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Original Article

Drug used in controlling chickens' diseases, the withdrawal periods and the threats of drugs residues in food chain in Tanzania. A Review

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Abstract

Drugs have been used by many farmers for the treatment of most infectious diseases in chicken regardless of their residue effects to human health if proper management has not adhered. This paper focuses on finding out the common chicken diseases, their prevalence, drugs used for treatment, and their residue implication in the chicken products and by-products. A systematic literature-review was used to synthesis the information from soft and hard copy sources of information. In this paper, it was noted that different infectious diseases were affecting chicken in Tanzania and other countries including Newcastle (Prevalence 7-90% per flock), Infectious bursal disease (Prevalence 7-100% per flock), Fowl Cholera (Prevalence 1-60% per flock), and Fowl Typhoid (Prevalence 0-20% per flock). As a remedy, drugs such as Amprolium, oxytetracycline, and sulphanilamide were used for treatment which could prompt antibiotic residues in chicken products and by-products. The antibiotic residue was reported in meat, eggs, liver, and kidneys of the chicken which are considered edible to a human thus posing public health challenges. In this regard, there is a need to create awareness to the farmers on the proper use of the drugs. In this case, the understanding of the withdrawal period for the applied drugs can minimize the risk of drug residues in chicken products.

Keywords: infectious diseases, drugs, chicken, antibiotic residues.

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Introduction

Chickens play an integral role in household livelihood and serve as an employment opportunity to the youth while empowering women in rural and peri-urban areas (Okitoi*et al.,* 2007). In Tanzania, the chicken population is around 40 million (AASS, 2016). The chickens are kept in 86% of the 4.6 million households that keep livestock. It is estimated that an income of USD 703 is generated from chicken per annum per household (Ndomba, 2015). The chicken industry in Tanzania is divided into traditional and commercial production systems. The traditional system is having about 70% of the chickens and is practiced in rural and peri-urban areas whereas commercial production systems are practiced in urban and peri-urban areas (NLP, 2006). In rural areas, 100% of chicken meat depends on indigenous chicken (local breed) while in urban areas about 20% of the chicken meat consumed comes from improved poultry raised commercially (MLFD, 2011). The main challenges of chicken production in Tanzania include disease outbreaks, poor management, and misuse of drugs (Wyatt *et al.,* 2014; Rao, 2015).

Diseases in chicken production are the major factor that causes great loss and reduction of income (Ngongolo*et al.,* 2019). Among the losses caused include reduced quality and quantity of chicken products such as eggs and meat (Rao, 2015). For instance, in Tanzania, Newcastle diseases have been reported to cause a loss of up to 90% due to mortality (MLFD, 2011) of chicken and can go up to 100% in chicks (Chuma*et al.,* 2019). Other common infectious diseases threatening the chicken industry in Tanzania and other African countries include Respiratory infection, Coccidiosis, Fowl Pox, Fowl Typhoid, Pullorum disease, Marek's Disease, Infectious bursal disease (IBD) and Aspergillosis (Sindiyo&Missanga, 2018; VP, 2013). The common non-infectious diseases are ectoparasites (lice, mites), Gastrointestinal parasites (worms), rickets, curled toe paralysis, salt poisoning, vitamin E and Selenium deficiencies (encephalomalacia), and food poisoning (Botulism) caused by *Clostridium botulinum* and *C. perfringens* (VP, 2013).

