ANTIBIOTIC USAGE IN myGAP POULTRY FARMS IN MALAYSIA

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ABSTRACT. Antimicrobials are extensively used in livestock farms incorporated in animal feed and water. A major concern is the rise of antimicrobial resistance and the subsequent impact on human health. There is a knowledge gap in the usage of antimicrobial used in poultry farms in Malaysia. This study aimed to identify the antibiotics most frequently used and usage patterns. A survey was conducted on antibiotic usage of 278 Malaysian Good Agriculture Practices (myGAP) poultry farms from the year 2015 to 2017. The results showed that antibiotics were used for disease prevention (100%), therapy (25%) and growth purposes (0.4%). The mode of administration of the antibiotics was mainly through the water. 36 antimicrobials belonging to 13 classes were used. Enrofloxacin was most commonly found (86%), followed by amoxicillin (62%), tylosin (29%), colistin (26%), tilmicosin (26%) and fosfomycin (21%). It is anticipated that the findings of this survey will help to develop new strategies for prudent use of antibiotics in livestock farms. Hence, a comprehensive national feed monitoring programme should be established to get information of antimicrobial usage quantitatively.

Keywords: antibiotics, antibiotic usage, poultry farms

INTRODUCTION

Poultry meat and eggs are the major food source in Malaysia with per capita consumption of 52 kg poultry meat per person each year and 23 kg eggs per person each year respectively, superseding pork consumption 17 kg/person/year and beef consumption 7 kg/person/year. (DVS, 2018). This trend is similar to the worldwide as reported by Food Agriculture Organisation (FAO) to feed the world's rapidly expanding population now approaching 7.5 billion (marking a 100 percent increase since the early 1960s) (FAOSTAT, 2019); considering that production costs are low (compared to, for example, pork) and the absence of religious restrictions, the poultry industry is probably the most widespread food production industry worldwide. Chicken meat and global egg markets have grown worldwide over the 5-year period from 2006-2010 by 19% and 9.52%, respectively (FAOSTAT, 2013). To feed the growing demands for poultry products, commercial poultry production evolves to be very intensive animal agricultural system, and one poultry house or barn can contain as many as 100,000 commercial layers or broilers (Landoni and Albarellos 2015). Disease management in a poultry production is therefore crucial and antimicrobial agents are among the important tools for the control and treatment of diseases in poultry production. Common diseases that are endemic in the poultry industry such as colibacillosis, Salmonellosis, Clostridium perfringens-induced necrotic enteritis, arthritis, complicated chronic respiratory disease (CCRD) caused by Mycoplasmosis,

fowl cholera, fowl coryza, airsacculitis (Bagust, 2008).

It is reported that the total amount of antimicrobials used globally for animal production has been estimated to be 63 thousand tons per year. It is expected that it will continue to increase over the next few years due to intensification of livestock production in emerging economies (Van Boeckel *et al.*, 2015). The use of antimicrobials in production animals has become a worldwide concern in the face of rising resistance levels in commensal, pathogenic and zoonotic bacteria (Persoons *et al.*, 2012). Farmers use antibiotics for growth promotion, prophylaxis or therapy, although their use in growth promotion is being heavily discouraged worldwide (Chattopadhyay, 2014).

The use of antibiotics in livestock is being associated with the increase in prevalence of antimicrobial resistance (AMR) (Marshall and Levy, 2011). Many countries in south-east Asia have already initiated a ban on antibiotics used as Antibiotic Growth Promotion in the livestock industry including Thailand since year 2015 (Nhung *et al.*, 2016), Vietnam since year 2017 (Coyne *et al.*, 2020) and Indonesia since year 2018 (Suryadi and Prasetyo, 2018). In Malaysia, under the Malaysian Action Plan on Antimicrobial Resistance (MyAp-AMR), a national effort was initiated to try to ascertain the pattern of antibiotic use in livestock and how it is related to the prevalence of AMR in the livestock industry. Malaysia is still in the process of developing the antibiotic usage policy for the livestock sector based on World Health Organisation (WHO) and World Organisation for Animal Health (OIE) recommendation (MOH, 2017).

