

Antibiotics in broiler: exhaustive survey among private veterinarians in eastern Morocco

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Abstract

Antibiotics have played a major role in improving the growth performance of poultry farms. However, the massive use, sometimes abusive, of antibiotics in poultry production induces the emergence of multi-resistant bacterial strains and causes the presence of antibiotic residues in poultry products. In 2014, Moroccan poultry produced more than 534.000 tons of meat of which 7% was achieved by poultry units in the region of the east. The aim of this investigation was to evaluate the importance and characteristics of antibiotics in broiler and identify dangerous antibiotic practices in eastern Morocco. A comprehensive survey was conducted among 35 private veterinarians settled in this region. It includes 39 questions divided into three sections. Statistical analysis of the data was made by the EPI-INFOTM 7.1.4 software. The Enrofloxacin is the most prescribed antibiotic in avian medicine by 51.43% of inquired vets, followed by Colistin and Tetracyclins prescribed, respectively, by 22.86% and 14.29% of them. July and August recorded the maximum of antibiotic prescriptions in 82% of respondents. All these vets have noted avian antibiotic abuses, 94.29% of them have denounced smuggling antibiotic use. The Moroccan law governing antibiotics in poultry was considered insufficient by 68.57% and the control system was deemed inefficient by 42.86% of inquired vets. The persistence of certain dangerous antibiotic practices in poultry production should call for the competent authorities to protect public health.

Keywords: Survey; Antibiotic; Resistance; Residues; Broiler; Veterinarian; Eastern Morocco.

Introduction

In the absence of official data in Morocco, the World Health Organization (WHO) estimated that about 50% of the antibiotics (ABs) produced in Europe and North America are used in food-producing animals especially in poultry farms (WHO, 2001). Therapeutic, prophylactic and metaphylactic antibiotic uses, is of essential importance in maintaining animal health and warranting poultry production profitability (Persoons *et al.*, 2012; Laxminarayan *et al.*, 2013). This activity consumes the most of veterinary ABs. However, the massive use of ABs in poultry has been implicated in several studies in public health problems such as

the selection of multi-resistant pathogens strains and the presence of their residues in poultry products (D'Costa *et al.*, 2011; Sanders *et al.*, 2011; Kempt, 2012).

Coaching veterinary poultry farms, worldwide, is of paramount importance. It allows their health and livestock monitoring so as to ensure the food safety of poultry as well as guarantee a good return on these farms. It is up to veterinarians to ensure proper use of ABs in these farms to limit their impact on public health (Pappaioanou, 2004; Scott *et al.*, 2012).

In Morocco, there are 7,293 broiler farms and 689 turkey farms having

produced 543,000 tons of meat in 2014 (FISA, 2015). The country has 1,300 veterinarians registered in the National Veterinarians Board (ONV, 2014). The region of Eastern Morocco (EM), including 7 provinces, spreads over an area of 82,820 km² with a population of 2,310,392 inhabitants recorded in 2014 according to the Moroccan High Commission for Planning (HCP, 2015). It is home for 500 broiler farms authorized by the National Office of Food Products Safety (ONSSA) with a total capacity of 5,567,900 chicks and providing 7% of the national production of white meat (FISA, 2015).

Such farms are supervised by 57 vets, including 35 ones practicing in the private sector as part of health contracts

Materials and methods

The study interested comprehensively all of 35 private vets in EM registered in the Veterinarians Moroccan Board (VMB) on December 31st, 2013 (ONV, 2014). Only four vets did not participate in this investigation, two of whom were unreachable and two others refused to cooperate without giving reasons. However, four other vets installed in Guercif (adjacent province of EM) and supervise some poultry farms in EM were asked to take part in this survey and their answers were accepted. The total number of vets responding to this survey was 35 ones.

The survey was conducted over a period of 18 months from 1st July 2012 to 31st December 2013. The questionnaire has

Results

Experience of inquired vets in avian medicine

The geographic distribution of private vets in the region of EM knows a disorder. Indeed, the axis of great cities Oujda-Nador-Berkane totaled 57.14% of vets while Drouich, Taourirt, Jerada and Figuig have only 42.86% of the total number of private vets in this region. Most

(HC) and 22 public vets ensure control of legal compliance (ONV, 2014).