In responding to livestock diseases including chicken diseases, livestock keepers in most cases opt for treatment and vaccination of their livestock which could result in the misuse of drugs. In recent times, diseases treatment and vaccination has been used as an option to minimize loss of chicken while increasing production through improved growth and productivity for sustainable food safety (Falowo&Akimoladun, 2019). High levels of antimicrobial residues in animal products like meat, eggs, and milk have been reported to be introduced in the food chain through diseases treatment and vaccination (Agmas&Adugna, 2018; Agyare*et al.,* 2018; Patel *et al.,* 2018). This has been due to the continued misuse of veterinary drugs in the livestock sector by the livestock keepers (Ngumbi&Silayo, 2017). This practice makes the drugs available into animal products and by-products. The presence of these residues in animal products and by-products poses a

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serious public health concern for it causes the development of antimicrobial-resistant pathogens (Ayukekbong*et al.,* 2017; Ngumbi&Silayo, 2017). In this case, understanding the recurring poultry diseases in Tanzania, drugs used and the impacts of drug residues in poultry products are essential. This paper focused on highlighting the common poultry diseases, their prevalence, drugs used for treatment, explaining the possible drug residues impact which can be linked with the improper use of drugs in chickens and pointing out the withdrawal period for the commonly used veterinary drugs.

The information from this paper will not only provide a means for proper disease control to increase productivity but also reduce the effects of drug residues in chicken products for the betterment of public health.

Methods

Study areas

The searching effort focused on the documents from Tanzania. In case the searched information was not available, more efforts were extended to other countries (particularly in Africa) that had related ecological zones. Tanzania and the other agro-ecological zone related countries were identified and chosen due to their prerequisite information on chicken production and the use of drugs for treating different diseases. Tanzania communities keep poultry for subsistance and commercial purposes.

Methods for gathering information

A systematic way through PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guideline as described by Moher*et al.* (2009) was used for metadata collection. Internet-based pieces of information, proceedings, reports, posters, and articles were retrieved using search database such as Google Scholar (https://scholar.google.com/) and PubMed. Printed. The number of papers retrieved from each database is as shown in Table 1. Hard copies were requested from the experts who have dealt with chicken for quite some time, besides personal communication with key players in the chicken industry was also established. The keywords employed during searching were: chicken diseases in Tanzania, impacts of chickens diseased, drugs used to treat chicken diseases, withdrawal period, drug residues in chicken products. Whenever it was difficult to get information for Tanzania, searching efforts were extended to other countries with agro-ecological zone similar to that of Tanzania. The scope of the search was emphasized for studies done in the past 20 years which are ranging from 2000 to 2020. Whenever necessary, searching for specific disease information was employed such as mortality of chicken due to NCD or the drug for treating Fowl typhoid.

Information that was considered for inclusion in the review, the paper had to include chicken diseases, drug uses, and drug residues in chicken products and by-products. On another hand, exclusion criteria were those documents that did not have information about chicken diseases and the associating drug residues. The flow table for selection of articles, proceedings and posters for inclusion or exclusions are shown in the table below (Table 1).

Table 1. PRISMA flow table showing the identification, screening, and eligibility for reviewed papers (Modified from Moher et al 2009; Ngongolo et al., 2020)

No	PRISM flow	Sorting criteria in each stage	N
1	**Identification**	Records identified through database searching (201 from scholar and 195 from Pubmed)	396
		Additional records identified through other sources	5
2	**Screening**	Records after duplicates removed	240
		Records screened	240
		Records excluded	160
3	**Eligibility**	Full-text articles assessed for eligibility	80
		Full-text articles excluded because they were not relevant to the study thus no information on drug use and residues in the chicken product	45
4	**Included**	Studies included in the qualitative synthesis	35
		Studies included in quantitative synthesis (meta-analysis)	0

Results

Overview of the searching efforts

Overall, a total of 396 documents were reviewed whereby 1.26% of them were printed and 98.74% were interned based. Also, 8.84% were included in the analysis while 91.16% were not eligible. About 54.29% of included documents were associated with chicken diseases, whereas, 37.14% were associated with a drug used by farmers to control chicken diseases. Furthermore, 20% of the included paper had pieces of information on drug residues in chickens products.