A survey was conducted to provide information on the most frequently used antibiotics and their usage patterns in poultry farms which has been certified with Malaysian Good Animal Practice (myGAP). This information can assist new strategies in the control of antibiotic use in livestock production in Malaysia.

MATERIALS AND METHOD

Study setting and sampling

A survey was carried out from January 2015 to December 2017 during an audit of 278 poultry farms. All the farms were myGAP farms which were certified by the Department of Veterinary Services Malaysia (DVS). Data were collected from the farms using the poultry manual (Manual GAHP Ayam Itik). All interviews were undertaken on the spot in the farms and information on records of treatment to the animals was retrieved from the farm supervisors. In addition, physical inspection in the farm's store for the type of antimicrobial presence was also conducted.

This cluster of myGAP farms represents 9% of all poultry farms Malaysia and comprise mostly of exporting and integrated farms. There were examined under these categories, namely Grand Parent Stock (10 farms), breeder broiler (58 farms), breeder layer (6 farms), broiler (158 farms), layer (35 farms) and pullet (11 farms). The myGAP farms are being certified to have proper herd/flock health programme, adequate level of biosecurity, and comply with proper

Table 1. Antibiotics use as growth promoter, for disease prevention and therapy purpose in three different types of poultry farm

Livestock	Total farms (n = 278)	Growth promoter	Disease prevention	Therapy
Grandparent stock (GPS)	10	0	10	3
Broiler Breeder (PS)	58	0	58	7
Layer Breeder (PS)	6	0	6	3
Broilers	158	1	158	50
Layer	35	0	35	5
Pullet	11	0	11	2
Total	**278**	**1 (0.4%)**	**278 (100%)**	**70 (25%)**

PS – Parent stock

Table 2. Antimicrobials usage in different types of poultry farms (n=278)

No. of antimicrobial	Broiler	Layer	Pullet	Grandparent Stock	Breeder		Total
					Broiler	Layer	
1 antimicrobial	16 (10%)	5 (14%)	1 (9%)	8 (80%)	12 (21%)	1 (17%)	43 (15%)
2 antimicrobials	37 (23%)	2 (6%)	1 (9%)	0	5 (9%)	1 (17%)	46 (17%)
3 antimicrobials	32 (20%)	11 (31%)	2 (18%)	0	11 (19%)	1 (17%)	57 (21%)
>3 antimicrobials	73 (46%)	17 (49%)	7 (64%)	2 (20%)	30 (52%)	3 (50%)	132 (47%)
Total	**158**	**35**	**11**	**10**	**58**	**6**	**278**

Table 3. Usage of different types of antimicrobials, active substance, disease indication and method of administration in different types of poultry farms year 2015-2017 (n = 278)

Antimicrobial class	Active substance	Poultry Farms (n=278)		Disease indication	Method of administration
		No. of Farms	(%)		
Aminoglycosides	Apramycin [V]	23	8.3	Coli, CCRD	Water
	Neomycin*[V]	23	8.3	Bacterial enteritis	Water, feed
	Gentamycin*[V]	6	2.2	Diarrhoea	Water
	Kanamycin*[V]	1	0.4	N.A	N.A
	Spectinomycin*[V]	2	0.7	CCRD	Water
	Merimycin*[V]	2	0.7	N.A	N.A
Amphenicols	Florfenicol [V]	35	12.6	CCRD, Coli	Water, feed
Cephalosporins First Generation	Cephalexin	25	8.9	Colisis	Water
	Cefadroxil	2	0.7	N.A	N.A
Diamino-pyrimidines	Trimethoprim [V]	21	7.6	Coli	Water
Lincosamides	Lincomycin	4	1.4	CCRD, diarrhoea	Water
Macrolides	Tilmicosin*[V]	72	25.8	CCRD	Water
	Tylosin*[V]	81	29.1	CCRD	Water, feed
	Erythromycin*[V]	52	18.7	CCRD	Water
	Spiramycin*[V]	2	0.8	CCRD	Water
	Tylvalosin*[V]	4	1.4	CCRD	Water, feed
Penicillins	Amoxicillin*[V]	172	61.9	CCRD	Water, feed
	Penicillin*[V]	4	1.4	Enteric and respiratory diseases	Feed
	Ampicillin*[V]	1	0.4	N.A	N.A
Phosphoglycolipids	Bambermycin	1	0.4	N.A	Feed
Phosphonic Acid	Fosfomycin*	59	21.2	Coli, CCRD	Water
Polypeptides	Colistin*	73	26.3	Coli	Water, feed
	Bacitracin	24	8.6	N.A	N.A
Quinolones First Generation	Flumequine*	16	5.8	N.A	N.A
Quinolones Second Generation	Enrofloxacin[V]	239	86.0	CCRD, airsacculitis	Water, feed
	Norfloxacin*	34	12.2	CCRD	Water
	Levofloxacin*	2	0.7	N.A	Water
Sulfonamides	Sulfachlorpyridazine/ Sulfachloropyrazine[V]	6	2.1	Cocci	Water
	Sulfadiazine[V]	10	3.6	Coli	Water
	Sulfamonomethoxine[V]	1	0.4	N.A	N.A
	Sulfaquinoxaline[V]	14	5.0	Coccidiosis	Water
	Sulfamethazine[V]	2	0.7	Enteric and respiratory disease	N.A
Tetracyclines	Doxycycline[V]	21	7.6	CCRD, Coli	Water
	Chlortetracycline[V]	16	5.8	CCRD	Feed

