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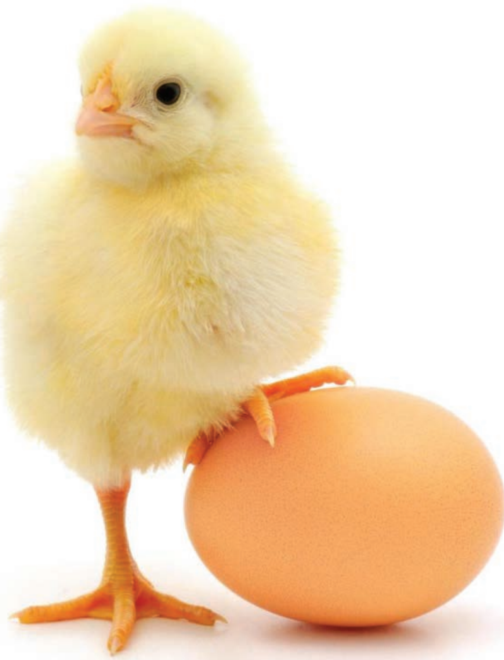

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Research Article
Chicken Farming Practices and Occurrence of Antimicrobial Resistance in Four Regions of Cameroon

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Abstract
Background and Objective: Chicken farming in Cameroon has increased with population growth, this has increased the use of antimicrobial and a rise in antimicrobial resistance (AMR). The aim of this study was to assess chicken farming practices and quantify antimicrobial us age. **Materials and Methods:** Across-sectional study was conducted in 120 chicken farms in four regions of Cameroon (Centre, Littoral, South and West). Data was analyzed using descriptive statistics. Association between variables was tested using chi-square. Differences were considered significant at $p<0.05$. **Results:** Approximately 60% of farmers in the four regions, had no formal training on chicken farming. Thirty three different veterinary drugs containing active substances varying between one and two were used in the 120 farms. In center region the usage of veterinary drugs was the highest, with oxytetracycline as the most used active substance followed by sulfadimidine. In the littoral region the farmers mostly used levamisole (8), sulfadimidine (5) and oxytetracycline (5). In the west region, levamisole is used by 10 farms, sulfadimidine and oxytetracycline by 7 farms and doxycycline by 6 farms. Relatively higher usage of antimicrobial agents per chicken per unit time was observed in all the farms. **Conclusion:** High antimicrobial usage (AMU), including use of critically important antimicrobials was observed at poultry farms in selected regions. A monitoring system should be established to control the prudent use of antimicrobials. Rules and regulations for farmers should be implemented to reduce the AMU on priority basis.

Keys words: Veterinary drug, antimicrobial usage, farming practice, antimicrobial resistance, public health

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Poultry production is the best source of income generation and provides protein for human nutrition[1]. Recently, poultry industry, gains more attention and the demand is growing due to the higher cost of others animal protein sources[2]. In order to satisfy the growing demand, farmers should ensure the quality of the flock by reducing diseases incidence. However diseases constitute one of the main constraints in the poultry industry[3]. To control and prevent diseases occurrence during poultry farming, veterinary drugs are used. These drugs when misused can entered the food chain, thus leads to a contamination of chicken products[4]. The occurrence of veterinary drugs residue in chicken meat and eggs could have side effects (allergic reactions, toxicity, carcinogenic effects and change of natural micro flora of intestine) on consumers. These occurs when concentrations are over the maximum residue limits defined for veterinary drugs in edible animal tissues[4,5]. Previous studies reported the occurrence of veterinary drug residues in chicken products in India and Ghana[6,7]. In Cameroon, improper use of antibiotics by farmers as well as the occurrence of antibiotics residues in chicken meat and eggs has been reported[1,8]. This can lead to occurrence of antimicrobial resistance. Thus there is a need to assess the usage of veterinary drugs and farming practices in order to make hypothesis on occurrence of antimicrobial resistance. During the last avian influenza in 2016 several measures were taken to protect human and animalhealth[9]. Furthermore few studies in Cameroon have investigated the quantitative usage of veterinary drugs in chicken farming. Assessment of veterinary drugs usage and chicken farming practices are the first step in evaluating health risk for consumers[7]. The present study was designed to assess chicken farming practices and usage of veterinary drugs related to antimicrobial occurrence in some chicken farms in four regions of Cameroon.