The present study aims to evaluate the importance and uniqueness of ABs in poultry production in EM and to update on some dangerous antibiotic practices. This is a comprehensive survey, led for the first time, with all private vets in EM. This survey will serve as a pilot study at the national level for monitoring and controlling therapeutic practices in poultry. It is part of a more comprehensive research work which focuses on antimicrobial resistance in commensally bacteria in poultry and antibiotic residues in food producing animals. It is thus the first link in a series of scientific articles that will be published shortly.

undergone several improvements in collaboration with a dozen vets before obtaining the final version which has 39 different questions. Responses were collected from inquired vets (IVs) by a public vet (first author).

The data was gathered into three different categories:

- Experience of inquired vets in avian medicine;
- Therapeutic practices in poultry farmers;
- Conduct of antibiotics in poultry production in the regional context.

A descriptive analysis of all variables was performed by the EPI-INFOTM 7.1.4 software. Missing values were not included in the rate calculation.

of them are young vets: 65.71% are under 45 years old and only 8.57% are over 60. In terms of required experience, 34.29% of vets have less than 10 years of professional activity in the private sector against 17.14% who are over 25 years of experience.

Avian medicine is the main activity (activity A) in 25.71% of IVs, a secondary

activity (activity B) in 48.57% and rare or absent (activity C) in the remaining 25.71%. Exercise in organized working group was adopted by 28.57% of IVs. For the rest, 71.43% work individually. There are 20% of vets who regularly attend specific training in avian medicine against 54.29% who do so occasionally. The remaining 25.71% have never done. As for the non-specific continuing training, it is followed by 85.71% of IVs.

During the period of the survey, 74.29% of private vets in EM had HC for framing poultry farms, 17.14% have never had HC and 8.57% remaining have broken their HC. Table 1 reports the main competitive private vets in EM in terms of ABs sales announced by IVs. Indeed, smugglers are accused by 94.29%, chemists by 54.29%, chicks' dealers by 37.14% and livestock technicians by 28.57%. These vets also reported the sale of veterinary ABs by traditional market traders (14.29%). On the other hand, 74.29% of IVs claim that they face competition in their areas of action by other vets settled in far remote areas. In addition to competition by smugglers, the sale of ABs by chicks' dealers was denounced by 77.78% of vets with activity A.

Therapeutic practices in poultry farmers

All IVs with HC (100%) claim to have already found an abuse of ABs use. Table 2 shows the observed rates of private vets in EM having noticed some abuses of avian ABs in poultry farmers framed by HC. Among these abuses, there is self-medication, buying ABs by vets and chemists (outside the HC without prescription) and the use of smuggled ABs reported respectively by 96.55%, 93.11% and 89.66%. The non-respect of the ABs withdrawal period and its use without authorization to market for avian are reported respectively by 72.41% and 55.17% of IVs.

Self-medication, supply outside the HC and the use of smuggling ABs remain the most abuse recorded by these vets. Thus, 82.75% said that more than 50% of their customers resort to self-medication; 72.41% said that more 50% of their customers purchase ABs from other suppliers; 55.17% said that more 50% of their customers use smuggling ABs and 31.03% report that over 50% of their customers do not respect ABs withdrawal period.

In the presence of such practices, 75.86% of IVs have already broken their HC with unruly poultry farmers. The most important reasons pushing poultry farmers to adopt these dangerous practices are: Predominance of economic profitability, Ignorance of the antibiotics danger and Ignorance of the avian antibiotics legislation. Despite the recognition of these abuses, only 48.57% of IVs conducted a legal denunciation yet 82.35% have not had a positive response.

In terms of legislation governing the antibiotic poultry in Morocco, it is deemed sufficient by 31.43%, insufficient by 42.86% and very insufficient by 25.71%. When the public control (by Office National de Sécurité Sanitaire des Aliments: ONSSA) of avian ABs use, it is considered sufficient (11.43%), insufficient (51.43%), very insufficient (37.14%), effective (11.43%), less effective (42.86%) and ineffective (45.71%).