Diseases reported to frequently affect chickens in Tanzania

About eight diseases were reported in this paper as the common diseases of chickens in Tanzania. The most prominent diseases include NCD, IBD, and fowlpox which are viral, coccidiosis, a protozoan disease, fowl

typhoid and colibacillosis, bacterial diseases, and a fungal disease, Aspergillosis. (Table 2)

Drugs used in the treatment of common chicken diseases

In managing the common diseases, several drugs are recommended for use. Viral diseases are usually given supportive treatment where antibiotics and vitamins are usually used. Mortality caused by viral diseases (Table 2) is usually alarming and threatens chicken keepers, this usually results in panic and the use of a range of antibiotics in the chicken. The drug of choice by farmers for treatment of Coccidiosis is Amprolium. Bacterial diseases like fowl cholera, fowl typhoid, pullorum, and salmonellosis are treated using a range of antibiotics whereas Aspergillosis is treated using a range of antifungal preparations (Table 3). About 90% of these drugs are applied by farmers themselves without Veterinary assistance and Agro-vet shops being their main sources. The use of antibiotics, anticoccidials, and antifungal raise concerns on the escape of these drugs or their metabolites into the food chain or the development of the resistant pathogens.

The drug residual and recommended withdrawal period

Most of the drugs used in the treatment of common diseases affecting chicken have a varying length in days of stay in the chicken bodies. These are indicated in the drug containers as a withdrawal period. The period in which the chicken products and by-products are deemed not fit for human consumption. The withdrawal periods of various diseases are listed in Table 4.

Table 2. Chicken diseases, causes, prevalence and their mortality rate.

No	Diseases	Causes	M (Min, R) Prevalence %	M (Min, R) Mortality rate%	Reference
1	Newcastle	*Newcastle virus*	48.5 (7, 87)	90 (80, 20)	Sindiyo&Missanga,2018; VP,2013;Yongolo&Minga, 2002
2	Infectious bursal disease (IBD)	*IBD Virus*	60 (20, 80)	60 (40, 60)	Swai *et al.,* 2011; Swai *et al.,* 2013; PW, 2015
3	Fowl Pox	*Fowl pox virus (FWPV) (avipoxvirus)*	65 (30, 70)	55 (10, 85)	VP,2013; Yeo *et al.,* 2019; Masola,2016; Adebajo*et al.,*2012**;** GAM,2020;VP,2013; Cardona &Msoffe.2019
4	Marek's Disease	*Marek's disease* virus' (MDV) or Gallidalphaherpesvirus 2	74 (50,48)	15 (0, 30)	VP,2013; Saile*et al.,* 2019 ;Cardona &Msoffe,2019
5	Coccidiosis	Coccidian protozoa (*Eimeria spp*)	45 (10,70)	25 (0, 50)	VP,2013; Molla& Ali,2015; PW. 2015; Ketema&Nigussu, 2019; Komba, 2017
6	Fowl Cholera	*Pasteurella multocida*	30.5 (1,59)	80 (60, 90)	Singh *et al.,* 2014;Mbuthia *et al.,* 2008;GAM. 2020; VP. 2013
7	Salmonellosis	*Salmonella gallinarum / Salmonella pullorum*	10 (1, 19)	55 (10, 90)	Robinson*et al.,*2000; GAM,2020; VP,2013
8	Aspergillosis	AflatoxinB1 produced by *Aspergillus flavus and Aspergillus parasiticus*	40 (10, 60)	27.5 (5, 45)	Kajuna*et al.,* 2013; Salem & Fatah, 2014; VP,2013

Note: For peravlence and mortality rate, **M=Mean, Min=minimu and R=Range.**

Table 3. Chicken diseases and the drugs used for Treating or vaccinating

No	Diseases	Drugs used for treatment	References
1	Coccidiosis	Amprolium, oxytetracycline, sulphanilamide	Siddiki *et al.,* 2008, Nonga et al., 2010
2	Fowl Pox	Supportive therapy provided	Komba, 2017.
3	Marek's Disease	Supportive therapy provided	Komba, 2017.
4	Newcastle	Supportive therapy provided	Komba, 2017.
5	Fowl Cholera	oxytetracycline,Sulphur drugs, Norfloxacin	Nonga *et al.,* 2010, Komba, 2017.
6	Salmonellosis/ Fowl Typhoid	Oxytetracycline, Sulphur drugs	Nonga *et al.,* 2010, Komba, 2017.
7	Aspergillosis	Itraconazole, Ketoconazole, Clotrimazole, Miconazole, Fluconazole and Amphotercin B	Olwande *et al.,* 2016, Kajuna*et al.,* 2013,