Coli – Colibacillos, Cocci – Coccidiosis, CCRD – Complicated Chronic Respiratory Disease N.A. – Not available,
* – Critically Important Antimicrobials in Human or CIA (WHO, 2016), V – Veterinary Critically Important Antimicrobials or VCIA (OIE, 2018).

waste management practices. Johor state has the most myGAP farms (214 farms), followed by Perak (40 Farms), Melaka (39 farms), Negeri Sembilan (39 farms), Selangor (19 farms) and few others in Sarawak, Sabah, Kedah, Pahang, Pulau Pinang, and Kelantan.

Data collection

The information collected included the antimicrobial trade name, the formulation form (powder, liquid, etc.), composition (antimicrobial active ingredient only or mixed with other substances), purpose of use, disease targeted, duration of use, frequency of use, withdrawal period, administration route (water and in feed) and the application of prescription.

Data analysis

Data collection and management was done on Microsoft Excel version 2016.

RESULTS

A total of 278 myGAP farms were visited over two years. Majority of the poultry farms are big scale with population size in the range of 130,000 to 3,400,000 birds. All the farms used antimicrobials as disease prevention, 70 farms (25%) for therapeutically purpose and 1 broiler farm (0.4%) used for growth promotion (Table 1).

All the treatment that were given to the poultry in the visited farms were mostly applied via drinking water administration. 43 (15%) of the farms used one antimicrobial, 46 (17%) used 2 antimicrobials, 57 (21%) used 3 types antimicrobials and 132 (47%) used more than 3 types antimicrobials, as shown in Table 2.

A total of 36 antimicrobials belonged to 13 classes were used in poultry farms studied. The active ingredients of the antimicrobials were described by observing the container. Enrofloxacin was most commonly found (86.0%), closely followed by amoxicillin (61.9%), tylosin (29.1%), colistin (26.3%), tilmicosin (25.8%), fosfomycin (21.2%), tetracycline class (13.4%), quinolones class excluding enrofloxacin (18.7%), sulfonamide class (11.8%), and polypeptides excluding colistin (8.6%) (Table 3). Amongst the 35 types of antimicrobial found in this study, 18 out of 35 (51.4%) types of antimicrobials used in poultry farm belongs to the group of critical importance antimicrobial also used in human according to the WHO (WHO, 2016).

Whereas 24 out of 35 (68.5%) types of antimicrobials used in poultry farm belongs to the group of Veterinary Critically Important Antimicrobials according to OIE classification (OIE, 2018).

