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Analysis of the use of antibiotics in modern laying hen farms in the Dakar region and surrounding area

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ABSTRACT

Previous studies on the presence of antibiotic residues in eggs in Senegal and other African countries have shown sometimes worrying prevalences. This prompted us to carry out this study, which aims to assess antibiotic use practices in laying hen farms where the withdrawal period is often not respected. Surveys were carried out in 70 farms, 59 of which were in the Dakar region and 11 in the Thiès region. A cross-sectional survey made it possible to determine the typology of farms according to the level of hygiene and it appeared that 50% of the farms had a good level of hygiene (class 3), 24.29% an acceptable level of hygiene (class 2) and 25.71% a poor level of hygiene (class 1). The surveys also showed that supervised farms had a better level of hygiene than unsupervised farms. This level of hygiene was closely related to the occurrence of diseases and the use of antimicrobials. Among the antibiotics, Quinolones are the most used (51%), followed by the Tetracycline family (16%) in the treatment of laying hens where self-medication is practiced in 50% and the dosage was strictly respected in only 27% of the farms. A follow-up of 15 of the 70 farms surveyed was carried out to check whether the behaviour of the farmers observed during the survey persisted. This follow-up showed results similar to those obtained during the cross-sectional survey. None of the farms respected the withdrawal periods for antibiotics used during production. These results show: failures of antibiotic therapy, the risk of the appearance of antibiotic resistance, as well as the risk of antibiotic residues in eggs. We recommend the implementation of antibiotic residue monitoring in poultry farming and the sensitisation of poultry farmers to the risk of antibiotic residues in consumed eggs.

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Keywords: Antibiotics, poultry farms, laying hens, Dakar, Thiès

INTRODUCTION

In many parts of the world, the poultry sector continues to grow and industrialise. This is due to the growth of the human population which constitutes a great purchasing power, an

engine favouring the growth of this sector (FAO, 2014).

Since the suspension of the import of poultry products and materials in 2005 following the advent of Highly Pathogenic

Avian Influenza (HPAI), the Senegalese poultry sector has been booming with the aim of achieving food self-sufficiency in animal proteins. The establishment of a better organisation of this poultry sector is possible thanks to the presence of the different components necessary for the development of modern poultry farming, i.e. breeding stock, hatcheries, feed manufacturers and professional associations (CNA/CIMEL, 2013).

Nevertheless, this sector is faced with numerous problems, including pathological ones. Poultry diseases remain one of the main factors limiting the expansion of the poultry sector in Senegal. In order to combat these diseases, farmers use veterinary medicines, particularly antibiotics (Biagui, 2002).

Despite their necessity in the therapeutic arsenal, these antibiotics are sometimes used in an abusive manner, and it is therefore appropriate to question about the risks incurred by consumers when they are used in food-producing animals (Stolz, 2008).

Indeed, if their withdrawal period is not respected, these antibiotics can leave residues in the foodstuffs produced that are dangerous for consumers and are capable of causing hypersensitivity accidents or intoxications by promoting the selection of bacteria that are resistant to subsequent treatments (Bada Alambédji et al, 2008).

In other words, the use of these antibiotics can cause side effects and pose public health problems despite their benefits.

In the interest of consumer protection, this study was undertaken to assess antibiotic use practices in laying hen farms.

MATERIALS AND METHODS

Study area

The present study was carried out in the Dakar region and its periphery, which includes part of the Thiès region and mainly in the division of Rufisque, Pikine, Keur Massar, Pout and Tivaouane. These areas are characterised by a high demographic concentration that is in line with a growing demand for animal protein, which explains the

concentration of poultry farms and the choice of these localities.

Surveys or cross-sectional study

Two types of survey were carried out: an exploratory survey was first carried out, which allowed us to collect general information on poultry farming in Senegal and data on the farms located in the study areas in particular, in order to gain a better understanding of the subject. In addition, some information was also collected from veterinary practices.

The surveys themselves were conducted during the period from 2nd August to 27th December 2019, a period chosen to cover both the dry and rainy seasons in the area.

The cross-sectional survey using questionnaires administered to poultry farmers on farm hygiene, husbandry practices and treatment of animals with antibiotics was followed by a longitudinal survey.

