A survey of antimicrobial usage/consumption in animal production: a cross-sectional study of Kaduna metropolis

Abdulkadir Aliyu, Ajayi Marvelous, Kusfa Abubakar Halima

Department of Animal Health Technology, College of Agriculture and Animal Science, Ahmadu Bello University, Zaria, Kaduna, Nigeria

abaliqadir@gmail.com

Introduction

The use of antimicrobials in animals is a global practice against infections and the enhancement of productivity. It has been established that a linear relationship exists between antimicrobial usage/consumption (AMU/AMC) and antimicrobial resistance (AMR) (Sadiq *et al*., 2018). Much of the effort in monitoring AMU/AMR in animal production has been driven by the consensus that AMU/AMR in animal production contributes to the overall burden of AMR in humans (O`Neil, 2016). These have led to the establishment of several initiatives globally, regionally, and nationally to promote responsible use of antimicrobials, reduce excessive AMU in animal production and support surveillance systems for monitoring AMU/AMR (Pinto Ferreira *et al*., 2022).

Incorrect use and abuse of antimicrobials such as frequent and prolonged use are key drivers for the spread and emergence of antimicrobial resistance. High levels of such antimicrobial resistance have a negative impact on livestock production either by reducing productivity, or high costs of treatment on farmers/owners. This increased AMR in animals conversely affects patients (human) health outcomes as it result in concomitant emergence or increase in antimicrobial resistance in humans rendering human infectious diseases harder or more difficult to treat in addition to the increase costs of human healthcare treatments. Measuring AMU in animal production may address several challenges including providing data useful for monitoring AMU overtime that will assist in setting benchmarks to promote AMU reduction. Also, measuring AMU is fundamental to investigating the qualitative and quantitative associations between AMU and AMR.

This study aimed to measure antimicrobial usage/consumption in animal production using active primary drug sales and prescription data within Kaduna Metropolises. The objectives were;

1. To compile qualitative prevalence of usage of specific antimicrobials and their classes in Kaduna metropolis.
2. To measure quantitative amounts of antimicrobial active principles.

Materials and methods

This study was carried out in the four (4) local government areas (LGA), that make up Kaduna metropolis including Igabi, Kaduna North, Kaduna South and Chikun LGAs. The study was conducted for twelve (12) weeks from April 2022 to July 2022.

The study was a cross-sectional survey to generate qualitative and quantitative data on antimicrobials used or consumed in animals (prevention or treatment of disease and growth promotion) through structured interview questionnaire administration at veterinary clinics and veterinary pharmaceuticals outlets (retail and wholesale) daily to buyers or end users of these antimicrobials. Forty-one (41) pre-identified points of which two (2) trademark points (wholesale), twenty-two (22) retail veterinary drug stores, and eight (8) prescription points (clinics) participated in the study (78% of the survey population).

The survey questionnaire was designed in English containing two (2) sections: i) demographic information of the respondent and ii) veterinary care information with the antimicrobial and animal production information. To include AMU questions in the questionnaire, AMR expert documents of FAO were consulted, and eleven (11) questions suggested to gather information on AMU/AMC in animal production were included. These questions included purpose of using the antibiotics, frequency of usage, who advises on use of antibiotics, number of animals and the species treated, source of drugs. The questionnaire was orally administered to each respondent as a one-on-one interview at point of purchase, administration or prescription.

Data obtained were summarized for clearing, processing, and analysis. All data regarding demographic features and AMU/AMC (sale, prescription) were analyzed through descriptive statistics. Quantitative data were analyzed by calculating the population correction unit (PCU, with some modification); The standardized average weight in kilograms (kg) of all animals at time of treatment multiplied by the number of animals based on national statistics (live and/or slaughter) (here we used actual head count of animals in the survey), to estimate the relative amount of antimicrobial active ingredient used for every kilogram body weight at times of treatment over the course of the study period covered (12 weeks). Class specific PCU and AMU were thus estimated for antibiotics, antiprotozoals, and anthelminthics in addition to the overall AMU/AMC.

Results

Table 1: Animals population distribution and the relative prevalence of antimicrobials used per group.

