

GLIMPSE INTO THE BIOSECURITY, ANTIMICROBIAL USAGE, AND ANTIMICROBIAL RESISTANCE OF FECAL *ESCHERICHIA COLI* ASSOCIATED WITH COMMERCIAL CHICKEN LAYER FARMS IN A POULTRY DENSE AREA IN SRI LANKA

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SUMMARY: Industrial food animal production plays an essential role in the global food supply chain. In parallel with the growth of the Sri Lankan poultry sector, antimicrobial usage has also been increased with the aim of reducing disease incidents. The development of antimicrobial resistance due to the irrational use of antimicrobials is a global problem. Commensals like *Escherichia coli* (*E. coli*) can easily acquire and transfer resistance to pathogenic and zoonotic bacteria which cause treatment failures in both humans and animals. The present study was conducted in 50 poultry layer (commercial chicken layers) farms in Kurunegala district of Sri Lanka during the period from November 2016 to January 2017. A questionnaire-based survey was conducted to collect information mainly on the management, biosecurity, and antimicrobial usage of selected farms. Further, *E. coli* were isolated from the fecal samples collected from 26 farms among those 50 farms, and their antimicrobial-resistant profiles (AMR) were investigated. Results revealed that 98% of the farms had poor biosecurity management practices while using at least one antimicrobial drug (98%). The most commonly used antimicrobial drug was enrofloxacin (79.6%) followed by amoxicillin (61.2%), both sulfamethoxazole and trimethoprim (49%), tetracycline (26.5%), neomycin (22.4%), and tylosin (4.1%). AMR profile of fecal *E. coli* revealed that the highest resistance is for tetracycline (81.8%) followed by nalidixic acid (54.5%), trimethoprim-sulfamethoxazole (40.9%), ampicillin (45.5%) and ciprofloxacin (31.8%). Lower levels of resistance, 13.6%, 9.1%, and 4.5% were observed for streptomycin, ceftazidime, and imipenem respectively. All the isolates were susceptible to amikacin and gentamycin; while 68.18% of isolated *E. coli* were multidrug-resistant (MDR). AMR and MDR findings of this study highlight the need of implementing strategies to regulate the usage of antimicrobial drugs in poultry farms in Sri Lanka, to prevent and control the emergence of antimicrobial-resistant pathogens and diseases from a 'one health' perspective.

KEYWORDS: biosecurity, antimicrobial usage, antimicrobial resistance, commercial chicken layer farms

INTRODUCTION

The poultry industry is one of the major industries of the agriculture sector in Sri Lanka which supply the majority of animal protein requirement of humans (De Silva, 2014). With the development of the poultry industry, extensive free-range backyard poultry rearing systems switched to semi-intensive

and then to intensive farming systems with increased stocking density in a confined environment, leading to an increase in the incidence of infectious diseases (Prabakaran, 2003). Since then, poultry health management and the use of biosecurity measures have become emerging issues. As poultry birds play a major role in zoonotic disease transmission, the implementation of proper biosecurity measures and

appropriate management practices will enhance the safety and hygiene of poultry-origin food (Sharma, 2010). The poultry industry in many developing countries tends to be over-dependent on vaccines and antimicrobials rather than practicing biosecurity in poultry operations (Prabakaran, 2003).

The use of antimicrobial agents to treat diseases in food-producing animals started in the mid-1940s (Hammerum and Heuer, 2009) with the good intention to restore the damage to the food system caused by World War 2 (Founou *et al.*, 2016). However, in the early-1950s, the use antimicrobial agents was started for different alternative purposes such as controlling diseases caused by poor biosecurity, to reduce stress, and improve growth and feed efficiency (Hammerum and Heuer, 2009) in farm animals. The irrational use of antimicrobials has caused different devastating effects. Overuse or misuse of antimicrobials, use of antimicrobial growth promoters in animal feed, and improper disposal of farm animal waste have led to the exposure of bacteria to sub-lethal levels of antimicrobials which promote the development of antimicrobial resistance over the years (Manyi-Loh *et al.*, 2018). Antimicrobials kill the susceptible bacteria while selecting resistant types in both pathogenic and endogenous flora of exposed animals (Van Den Boggard *et al.*, 2001). Other than induction of natural resistance due to exposure to antimicrobials, non-pathogenic *Enterobacteriaceae* such as *E. coli* may have the ability to transfer the mutations and genes of resistance to pathogenic bacteria through the mechanisms of horizontal gene transfer such as conjugation, transduction, and transformation (Munita and Arias, 2016). Other than that, usage of the same antimicrobial agents that are used in human medicine, for the livestock industry can increase the development of resistance in human bacterial pathogens with food animal reservoirs which may result in treatment failures, prolonged or more severe illnesses, increased hospitalization and increased mortality in humans (Angulo *et al.*, 2004). These antimicrobial-resistant bacteria of animals can reach humans via food, water, food-derived products, and direct contact with infected animals or their biological substances such as blood, urine, feces, saliva, and semen (Founou *et al.*, 2016).