The usage of antibiotics along with its indications and method of administration in these farms are shown in Table 3. Enrofloxacin was the commonest used in broiler (98%), layer (94%), pullet (91%), broiler breeder (60%) and layer breeder (67%) farms. Amoxicillin was also commonly used in broiler (64%), layer (80%), broiler breeder (57%) and layer breeder (83%) (Figures 1 and 2). Both enrofloxacin and amoxicillin are commonly indicated for respiratory diseases. Colistin was less common in breeder productions, compared to commercial broilers. Fosfomycin (82%) and erythromycin

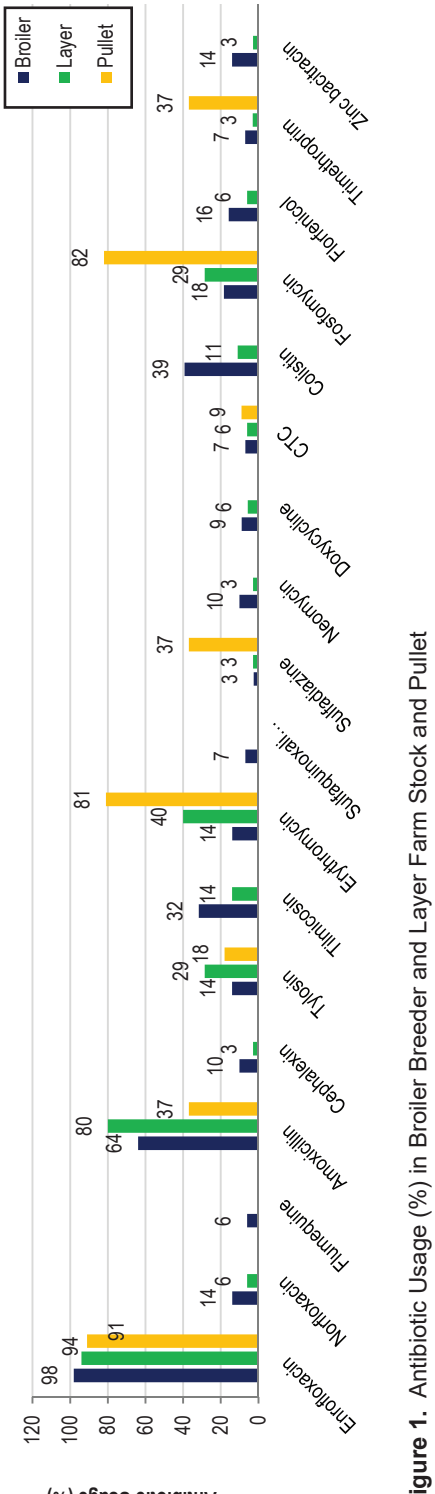

Figure 1. Antibiotic Usage (%) in Broiler Breeder and Layer Farm Stock and Pullet

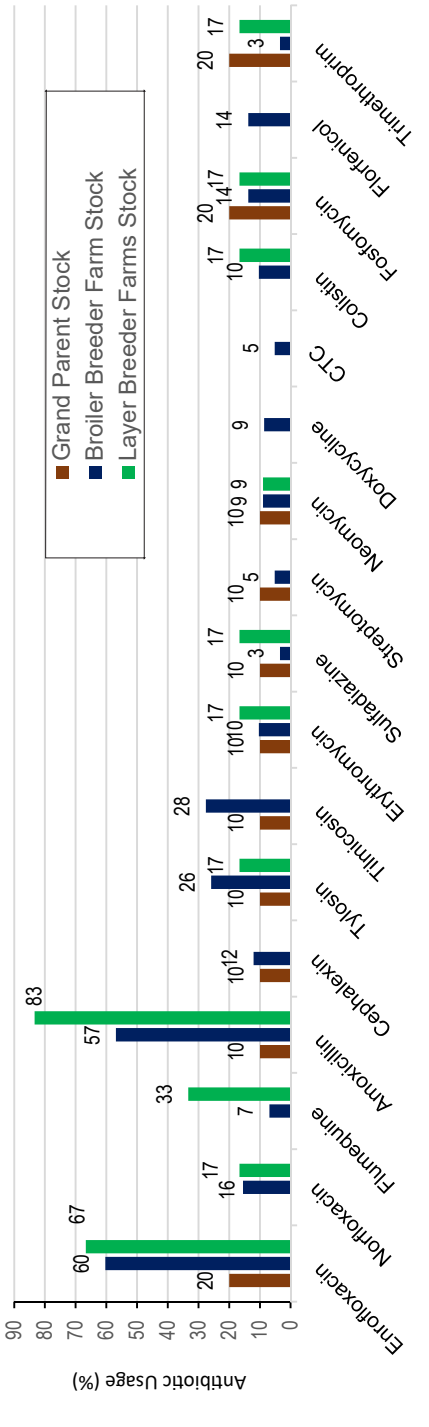

Figure 2. Antibiotic Usage (%) in Poultry Grand Parent Stock, Broiler Breeder and Layer Farm Stock

(81%) were the other two antimicrobials used for pullet (Figure 1).