Animals	Average Weight (kg)	Antibiotics	Antiprotozoals	Anthelmintics	Ectoparasiticides	Total (%)
Cattle	290kg; Babayemi et al. 2018	28,907	637	8274	5699	43,517 (0.14)
Sheep	39kg; Lawal, 2012	8475	304	4551	2135	15,465 (0.05)
Goat	20kg; Lawal, 2012	12,668	321	10,522	1956	25,467 (0.08)
Poultry	1.5kg; Mahmud et al. 2020	30,698,740	346,030	153,194	304,040	**31,502,004 (99.55)**
Horse	200kg; Saidu et al. 2020	565	-	84	2	651 (0.01≤)
Pig	60kg; Weka et al. 2021	364	-	210	120	694 (0.01≤)
Rabbit	2,2kg; Agaviezor & Ologbose, 2020	1145	-	4	14	1163 (0.01≤)
Fish	1.0kg	54560	-	-	-	54560 (0.17)
Total (%)		**30,805,424 (97.35)**	347,292 (1.10)	176.839 (0.56)	313,966 (0.99)	31,643,521 (100)

Figure 1. Proportion of class specific antimicrobial usage and the two modes of administration (oral vs parenteral)

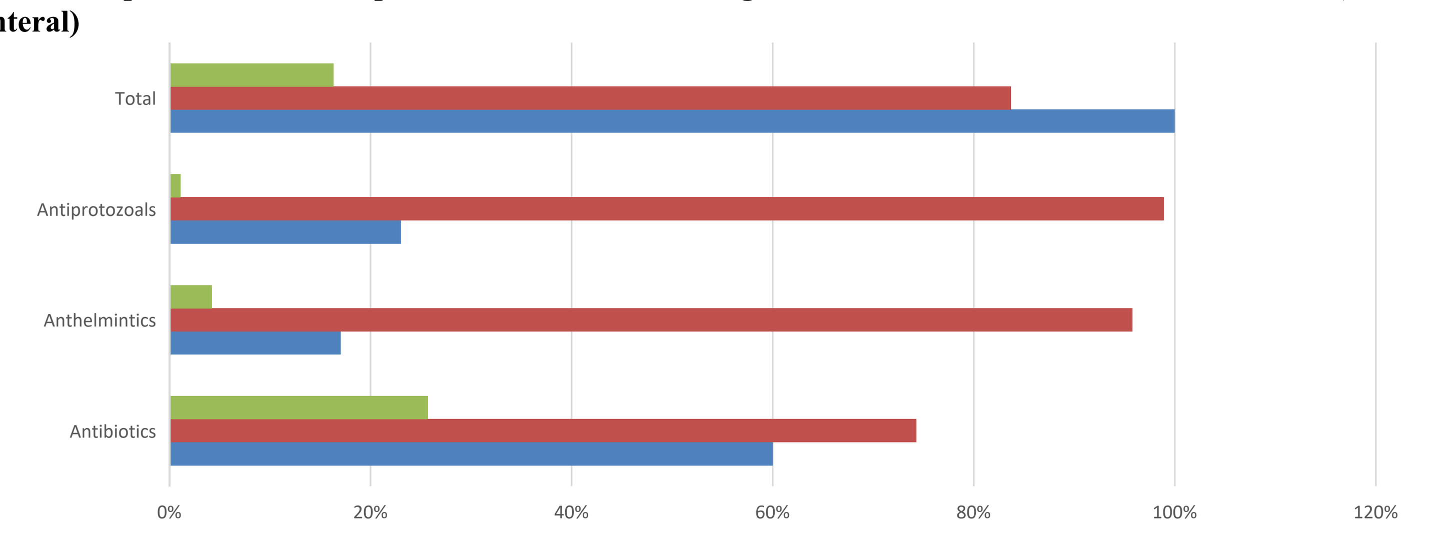


Table 2. Class specific and total antimicrobial usage/consumption (AMU/AMC) in animals of the study for the study period (12weeks)