According to the World Organization for Animal Health's (WOAH) annual report on antimicrobial agents intended for use in animals in 2018, the highest level of antimicrobials has been used in the poultry industry (between 2015 and 2017) compared to other food-producing animal industries. Similar

to other countries, in par with the development of the poultry industry in Sri Lanka, antibiotic usage has been increased to treat infections and improve overall health in chickens and the penicillins (amoxicillin), quinolones (enrofloxacin) and tetracycline (doxycycline, oxytetracycline) were identified as the most frequently used antimicrobials in Sri Lanka (Herath *et al.*, 2016; Liyanage and Pathmalal, 2017). Therefore, poultry is an important source for the dissemination of antimicrobial-resistant *E. coli* in the community and environment. Pathogenic Multidrug-resistant *E. coli* in poultry is a direct threat to both the poultry industry and human health as it may cause incurable infections (Hussain *et al.*, 2017). Although antimicrobials are vastly used in Sri Lankan poultry industry, while reporting treatment failures in both human and veterinary medicine and presenting foodborne pathogens carrying AMR in food of animal origin, comprehensive information on the AMR profiles in commercial poultry are scarce to find in Sri Lanka except some studies (Jayaweera *et al.*, 2021).

This study presents an overview of the management systems, biosecurity practices, and antimicrobials used in poultry layer farms in Kurunegala district, Sri Lanka. In addition, the AMR profile of *E. coli*: used as an indicator organism isolated from poultry fecal samples for commonly used antimicrobials in both human and animal medicine was investigated.

MATERIALS AND METHODS

Study area and sampling

Questionnaire survey and sample collection was conducted using poultry layer farms (commercial chicken layers) situated in Kurunegala district in North Western Province, during three-months period from November 2016 to January 2017. Fifty poultry layer farms, having more than 1000 birds were selected for the study.

Data collection (questionnaire) in each farm

The survey was carried out in 50 farms during the 3-month period. Piloting the questionnaire data were collected mainly on management systems, biosecurity, antimicrobial and other drug usage at poultry layer farms by interviewing the farmers or other employees of selected farms.

Collecting, transporting, and storing fecal samples in the laboratory

For fecal sample collection, 26 farms among 50 farms were selected based on the willingness of the farmers to provide samples for analysis. The pen holding the layer birds of the oldest age group was chosen and from that particular layer pen, five fecal samples were collected from five different places including four corners and the center. Then the 5 fecal samples collected from each pen were pooled to make one sample. Pooled samples were transported to the laboratory at 4 °C using ice blocks in an insulating container. Samples were stored in a 4°C refrigerator until analysis.

Isolation and identification of *E. coli*

Each fecal sample was mixed properly. A loop full of properly mixed fecal samples were streaked on MacConkey agar (Oxoid, UK) plates and incubated at 37°C for 24 hours in an aerobic incubator. After incubation, the presence of presumptive colonies with the typical colony characteristics were evaluated comparing with ATCC *E. coli* 25922 grown in MacConkey agar.

Three typical colonies were selected and inoculated on Nutrient agar (NA) (Oxoid, UK) and incubated at 37°C for 24 hours in order to obtain bacterial colonies for further laboratory confirmatory tests. Each colony on NA was streaked on Eosin Methylene Blue (EMB) agar (Oxoid, UK). Culture characteristics were observed after incubation at 37°C for 18-24 hours. Gram staining and biochemical tests (urease utilization test, citrate utilization test, indole test and Triple Sugar Iron test) were performed for confirmation of *E. coli*.

Antimicrobial susceptibility testing for *E. coli*

Disk diffusion method (Kirby-Bour Method) was performed to assess the AMR profile of each confirmed isolate. Mueller Hinton (MH) agar (Oxoid, UK) and antibiotic disks from Oxoid (Oxoid Limited, UK) were used following the procedures described in clinical laboratory standard institute

(CLSI, 2013). The isolates were tested for 12 antimicrobials: gentamycin, amikacin, streptomycin, ampicillin, cefotaxime, ceftazidime, ciprofloxacin, nalidixic acid, imipenem, sulfamethoxazole-trimethoprim, tetracycline, and chloramphenicol, which are currently used in human and veterinary practices in Sri Lanka.