MATERIALS AND METHODS

Study area: The present study was conducted in four regions of Cameroon, the Center, the Littoral, the West and the South Regions in Fig. 1. The Central region covers 68.926 km^2 and is composed of rolling hills on a vast plain with a mean altitude of 700-800 m, with lowered mounds. The climate has two wet seasons. According to National Institute of Statistics, Cameroon[10], the population density is low, with about 36 inhabitants/km^2. The Littoral region is covering an area of 20.239 km^2 and housing more than 2.202.340 inhabitants. The population density is 124 inhabitants per km^2. The west region covers 13.872 km^2 and is mountainous, marked by highlands with a mean altitude of 1600 m and narrow valleys with catchments separating them. The climate has a unimodal wet season. The population density is relatively high[10], with about 143 inhabitants/km^2. The south region covers an area of 47.110 km^2, with a population of about 534.900 inhabitants and a density of 13.4 inhabitants per km^2.

Study design and data collection: A cross-sectional study was conducted in four regions (Centre, Littoral, West and South) of Cameroon due to their high potential for chicken farming. Three clusters, each cluster representing 10 chicken farms, were selected in each region using a random start point. Farm owners or workers were briefed about the objective of the study and their consent was obtained before administration of the questionnaire. A structured questionnaire pre tested was used to collect data on veterinary drug usage and chicken farming practices. Farm owners or workers were asked to provide detailed information on various veterinary drugs in use within the last three months. Data on each veterinary drug administered were collected and used to quantify the total amount of active drug compound. Quantification of drug was done using weight indicators.

Calculation of antimicrobials consumption: The consumption of antimicrobials per farm was defined as animal treatment days per year (ATD/Y). This is similar to the standard unit for consumption of antimicrobials in humans (DDD/1000 days). ATD/Y was estimated base on two variables, the first in the numerator that was the summation of the number of treatment days for all broilers present during the year. The denominator was the sum of the number of birds present per day for the year. By dividing these numbers and multiplying by 365, we obtain the number of days in which antimicrobials were administered to broilers on a farm per year. An ATD/Y of 1 means that the animal in the population was exposed to an antimicrobial for one day per year (ESVAC).

Estimation of antimicrobial usage: The formula adapted by Carrique-Mas *et al.*[12] with little modification was used to estimate usage in mg kg^{-1} per week (Uwc milli grams). The weight of broilers after the growth period of 6 weeks was estimated to be 3 kg, while that of layers after 24 weeks was 2.5 kg. The estimation of antimicrobial usage was obtained by using the following equation:

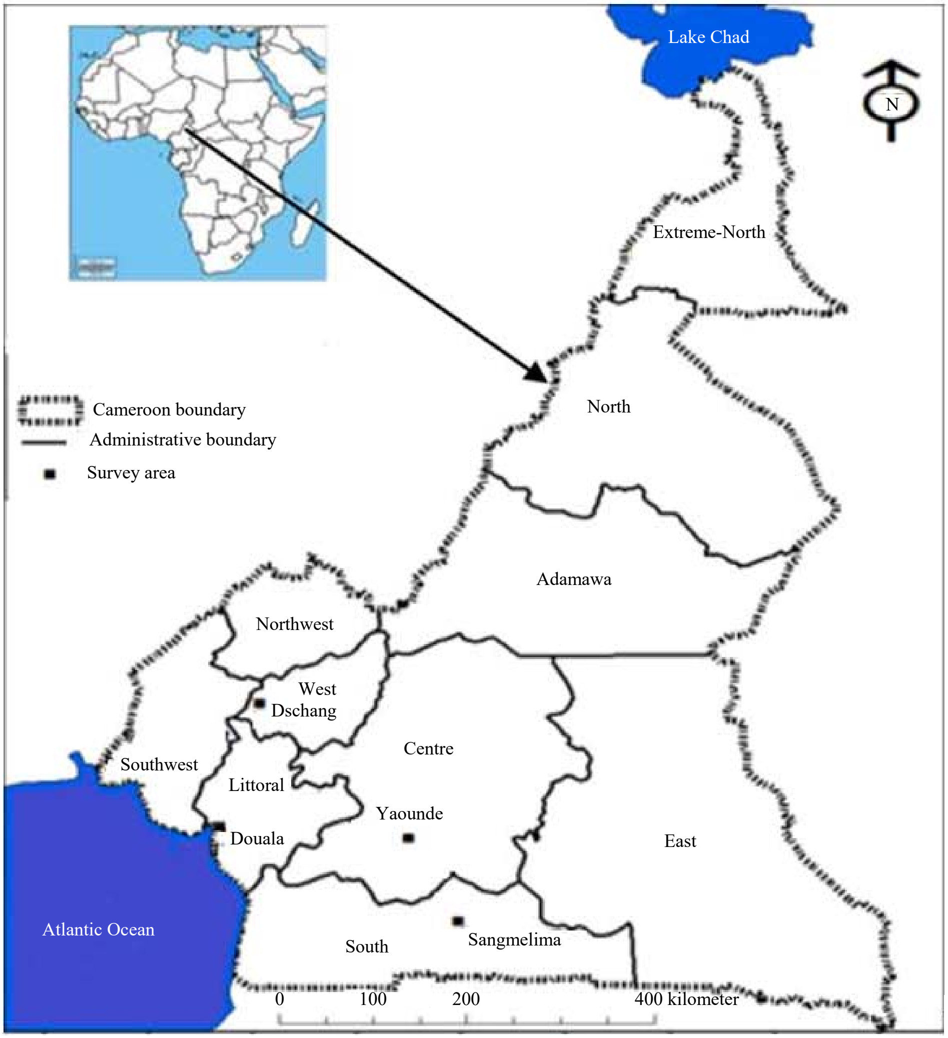

Fig. 1: Map of the study area[11]

$$Uwc = \frac{Ur \times Np}{t \times Nc / Wkg}$$

Where:

Ur : Amount of each active antimicrobial ingredient (milligrams)
Np : Number of used antimicrobial products
t : Length of reporting period for that farm (weeks)
Nc : Number of chicken present in the farm
W : Weight of the chicken (kg)

Data analysis: Data were analyzed using a computer software SPSS version 20.0 for windows. Descriptive statistics (frequency, mean and percentages) was used to analyze the data. The AMU at the farm was categorized into low and high usage based on a previous estimate (10.6 mg kg^{-1}) of Layers[13]. AMU less than 10.6 mg kg^{-1} was termed as low, while usage above this cut-off value was considered as high. Chi-square was used to present the relationship between variables. The value of $p<0.05$ was considered as significant.

RESULTS

Characteristics of farmers and chicken farming practices: Table 1 shows the characteristics of farmers who participated in the present study. The poultry farmers in the four regions were mostly men. Male poultry farmers in the center were 85.71%, in the littoral were 100%, in the west were 93.33% and in the south region were 92 %and the total were 92.5%. Only 7.5% of the farmers were female. The majority of the farmers