Conduct of antibiotics in poultry production in the regional context

When asked about the effect of sanitation on the consumption of ABs, 97.14% of IVs said that control of hygiene in poultry farms minimizes the use of ABs especially their preventive use. However, 60% of them continue to prescribe these ABs preventively in broiler of which 57.14% do it in the starting phase, 20% do it the feeding phase (growth) and 2.86% do it in the finishing phase. However, the use of ABs in poultry is not regular in the year. Indeed, 82.86% of IVs reported that during

Table 1. Competitors in veterinarian antibiotics sales according to private vets in Eastern Morocco Smugglers.

Competitors	Vets			Total (n=35)
	A (n=9)	B (n=17)	C (n=9)	
Smugglers	100	94.12	88.89	94.29
Chemists	55.56	47.06	66.67	54.29
Chicks' dealers	77.78	29.41	11.11	37.14
Livestock technicians	22.22	29.41	33.33	28.57
Traditional market traders	0	11.76	33.33	14.29
Public Vets	11.11	0	0	2.86

These percentages are obtained from inquired vets with avian medicine is A: Main, B: Secondary, C: Rare or absent here.

July and August records the highest ABs prescriptions in broiler. Against by 17.14% of them say that it was during winter (December and January) when more ABs are prescribed. Figure 1 shows the months with strong prescriptions of ABs in broiler according to IVs.

The use of Antibiotics Growth Factors (AGF) in broiler is very limited. Indeed, 71.43% of IVs do not use this practice, 11.43% do it in the

Table 2. Percentages of private vets in Eastern Morocco have seen some abuses of avian antibiotics in their customers within the health contracts.

Abuses	Percentages of poultry farmers (estimated by inquired vets)									
	≥ 10%	≥ 20%	≥ 30%	≥ 40%	≥ 50%	≥ 60%	≥ 70%	≥ 80%	≥ 90%	100%
A	96.55	96.55	89.66	86.21	82.75	75.85	65.51	55.17	34.48	20.69
B	93.11	86.21	79.31	72.41	72.41	58.62	55.17	48.27	34.48	20.69
C	89.66	75.86	68.97	58.62	55.17*	44.83	41.38	34.48	17.24	10.34
D	72.41	62.07	51.72	37.93	31.03	24.14	20.69	13.79	13.79	3.45
E	55.17	44.83	31.03	17.24	10.34	10.34	10.34	3.45	3.45	0

A, Self-medication. **B**, Purchase of antibiotics from chemists and vets (outside the health contract without prescription). **C**, Use of smuggling antibiotics. **D**, Non-respect of withdrawal periods. **E**, Use of antibiotics out of authorization to market for poultry.

* Example: 55.17% of inquired vets estimate that more than 50% of their customers use smuggling antibiotics.

starting phase, 14.29% do it in the feeding phase (growth) and 2.86% do it in the finishing phase.

Although all vets (100%) claim to have had treatment failure, 34.29% of them have never resorted to susceptibility tests. One vet do it systematically before each therapy, while 34.86% said they do it in consultation with poultry farmers and 37.14% do it after treatment failure. Only 22.86% of them allow for susceptibility test controlling one day-old chicks.

The sale of ABs (all species) is less than 50% of turnover in 88.57% of IVs with 77.14% making less than 30% of their

revenue from the sale of avian ABs. Only two vets (5.71%) who achieve more than half of their turnover from the avian ABs sales. Among a range of ABs on the market, Enrofloxacin remains the best selling avian ABs for 51.43%, then comes Colistin for 22.86% and last Tetracyclins for 14.29%. Tables 3 and 4 show the therapeutic preferences in various poultry pathological cases declared by IVs.

Enrofloxacin is preferred as the first antibiotic choice in respiratory diseases for 65.71%. This antibiotic is prescribed by 42.86% in cases of associated digestive and respiratory symptoms. Colistin finds

