Original Article

Prevalence and knowledge of antibiotics misuse and resistance in poultry and livestock in Khartoum State - Sudan

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Abstract

Introduction: The irrational use of antibiotics could be noticed during prescribing and dispensing of antibiotics or when the drug is misused by the patients themselves. Misuse is also noticed at veterinary practice related to/or in food production of animal source. The vast majority of livestock antibiotics are used not only for therapeutic purposes but also for prophylaxis and enhancement of growth. **Objective:** The objective of this study is to investigate the prevalence of antibiotic misuse and resistance in Khartoum state, and to assess the knowledge and awareness of poultry producers and consumers regarding the production and hygiene of animal-derived foods. **Methodology:** A descriptive, analytical, observational, cross-sectional study was done in Khartoum. The study covered 130 poultry producers and 130 consumers of poultry meats. The data were collected using two sets of structured interviews one for poultry producers and veterinary workers and the other for consumers of poultry meat to obtain information on the use of antibiotics for animals and the perception about the induced antibiotic resistance in humans due to misuse of veterinary antibiotics in poultry. Furthermore, clinical laboratories were visited to obtain the information about the cases resistant to antibiotics. **Results:** This study reveals that 48% of the producers were found using antibiotics for medical treatment, 37% used antibiotics for prophylaxis, and 8% used antibiotics together with other interventions to stimulate growth and gain weight for their livestock. As for butchering, 68% of the producers agreed that the production department always commits to slaughtering regulation. However, 48% of the participants claim that the marketing department interferes with the veterinary department decisions in a way that is not consistent with the slaughtering or production control measures. This interference is the major cause of the implications that accompany the production finishing process. As a result of this irrational practice, the resistant types of pathogens in human have been found as follows, 95% resistant to co-trimoxazole, 89% to norfloxacin, 81% to cephalexin, 75% to tetracycline, 69% to pefloxacin, 65% to nalidixic acid, 59% to ciprofloxacin, and 46% resistant to ofloxacin. Most of the consumers have good knowledge about chemicals additives given to food-producing animals. They are also quite aware that the irrational use of these chemicals can lead to negative effects on human's health. **Discussion:** Wide ranges of antibiotics, belonging to different classes of drugs were applied. It is perceived that these antibiotics are used also in humans, sub-therapeutic doses or traces of these antibiotics might reach healthy humans by the food chain which gives a chance to the resistant strain of bacteria to develop, or might cause allergic reactions to

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susceptible individuals. High resistant rates to antibiotics were observed**.** It is obvious that antibiotics are used for treatment and prophylaxis as well as growth promoter in the absence of clear protocols to treat food animals or authorities to control this irrational behavior. **Conclusion:** Relying heavily on antibiotics to ensure medical, nutritional, and economic security will simultaneously reduce their usefulness with overuse and ill-advised use. There is high awareness about antibiotic resistance arises in animal husbandry among animal producers and consumers, but there is no national measures against this growing problem of "antibiotic resistance."

Key words: Antibiotics, humans, misuse, poultry, regulations, resistance

INTRODUCTION

The use of antibiotics in animal feed to promote the healthy growth of animals raised for food began in the late 1950s without any investigation for the potential consequences of the antibiotic use.[1] It has been observed that animals whose feed was treated with antibiotics grew larger than those without antibiotics. "The antibiotic growth effect," and this observation has not been fully explained, and a few published studies have dealt with the legitimacy of these observations. Despite the tenuous nature of the antibiotic growth effect, the vast majority of livestock antibiotics are used not only for therapeutic purposes but also for prophylaxis and enhancement of growth. These uses involve different classes of drugs applied at different doses, and their relative importance and methods of implementation vary in different parts of the world. The sub-therapeutic use of antibiotic as growth promoters at a large scale for longer periods to increase production and to reduce cost came under heavy criticism.[2] This indiscriminate dosing results in the transfer of an animal into a good reservoir for antibiotic-resistant infections. These resistant organisms are then passed to humans when the animals are slaughtered and finally presented as food.[3]

Global concern at the present time is arising about the misuse of veterinary preparations, and its effects on food-producing animals and human's health, particularly with respect to the issue of antibiotics resistance in humans.[1] A substantial share of antimicrobial consumption is attributed to animal production. Global meat production in 2012 was 304 million tons with average annual meat consumption of 42.9 kg/person.[4] Recent findings conservatively estimate that the total consumption of antibiotics in 2010 at 63151 (±1560) tons.[5] Antimicrobial consumption is projected to rise by 67% to 105596 (±3605) tons by 2030, and by nearly double in the countries (Brazil, Russia, India, China, and South Africa.). Consumption in hotspots like India is expected to grow by 312% by 2030 and is likely to be driven by the growth in consumer demand for livestock products in middle-income countries and a shift to large-scale farms where antimicrobials are used routinely.[5] In developing countries, misuse of antibiotics in food-producing animals represents a major public health issue today. Agricultural practices in developing countries have a higher dependency on antibiotics because of a more disease-prone environment and lower levels of biosecurity than developed countries.[6]

