbed Tylosin is excreted unchanged in the faeces (BAM, HACCP Manual). There is the possibility of its ingestion from the deep litter system as feed spill on the litter.

Borehole water was drawn from farm premises where carcasses of diseased birds had been buried. The popular farmer-formulated feed (to beat the cost of commercially produced feed) did not have controls for microbial contamination and nutrient composition. Borehole water and farmer-formulated feed are speculated to be sources of pathogens. The few staff without education was likely to have low appreciation of the importance of maintaining farm hygiene and personal protection from zoonoses.

Conclusion

Antibiotics flood the Ghanaian market as medications and promoters in feed. Their purchase was often without prescription. The general organisation of poultry production in the two agro-ecological zones of this investigation seems to rely on heavy doses of antibiotics to cover up hygiene deficiencies in their farm operations. Dosage and administration of antibiotics were often subjective. Withdrawal periods were not observed in many cases. Albumen seemed to accumulate more antibiotics than egg yolk. It is suggested that the relevant government agencies like the Vaterinary Services, Food and Drugs Board, Ministry of Health, Ghana Poultry Farmers Association and consumers make advocacy for enacting and enforcing regulations on food hygiene and use of antibiotics.

Table 6: Farm factors that impact directly or indirectly on farm hygiene

Factors	Central n=10	Greater Accra n=20	Ashanti n=20	Tallies n=50
Location and hygiene security				
Farm in residential area	4(40)	6(30)	7(35)	17(34)
Unfenced farms	3(30)	3(15)	4(20)	20(20)
Farm gate disinfection barrier	0(0)	4(16)	5(25)	9(18)
Foot bath presence/ maintained	5(50)	15(75)	12(60)	32(64)
Heath Records	1(10)	15(75)	14(70)	30(60)
Vaccination schedule adherence	9(90)	19(95)	18(90)	30(60)
Litter disposal as manure	10(100)	20(100)	20(100)	50(100)
Carcass disposal as animal feed	1(10)	3(15)	2(100)	6(12)
Carcass disposal by burning	0(0)	2(10)	0(0)	2(4)
Carcass disposal by burying	9(90)	15(75)	18(90)	42(84)
Production type/system				
Deep litter	10(100)	10(50)	17(85)	37(74)
Battery cage	0(0)	4(20)	1(5)	5(10)
Deep litter and battery cage	0(0)	6(30)	2(10)	8(16)
All-in-all out production	2(20)	5(25)	2(15)	10(20)
Continuous production	8(80)	15(75)	17(85)	40(80)
Water and feed sources				
Portable tap water	7(70)	8(40)	4(20)	19(38)
Borehole water	2(20)	10(50)	12(60)	24(48)
Tap and borehole	1(10)	2(10)	4(20)	14(14)
Industrially produced feed	2(20)	4(20)	5(25)	11(22)
Farmer formulated feed	8(80)	16(80)	15(75)	39(70)

*Percentages in parenthesis

Recommendations

Stakeholders like Veterinary Services, Food and Drugs Board, Standards Board, Consumer Protection Agency, Ministry of Health must come together to enact guidelines and enforce them to promote hygiene compliance in poultry farms. Stricter surveillance should be done on the importations of antibiotics and their sales.

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