Antimicrobial Category	SMW (kg)	Animal Population	PCU (kg)	Total Amount (mg)	AMU/AMC (mg/kg)	Confidence Interval	P value
Antibiotics	3.6	30,805,424	110,899,526.40	30387.57×10^6	274	274±35.1(CI:238.9-309.1)	0.015
Antiprotozoals	5.4	347,292	1,875,376.80	786.68×10^6	418	418±126.7(CI:291.3-544.7)	0.045
Anthelminthic	5.8	176,839	1,025,666.20	590.94×10^6	576	576±66.6(CI:509.4-642.6)	0.000
Total	3.6	31,329,555	112,786,398	31765.19×10^6	282	282±35.9(CI:246.1-317.9)	0.045

Figure 2. Quantities and class proportions of antiprotozal agents consumed/used in animals within the study period (12weeks)

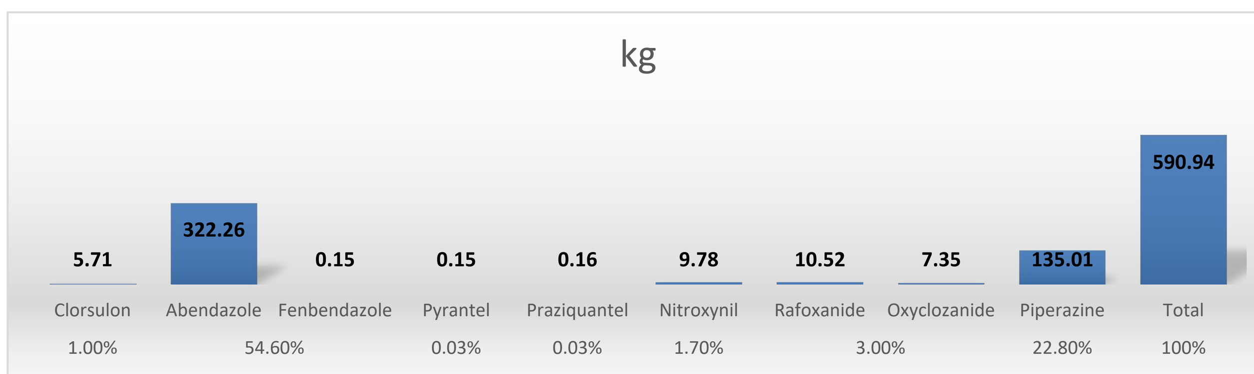
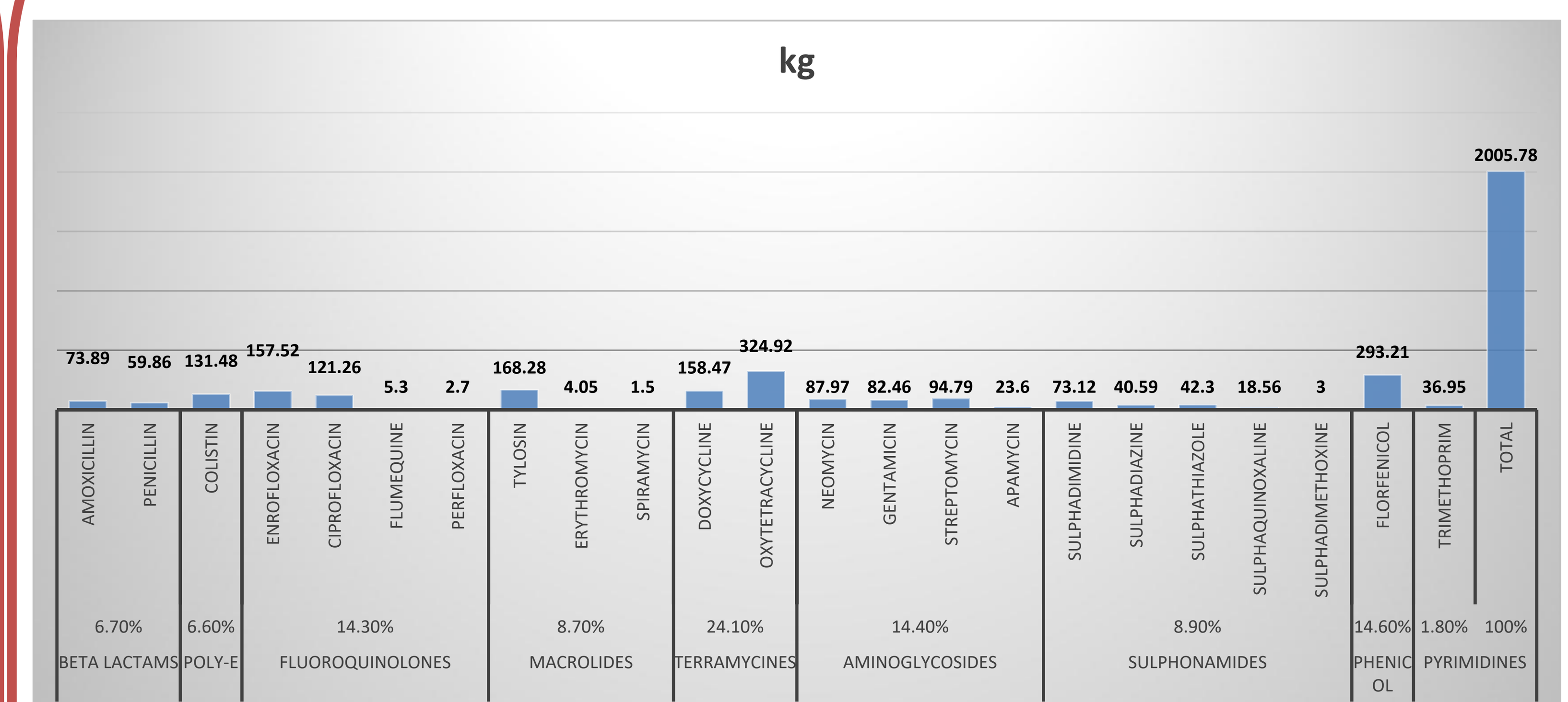