The diameters (in millimeters) of the inhibitory zones of each isolate were measured using a Vernier caliper and then each isolate was designated as resistant (R), intermediately susceptible (I), or susceptible (S) based on the clinical breakpoints given in CLSI, 2013.

Maintaining standards using ATCC *E. coli*

A standard strain, American type culture collection (ATCC) *E. coli* 25922 was used as the quality control strain to assess the laboratory quality assurance of the methods that were performed throughout the procedure.

All the laboratory procedures were conducted in the Microbiology Laboratory, Department of Veterinary Public Health and Pharmacology, Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Sri Lanka.

Data analysis of the questionnaire

The data obtained from the questionnaire were categorized mainly in to four categories: details of the farms and farm management system, drug usage, biosecurity and product selling. Data were analyzed and graphs were plotted using Microsoft Excel.

RESULTS

Questionnaire based survey results

Poultry farm management

Data collected from questionnaire-based survey were analyzed under 3 categories namely general information, housing and feed (Table 1).

Usage of drugs

Antimicrobial usage

According to the survey, 76% (38/50) farmers had knowledge about the purpose of antimicrobials while others don't have the knowledge. Considering about purchasing medicines, 28% (14/50) farmers used to buy medicine only from drug company representatives without prescriptions. Remaining 72% (36/50) was purchasing drugs from both veterinary stores and drug company representatives. Only 10% (5/50) of the farmers seek advice from veterinary surgeons and through their prescriptions

while 22% (11/50) of them take advice only from drug company representatives and 68% (34/50) of them from both. Only 10% (5/50) farms had a separated place for drug storage while 90% (45/50) did not have an allocated place for drug storage.

Ninety-eight percent (49/50) of farmers were using at least one type of antimicrobial preparation. The antimicrobials most frequently used in layer poultry operations were: enrofloxacin 79.6% (39/50), amoxicillin 61.2% (30/50), sulfamethoxazole-trimethoprim 49% (24/50), tetracycline 26.5% (13/50), neomycin 22.4% (11/50), and tylosin 4.1% (2/50) (Figure 1).

Table 1: Results of questionnaire-based survey on general information of the farm, housing and the feed, conducted using 50 poultry layer farms (commercial chicken layers) situated in Kurunegala district in North Western Province, during the three-months period

	Management Criteria		Results				
General information of the farm	1)	Type of layer birds in the farm	Only white = 70%	Only brown = 2%		Both = 28%	
	2)	Farm scale (FAO standards)	(Small scale = 74% </=10 000 birds)	Medium scale = 26% (10 001-50 000 birds)		Large scale = 0% (>50 000 birds)	
	3)	Life span of birds	1-2 years = 56%	>2 year- 2&1/2 years = 40%		>2&1/2 years = 4%	
	5)	Record keeping	Yes = 6%	Yes, to some extent = 74%		No = 20%	
	6)	Current age of the flock	7-11 months = 30%	1-1&1/2 years= 48%		>1&1/2 years= 6%	
	7)	Age at laying started	3&1/2 – 4 months = 66%		>4-4&1/2 months = 24%		
			>4&1/2 – 5 months = 4%		>5 months = 6%		
Housing	8)	Type of house	Environment controlled = 0%		Semi opened houses = 100%		
	9)	Raw material	Wall	Brick wall = 100%		Floor	Cement floor = 100%
				Mud wall = 0%			Mud floor = 0%
				Wooden wall = 0%			Other = 0%
				Metal mesh = 100%			
			Roof	Asbestos = 44%		Type of litter	Paddy husk = 100%
				Galvanized = 54%			Wood shaving = 0%
				Tiled roof = 2%			Other = 0%
			Other = 0%				
	10)	Feeders	Manual = 100%		Automated = 0%		
11)	Drinkers	Manual = 100%		Automated = 0%			
12)	Electricity	Present = 100%		Absent = 0%			
Feed	13)	Feed processing	Mixed at farm = 68%		Commercial = 32%		
	14)	Type of feed	Crumble = 36%	Mash = 64%		Pelleted = 0%	
	15)	Water supply	Well = 100%	Tube well = 0%		Municipal water = 0%	Pond/River = 0%