In Sudan, the problem of antibiotics transferred resistance is expected to be worsened as a result of the increased investments in poultry massive farming, particularly in the absence of well-established regulations and guidelines that govern, regulate, and control the use of veterinary preparations. Moreover, the poor economical status of a sizeable portion of the Sudanese population drives them to search for economical or cheaper sources of animal proteins. Thus, poultry products are expected to represent the major alternative in that regard.

Humans misuse antibiotics in three distinctive ways: medical use, the antibacterial hygiene products, and the veterinary or food animal production. This study focuses on the veterinary and food animal production settings. The objective of this study is to investigate the prevalence of antibiotic resistance in Khartoum state, and to assess the knowledge and awareness of poultry producers and consumers regarding the production and hygiene of animal-derived foods.

METHODOLOGY

A descriptive, analytical, observational, cross-sectional study was done in Khartoum State, during April 2013–February 2014, including 130 poultry farms (companies) working staff (veterinary workers), 130 clinical laboratories/technicians and 130 consumers of poultry meat. The sample was selected using a nonrandom convenient sampling method.

The data were collected using two sets of structured questionnaires one for poultry producers and veterinary workers and the other for consumers of poultry meat. Poultry producers and veterinary workers were interviewed to assess their use of antibiotics in the production of

poultry and their awareness of antibiotic resistance. Consumers were interviewed to assess their knowledge regarding the hygiene of animal-derived foods and dietary habits. Data collection forms were designed for clinical laboratories technicians to indicate the most antibiotics induced resistance in humans, due to misuse of veterinary antibiotics in livestock and poultry. The data collected were analyzed using SPSS 169(UNICOM GLOBAL SYSTEMS, Inc.)($P \geq 0.05$) and Microsoft Excel.

RESULTS

For poultry producer's survey, Table 1 shows the demographic data of the poultry producers and veterinary workers participated in the study. 83% of poultry producers and veterinary workers interviewed stated that they were using antibiotics in their practice. Asking for the purpose using antibiotics, 48% of the producers for medical treatment, 37% for prophylaxis, 8% using antibiotics together with other interventions to stimulate growth and increase the weight of their livestock, and 7% for other different reasons. For medical treatment and prophylaxis the most important diseases that afflict the bird from 1 day old until the age of maturation (slaughtered) were chronic respiratory disease (CRD), Salmonellosis, Gambro, and *Escherichia coli* (46%, 37%, 17%, and 15%), respectively.

Table 1: Demographic data of product producers study population

Demographic data	*n* (%)
Respondents	130 (100)
Occupation	
Veterinarian	56 (43.8)
Farmer	54 (41.5)
General manager	11 (8.5)
Other	9 (6.2)
Underserved employer	
Governmental sector	22 (17)
Private sector	86 (66)
Small-scale production	22 (17)
Years of experience	
>2	37 (28)
2-5	93 (72)
6-9	10 (8)
>9	45 (35)
Specialization	
Feed and nutrition department	26 (20)
Microbiology and prevention	28 (21.5)
Advertising marketing	20 (15.3)
Administration sector	56 (43.2)
Average size of the production/year	
Small-scale production	13 (10)
Medium-scale production	15 (12)
Large-scale production	30 (23)
Do not know	72 (55)
Purpose of the production	
Table egg production	49 (38)
Broilers production	55 (42)
Table egg production and broilers production	26 (20)

Erythromycin and Tylosin were the most antibiotic used (17%), followed by Neomycin (15%). Figure 1 shows the details of antibiotics which usually used in poultry.

The distribution of antibiotic sensitivity among different patients obtained from clinical laboratories records showed that there is a significant variation of the sensitivity to bacteria especially for the fluoroquinolones, tetracyclines, and cephalosporins classes with lower sensitivity to microbes compared to other antibiotics [Figure 2].

As for butchering, 68% of the producers agreed that the production department adheres to slaughtering regulation. Fifty-two percent of the interviewees agreed that the veterinary department in farms always make their decisions in terms of production and the health of the carcass without pressures by the marketing department while 48% of them claim that the marketing department interferes with the veterinary department decisions; in a way that is not consistent with the slaughtering or production control measures. This interference stands to be the major cause underlying the implications accompanying the production finishing process.