For Poultry Grand Parent Stock (GPS), usage of antibiotic was fairly limited, whereby only 20% of farms used enrofloxacin, fosfomycin and trimethoprim, 10% of farms used amoxicillin and cephalexin, tylosin, tilmicosin, erythromycin, sulfadiazine, streptomycin, neomycin as shown in Figure 2. This can be associated with the higher prevalence of respiratory diseases caused by mycoplasma, fowl coryza and colibacillosis associated enteritis based on the declared indication for using the antibiotics.

Other than enrofloxacin and amoxicillin, broiler breeder stock production also used tilmicosin (28%), tylosin (26%) and florfenicol (14%) (Figure 2). This gives an overall picture of respiratory disease and colibacillosis.

DISCUSSION

Antimicrobial usage in animal production is thought to be a contributing factor for the emerging antimicrobial resistance (AMR) in human (Marshall and Levy, 2011). Although this statement remains controversial, the recent emergence of plasmid-mediated resistance against "last resort" antimicrobials such as colistin from animal production has strengthened the case that antimicrobial usage in food animal production is likely to contribute to the selection, spread, and maintenance of AMR bacteria on farms and may spillover to AMR in humans (Nung *et al.*, 2016). Combating AMR efforts are generally focus on limiting the use of Human Critically Important Antimicrobials as compiled by WHO in animal production (Gumphol, *et al.*, 2018). In efforts to address AMR concerns, the Malaysian government has made a series of efforts to control antibiotic use in animals. For example, it has successively released a prohibited list of antibiotics not to be used in animal feed (Animal Feed Act, 2009). With the establishment of interagency Malaysian Action Plan on Antimicrobial Resistance (MyAp-AMR) committee, the use of colistin as growth promoter and prophylaxis was banned effective 1st January 2019 (OIE, 2019a). To the authors knowledge, there is no published data on AMU pattern for Malaysian poultry production, which is this paper hopes to explore.

Based on the principles of prudent use of antimicrobial agents as recommended by OIE, the choice of antimicrobial should have appropriate activity towards the pathogenic bacteria causing the disease, and taking into considerations of the OIE list of antimicrobial agents of veterinary importance (OIE, 2019b). According to this study, the majority of the antibiotics were reported to be indicated mainly for colibacillosis, CCRD and diarrhoea. Review of use of antimicrobial in poultry medicine was done by Landoni and Albarellos, 2015. In their review paper antimicrobials from the beta-lactam groups were commonly used for treating clostridial infections causing necrotic enteritis, and pasteurellosis or fowl cholera, *Escherichia coli* air sacculitis, secondary infections in chronic respiratory disease caused by *E. coli, Pasteurella* and, *Salmonella* spp. Polypeptide groups such as bacitracin was commonly administered for controlling necrotic enteritis. Three aminoglycosides were used in poultry, namely, gentamicin, streptomycin

and neomycin for treating enteric infections, including colibacillosis, and systemic *E. coli* infections. Macrolides that were commonly used in poultry production were erythromycin, tylosin and tilmicosin for treating *Staphylococcus aureus* arthritis, mycoplasma infection, *Pasteurella multocida* and *Ornithobacterium rhinotracheale* bacterial infections, avian intestinal spirochaetosis, Clostridium perfringens-induced necrotic enteritis. Florfenicol commonly used for treating bacterial infection caused by *E. coli*, *Salmonella*, anaerobes *Chlamydia* spp., *Mycoplasma* spp, *Pasteurella* spp. and *Haemophilus* spp. The most commonly used tetracyclines in poultry production were chlortetracycline, tetracycline and oxytetracycline for treating Staphylococci, Mycoplasma, *E. coli*, *Pasteurella multocida* and *Haemophilus paragallinarum*. Sulphonamide group which are commonly used in poultry include the sulphachlorpyridazine, sulphadimethoxine, sulphamethazine, sulphaquinoxaline and sulphathiazole and the potentiated sulphonamides sulphachlorpyridazine/ trimethoprim, sulphadimethoxine/ ormetoprim and sulphaquinoxaline/ trimethoprim which are indicated for the prevention and treatment of coccidia and in outbreaks. In the group of fluoroquinolones the most commonly used was enrofloxacin for treatment of Mycoplasma, *E. coli* and *Pasteurella* spp. Ionophores commonly used to prevent coccidiosis and necrotic enteritis (Landoni and Albarellos, 2015).