Table 1: Chicken farming practices in four regions of Cameroon

Variables	Centre 35 (%)	Littoral 30 (%)	West 30 (%)	South 25 (%)	Total 120 (%)	χ^2	p-value
	----------Characteristics of farmers----------						
Gender							
Male	30 (85.71)	30 (100)	28 (93.33)	23 (92)	111 (92.5)	0.122	0.72
Female	5(14.28)	-	2 (6.66)	2 (8)	9 (7.5)		
Qualification in poultry farming							
Formal training	15 (42.85)	15 (50)	13 (43.33)	5 (20)	48 (40)	67.200	0.000*
No formal training	20 (57.14)	15(50)	17 (56.66)	20 (80)	72 (60)		
Categorization of farms							
Small (<1000 birds)	17 (48.57)	15 (50.00)	12 (40.00)	11 (44)	55 (45.83)	60.200	0.000*
Medium (1001-2000 birds)	14 (40.00)	15 (50.00)	10 (33.33)	9 (36)	48 (40)		
Large (>2000 birds)	4 (11.43)	-	8 (26.66)	5 (20)	17 (14.16)		
Experience in poultry farming							
0-3 years	24 (68.58)	14 (46.67)	23 (76.66)	15 (60.00)	76 (63.33)	133.780	0.000*
4-7 years	6 (17.14)	12 (40.00)	4 (13.33)	6 (24.00)	28 (23.23)		
8-11 years	5 (14.28)	4 (13.33)	3 (10.00)	4 (16.00)	16 (13.33)		
	----------Chicken farming practices----------						
Type of birds							
Layers	27 (77.15)	28 (93.33)	25 (83.33)	10 (40)	90 (75)	6.800	0.52
broilers	5 (14.28)	1 (3.33)	3 (10.00)	9 (36)	18 (15)		
breeders	3 (8.57)	1 (3.33)	2 (6.67)	6 (24)	12 (10)		
Antibiotics usage							
Yes	31 (88.57)	30 (100)	27 (90.00)	15 (60)	103 (85.83)	3.800	0.000*
No	4 (13.33)	-	3 (10.00)	10 (40)	17 (14.16)		
Sources of antibiotics							
Markets	7 (20)	2 (6.66)	1 (13.33)	3 (12)	11 (9.16)	3.500	0.02*
veterinary shops	24 (68.58)	14 (46.67)	26 (86.66)	17 (68)	81 (67.5)		
Mobile sale men	4 (11.42)	14 (46.67)	3 (10.00)	5 (20)	26 (21.66)		
Reasons for antibiotics usage							
Prophylactic	2 (6.67)	-	4 (13.33)	7 (28)	13 (10.83)	4.880	0.000*
Therapeutic	2 (6.67)	-	-	8 (32)	10 (8.33)		
Therapeutic and prophylactic	31 (88.57)	30 (100)	26 (86.66)	10 (40)	97 (80.83)		
Withdrawal period							
0-3 days	21 (60.00)	29 (96.66)	20 (66.67)	20 (80)	90 (73.68)	67.910	0.69
3-7 days	9 (25.71)	-	6 (20.00)	-	15 (15.78)		
7-10 days	5 (14.28)	1 (3.33)	4 (13.33)	5(20)	10 (10.52)		
Type of litter							
Wood shaving	30 (87.71)	28 (93.33)	30 (100)	22 (88)	110 (91.66)	0.000	0.13
Battery cage	5 (14.29)	2 (6.66)	-	3 (12)	10 (8.33)		
Frequency of litter change							
Monthly	19 (54.28)	20 (66.66)	30 (100)	25 (100)	94 (78.33)	5.870	0.24
Quarterly	7 (7,36)	5 (16.66)	-		12 (10)		
Every 4 months	5 (14.28)	5 (16.66)	-		10 (8.33)		
Every six months	4 (4.21)	-	-		4 (3.33)		

(72%) had no formal training on chicken production. The highest percentage of trained farmers (57.14%) were found in the center region. The farms were categorize in three groups depending on the number of birds in the farm, small size farm contains <1000 birds, medium farms contain 1001-2000 birds and large farms contain >2000 birds. Majority of the large farms (26.6%) were found in the West region. Concerning their experience in chicken farming, 76 (63.63%) farmers have more than three years of experience, center (68.58%) and the west (76.66%) regions exhibit high number of experienced farmers.

