The Bioscientist Vol. 9 (1): 38 - 50, January 2021 Available online at
http://www.bioscientistjournal.com

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Full Length Research Paper

Farm Characteristics and Practices Related To The Use Of Antibiotics In Pig Farms In Anambra State

[1*]Kyrian-Ogbonna, E. A.,[1] Ekwealor, C.C., [1]Okey-Ezeokoli, S.C., [1]Offordile C.F and [1]Ekwealor, I.A.

[1]Department of Applied Microbiology and Brewing, Faculty of Biosciences, Nnamdi Azikiwe University, Awka, Anambra State.

*Email: ea.eze@unizik.edu.ng

Submitted June, 2021, Accepted August, 2021

ABSTRACT

Increasing concern about antimicrobial resistance has attracted attention to antibiotics use in livestock. This research was aimed at studying pig farms' characteristics and practices related to antibiotics use in pig farms in Anambra State. A structured questionnaire was used to capture the socio-economic characteristics of farms and practices related to antibiotic use. The data obtained were analyzed using ANOVA by Student-Newman-Keul (SNK) test at 95% confidence level. The questionnaires revealed that 40% of the farms kept more than hundred sows and 52.5% had other types of livestock. 87.5% combined the use of kitchen waste and conventional feed. 85% recycled their waste in crop production process. There is a significant difference in the diseases reported in the farms in the zones ($p < 0.05$). Only 5% of the farms consulted veterinary doctors for the diagnosis of pigs' infection. Only 5% of all the farms in Anambra State reported not using antibiotics in the past one year. Knowledge of antibiotic resistance by the farmers ranged from 6.25% in farms in Anambra North to 14.3% in Anambra South. Improved farm management practices and education of farmers and veterinarians on prudent antibiotics use would likely prevent the development of antibiotic resistance in pig farms.

Keywords: Pig farms, antibiotic resistance, farmers' education

INTRODUCTION

Food animals such as cattle, poultry and pigs have been extensively reared worldwide, not only as a food source but on industrial scale, as source of income. The modes of productions are intensive, due to the rapidly increasing demand for livestock products, driven by human population growth and urbanization. This has necessitated the uncontrolled use of antimicrobials and has resulted to an increase in antimicrobial resistance (Schar *et al*., 2018; Kimera *et al*., 2020). Based on the predicted continued rise in global

demand for livestock products, antimicrobial consumption of farm animals is predicted to increase by two-thirds over the next 10 years. Within this sector, antimicrobial consumption is estimated to be highest in pigs, compared with chicken and cattle (Van Boeckel *et al*., 2015). The use of antibiotics in pigs is complex and associated with the interrelating domains of animal welfare, animal health and economics (Lekagul *et al*., 2020). It has been a common practice for decades to use subtherapeutic doses of antibiotics in food-animals for a number of reasons: to control the spread of symptomatic infections between animals in close contact, some of which may be subclinically infected; to prevent disease at points of high risk prior to the onset of symptoms, particularly when animals are under stress (e.g., extreme weather, post vaccination or moving pen) and to improve production performance (Callens *et al*., 2012; Filippitzi *et al*., 2014). The advancement in public health care through introduction of antibiotics against infectious agents is now being threatened by global development of multidrug-resistant strains. These strains are products of both continuous evolution and unchecked antimicrobial usage. Though antibiotic application in livestock has largely contributed towards animal health and productivity, it has also played significant role in evolution of resistant strains (Sharma, 2018).

Global monitoring efforts focusing on antibiotic consumption and antibiotic-resistant bacteria presently take place in clinical and public health laboratories, while they rarely focus on animal husbandry in most countries. However, previous studies have revealed that due to farm practices involving disposing of farm wastes in farmlands and waterways, an exchange of antimicrobial resistant genes (ARGs) could occur between bacteria from farm animals/soils and clinical pathogens via horizontal gene transfer. Livestock farm environments, such as farmed soils and animal waste, have been considered the most important reservoirs for environmental ARGs, as high abundances of various ARGs have frequently been detected in these environments (Liu *et al*., 2019).