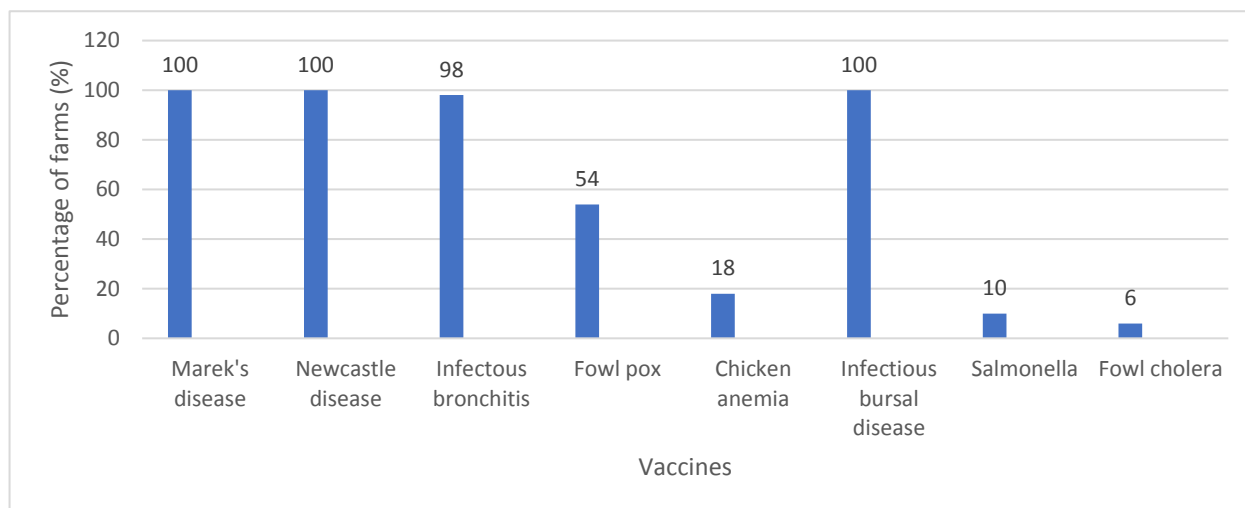


Figure 1: Use of antimicrobials in poultry layer farms

Use of vaccines and other drugs

All farms were using poultry vaccines mainly for Marek's disease, Newcastle disease, infectious bronchitis, infectious bursal disease, fowl pox etc. (Figure 2). Forty-five (45) farms using other drugs (except antimicrobials and vaccines) such as multivitamins, ions, amino acids, acidifiers etc. (Figure 3).