Figure 3. Quantities and class proportions of antibiotics consumed/used in animals within the study period (12weeks)



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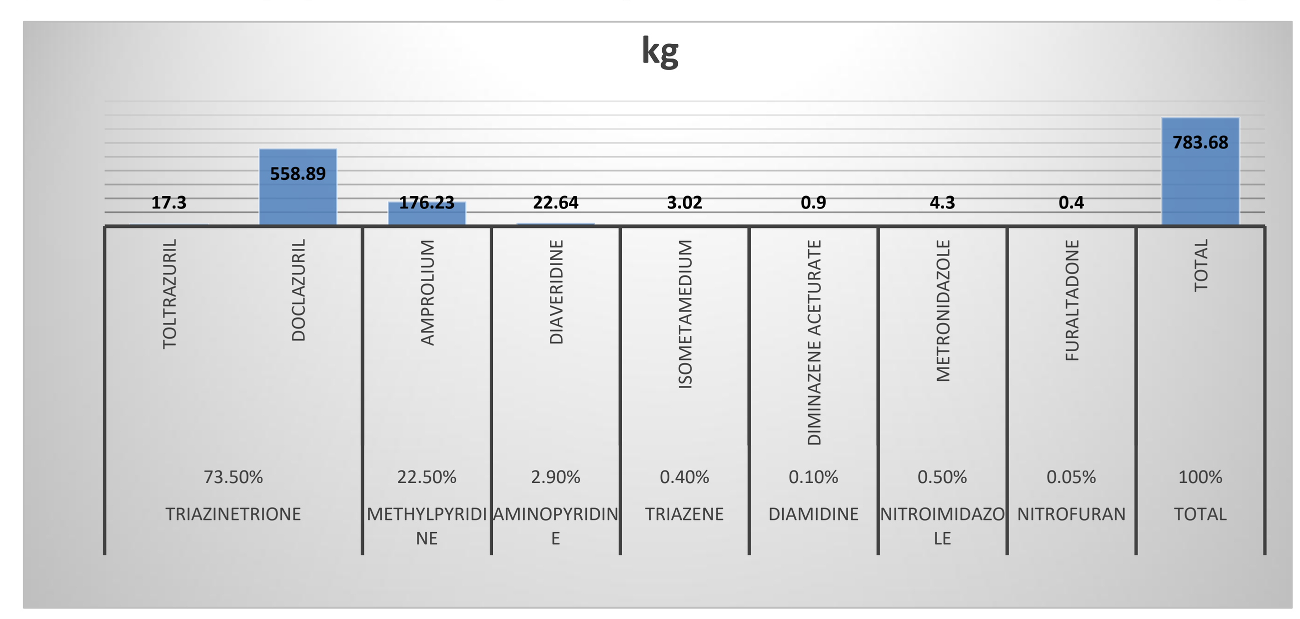