The pig industry in Nigeria is an important branch of the livestock sub-sector (Ezeibe, 2010). Pig production is an attractive business for the reason of superior production efficiency per unit area of land. Pig is one of the most prolific and fast growing livestock species that can convert food waste to valuable animal products (Vicente *et al*.,2010). Keeping pigs plays a crucial role in numerous tropical countries (Bienvenu *et al*., 2014).

As a step to encourage surveillance studies that shall help researchers track the factors influencing bacterial resistance, this study aimed to assess farm characteristics and practices related to the use of antibiotics in pig farms in the three senatorial zones of Anambra State.

MATERIALS AND METHODS

Description of Study Area

The study is Anambra State of Nigeria. It covers an area approximately 4416 km2 and lies at Latitude of 6˚20'N and Longitude 7˚00'E (Ifeka and Akinbobola, 2015). Ministry of Agriculture, (FADAMA unit), Awka was visited for the list of registered pig farms in Anambra State. From the list, forty

farms were selected from three senatorial zones of Anambra State (Anambra South, Anambra North and Anambra Central).

Description of the Sampled Pig Farms

The pig farms visited were all made of either local mud bricks or concrete dwarf walls. They were divided into pens to enable separation of different categories of the pigs. In many cases the floors were not concrete floor but bare sandy floor. The sources of water were boreholes or tanks filled by commercial water vendors. Feeding, medication and waste disposal methods were farm specific.

Administration of Questionnaire

Consent of the farm owners was sort before administration of the questionnaire. Farmers who did not consent to be included in the study were excluded. A structured questionnaire was used to capture some farm characteristics and practices related to the use of antibiotics in the farms. Information sought from the farms were: name of farm, age of farm, location of farm, size of farm/ herd size, number of farmers, sex of farmers, age of farmers, educational level of farmers, pig farming experience, breeds of pigs kept by farmers, feeding technologies, diseases and parasites control technologies, types of antibiotics used, frequency of administration of antibiotics, source of antibiotics, channel drug advice were received, incidence of infections, knowledge of antibiotics resistance and method of waste disposal.

Statistical Analysis

The data collected were analyzed for significant differences using one-way Analysis of Variance (ANOVA) by Student-Newman-Keul (SNK) test at 95% confidence level. IBM SPSS statistics version 20 was used for the correlation and ANOVA.

RESULTS

Characteristics of Pig Farms in Three Senatorial Zones Studied

Forty farms were studied in the three senatorial zones. The characteristics of the farms are shown in Table 1. Male farmers dominated the study zones accounting for 77.5% of all the farmers. 70% of the farmers were aged between 35-40years. 55% obtained a University degree and only 10% of them studied animal husbandry. 20% had more than ten years of experience in pig farming. 40% of the farms kept more than hundred sows and 52.5% had other types of livestock in their farms. Large white (85%) was the commonest breed of pig kept by farmers. Pig feeding methods varied in the farms but 87.5% combined both the use of kitchen waste and conventional feed. Waste management in the farms varied in the three senatorial zones. A majority of farms (85%) recycled their waste in crop production process. Daily cleaning of farm with disinfectant was the major (47.5%) biosecurity measure adopted by most farmers in the studied senatorial zones.

Farmers' Responses on Pigs' Health and Disease Prevention

Table 2 shows farmers' responses on pigs' health and disease prevention. Diseases reported in the farm during the study period (February, 2018- January, 2019) ranged from lameness (12.5%) to diarrhoea (77.5%) in the studied area. 100% of farms in Anambra North had digestive tract infections during the study period