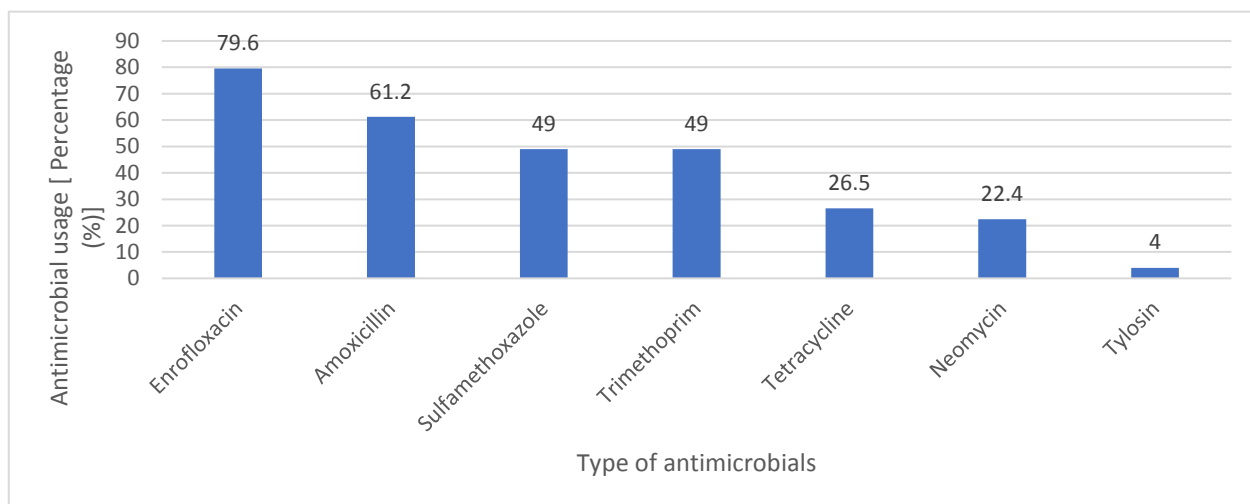


Figure 2: Use of vaccines in poultry farms

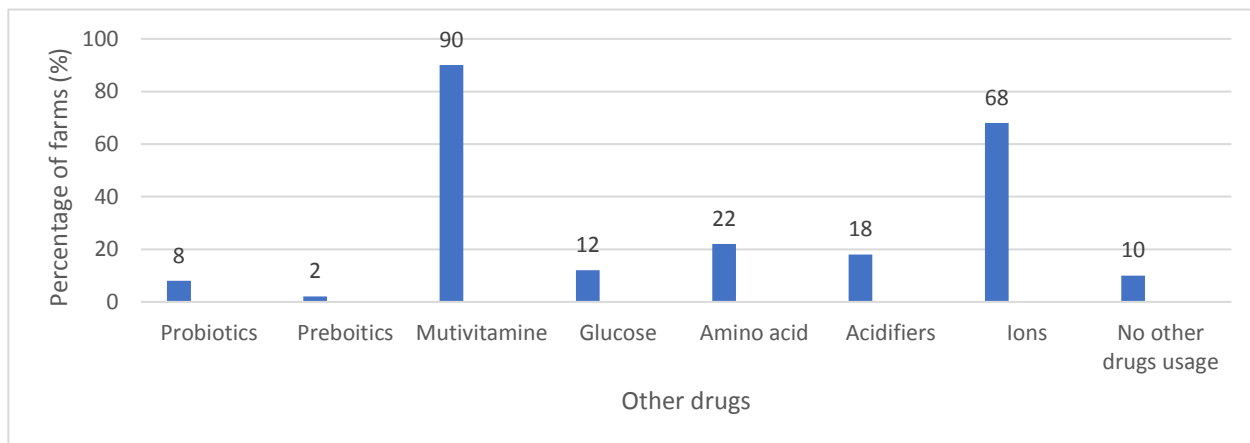


Figure 3: Use of other drugs in poultry farms

Farm biosecurity practices

None of the selected farms had functioning foot baths at the entrances. None of them were practicing coverall changing before entering to the poultry house. Sixty-six percent of the farms had no visitor restrictions. Only 94% of farms were practising cleaning of drinkers and feeders. Among them only 22% of farms were using Chlorine and Quaternary ammonium compounds containing disinfectants to clean the drinkers.

Only 2% of farms were burning the removed litter while 12% used as manure for crops, 38% were selling while majority (48%) of farms used it for both selling and manure purposes. All the farms bury dead carcasses under the ground. Eighteen percent of the investigated farms were integrated farms with goats, cattle, backyard poultry and gees. Majority (74%) of farmers did not practice restriction methods on contact with other animals: dogs, cats, wild birds, gees, and rodents with poultry.

Selling of farm products

When considering about selling products, 84% of farms sell eggs to intermediate people, 10% to the retail outlets, while remaining 6% sell to companies directly.

Majority of the farmers (88%) were giving spent live birds to intermediate people. Only 12% of farms sell meat. Eight per cent of them cull the birds at the farm

itself and sell it directly to the retail outlets while 4% to intermediate people.

Prevalence of *E. coli* and their AMR profiles

Antimicrobial susceptibility pattern of fecal *E. coli* isolates

Following CLSI guidelines (CLSI, 2013), the disk diffusion test was conducted for 12 selected antimicrobials to detect AMR patterns of all the isolated *E. coli* from feces, the results are shown in figure 4.

Among the 22 *E. coli* isolates that were isolated from layer faces, the highest resistance was for tetracycline (81.8%) followed by nalidixic acid (54.5%), trimethoprim-sulfamethoxazole (40.9%), ampicillin (45.5%) and ciprofloxacin (31.8%). Lower levels of resistance; 13.6%, , 9.1%, 4.5% were observed for streptomycin, ceftazidime, and imipenem respectively. All the isolates were susceptible to amikacin and gentamycin; while 68.18% of isolated *E. coli* were multidrug resistant.

Out of all 22 fecal *E. coli* isolates tested, one isolate was resistant to six antimicrobials (ampicillin, ceftazidime, ciprofloxacin, nalidixic acid, tetracycline and sulfamethoxazole-trimethoprim). No isolate was found as susceptible to all the tested antimicrobials. Majority of isolated *E. coli* (68.18%) were multidrug resistant strains with the resistance to ≥ 3 class of antimicrobials (Magiorakos et al, 2012).