Conclusions

This study has provided useful information on trends of antimicrobial usage in food animals. In comparing this survey with other surveillance systems undertaken by other countries, certain observations have been noted. The antimicrobial groups showing the largest sales, in terms of weight, were the antibiotics compared to anthelminthics and antiprotozoals. The terramycines constituted 24.1% (14.3% of the total volume of all antimicrobials), with reference specifically to oxytetracycline and doxycycline. These antibiotics are used for the treatment and prevention of diseases such as mycoplasmosis in poultry and as growth promoters in food animals. The extensive usage of all these drugs especially florfenicol, tylosin, and ciprofloxacin are a cause for great concern because their main route of administration is through the feed and water at sub-therapeutic levels for prophylaxis. This form of administration promotes the potential for resistance to related antimicrobials administered in human medicine. These antimicrobials are very important in human health and have the potential to add to the development of cross resistance to antimicrobials administered in human health. Fluoroquinolones usage in food animals is a cause for great concern with the emergence of quinolone resistant strains in zoonotic *Salmonella*, and *Campylobacter* being reported in western Europe and the United States. Resistance to this group leaves few treatment options available, as multiple cross-resistance is now commonplace (White et al., 2001).

The antimicrobials with the largest sales/usage were the triazenetriones; diclazuril and toltrazuril (17.1% of the total volume). This is unsurprising as coccidiosis is a major disease of concern in poultry and even small ruminants with most of the treatment almost always administered as prophylaxis. In addition, it also reflects the poor control measures established for such a common and important disease. The anthelminthics antimicrobials were also commonplace for albendazole, piperazine, and levamisole. Albendazole was most common use as it is a broad-spectrum anthelminthic, cheap, and most readily available of the anthelminthics with a wide safety margin.

The observation, that the oral dosing constituted 83.7% of the total of antimicrobial usage (either infeed or water), is significant. In humans, treatment is directed at the individual patient, but for animals' entire groups of animals may be treated with the administration of medicated feed or water. The dosages included for prophylaxis are usually at low concentrations for extended time periods. Both practices, in combination, have the potential to accelerate the emergence of resistant bacteria in the animals concerned, that can then infect humans, through contact or via the food chain.

Due to the concerns expressed above, antimicrobial usage should be reviewed by the regulatory authorities. These should be reviewed in order of priority, relating to the documented evidence for their ability to increase antimicrobial resistance in other groups of antimicrobials, or because of their structural relatedness to antimicrobials in human medicine. Concern is not as great for anthelminthic antimicrobials administered mostly orally, which are not registered as antimicrobial growth promoters (AGPs) like antibiotics. This is because the concentrations administered are broad-spectrum and the longer acting salts facilitate convenient and once-off administration.

Longitudinal study designs such as this allow insights into repeated behaviour of consumption over time (especially when consecutive cycles are investigated). Such studies may also shed insights into treatment practices for different diseases or types of animals.