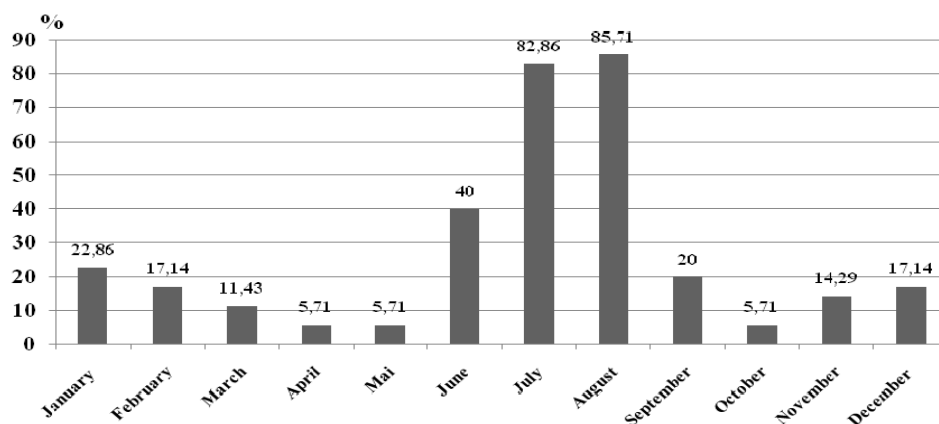


Figure 1. Seasonality of high periods of antibiotic prescription in broiler according to private vets in Eastern Morocco.

Table 3. Percentage of antibiotic prescriptions in various pathological cases in broiler according to private vets in eastern Morocco.

Symptoms	Enr	Col	Flor	Sul	Tet	Amx	Tyl	Neo
Digestive symptoms	0	68.57	0	14.29	8.57	2.86	2.86	2.86
Respiratory symptoms	65.71	2.86	11.43	0	2.86	8.57	2.86	0
Both digestive and respiratory symptoms	42.86	2.86	31.43	0	2.86	2.86	0	0
Mortality without pathognomonic symptoms	20	5.71	37.14	0	0	0	0	0
Salmonellosis	0	8.57	8.57	14.29	5.71	0	0	0
Colibacillosis	11.43	54.29	8.57	5.71	8.57	0	2.86	0
The most prescribed antibiotic	51.43	22.86	5.71	2.86	14.29	2.86	0	0

Symptoms	Tilm	Ery	Mul	Fos	T+A	C+E	Susc	Tot
Digestive symptoms	0	0	0	0	0	0	0	100
Respiratory symptoms	0	5.71	0	0	0	0	0	100
Both digestive and respiratory symptoms	0	2.86	2.86	0	2.86	8.57	0	100
Mortality without pathognomonic symptoms	2.86	2.86	2.86	2.86	0	0	25.71	100
Salmonellosis	0	0	0	0	0	0	62.86	100
Colibacillosis	0	2.86	0	0	0	0	5.71	100
The most prescribed antibiotic	0	0	0	0	0	0	0	100

Enr, Enrofloxacin; **Col**, Colistin; **Flor**, Florfenicol; **Sul**, Sulfonamides+Trimethoprim; **Tet**, Tetracyclins; **Amx**, Amoxicillin; **Tyl**, Tylosin; **Neo**, Neomycin; **Tilm**, Tilmicosin; **Ery**, Erythromycin; **Mul**, Multicin; **Fos**, Fosfomicin; **T+A**, Tylosin+Amoxicillin; **C+E**, Colistin+Enrofloxacin; **Susc**, Susceptibility.

its place as a first antibiotic choice in digestive diseases for 68.57% of IVs. However, in the absence of pathognomonic symptoms, Florfenicol remains the first antibiotic choice for 37.14% of IVs. These three molecules are also the first therapeutic choice for vets with activity A

in the above pathological cases. In cases of more serious diseases such as salmonellosis, 62.86% of IVs rely on susceptibility testing before making a therapeutic choice while in cases of colibacillosis, 54.29% of them rely on Colistin.

Table 4. Antibiotics preferences in avian therapy according to private vets in Eastern Morocco.