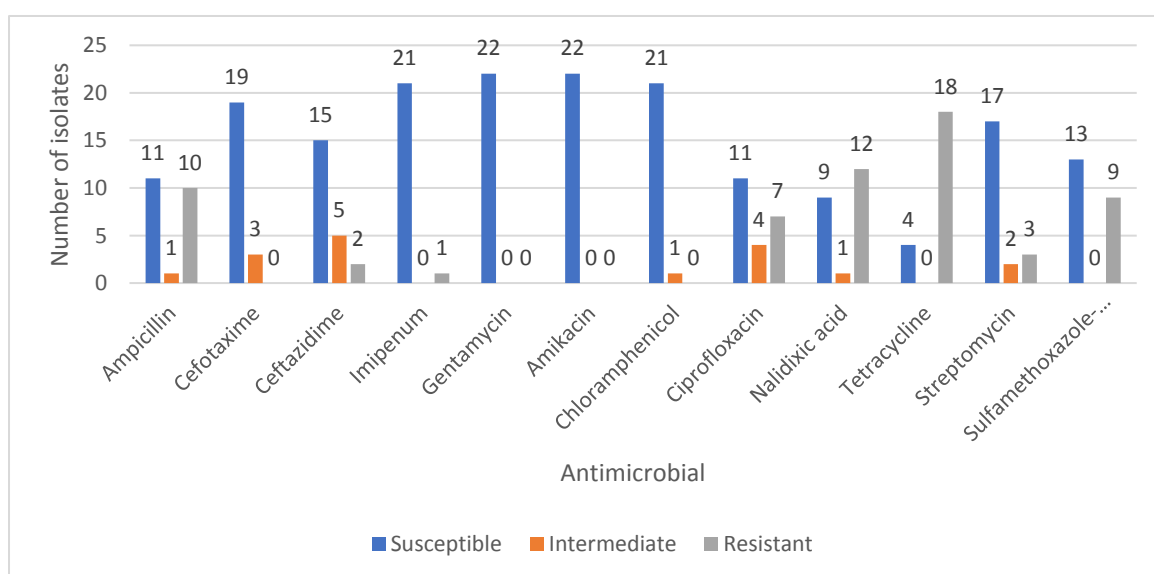


Figure 4: AMR profiles of *E. coli* from feces

Farm usage of antimicrobials and AMR profiles of E. coli isolated from those farms

Since different antimicrobial types are used in different farms and we have AMR profiles of *E. coli* isolated from those farms, antimicrobial usage and AMR profiles were plotted to see any associations. Accordingly, the most common antimicrobial classes used were, fluoroquinolones (Enrofloxacin – 79.6%), Penicillins (ampicillin – 61.2%),

sulfonamides (sulfamethoxazole-trimethoprim – 49%), tetracyclines (tetracycline – 26.5%) and aminoglycosides (neomycin – 22.4%). On the other hand, when analyzing AMR profiles, it was revealed that the highest resistance was observed for tetracyclines (tetracycline - 81.8%) followed by Penicillins (ampicillin - 45.5%), Sulfonamides (sulfamethoxazole-trimethoprim- 40.9%), fluoroquinolones (ciprofloxacin - 31.8%) and aminoglycosides (streptomycin – 13.6%) (Figure 5).

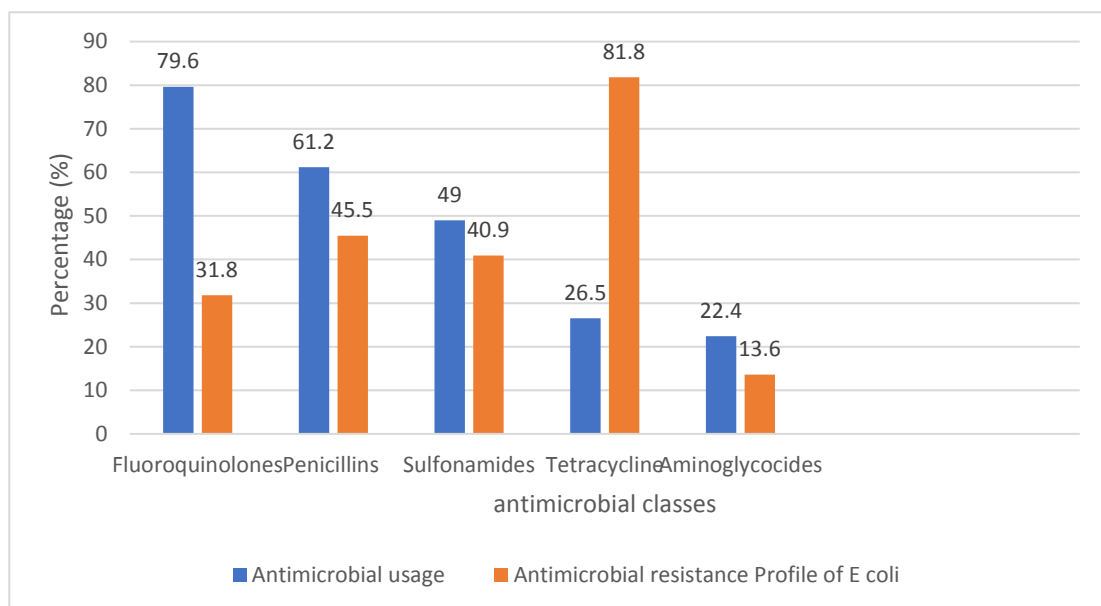


Figure 5: Comparison between farm antimicrobial usage and AMR profiles of *E. coli* isolated from those farms