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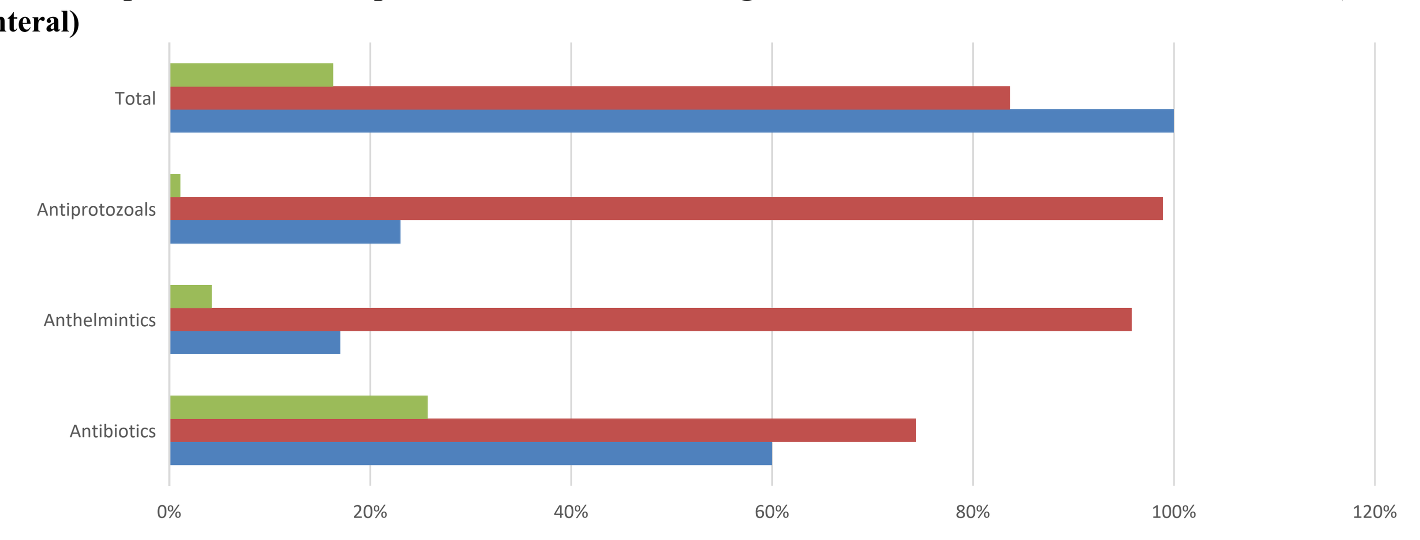

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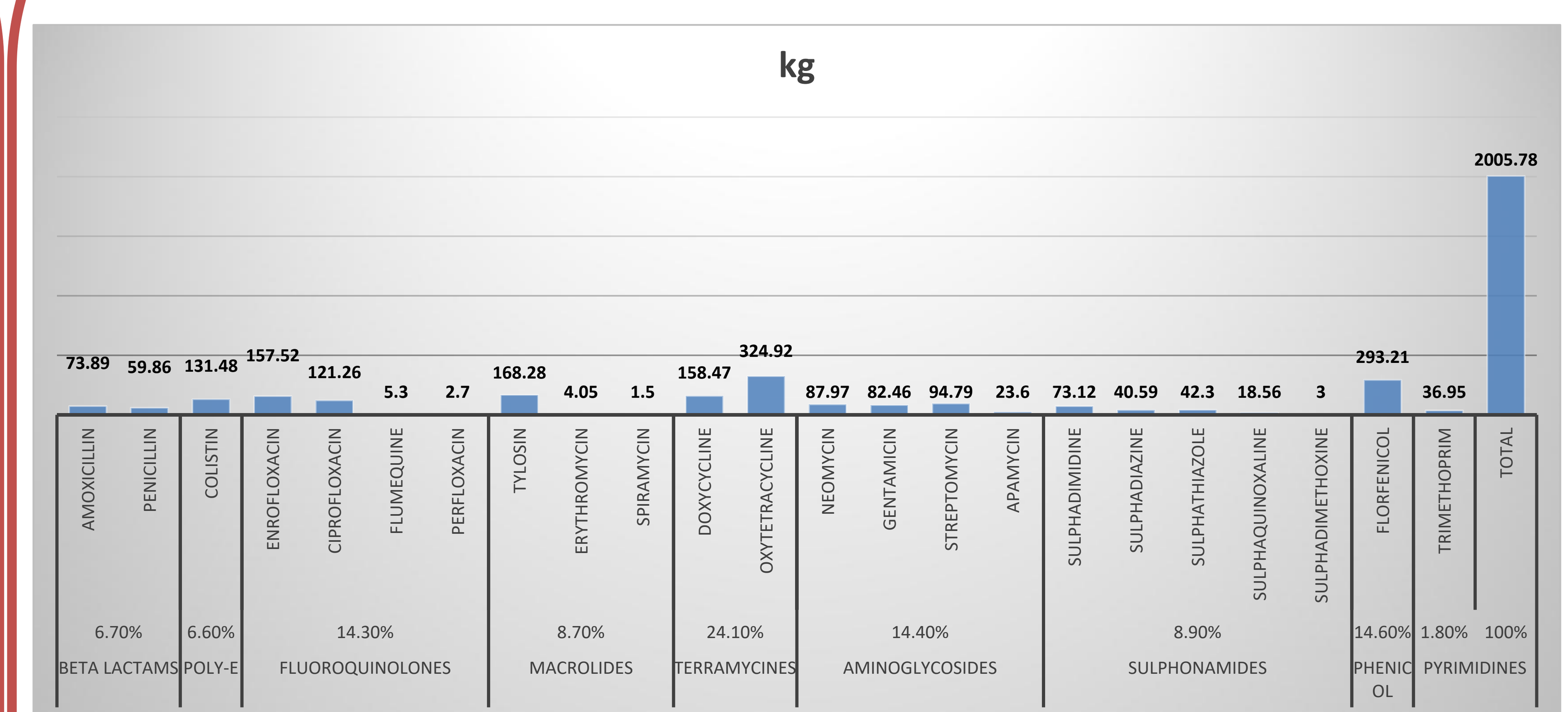