Digestive symptoms (n=35)		Respiratory symptoms (n=35)		Both digestive and respiratory symptoms (n=35)		Mortality without pathognomonic symptoms (n=35)		
1st Antibiotic choice								
1°	Colistin	68.57	Enrofloxacin	65.71	Enrofloxacin	42.86	Florfenicol	37.14
2°	Sulfonamides+TMP	14.29	Florfenicol	11.43	Florfenicol	31.43	Susceptibility	25.71
3°	Oxytetracyclin	8.57	Amoxicillin	8.57	Colistin+ Enrofloxacin	8.57	Enrofloxacin	20
2nd Antibiotic choice								
1°	Sulfonamides+TMP	31.43	Amoxicillin	45.71	Enrofloxacin	20	Susceptibility	42.86
2°	Tetracyclines	17.14	Enrofloxacin	20	Florfenicol	17.14	Florfenicol	22.86
3°	Colistin	14.29	Doxycyclin	11.43	Colistin	14.29	Enrofloxacin	17.14
3rd antibiotic choice								
1°	Tetracyclines	25.71	Florfenicol	40	Colistin	20	Susceptibility	48.57
2°	Sulfonamides+TMP	22.86	Amoxicillin	8.57	Susceptibility	17.14	Amoxicillin	14.29
3°	Enrofloxacin	11.43	Neomycin	5.71	Susceptibility	14.29	Florfenicol	8.57

Discussion

In Morocco, monitoring the consumption of avian ABs is very difficult. Indeed, the information gathered from the pharmaceutical companies is not always reliable and drug specialties are, in most cases, destined for several species at the same time. In addition to that, the large influx of smuggled ABs across Moroccan-Algerian borders really distorts all official data. This kind of investigations is very rare in Morocco. Indeed, we found only two similar works. The first one was conducted by Zouiten (2006) among 40 private vets settled in different regions of Morocco concerning anthelmintics use in sheep and horses. Jouahri (2002) conducted a non-exhaustive survey among a sample of 10 private vets settled in EM where he investigated about antibiotics used in avian colibacillosis.

The density index of veterinarians in EM is poor: 1 vet per 3.500 inhabitants compared to the national average of 1 vet per 2.300 inhabitants (ONV, 2014). This population of private vets, relatively young, has little experience in framing poultry farms.

Exercise within an organized group allows members to benefit in continuing training especially in avian medicine, to unify their treatment protocols and finally improve poultry livestock strategies. Only

a minority of inquired vets have believed in this concept, which explains, in part, the low further follow-up rates training in avian medicine.

In the absence of specialists in avian medicine, vets (general practitioners) are called upon to intervene in different disciplines at the same time. Thus, vets who have avian medicine as a main activity (activity A) have acquired considerable experience especially in health framing of poultry farms. Those vets are linked to poultry farms by HCs whose number may exceed 100 HCs per vet. This overload of coaching which is not regulated in Morocco raises a question about the quality of supervision of these farms.

The share of ABs in the turnover of vets in EM remains rather low. This can be explained by the predominance of sheep farms in this agro-pastoral region which use more antiparasitics than antibiotics. However, the investigation revealed that the sale of veterinarian ABs is often done without prescriptions namely from Chemists, livestock technicians, traditional market traders, smugglers, chicks' dealers, etc.

In the absence of a health card which determines a vet's responsibility over a specific area, we are face to what

we may call chaos in the field of poultry framing. Thus, 74.29% of IVs say they face competition in their areas of action by other vets settled in other remote areas. That is, in part, why some vets are unable to get HC to supervise poultry farms. Therefore, vets cannot control abusive treatment practices made by their clients.

Inquired vets are aware of the importance of hygiene practices to reduce the use of ABs in poultry production. This is consistent with the study conducted by Persoons *et al.* (2012). However, lack of hygiene in poultry farms is most often wrongly substituted by the massive use of ABs whose use reveals many failures. These bad practices lead to real danger to public health by the selection of multi-resistant bacterial strains and the accumulation of antibiotic residues in food products of poultry origin (D'Costa *et al.*, 2011; Croubels, 2012; Kempf & Zeitouni, 2012).

The preventive ABs use compensates rundown premises and lack of hygiene found in some farms and also avoid mortality. It can be justified both in the starting phase and the feeding phase. While in the finishing phase, the risk of non-respect of ABs withdrawal periods remains very high. However, the majority of inquired vets do not prescribe AGF. Unlike USA, where many AGF are still used, EU banned its use since 2006 (Chevalier & Dutil, 2012). The ban was rewarded by renewed bacterial susceptibility vis-à-vis several antibiotics namely Avilamycin and Streptogramins (Sanders *et al.*, 2011).