Sampling

The farms were selected according to the accessibility and availability of the managers. The 2008 census carried out by the Minister of Livestock and Animal Production and the update carried out by Niyibizi in his dissertation in 2012 enabled us to take 59 farms out of the 107 inventoried in the Dakar region and 11 farms in the Thiès region. We thus surveyed 70 laying hen farms with laying or mixed species.

Questionnaires

The questionnaires used collected information on :

- hygiene level of the farms: compliance with hygiene rules is very important and remains a key element for the smooth running of the farm. The farms surveyed were classified according to their compliance with hygiene rules.
- The supervision of farmers or the monitoring of the farm: supervision or monitoring often contributes to improving hygiene on the farms drug use practices.
- Drug use : for antibiotics, the questionnaires recorded the name given, the dose used, the duration of use, the reason for use, whether a

prescription was written or whether the patient self-medicated,

- Knowledge of the concepts of antibiotic residue and withdrawal period: the aim was to determine whether the farmer was aware of the concepts of residue and withdrawal period and whether the health worker took these concepts into account when prescribing.

- Awareness of withdrawal times : to make a statement on withdrawal times and compliance the withdrawal period is the time between the last administration of a drug and the collection of edible tissues or products from a treated animal, ensuring that the drug residue level in the feed complies with the maximum residue limit for that veterinary-drug.

Livestock monitoring or longitudinal survey

For seven (7) months, from 22 February to 18 September 2020, 15 of the 70 farms surveyed were monitored to determine the frequency and actual reasons for antibiotic use.

Weekly monitoring sheets were prepared to collect data from the farms each week. Indeed, the antibiotics used, their frequency and dosage were recorded.

RESULTS

Cross-sectional study

Location of farms and size of strips

As shown in the Figure 1, of the 70 farms surveyed, 85% were in the Dakar region and 15% in the Thiès region. On some farms, we found several bands of different sizes and ages; on the 70 farms we counted 81 bands. The size of these flocks varied: 61.42% were between 1,000 and 5,000, 28.57% were under 1,000 and 10% were over 5,000.

Hygiene level of the farms

The respect of hygiene practices is fundamental to the success of modern livestock farming. Thus, through hygiene practices, we determined a typology of the 70 farms and classified them as follows : Class 1 (farms with poor hygiene), Class 2 (farms with acceptable hygiene) and Class 3 (farms with good hygiene).

The study showed that 50% of the farms were in class 3, 24.29% in class 2 and 25.71% in class 1. These results are shown in Figure 2.

Relationship between the level of hygiene and the supervision of farmers

Farmers are beginning to understand that supervision by a poultry specialist is essential for successful production. Indeed, following the survey, as shown in Table 1, 46 of the 70 farms were supervised, i.e. 65.5% of the farms, while 34.29% were not supervised.

In addition, it was found that 77% of the supervised farms were in class 2 (acceptable) and 3 (good) and 45.8% of the unsupervised farms were in class 1 (poor) ; this is illustrated in the Figure 3.

Antibiotic molecules and reasons for use

According to the results of the survey, to manage pathologies in poultry farms, veterinarians use antibiotics that are chosen according to the type of disease and the reason for use.

For antibiotic prevention, the Tetracycline family is the most widely used. For the treatment of digestive diseases, Quinolones and Polypeptides are used in the first instance, while Sulfamides and Diaminopyrimidines are used in the second instance; for the treatment of respiratory diseases, Macrolides and Quinolones are the most used, while coccidiosis is treated with Sulfamides.

During the survey, we noted that in 50% of the 70 farms visited, self-medication was practised and that more than 50% of the molecules used belonged to the Quinolone family, which is prohibited for laying hens in European Union Countries. Only 27% of the farms strictly followed the dosage. In the remaining 73%, the 35% claim not to have the necessary tools for accurate measurements, while the 75% believe that increasing the dose increases the cure rate, which is why they overdose.

It should also be noted that farmers resorted to the use of antibiotics to combat viral diseases.

The concepts of antibiotic residues and withdrawal period: knowledge of withdrawal period and compliance

This study showed that 4% and 19% of the farmers have knowledge of antibiotic residues and withdrawal period respectively,

and also that none of the farms respected the withdrawal period after an antibiotic treatment.