DISCUSSION

This study was useful to to have a better understanding on management and biosecurity practices of small and medium scale poultry layer farms present in Kurunegala district where chicken layer operation is more popular. Furthermore, study enabled us to get the information about antimicrobial and other drug (vaccines, supplements etc.) usage and the antibiogram of poultry fecal *E. coli* in the selected area for selected commonly used antimicrobials in poultry

According to the data collected using the questionnaire survey, characteristics of poultry layer farm management such as farm record keeping, housing systems, feeding and water supplementation, and other farm details were almost similar to the poultry management practice in South Asian Countries that is described in Food and Agriculture Organization, 2003 (Prabakaran, 2003). Among all the other factors, record keeping can be

considered as an important practice to identify sub optimal performances in the farm and it plays a major role in monitoring of health history, vaccination and medication programs (antibiotic and other drug usage) as well as the bio-security program. However, in most of the developing countries, record keeping is not properly practiced among small scale farms compared to large scale poultry farms (Drafor, 2011). Similar to that, in Sri Lankan field situation, complete record keeping is barely practiced among small and medium scale poultry farmers. In this study, even though 80% of the farms had some kind of farm records, only 6% of them were properly maintained. According to Islam *et al* (2022) a higher segment of poultry layer farmers had no habit of record keeping specially on antimicrobial usage (56.3%) compared with broiler farmers (37.7%) in Bangladesh (Islam *et al*, 2022).

Other than record keeping, poultry housing system also plays a key role as it contribute to the production and health of the birds. All the farms

considered in this study were semi opened poultry houses with less than 50 000 birds reared under deep litter system. Almost all the farms were constructed with brick wall and metal mesh which permits the access of vectors, and they had a cement floor with paddy husk used as litter (100%). According to Touson, (2005), spreading of cannibalistic pecking, issues with feed intake, misplaced eggs, and air quality (dust, ammonia levels) were recognized as major problems associated with rearing large groups of birds under deep litter system as in this setup. Other than that, there is a higher risk of bacterial, viral, and parasitic infections like coccidiosis and red mite infestation in this system. In this case, contact with litter, feces, vectors like rodents, insects and wild birds increases the possibility of infectious diseases. Adherence to proper biosecurity and management practices could considerably lower the risk of diseases (Hartcher and Jones, 2017).

In accordance with WOA definition, “a set of management and physical measures designed to reduce the risk of introduction, establishment and spread of animal diseases, infections or infestations to, from and within an animal population” is known as biosecurity (https://www.oie.int/fileadmin/Home/eng/Health_standards/tahc/2018/en_glossaire.htm, accessed on 27 April 2023). Biosecurity measures such as functioning of foot bath at the entrance of poultry houses, protective clothing, visitor restrictions, prevent contact with vector species, proper cleaning of feeders and waterers, litter removal, and carcass removal were investigated in the study.

Previous studies report poor biosecurity practices present in developing countries increase the incidence of disease spreading (Adelowo *et al*, 2009; Ogunleye *et al*, 2008; Sirdar *et al*, 2012; Oluwasile *et al*, 2014; Islam *et al*, 2016). Similar type of surveillance studies that have been carried out in developed European countries such as Denmark, Netherlands, Norway, Poland, Spain and the UK and Georgia reveal the presence of dedicated tools, cleaning and disinfecting programs, and traffic, visitor and rodent control programs in more than 70% of farms (Hog *et al*, 2012; Dorea *et al*, 2010). However, in our study, around three-fourths of the farmers (74%) have no practices in restricting or controlling the entry of other animal species in the farm. Free ranging wild birds and rodents may act as reservoirs of poultry diseases as well as zoonotic diseases when they have closed contact with poultry layer birds. Internal and external parasites, fowl

cholera, Avian Influenza, *Salmonella*, *E. coli*, *Campylobacter* are few of the diseases that spread through fecal droppings and aerosols. Dogs, crows and cats may eat or take away the remnants of improperly disposed carcasses and contaminate the water sources and soil (Food standards agency, 2006). Carcasses and litter disposal is one of the main components in biosecurity as improper disposal of infected carcass and litter may lead to endemic disease outbreaks as they contain pathogenic microorganisms spread by vectors and contaminated food or water sources.

Poultry litter is mainly used as manure for their crops within and outside the farms. When the chicken are fed with high concentrations of antimicrobials, there is a risk of transmission of antimicrobial residues through the crop products and also water sources can be contaminated with antimicrobial residues as well as poultry litter containing pathogenic microorganisms. Producing composts using litter is a way of minimizing pathogens in poultry dropping as the heat produced may destroy them (Prabakaran, 2003). Although the survey reveals only the basic principles of management and biosecurity, even this study can reveal the poor biosecurity level of small and medium scale poultry farms in Sri Lanka.