Table 4. Drug residues in the chicken product and recommended withdrawal period for the selected drugs

No	Drug	Withdraw period (Days)	Chicken's product kept as residues	References
1	Oxytetracycline	5	Meat, liver, kidney	Bienenmann-Ploum *et al.,* 2012
2	Amprolium	10	liver, kidney, muscle and skin with fat	Kan et al 1989
3	Sulfadimethoxine	5-56	Meat eggs	Siddiki *et al.,* 2008: Bienenmann-Ploum *et al.,* 2012: Malik*et al.,* 2013
4	Erythromycin	1-17	Meat, eggs	MPM, 2017
5	Albendazole	8-14	Eggs	MPM, 2017,Alhendi*et al,* 2020
6	Ciprofloxacin	15-19	Eggs and Meat	Bienenmann-Ploum *et al.,* 2012
7	Ampicillin	5-7	eggs	Bienenmann-Ploum *et al.,* 2012 , Alhendi*et al,* 2020

Discussion

Chicken diseases are a big burden to chicken keepers because they cause significant losses due to mortality, retarded growth, and costs associated with treatment and control. Most of the viral diseases cause alarm to chicken keepers due to high morbidity and mortality. For instance, the prevalence of NCD is reported to range between 7% – 90% with the mortality of up to 100% (Yongolo & Minga. 2002; VP, 2013; Sindiyo&Missanga, 2018). Also, IBD which is among the viral diseases had an overall 58.8% seropositivity and 82.8 (74/90) flock seropositivity among non-vaccinated scavenging chicken (Swai et al., 2011). Lastly, fowlpox with prevalence ranging from 30%- 100% can cause mortality of up to 95% which is a serious problem to chicken keepers (Refer Table 2). Vaccinations have been a long time practice in which the chicken keepers have relied on, but of recent serious vaccine, failures have been recorded.

In this paper it was noted that diseases such as New castle, fowl pox, coccidiosis, Infectious bursal disease (IBD) and fowl typhoid, cause serious threat in chicken production due to its high mortality rate in chicken. In the latest study, the infectious bursal disease was reported to cause havoc in vaccinated farms. The finding by Said *et al.* (2020) revealed that the genetic disparity between field and vaccinal strains, chicken keeper's knowledge, and disrupt in the cold chain are among the possible causes of vaccine failure. As a result of these failures, chicken keepers tend to continuously use antibiotics in the efforts to rescue their chickens. Diseases caused by bacteria are even more confusing to the farmers due to the nature of prevalence and mortality. Prevalence can be as low as 1%, fowl cholera (Mbuthia*et al.,* 2008; VP. 2013; Singh *et al.,* 2014; GAM. 2020,), 0 up to 20%, fowl typhoid (Robinson *et al.,* 2000, VP, 2013, GAM, 2020) or 10% for aspergillosis (Kajuna *et al.,* 2013; VP. 2013; Salem & Fatah, 2014) and Coccidiosis (VP. 2013; Molla and Ali. 2015; PW. 2015; Komba 2017; Ketema&Nigussu 2019). But mortality can still be as high as 50% to 100% indicating continuous deaths in the flocks. This results in the continuous use of the drugs in the efforts to reduce losses. The fact that diseases are constantly in the flocks this means constant use of drugs in the flocks. The used drugs are at times bought without consultation with the veterinarians thus resulting in misuse as it was reported by Ngumbi & Silayo. (2017) in the control of trypanosomes.