For the health workers, the survey showed that 77% and 94% of the health workers said they had knowledge of antibiotic residues and the withdrawal period respectively; but 90% of them said that they did not take into account the notion of antibiotic residues and the withdrawal period when prescribing and administering antibiotics.

Livestock monitoring

Of the 70 farms surveyed, 15 were monitored for seven (7) months. On these farms, 3,667,033 eggs were produced. Considering the duration of use and the withdrawal period of each of the antibiotics used by these farm 395,638 eggs were produced during the treatment and withdrawal periods, which could probably be contaminated by residues of the antibiotics used; this gives us a prevalence probability of 10.76% for these farms.

Antibiotic therapy in the monitored farms

Antibiotics are used in 9 of the 15 farms monitored, i.e. 60% of the farms. In addition to these antibiotics, anti-stress drugs with a certain dose of antibiotics are often used. The most important information about this antibiotic therapy is given in Tables 2 and 3.

The antibiotic molecules in these stress relievers used are identified and classified in 9 known families. The Polypeptide family is the most used with 37.87% of the 37 treatments

performed, followed by the Quinolone family with 29.7% and the Tetracycline family with 10.8% (Figure5).

Relationship between supervision, level of hygiene, compliance with dosage and self-medication

During the monitoring of the farms, it appeared that 40% of the farms were supervised and 60% were not. Among the supervised farms, 66% are in class 2 (acceptable) and 3 (good), 83% respect the dosage of medicines and 66% do not practise self-medication.

Of the farms not monitored, 45% were in class 1 (poor), 45% did not respect the dosage and 55% practised self-medication.

Frequency and duration of antibiotic use

Most farmers believe that the effectiveness of a drug depends on the duration of its use. Out of a total of 37 antibiotic treatments in the 15 farms monitored, the average duration of treatment was 3 days. The most observed treatment duration was between 3 and 5 days and 26.92% of the treatments lasted more than 5 days as shown in Figure 6.

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Table 1 : Relationship between the hygiene level of the farms and the supervision

	Farming		Class 1 (poor)		Class 2 (acceptable)		Class 3 (good)	
	units	%	Units	%	Units	%	Units	%
Supervised livestock	46	67,71	11	23,31	19	40,91	16	35,78
Non-framed livestock	24	34,29	11	45,8	7	29,5	6	25