In 75% of the farms the layer was raised followed by broilers (18%). Majority of farmers (85.83%) used veterinary drugs and antibiotics to prevent disease outbreak in the chicken farm with various reasons. Large number of farmers in the littoral (100%) and the west region (90%) used veterinary drugs and antibiotics. The mentioned reasons were therapeutic (2.10%), prophylactic (6.31%), both therapeutic and prophylactic (91.57%). These veterinary drugs were obtained from market (10.52 %), from veterinary shops (67.36%) and from mobile sellers (22.10%). In 77.8% chicken farms, owners declared not knowing or applying withdrawal periods and not respecting doses. Only 10.52% chicken farms were respecting withdrawal periods. Wood shaving is the type of liter used by the majority of the farmers (92.63%), which was generally changed monthly by 69 (72.63%) farmers.

Table 2: Types of veterinary drugs used in farms surveyed regions of Cameroon (N = 120)

		Regions			
		Centre	Littoral	West	South
Class of veterinary drugs	Name of active substance	Farms using veterinary drug (%)	Farms using veterinary drug (%)	Farms using veterinary drug (%)	Farms using veterinary drug (%)
Aminoglycosides	Neomycin	2 (5.71)	1 (3.33)	-	-
	Streptomycin	1 (2.85)	-	-	-
Antihelminthic	Levamisole	10 (28.57)	8 (26.66)	10 (28.57)	10 (40)
Benzimidazoles	Albendazole	2 (5.71)	-	-	10 (40)
Diaminopyrimidines	Trimethoprim	3 (8.57)	1(3.33)	1 (3.33)	-
Fluoroquinolones	Flumequine	2 (5.71)	-	-	-
	Norfloxacin	7 (20)	-	2 (6.66)	9 (36)
Ionophores	Amprolium	2 (5.71)	-	1 (3.33)	5 (20)
Lincosamides	Lincomycin	1 (2.85)	-	-	-
Macrolides	Erythromycin	2 (5.71)	-	-	-
	Tylosin	1 (2.85)	-	-	-
Nitrofurans	Furaltadone	5 (14.28)	2(6.66)	2 (6.66)	3 (12)
Polymyxins	Colistin	4 (11.42)	1(3.33)	3 (10)	3(12)
Sulfonamides	Sulfadimidine	11 (31.42)	5(16.66)	7 (23.33)	13 (52)
	Sulfadiazine	2 (5.71)	2(6.66)	2 (6.66)	-
	Sulfaquinoxaline	-	-	1 (3.33)	-
Salicylanilides	Niclosamide	-	-	2 (6.66)	-
Systemic anthelmintic	Peperazine	2 (5.71)	-	-	-
Tetracyclines	Doxycycline	6 (17.14)	-	6 (20)	-
	Oxytetracycline	20 (57.14)	5 (16.66)	7 (23.33)	10 (40)
	Tetracycline	-	-	-	10 (40)

Statistical analysis using cross-tabulation was performed to verify the relationship between variables. The results revealed that characteristics of farmers has a significant association with qualifications, experience and the size of the farms. Antibiotics usage, source of antibiotics and reasons for usage also had significant association with the good farming practices.

Consumption of veterinary drug in the four regions: A total of 33 different veterinary products containing one or two active ingredients were used in the 120 farms visited at the time of survey (Table 2). The twenty-two active ingredients found in the different products were belonged to 14 veterinary drug classes. The higher number of veterinary drugs and antibiotics was used in the center region. Oxytetracycline from the tetracycline class of antibiotics was the most used (20 farms) active substance followed by sulfadimidine (11 farms) from polymyxins class of antibiotics and levamisole (10 farms) from the class of antihelminthic. In the littoral region the farmers mostly used levamisole (8 farms), sulfadimidine (5 farms) and oxytetracycline (5 farms). In the west region, levamisole was used by 10 farms, sulfadimidine and oxytetracycline by 7 farms and doxycycline by 6 farms. The farmers in the South region were using tetracyclines (Oxytetracycline), antihelminthic (levamisole) and benzimidazoles (albendazole) classes of veterinary drugs.

In the present study, the consumption of antimicrobials was presented as animal treatment days per year (ATD/Y) in Fig. 2. The values obtain varies from one region to another, these ATD were grouped in three classes 0-3, 3-6 and over 6. The consumption of antimicrobials was mostly 0-3 ATD for 14 farms in centre and the west region, whereas ATD was 3-6 for more than 20 farms in south region. An ATD/Y of 1 means that the animal was exposed to an antimicrobial for one day per year (ESVAC).