The poultry producers, when investigated about the practices in poultry production, showed that 78% of the participants agreed that there is a known therapeutic protocol for the prevention of bacterial diseases, but only 39% do follow these protocols in healthy and diseased birds. 92% of the participants agreed that there are slaughtering regulations during the treatment period, and about 68% agreed that the production department adheres to slaughtering regulation even in cases of high market demand for the product. About 74% of the participants agreed that they do consume the farm products in which they work.

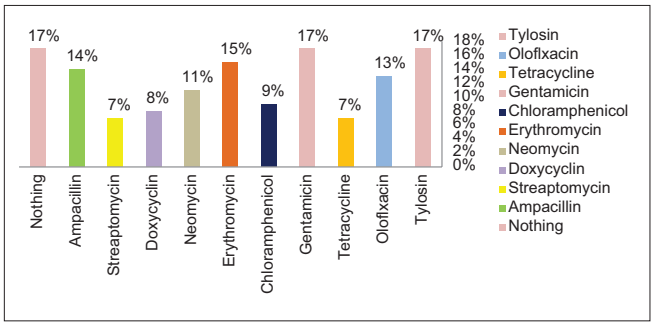

Figure 1: Types of antibiotics used in poultry

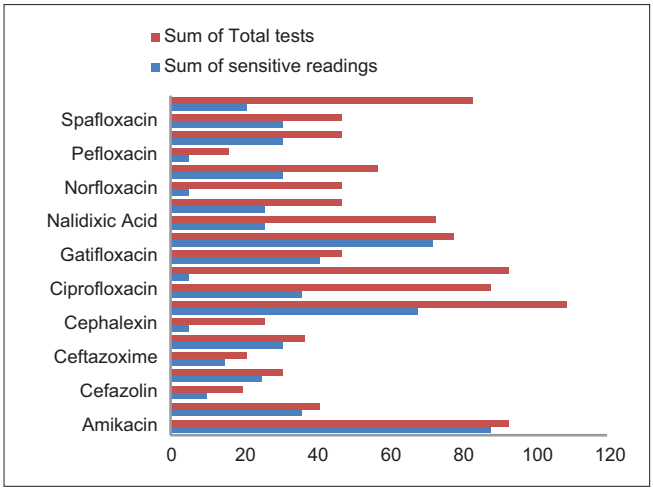

Figure 2: The distribution of antibiotic sensitivity among different patients obtained from clinical laboratories record

The opinions about the role of the Ministry of Agriculture and the regulatory bodies regarding the control and regulation of the poultry industry showed that 27% of the participants stated that Ministry have a role, quality control (11%), and drug control departments (8%), while the rest indicated no role.

For consumers survey, Table 2 shows the demographic background about the consumers' sample population participate in the study.

The results described in Table 2 show that 77 (58%) of the interviewees consume 3–5 kg/person/month, 29 (23%) consumes 6–10 kg, 18 (14%) consumes 11–20 kg, and 6 (5%) were consume more than 20 kg/person/month. Ninety-two (71%) of the consumers think that production of poultry meat in Sudan find the same attention of red meat regarding the production control and inspection of health and hygiene of the workers and slaughters and slaughterhouses and also on-going follow-up.

Investigating the consumers' knowledge and awareness of the interviewed when they are buying poultry shows that 114 (88%) of the participants buy a well-known product and ask and investigate about the producing company and 110 (85%) of the participants are aware of that poultry and other food animals are given chemicals such as antibiotics. Furthermore, 102 (79%) of the participants knew that one of the reasons of antibiotic resistance is the use of antibiotics which is not rational in poultry and food-producing animals. There was a significant statistical association between age, education, occupation of respondents, and their awareness of the use of chemicals such as antibiotics in poultry and also between sex, occupation, and their knowledge that it is one of the reasons of antibiotic resistance ($P \geq 0.05$).

Table 2: Demographic data of consumers study population

Demographic data	*n* (%)
Respondents	130 (100)
Sex	
Male	108 (83)
Age (years)	
>20	13 (10)
20-30	26 (20)
30-40	47 (28)
40-50	22 (21)
>50	22 (21)
Marital status	
Single	37 (28)
Married	93 (72)
Educational level	
Primary	10 (8)
Secondary	45 (35)
University	57 (51)
Higher studies	18 (14)
Occupation	
Clerk	13 (23)
Labor	14 (11)
Medical-related job	9 (6)
Housekeeper	7 (5)
Other	69 (55)
Number of family members	
1 person	15 (12)
2 persons	4 (3)
3 persons	12 (9)
4 persons	12 (9)
5 persons	18 (14)
>6 persons	69 (55)
Monthly income (£)	
<600	36 (28)
600-900	39 (30)
900-1500	40 (31)
>1500	15 (11)

DISCUSSION

The objective of this study is to investigate the prevalence of antibiotic resistance, by surveying clinical laboratories in Khartoum state, and to assess the knowledge and awareness of poultry producers and consumers regarding the production and hygiene of animal derived foods.