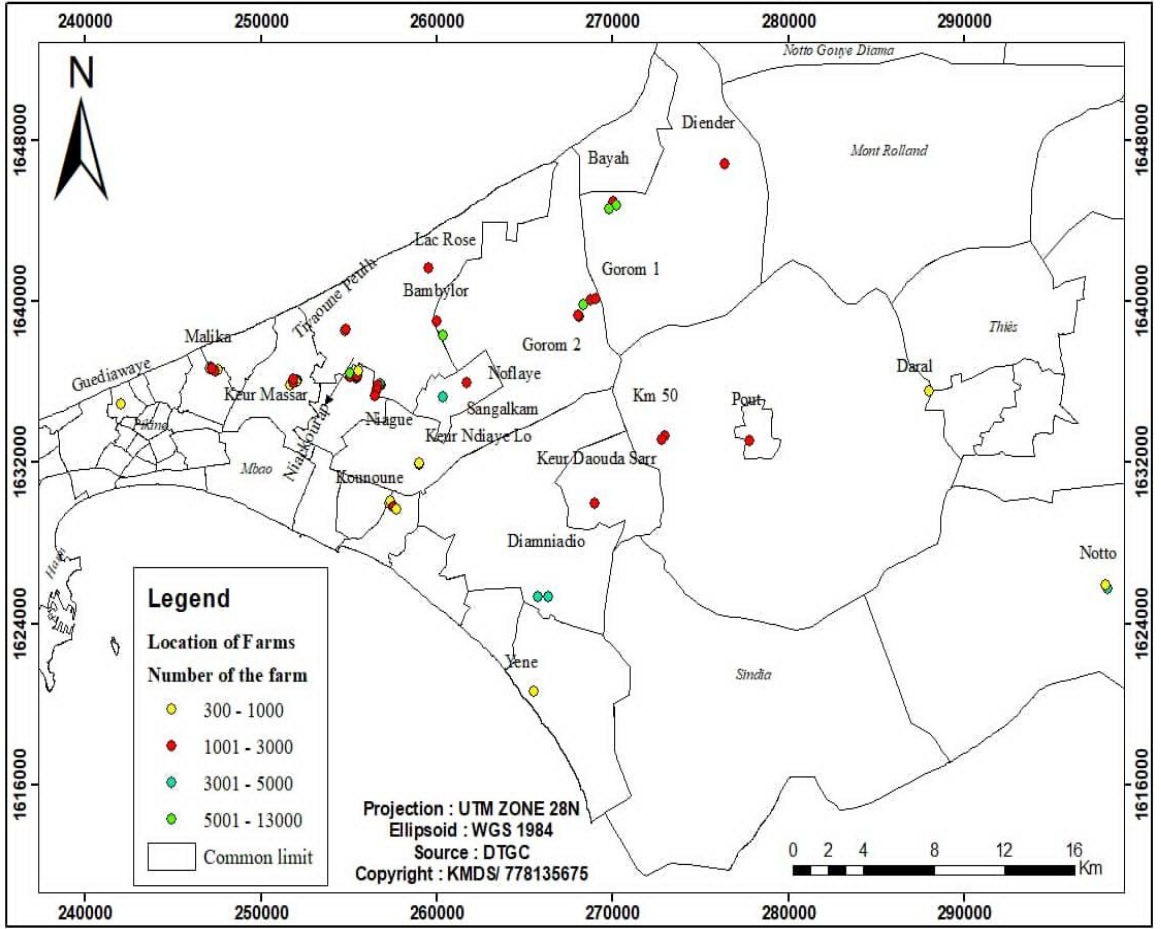


Figure 1 : Location of farms and size of strips.

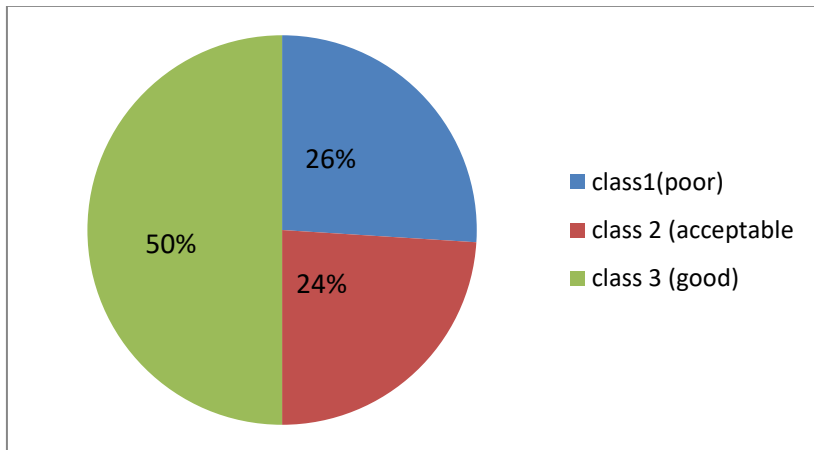


Figure 2 : Hygiene level of farms.

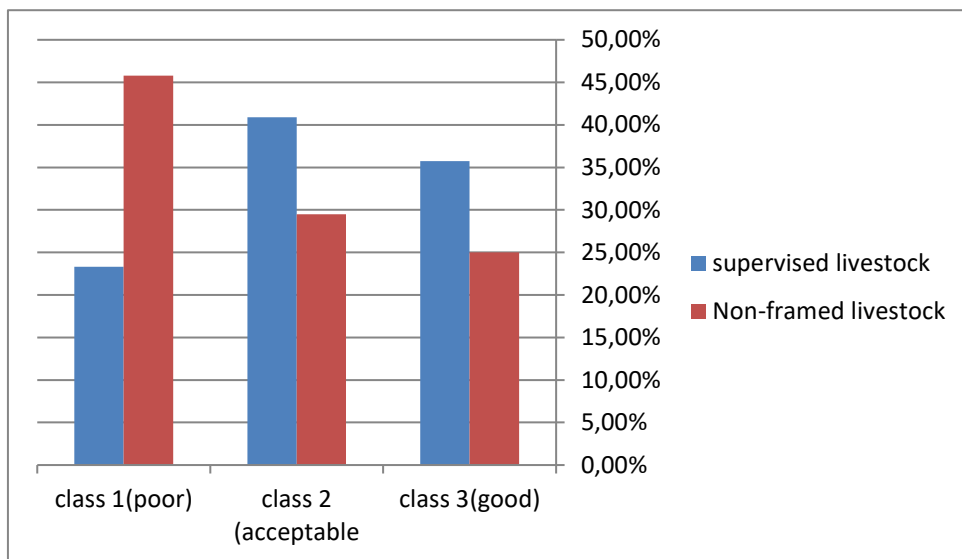


Figure 3 : Relationship between the hygiene level of the farms and the supervision.