Quantitative use of antibiotics: It was observed that some antimicrobials had the highest average usage per chicken per week, norfloxacine (18.26 mg), neomycin (6.33 mg) lincomycin (6.15 mg), oxytetracycline (4.07 mg) were overdosed. Albendazole, amprolium, erythromycin, piperazine, sulfadimidine and streptomycin were used as recommended, flumequine (1.6 mg), streptomycin (1.8 mg), sulfaquinoxaline and tylosin were under dosed, while Florfenicol had the highest average usage per chicken per week (15 mg), followed by sulphadimidine, sulphathiazole (5 mg each), oxytetracycline (5 mg), colistin (4 mg) and ciprofloxacin (3 mg), while tylosin, (2 mg), gentamicin (2 mg), neomycin (2 mg), trimethoprim (1 mg) and streptomycin (1 mg) had the lowest usage (Table 3). The estimated weight of layers at 6 and 24 weeks of age was 2.5 and 1.8 kg, respectively. Data of antimicrobial consumption showed more usage in broilers.

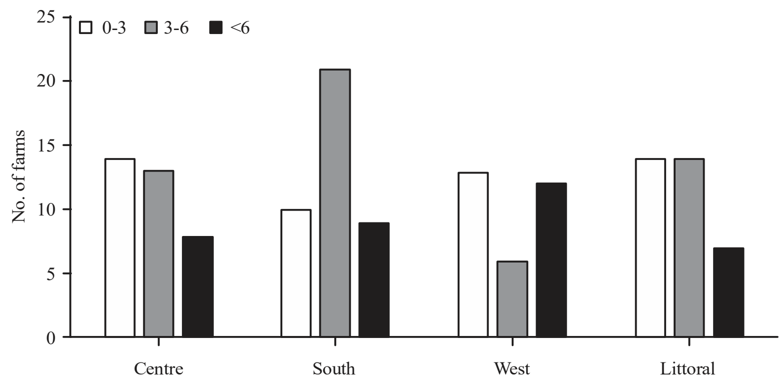

Fig. 2: Frequency distribution of ATD/Y per farm in the four Regions (N = 120)

Table 3: Quantitative usage of antibiotics on the 120 farms surveyed

	Regions				
	Centre	Littoral	West	South	
Antimicrobials	Average antimicrobial usage				Total used in mg/kg/week
Colistin	2.20	0.80	0.23	0.18	3.41
Doxycycline	0.25	0.37	0.11	0.09	0.82
Erythromycin	0.80	0.54	0.20	1.18	2.72
Flumequine	0.12	1.30	0.18	0.05	1.65
Furaltadone	1.40	0.90	0.28	0.22	2.80
Vancomycin	4.00	0.51	0.74	0.90	6.15
Neomycin	1.70	3.33	0.10	1.20	6.33
Norfloxacin	3.60	6.66	2.00	0.60	18.26
Oxytetracycline	1.90	1.40	0.43	0.34	4.07
Streptomycin	0.70	0.40	0.60	0.10	1.80
Sulfadiazine	2.20	0.15	0.04	0.03	2.42
Sulfadimidin	0.90	0.15	0.07	0.03	1.15
Sulfaquinoxaline	0.20	3.30	0.02	0.60	4.12