The findings from this study reveal that improper handling of drugs particularly antibiotics can lead to accumulation drug residues in chicken products. This has great implications for antibiotic resistance to consumers. A surge in the development and spread of antibiotic resistance and the escape of antibiotic residues into the food chain has become a concern. For quite some time, there have been no development of new drugs and the current in use has been losing their activity against pathogenic microorganisms (Agyare*et al.,* 2018). The resistance of microorganisms and the continuing mortality results in the continued use of antibiotics. The destination of the used drugs is in humans through the consumption of the residues in chicken products or by-products. The most common drugs include antibiotics whose activity is bactericidal (kill the bacteria) or bacteriostatic (slow growth of bacteria). The good example of antibiotics used are: tetracyclines and sulphonamides (Siddiki et al., 2008, Nonga et al., 2010) in the treatment of coccidiosis, sulphonamides, and quinolones (Nonga et al., 2010, Komba, 2017) in the treatment of Fowl cholera and Fowl typhoid), coccidiostats (Siddiki*et al.,* 2008, Nonga*et al.,* 2010) in the treatment of coccidiosis and antifungal agents (Olwande et al, 2016, Kajuna et al, 2013,) for the treatment of aspergillosis. Because of the increasing concern of antibiotics in public health concerns, strengthening research on vaccines and vaccination programs should be the focus.

It was noted that at most 10% of livestock keepers seek veterinary assistance during drug administration to their chicken which could have implications in the food chain as far as public health is concerned. Strengthening veterinary service provision is another key approach to control the increasing public health concerns. Prescription of the over the counter drugs needs to be routed through veterinarians to reduce the misuse of the drug, overuse, and the current increasing use of the same drugs as feed additives to increase productivity. Practically, these drugs have withdrawal periods, the minimum period required for the body to clear the drugs through various methods. For instance, Amprolium requires a minimum of 10 days (Kan*et al.,* 1989), Oxytetracycline 5 days (Mund *et al,* 2017), sulphonamides 5-56 days (Siddiki*et al* 2008, Mund et al., 2017, _Malik *et al.,* 2013). In chicken drugs like oxytetracycline are likely to remain as residues in products and parts such as meats, eggs, kidneys, liver, and kidney after applying as treatment (Mund*et al,* 2017). These drugs remaining in the animal products or by-products alter the useful microflora of the digestive system (Mund*et al.,* 2017) or can cause allergic reactions (Babapour*et al.,* 2012) or teeth staining, gastrointestinal disorder, reduced immunity, and poor fetuses development (Idowu *et al.,* 2010; Palmieri *et al.,* 2014). This is mainly due to failure in observing the withdrawal period by farmers during the use of drugs (Concordet & Toutain, 1997).

An overview study on diseases, treatments, and residues in chicken products and by-products is essential in ensuring food and public health safety. Because of this fact, efforts have to be made by the stakeholders in creating awareness to chicken keepers and the public on the threats posed by drug residues and resistant microorganisms and further establishing the proper management and control strategies to reduce the need for drugs use.

Conclusion and recommendation

Conclusion

Infectious diseases varied in prevalence and mortality. The use of drugs caused residues in chicken products such as meat and eggs while their majority of use

antibiotics had the withdraw period interval of 5-20days. For example, Newcastle was reported to have a mortality rate of up to 100% while diseases like Salmonellosis its prevalence can go up to 20%. Antibiotic has been used in many cases as a remedy for overcoming the challenges of infectious diseases. The various findings indicated that antibiotics were frequently used by human beings for treating most infectious in chicken. However regardless of their usefulness in chicken production, yet there is an effect of antibiotic residues on chicken products such as meat and eggs.

Recommendation

More education is needed for farmers on the proper use of drugs to reduce the impact of drug residues in chicken products. The understanding and awareness of the withdrawal period to the farmer and other stakeholders are required to improve public health by reducing antibiotics resistance which could develop as a result of antibiotic residues in chicken products. This is in support with our study in Dodoma which showed that, 56% of chicken keepers use antibiotic and 91% of them are not aware of the withdrawal period of the used drugs (Ngongolo et al., 2020).

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