Table 2 : Antibiotics used in the monitored farms.

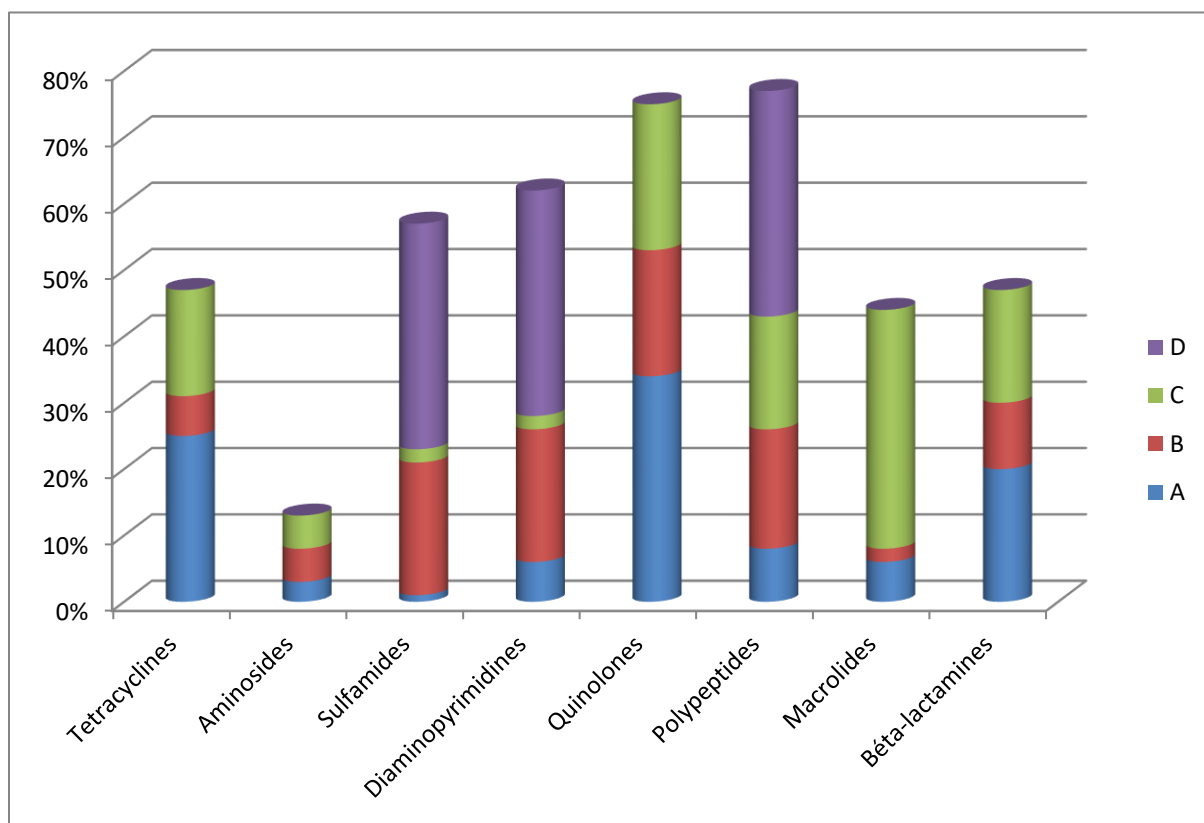
Filed name	Active ingredients	Antibiotic Families	Number of Farms Users	Percentage
Quinocol	Enrofloxacin	Quinolones	4	26,66
	Colistine	Polypeptides		
Roxacoli	Enrofloxacin	Quinolones	3	20
	Colistine	Polypeptides		
Vetocoli	Colistine	Polypeptides	2	13,33
Coliflox	Colistine	Polypeptides	2	13,33
Norfloxan ou Norflox	Norfloxacin	Quinolones	3	20
Dimoxan	Colistine	Polypeptides	2	14,28
	Amoxicilline	B-Lactamines		
TTS	Tylosine	Macrolides	1	6,66
	Trimethoprim	Diaminopyrimidines		
Tyloxox	Sulfamidiazone	Sulfamides	1	6,66
	Doxycycline	Tetracyclines		
Limoxan	Tylosine	Macrolides	1	6,66
	Oxytetracycline	Tetracyclines		

**Not recommended for laying hens in EU countries

*Not determ

Table 3 : Stress relievers used in the monitored farms.