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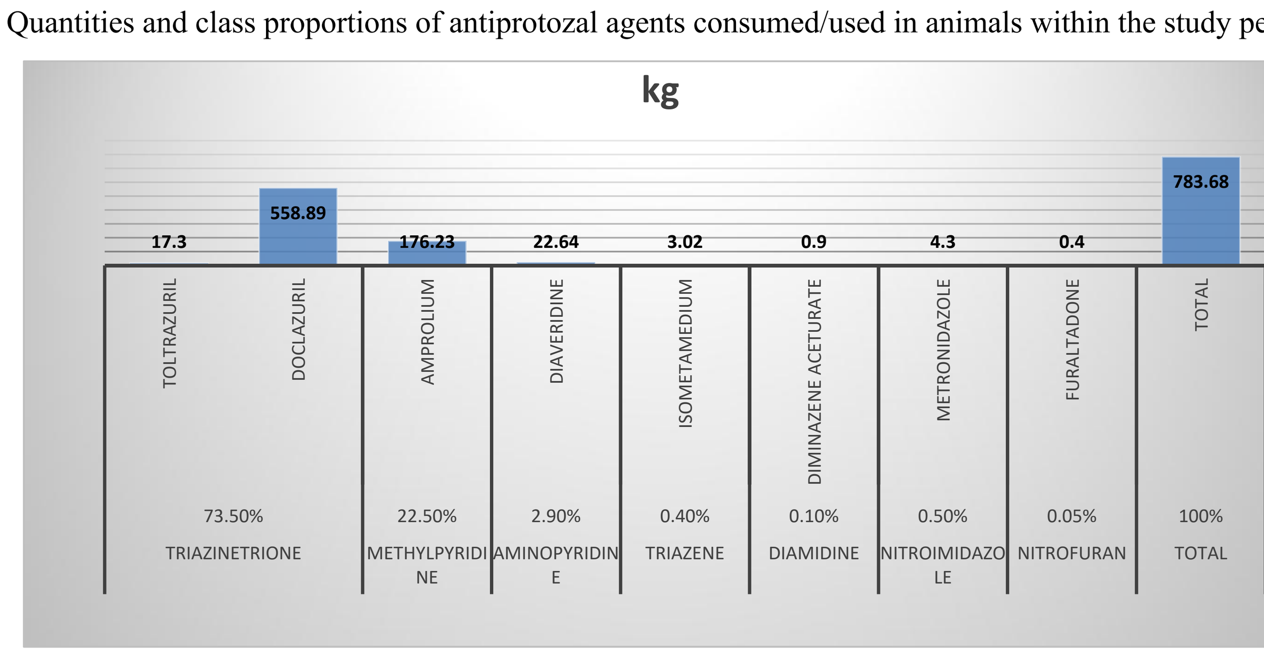

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