In the survey, even though 76% of farmers know about the antimicrobials and their usage they have no idea of judicious use of antimicrobials, antimicrobial resistance and transmission of antimicrobial residues to humans through animal origin food. Majority of the farms (72%) purchase drugs from both veterinary stores and through drug company representatives. This implies that the majority of the usage of antimicrobials is not done under supervision of veterinarians. The antibiotic usage pattern in this survey revealed that poultry farms relied heavily on antimicrobials to control diseases and as prophylaxis to mask their poor biosecurity practices, because most farms (more than 80%) were multi-drug users and majority (98%) farms used one or more antimicrobial. Studies conducted in several states of Nigeria and Bangladesh have revealed almost similar results (Sirdar *et al*, 2012; Oluwasile *et al*, 2014; Islam *et al*, 2016).

Very limited amount of data have been published on antimicrobial usage patterns in poultry in Sri Lanka. Although the most common type of antimicrobial may differ from region to region, the type of

antimicrobial generally using are quite same. According to Oluwasile *et al* (2014), the most common antimicrobial type used in poultry is fluoroquinolones. Because it is comparatively new, readily available in drug stores, have several brands, can be administrated via drinking water and present as long-acting preparations (Oluwasile *et al*, 2014). Other than that, very recently published data on antimicrobial usage in poultry sector in Sri Lanka reports tylosin (37%) as the mostly used antimicrobial drug and usage of sulfonamide and sulfa-trimethoprim, amoxicillin, neomycin, tetracycline and enrofloxacin were recorded as 15%, 14%, 10%, 9%, and 6% during the study period respectively. Further the same study reports, based on antimicrobial classes sulfonamides, beta-lactams, macrolids, fluoroquinolones, and pleuromutilin as the mostly used antimicrobials in Kuliyaipitiya and Paduwasnuwara divisional secretariat areas in Sri Lanka (Ariyawansa, *et al*, 2023).

Considering all the findings of the current study, it is difficult to compare the results of survey with AMR results because of the lack of proper record keeping and no reliable accessibility to farm records on antimicrobial treatment, biosecurity and management practices. Further as in the present study 98% of the farms were in poor biosecurity and use of at least one antimicrobial it was difficult to analyze the effects of either biosecurity or use of amicrobial on the occurrence of AMR since there were no control cohorts. Therefore, as mentioned above the use of different types of antimicrobials and phenotypic presence of AMR in *E. coli* against different antimicrobials were analyzed. It is interesting to mention that a similar study conducted by Mudenda *et al.*, (2022) in Zambia states, small and medium scale poultry layer farmers have poor awareness on antimicrobials and biosecurity which have led to the poor biosecurity practices and imprudent use of antimicrobials ultimately exacerbating the AMR in poultry. The same scenario could be here among the farmers in Sri Lanka too.

Antimicrobial resistance is a global issue which is being discussed by this type of surveillances and laboratory diagnostic techniques in the world. Ineffective implementation of veterinary laws and legislations, lack of government supervision and lack of awareness of public may cause this problem. It is essential to reduce antibiotic use in animal feed as antibiotic growth promoters, implement laws and regulations against use of antimicrobials in production animals, create a national system to

analyzes the antimicrobial use, encourage surveillances, research programs and studies on antimicrobial resistance and its periodic change, reduce the use of antimicrobials in food animals which are critically important in human medicine such as third and fourth generations cephalosporins and fluoroquinolones, improving animal health through alternatives like immunization, proper nutrition, good management and proper biosecurity practices rather than using antimicrobials. Developing guidelines to veterinarians regarding antimicrobial prescriptions, providing education and training to farmers about responsible use of antimicrobials, improving public health awareness of consuming safe food, establishment of system to trace antimicrobial residues and resistant organisms in imported animal originated foods are some of practices to reduces the antimicrobial resistance and public health risk (Action.H *et al*, 2013; Islam *et al*, 2016; Oluwasile *et al*, 2014).

This study is a basic effort to raise awareness regarding the globally concerned issue and further analysis can be done using wider area of the country with more samples of several food animal species and using different cohorts including controls that enable to see the direct effects of bio-security management practices, antimicrobial usage etc. on the development of AMR.

CONCLUSION

A high level of poor bio-security, management practices along with considerable level of antimicrobial usage was observed in the study. Confirming the poor practice of antimicrobial usage, alarming levels of AMR was found among *E. coli* isolates tested. The information warns the necessity of practicing antimicrobial stewardship in the poultry industry in Sri Lanka.

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