Filed name	Active Ingredients	Antibiotic Families	Number of farms users	Percentage
Alisériel	Erythromycine	Macrolides	1	6,66%
	Oxytétracycline	Tétracyclines		
	Streptomycine	Aminosides		
Néoxyvital	Colistine	Polypeptides	1	6,66%
	Norfloxacin	Quinolones		
Tétracolivit	Oxytétracycline	Tétracyclines	1	6,66%



A : antibioprevention
 B : treatment of digestive diseases
 C : treatment of respiratory diseases
 D : treatment of coccidiosis

Figure 4 : Antibiotics used according to pathologies.

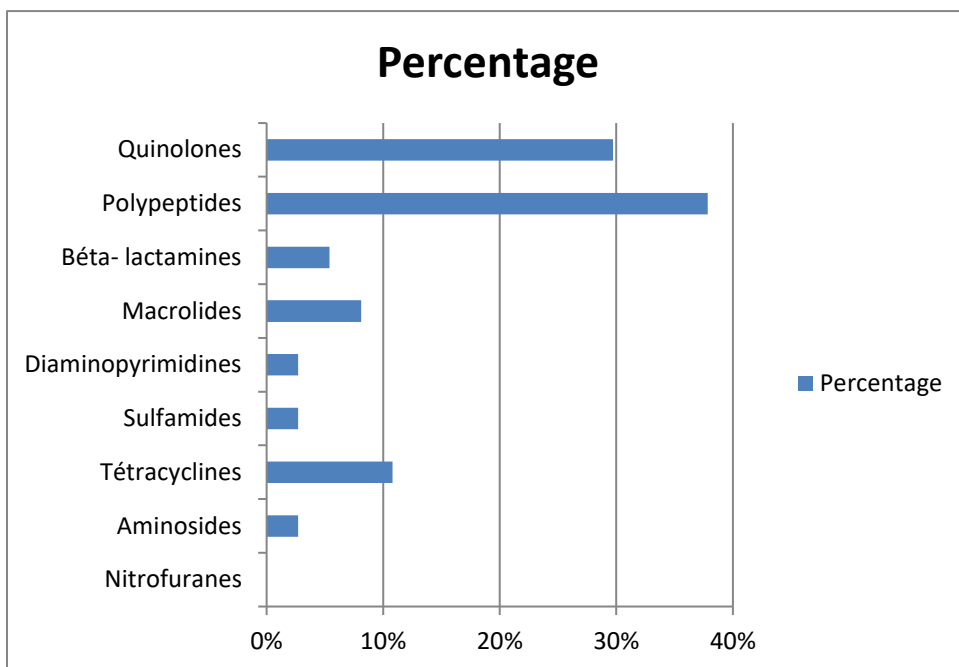


Figure 5 : Antibiotic molecules used in the monitored farms.