The antimicrobial usage pattern observed in the present study showed that all (100%) chicken farms administered antimicrobial medication routinely to prevent diseases as prophylaxis and majority farms had to use 3 or more antibiotics per lifecycle of a bird. On average across all poultry productions, enrofloxacin was most commonly found, followed by amoxicillin, tylosin, colistin, tilmicosin and fosfomycin. This result agreed with previous studies done in Bangladesh, Pakistan, China and African country, Cameroon. In this regard, Gondam Kamini *et al.*, 2016 in Cameroon, reported the use of fluoroquinolones, sulfonamides, tetracyclines were most common in poultry production. Also, fluoroquinolones were the most commonly detected antibiotics (68.4%), followed by sulfonamides (47.4%) and polymyxin (42.1%) in Bangladesh (Islam *et al.*, 2012). Xu *et al.*, 2020 reported high usage of amoxicillin, followed by norfloxacin, ofloxacin and oxytetracycline in China. Tylosin, doxycycline and enrofloxacin were the most frequently used antimicrobials for prophylactic or therapeutic use in Pakistan (Mohsin *et al.*, 2019). Interestingly, in this study only 0.4% of poultry farms were detected using antibiotics as a growth promoter (AGP). In Thailand, AGP was banned since year 2015 thus shows a slightly different trend of antimicrobials usage reported in this sequence: amoxicillin, colisin, oxytetracycline, doxycycline and tilmicosin (Gumphol *et al.*, 2018).

Amongst all the types of antimicrobial used, 51.4% (18 out of 35) were found to be Human Critically Important Antimicrobials (CIA), and were reported to commonly be used as treatment or prevention. CIA should be avoided for animal use in order to discourage the development of AMR, they are also often used for lifesaving in human health care (WHO, 2016). Government

future efforts to phase out Human Critically Important antimicrobials used as AGP should consider the readiness of the industry to upgrade production facilities and the availability of alternatives for sustainable poultry production. It was shown in a study that the reduction of antibiotics use can be realised provided there are improvements in biosecurity, good hygiene, cleanliness and good farm management (Xu *et al.*, 2020).

It was observed that 68.5% (24 out of 35) of the commonly used antibiotics in livestock productions used for prevention purposes falls under the Veterinary Critically Important Antibiotics (VCIA) category. This is not in line with OIE recommendations on prudent use (OIE, 2018). OIE provides a clearer guidance whereby OIE recommends that Veterinary Critically Important Antibiotics (VCIA) should not be used as preventative purposes, and not to be used as first line treatment (OIE, 2018). This calls for more aggressive awareness on AMR amongst all levels of food producers is warranted to minimise the risk of AMR via prudent use of antimicrobial and emphasizing the importance of veterinary oversight with the use of prescription. This study also points out the lack of quantitative data on AMU and information on the use of AGP in feed**.**

Limitation

There was a possibility that antimicrobial usage in this is study was under-declared. This is due to lack of proper recording or under-reporting of antibiotics compounded in feed commonly used as antimicrobial growth promotion in several farms.

CONCLUSION

This study provides information on the commonly used antibiotics and reasons for their use in myGAP poultry farms. The findings will contribute to the development of strategies for prudent use of antibiotics in veterinary industry such as strengthening the monitoring system for antibiotic usage and prescription of antibiotics and to improve awareness among farmers on alternative methods of infectious disease management. The results also highlight the need for training poultry producers to improve their awareness of AMR and the prudent use of antimicrobials. Further studies are suggested to be carried out, on more detail information for quantitative AMU based on scientific evidence in local scenario and to investigate the extend of AGP practised in the poultry industry by establishing a national feed monitoring programme to quantify the antimicrobials used as AGP in poultry production.

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