Preserving farming profitability remains the underlying reason why poultry farmers still abuse antibiotic therapy. Faced with these hazardous abuses, some vets prefer to break their HC with malicious farmers. Denunciation is not always favored for fear that vets should lose their customers or because they are sure the repression system is inefficient.

Avian antibiotic therapy in EM is characterized by four main criteria: a peak of ABs use in Summer, self-medication, massive use of smuggling ABs and high requirement of Enrofloxacin. Indeed, the geographic location of this border region encourages poultry farmers to use smuggling ABs and self-medication. The summer peak of ABs prescriptions can be explained by high levels of poultry production during this season due to a high demand for weddings and for returning migrants. Enrofloxacin remains the best selling antibiotic in poultry use, especially for respiratory diseases. As for digestive diseases, Colistine is much prescribed.

Enrofloxacin is the most used avian antibiotic. It is characterized by its bactericidal activity with a low Minimal Inhibitory Concentration (MIC) for many bacteria (Protogeraki *et al.*, 2014). In broiler, it is absorbed very quickly and widely distributed in the body reducing the mortality associated with *E. coli* and *Mycoplasma* (Morales-Gutiérrez *et al.*, 2015). However, its massive use could lead to cross-resistance to other Quinolones used in human therapy (Cattoir, 2012).

Colistin is an antibiotic that acts mainly on gram-negative bacteria especially *E. coli*, *Salmonella* and *Campylobacter* (Jian *et al.*, 2006). It is strongly indicated in cases of colibacillosis and salmonellosis. Due to its low intestinal absorption, oral administration is restricted to enteric infections while its parenteral administration is reserved only for infections caused by multidrug-resistant bacteria (Abdennebi, 2006).

Following the massive use of ABs for more than 60 years in human medicine and in intensive farming, antibiotic resistance has become a very worrying phenomenon (Struelens *et al.*, 2007). It causes treatment failure, increases costs of health system and raises morbidity (Weiss, 2002). Vets in EM are also suffering from this problem but they do not seek to limit their treatment failure by resorting to susceptibility testing. This can be

explained first by the limited number of specialized laboratories (2 privates and 2 publics) and also by the urgency of antibiotic therapy which cannot support the two days before obtaining susceptibility results. However, preventative actions in such cases as the control of one day-old chicks are not common.

Clinicians exhaust their therapeutic arsenal face to more resistant germs, while the development and commercialization of new molecules with antibiotic activity are almost dried up in the last twenty years (Struelens *et al.*, 2007). Thus, it is imperative to streamline veterinarian ABs use to prevent public health problems. This rationalization must go with reducing and monitoring their use (FAO, 2007; Sanders *et al.*, 2011), the prohibition of their metaphylactic and prophylactic use in poultry (WHO, 2001), more firm control to prevent transmitted diseases, antimicrobial resistance monitoring (Struelens *et al.*, 2007), unification of treatment protocols in

intensive farming through the introduction of antibiotic therapy cycles and the development of more immunogenic vaccines against the predominant infectious agents (Weiss, 2002). However, legislation and control of poultry ABs which is considered insufficient and ineffective by inquired vets must be strengthened to support these efforts.

In this study, we find that private vets in EM are powerless against these ABs dangerous practices. They should be integrated into a monitoring network where they can synchronize their efforts to better control these practices. Fighting against smuggling, establishing a health card, limiting the number of HC by vets, increasing state control, monitoring of ABs consumption, monitoring of multidrug-resistant bacteria and sensitization of various intervening elements in the poultry industry in best practices of ABs could relatively reduce the danger associated with ABs use in poultry.

Conclusion

All private vets in Eastern Morocco say they have found abusive practices in avian antibiotics. Smuggling antibiotic use, self-medication and non-respect of antibiotics withdrawal period remain the most dangerous practices that have been identified by this survey. Intensive use of Enrofloxacin in broiler is also a serious danger for public health. These practices are contested by several authors in the selection of multi-resistant bacterial strains and the accumulation of antibiotic residues in poultry products. This survey will serve as a pilot study for monitoring the use of veterinary antibiotics and their residues in food producing animals in Morocco. The

results should call the authorities to double vigilance to strengthen supervision and control over the use of antibiotics in intensive farming.

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