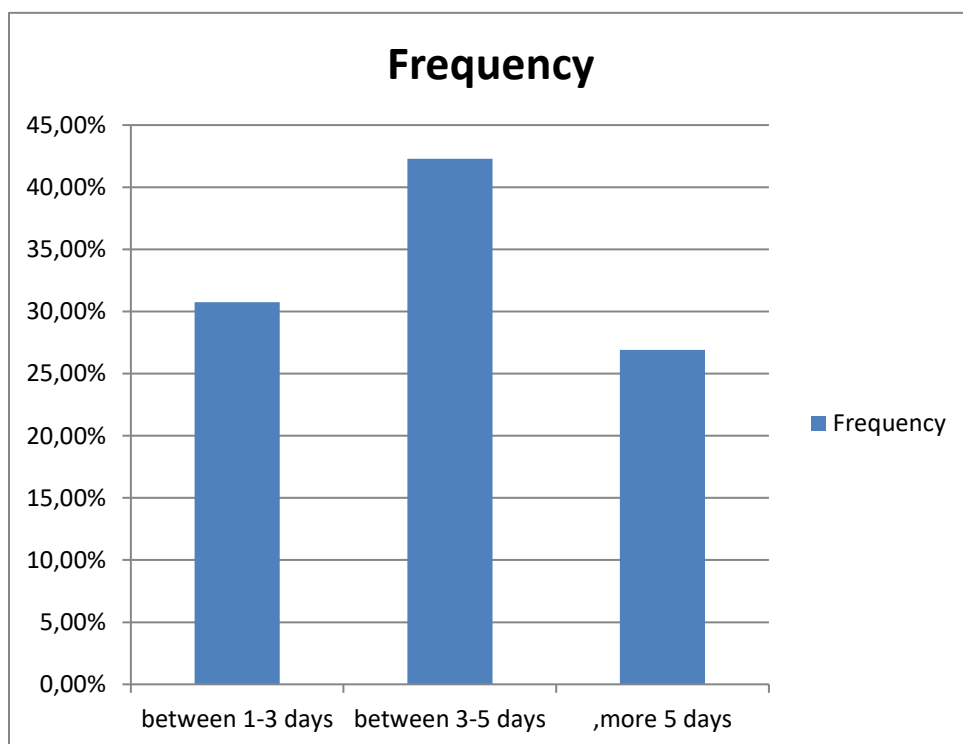


Figure 6 : Frequency of duration of antibiotic use.

DISCUSSION

The present study has allowed us to analyse the use of antibiotics in laying hen farms in the Dakar region and its periphery. It gives an idea of the trend in sales and antibiotic use practices.

The study area chosen is a privileged place for poultry farming. Indeed, it is in the division of Rufisque and Thiès that there is the greatest concentration of poultry farms, feed depots and slaughterhouses commonly known as *deplumeuses*. This area supplies more than 70% of the population of the Dakar region with eggs for consumption.

The lack of information on the list and location of farms led us to use a non-probabilistic sampling method. Indeed, we chose the technique used by Bitty (2013) during his surveys on health management and medical practices on farms in the Dakar peri-urban area.

In these farms, the number of animals has changed considerably over the last two decades. Indeed, in the study conducted by Biagui (2002), 76% of the farms had a population of less than 700; they increased in that of Niyibizi (2012), of which 68.85% are between 1,000 and 5,000. Niyibizi's results are close to those of the study with 61.42% of the farms having numbers over 5,000 birds, although some farms have disappeared with the expansion of the Dakar region.

In the present study, only farms in the main roads were selected, especially the most accessible ones, because of the lack of information on the list and location of poultry farms.

Many studies have been done on the presence of veterinary drug residues in foodstuffs throughout the world, in Africa more precisely in Togo (Tona, 2011), Senegal (Pare, 2012), Cameroon (Khaleh Wouembe, 2013) while this study aimed at relating antibiotic use practices during production to the presence of these residues in food.

In the farms visited, we noted the use of these antibiotics either as a curative treatment, often applied collectively to animals suffering from microbial diseases, or as a preventive treatment to avoid the onset of certain

pathologies or, in certain extreme cases, to compensate for inadequate hygiene on the farms, as observed by Sanders in 2005. During the survey, it was found that the level of hygiene on the farms had evolved considerably compared to the Biagui study, where 19.3% of the farms had a good level of hygiene, whereas 50% of the farms visited in our study had a good level of hygiene. This can be explained by the increase in the number of farmers, which has made it possible to obtain higher incomes, allowing farmers to afford the services of a health worker to supervise them during production. Indeed, the results of this study show that 67.71% of the farms are monitored by a veterinarian or a livestock technician. Of these supervised farms, 76.65% are in classes 2 (acceptable hygiene) and 3 (good hygiene). Of the remaining 34.29% of farms without supervision, 45.8% are in class 1 (poor hygiene). This shows that the level of hygiene is closely related to the occurrence of diseases, and therefore to the use of antibiotics.