DISCUSSION

The present study was conducted to investigate the link between the use of veterinary drugs in poultry farming and the occurrence of antimicrobial resistance. Concerning chicken farmers characteristics, the farmers surveyed were mostly men 87 (92.5%) on the three regions, with no formal training in chicken production (54.73%) and 64.21% of farmers have more than three years of experience in poultry farming. Previous studies reported similar results, as men have more potential to invest in farming. Geta and Mulugeta[14] in Ethiopia showed that majority of the participants were male (86.8%), married (61.5%) and at the age of 31-45 years (41.8%). For chicken farming practices, the type of birds are layer in 84.21% of the farms. In Nepal, Lambrou *et al.*[15] reported that most of the respondents included in the study were male (68%) and completed at least secondary education (65%). Majority of poultry producers raised layers (66%) as compared to broilers (33%) or both layers and broilers (1%). All the farmers (88.57%) were using veterinary drugs to prevent disease outbreak in the chicken farm with various reasons, the mentioned reasons were therapeutic (2.10%), prophylactic (6.31%), both therapeutic and prophylactic (91.57%). Amongst these veterinary drugs used, some originated from market (10.52%), from veterinary shops (67.36%) and from mobile sellers (22.10%). In 77.8 % farms, owners were not following accurate dosage and withdrawal periods. Only 10.52 % were concerned about it. Wood shaving was used as liter by 92.63% farmers and it was changed on monthly basis by 72.63% farmers. The antibiotics were commonly used as veterinary drug, previous studies conducted in Cameroon[1,8] and in other countries[16-20] showed the high usage of veterinary antibiotics in poultry farming. Sirdar *et al.*[18] reported that drugs should be administered orally in drinking water. The use of veterinary drugs in poultry feed lead to the occurrence of antimicrobial resistance. Inappropriate use of antibiotic in animal production has serious consequences for public health and the environment[21], particularly in low- and middle-income countries (LMICs) such as Cameroon. A number of other studies have estimated antibiotic use and resistance in livestock. Due to lowcost and ease of availability, gentamicin and tetracycline were the most commonly used antibiotics by farmers[18]. Misuse of quinolones particularly ciprofloxacin and its resistance in animals is of great concern as it is one of the essential medicines listed for humans.

Present study showed that tetracyclines, sulfonamides, fluoroquinolones and nitrofurans were commonly used antibiotics by farmers. Kamini *et al.*[8] reported the use of fluoroquinolones, sulfonamides and tetracyclines in 57.1, 53.1 and 46.9% of chicken farms, respectively, in Yaoundé, Cameroon. Nonga *et al.*[17], reported the use of tetracycline and sulfonamides in 90 and 85% of poultry farms respectively in Tanzania. Ogunleye *et al.*[22], in Nigeria, reported high usage of fluoroquinolones in poultry farms against 48.9 and 12.2% in chicken farms in the present study. However, the qualitative estimate of veterinary drug usage was different from the quantitative estimate. In fact, lincosamides was the most commonly used antibiotic in quantitative terms, followed by polymyxins, nitrofurans and tetracyclines. Kamini *et al.*[8] reported that in Yaoundé, qualitative estimate of antibiotic usage was different from the quantitative estimate. The difference between quantitative and qualitative estimates was mainly due to the differences in doses and concentrations of active ingredients[12]. In agreement with current results a previous study[23] reported that farmers in many countries use their prior experience and can easily obtain antibiotics without a prescription to reduce the cost of veterinary services. According to an Indian study, only one-third of farmers seek the assistance of a veterinarian to reduce veterinary costs[24]. Although, a number of measures have recently been implemented to limit antibiotic use in human medicine in order to combat antibiotic resistance, but their implementation in the field of animal health is moving slowly and insufficiently. As a result, animal farm owners can still easily obtain antibiotics from veterinary clinics without prescription. In fact a great proportion of farms relied on veterinarians for prescription (96.3%) and they are not applying withdrawal period. The withdrawal period is very important because it can reduce the residues in chicken meat and thus protect the consumers. In fact the improper or illegal use of veterinary drugs is the most likely reason for drug residues in the chicken meat tissues and eggs. Darko *et al.*[7] in Ghana and Wadoum *et al.*[1] in the West Region of Cameroon reported the presence of antibiotic residues in chicken tissues and eggs. According to regulation and guidelines, antimicrobials, should only be used to treat infection, respecting the dose, the length of treatment and withdrawal period (Commission Notice 2015/C299/04). Thus some veterinary drugs particularly antibiotics were used in absence of clinical disease probably to prevent infections and/or for growth promotion. Such usages could be linked to development of antimicrobial resistance. Previous studies reported that the use of antimicrobial apart from the treatment of a disease has been linked to development of antimicrobial resistance[1,25,26]. It has been reported that the administration of drugs via drinking water or medicated feed (both cases in the present study) lead to imprecise dosing and potentially increase the risk for veterinary drug resistance[27]. To fight against the development of drug resistance, the use of antimicrobials as growth promoters was banned by several jurisdictions such as European Union[28]. Amongst veterinary drugs recorded in the present study some (fluoroquinolones, colistin) are considered as critically important or highly important (albendazole, sulfadimidine, sulfadiazine, sulfaquinoxaline, doxycycline, oxytetracycline) or important (lincomycin) for human medicine by World Health Organization. The use of banned substances such as nitrofurans (13.2% in quantitative terms) is still of great concern. A study before the avian influenza also reported the use of nitrofurans but in lower proportion (7%) in terms of quantitative usage[8]. The use of Nitrofurans have been banned in food-producing animals since 1991 in the United States and 1995 in the EU because of concerns over the carcinogenicity of these compounds (Council Regulation 1442/95).