Participants stated that they use various types of antibiotics in poultry, that involve different classes, namely, "ofloxacin, streptomycin, doxycycline, gentamicin, neomycin, erythromycin, ampicillin, chloramphenicol, and tetracycline," ranging from 7% to 17% [Figure 1]. It is perceived that these antibiotics are used also in humans, sub-therapeutic doses or traces of these antibiotics might reach healthy humans by the food chain which gives a chance to the resistant strain of bacteria to develop, or might cause allergic reactions to

susceptible individuals. Reported international studies show that improvement in feed efficiency and growth rates of pig, poultry, and cattle fed sub-therapeutic antimicrobials were as high as 5%–15%, and there is substantial variability in the growth response to sub-therapeutic antimicrobials.[7-10] Regional studies support that high incidence of antibiotics residues (e.g., oxytetracycline, tetracycline, chlorotetracycline, and doxycycline sulfonamides and trimethoprim, nitrofurans, aminoglycosides, β-lactams, and quinolones) in fresh chicken samples (meat and liver) and in food-producing animals.[11-16] A local study showed that the most commonly used antibiotics by farmers in Khartoum are quinolones and tetracyclines. The majority of farmers use antibiotics for prevention and control of disease; only 5% of farmers use antibiotics for livestock health maintenance.[17] High resistant rates to antibiotics were observed to co-trimoxazole (95%), norfloxacin (89%), cephalexin (81%), tetracycline (75%), pefloxacin (69%), nalidixic acid (65%), ciprofloxacin (59%), and ofloxacin (56%). As observed norfloxacin, pefloxacin, nalidixic acid, ciprofloxacin, and ofloxacin all of which are quinolone derivatives; the importance of these antibiotics comes from its use in veterinary as well as humans (except for pefloxacin but still structurally related). There is a high correlation between veterinary antimicrobial use and antimicrobial resistance in food-producing pigs, poultry, and cattle.[5] There is growing consensus that specific medically important classes of antimicrobial, in particular, the critically important antimicrobials classified by the WHO with the highest priority to human medicine should be restricted[18] It is obvious that antibiotics are used for treatment and prophylaxis as well as growth promoters. This practice gives an insight picture to what's happening inside farms, especially those farms that lack veterinary supervision. Farmers there, get their information about anti-infective agents from each other. Moreover, self-medication is very common due to acquiring of drugs without authorized prescriptions. Another important factor is the absence of a clear and active role of the authorities to govern and regulate the use of these hazardous substances. The absence of clear protocols to treat food animals in addition to the availability of veterinary drugs without prescription opens the door widely to the emergence of antibiotic resistance and many hazards to be raised, as reported by Eltayb A *et al*. Antibiotics in Sudan, can be obtained from pharmacies without a prescription, resulting in a high level of self-medication and probably antibiotic resistance.[17]

Almost half of the participants (producers) claim that the marketing department interferes with the veterinary department decisions concerning the slaughtering timing even in cases where drug withdrawal period is not due. The finding concerning the marketing department reveals a serious unjustifiable interference of this department in affairs pertaining to the technical veterinary department. Slaughtering decisions, after a grace period, allowing for enough time of the drug withdrawal process to take place, and finished product packaging are the sole responsibility of the veterinary department.

The consumption rates to the majority of the interviewee's sample 36–60 kg/person/year which reflect the huge reliance on poultry meats in the diet which resembles the global annual consumption with average of 42.9 kg per person.[4] It is worth mentioning that the majority of consumers are aware that poultry and other food animals are given antibiotics and it is one of the reasons of antibiotic resistance but they do not know that the state's authorities intervention is lacking as regards the above mentioned irrational behaviors, and are not involved in the production processes, such as feed additives, authorized, or nonauthorized drugs use, and vaccines…. Authorities' supervision is confined only to slaughtering workers' hygiene and meat inspection.

CONCLUSION

Different classes of antibiotics were used for treatment and prophylaxis as well as growth promoters with the absence of a clear and strict role from the authorities to govern and regulate the use of these hazardous substances. We are relying more heavily on antibiotics to ensure medical, nutritional, and economic security while simultaneously causing the decline of their usefulness with overuse and ill-advised use. There is high awareness of antibiotic resistance arising in animal husbandry among animal producers and consumers, but there is no national measures against this growing problem of "antibiotic resistance." Three principle measures could be applied to limit the antibiotic resistance in the context of animal health; first, antimicrobial used as animal growth promoters and for inappropriate routine infection prevention in herds should be banned. Second, access to nonmedicated animal feed for farmers should be improved. Third, the use of specific classes of antimicrobials should be restricted to either humans or animals.

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Conflicts of interest

There are no conflicts of interest.

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