The survey showed that antibiotics are used with or without a veterinary prescription while unchecked misuse of antibiotics can give rise to a selection of resistant bacterial strains (Bodering et al, 2017). Indeed, in 50% of the 70 farms visited, self-medication was practised, and the dosage of drugs was strictly adhered to in only 27% of farms. Farmers do not even care about the consequences of their actions, as the study showed that 4% and 19% of the farmers have knowledge of antibiotic residues and the waiting period respectively. In addition, the types of drugs used, where the Quinolone family (third generation) accounting for more than 50% of the treatments, are also of concern. These results are very worrying given the use of third generation Quinolones, especially as these are antibiotics that should not be used on laying hens of which eggs are intended for human consumption (EU Regulation 37/2010). Veterinarians who want to obtain good results, mask their diagnostic errors and avoid therapeutic failures, use these very powerful antibiotics which have a broad bacterial spectrum. These results are similar to those of Niyibizi (2012) who found that the Quinolone

family was used in 53.3% of the treatments carried out on laying hens in the Dakar region.

During the monitoring of the farms, the Polypeptide family is the most used, but it is followed by the quinolone family. Apart from these two families, tetracyclines are often used because they are very effective and broad spectrum, although their effectiveness has decreased over the last decades due to the appearance of resistance phenomena in bacteria.

In the course of this study, it was found that the major problem is the easy availability of veterinary drugs. This explains the large amount of antibiotic consumption, but this amount is much lower than that found by Dosso (2012) in Côte d'Ivoire; on the other hand, our figures are higher than that of Chevance and Moulin (2012) who found that poultry on French farms did not receive even half the amount found on the farms visited. These abusive treatments cause the selection of resistant bacteria that can pass from animals to humans, which contributes considerably to the development of human infections. This is the case of fluoroquinolone-resistant *Campylobacter* infections, which constitute a risk for human health (Van Vuuren, 2001), and enteric organisms such as *E. coli*, which also present public health risks (Guyonnet, 2004). This antibiotic resistance remains a public and animal health problem of global dimension, dependent on the use of antimicrobial agents in human and veterinary medicine and in the phytosanitary field (OIE, 2014).

Furthermore, some farmers think they are able to make their own diagnosis or by referring to their fellow farmers instead of asking for a veterinarian. In the Democratic Republic of Congo, a study showed that many herders treat their animals themselves using both modern and traditional practices (Okombe et al., 2017). This explains the very high percentage (47.42%) of antibiotic overdoses and the prolongation of the duration of treatment (26.92%) to more than 5 days. In view of these practices, the waiting periods for the presence of residues in eggs could be prolonged and go far beyond the deadlines already set. In addition, these are not respected

in any of the farms, so the consumption of these eggs probably contaminated with residues remains a major public health problem because the presence of drug residues in poultry products and by-products is detrimental to the health of consumers (Dkpoga et al., 2012). Indeed, the consumption of these residues can lead to hypersensitivity accidents or intoxications; but also to the selection of bacteria resistant to subsequent treatments (Bada Alambédji et al., 2008).

This non-respect of waiting periods by farmers is explained by the fact that many of them (96%) are unaware of the risks linked to residues but also of the economic losses linked to the rejection of eggs from hens already treated or under treatment.

Conclusion

The aim of this study was to analyse the use of antibiotics in laying hen farms in the Dakar region and its suburbs. The surveys carried out revealed a significant use of antibiotics accompanied by self-medication in 50% of the farms. In addition, 50% of the molecules used belong to the Quinolone family, which is banned for laying hens by the European Union. The study also revealed the use of antibiotics in 60% of the farms monitored for seven (7) months. The use of these antibiotics is accompanied by a failure to respect withdrawal periods. This constitutes a real public health problem because it is associated with risks of toxicity and resistance problems linked to the presence of residues in eggs. This problem of drug use and non-compliance with withdrawal times by farmers has been observed in other studies and in other African countries. The importance of these risks and the lack of data on the use of antibiotics in laying hen farms in Senegal show the need to take stock of antibiotic use practices, particularly in poultry farming. But also to complete the present study by researching antibiotic residues in marketed table eggs in order to assess the risks incurred by consumers.

AUTHORS CONTRIBUTIONS

AT contributed to the conceptualisation, data collection, formal analysis, methodology, drafting, révision and editing. SB contributed to data collection, methodology and formal analysis. KSBS contributed to révision, validation and editing. RB-A contributed to the conceptualisation, methodology, validation, editing and supervision.

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