This study highlighted a high level of antimicrobial usage (mg kg^{-1}) per week across all the categories of farms that raised broilers and layers in the study area. Results showed that farmers in the study area administer 421.5 mg (28.1 mg kg^{-1}) per chicken of antimicrobial agents for a 6 weeks.

In Mekong Delta of Vietnam, usage of antimicrobial agents is even higher than 158.2 mg per chicken to produce one broiler[13]. The high usage observed in this study could be linked to real or perceived higher prevalence of disease, the lack of government restriction and control on antimicrobial usage and inappropriate adherence to dosing intervals[1]. Qualitative studies conducted else where in Nigeria and in Uganda, using questionnaire surveys, have reported a high usage of antimicrobials in poultry farms[20].

Broiler farms used higher amount of antimicrobials compared to layer farms. The high usage in broilers may be attributed to the common practice of administering antimicrobials and vitamins at the beginning of production cycle. This outcome was surprising and could be due to the fact that most backyard farms do not have consulting veterinarians, lack of technical ability to administer antimicrobials correctly, lower loss tolerance capacity or a higher perception of risk of disease by house hold farmowners[13]. In Cameroon, national action plan on antimicrobial resistance showed systematic misuse and over use of antibiotics in livestock production system putting local, national and global communities at risk.

The present study revealed that use of veterinary drugs in chicken farming is still a serious threat to public health in Cameroon and that it is necessary to take and implement preventive actions. The safety of foods can be achieved by the implementation of appropriate rules applied from primary production to retain and requires the participation of all stakeholders involved[29]. Improper administration of veterinary drugs by farmers and lack of suitable legislation are the key factors promoting misuse of drugs. Training of farmers on biosecurity measures, a more efficient use of drugs and improvement in existing veterinary law would be effective strategies to restrict misuse of antimicrobial active substances. Therefore, the use of veterinary drugs could be reduced by the implementation of biosecurity measures[30].

CONCLUSION

The present study showed that, few months after the avian influenza, the use of veterinary drugs in chicken farming in the Centre, Littoral and West Regions of Cameroon is still problematic. In addition, all factors favouring the occurrence of consumer hazards and veterinary drug resistance were met: withdrawal periods were not applied by the majority of farmers, several veterinary drugs and antimicrobials were used in the absence of clinical disease, dosage of veterinary drugs in many cases was not according to the indications for the product. It is urgent and necessary not only to improve existing veterinary legislations, set up a monitoring system but also to trainee and educate farmers on alternative methods for disease management such as vaccination associated to biosecurity measures implementation, which could decrease the use of veterinary drugs, educate veterinary drug sellers and improve public awareness. Quantitative data on antimicrobial usage on farms should ideally be complemented with surveillance of antimicrobial resistance of selected bacterial species in farmed animals, food and humans. This should allow accurate monitoring of potential reductions in use and resistance in animal production as well as in humans.

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