Table 1: Characteristics of Pig Farms (N=40) in the Senatorial Zones Studied

Variables	Category	AN (n=16)	AC (n= 10)	AS (n= 14)	Total (%)
Sex of respondent / farmer	Male	14	7	10	31 (77.5)
	Female	2	3	4	9(22.5)
Age of respondent	35-40	11	8	9	28(70)
	50-60	5	2	5	12(30)
Education level respondent	Primary education	3	0	0	3(7.5)
	Secondary education	5	4	6	15(37.5)
	University education	8	6	8	22(55)
Field of study	Animal husbandry	3	1	0	4(10)
	Others	13	9	14	36(90)
Pig farming experience of farmers (years)	1—5	4	4	11	19(47.5)
	6—10	6	5	2	13(32.5)
	>10	6	1	1	8(20)
Number of sows	0-50	4	2	2	8(20)
	50-100	6	3	7	16(40)
	>100	6	5	5	16(40)
Presence of other animals in the farm	Yes	2	7	12	21(52.5)
	No	14	3	2	19(47.5)
Breeds of pigs kept by farm	Large white	13	9	12	34(85)
	Duroc	4	5	5	14(35)
	Land Race	8	6	2	16(40)
	Wagon	1	0	1	2(5)
Pig feeding methods	Kitchen waste only	0	0	3	3(7.5)
	Conventional feeds	13	7	11	31(77.5)
	Combination of both	14	10	11	35(87.5)
Waste management strategies by farmers	Selling	2	1	2	5(12.5)
	Burying	8	4	6	18(40)
	Flushing into pit, stream, and rivers	6	2	4	12(30)
	Burning	0	1	2	3(7.5)
	Recycling in crop production process	13	9	12	34(85)
	Others (combinations of methods)	10	7	10	27(67.5)
Biosecurity measures observed in farms	Daily cleaning of farm with disinfectant	9	4	6	19(47.5)
	Disinfectant foot dip at the entrance of farm	1	0	0	1(2.5)
	Isolation of sick animal	7	6	3	16(40)
	Quarantine of new sows before mixing with herd	2	0	0	2(5)

Key- AN: Anambra North, AC: Anambra Central, AS: Anambra South

14.29% of farmers in Anambra South reported no illness in their farms while 50% reported diarrhoea. There is a significant difference in the diseases reported in the farms in the three senatorial zones ($p< 0.05$).

Farmers diagnosed infections in 92.85% and 100% of the farms in Anambra South and Anambra Central respectively. No farm (0%) in Anambra Central consulted veterinary services in diagnosis of pigs' infections. In the whole of the studied area, only 5% of the farms consulted the services of a veterinary doctor in the diagnosis of pigs' infection. Farmers' responses to disease problem are also shown in Table 2. 85.71% of farms in Anambra South bought antibiotics from human medicinal shops, no farms (0%) in Anambra Central and South consulted a veterinarian and only 42.5% of all the farms in Anambra State bought veterinary medicine from veterinary drug stores. A one way ANOVA shows a significant difference ($p< 0.05$) in farmers' responses in the senatorial districts.

Table 2: Farmers' Responses on Pigs' Health and Disease Prevention

Variables	Category	AN (n=16)	AC(n= 10)	AS (n= 14)	Total
		No. (%)	No. (%)	No. (%)	No. (%)
What was the main disease problem during the last 12 months?	Respiratory Infection	2(12.5)	4(40)	4(28.57)	10(25)
	Digestive tract Infection	16(100)	8(80)	7(50)	31(77.5)
	Reproductive infection	3(18.75)	1(10)	1(7.14)	5(12.5)
	Skin disease/wounds	8(50)	3(30)	2(14.29)	13(13.5)
	Lameness	2(12.5)	1(10)	2(14.29)	5(12.5)
	No disease	2(12.5)	4(40)	2(14.29)	8(20)
Who diagnosed the disease?	Farmer	15(93.75)	10(100)	13(92.85)	38(80)
	Veterinary doctor	1(6.25)	0(0)	1(7.14)	2(5)
What do you do in response to disease problems?	Use traditional medicine/herbs	2(12.5)	0(0)	0(0)	2(5)
	Use antibiotics from veterinary drug store	6(37.5)	5(50)	6(42.85	17(42.5)
	Bought antibiotics from human medicinal Shops	8(50)	7(70)	12(85.71)	27(67.5)
	Consult veterinarian	2(12.5)	0(0)	0(0)	2(5)
	Did nothing	0(0)	0(0)	0(0)	0(0)

Key - AN: Anambra North, AC: Anambra Central, AS: Anambra South

Reported Practices Related to the Administration of Commonly used Antibiotics from February 2018-January 2019.

Table 3 shows the reported practices related to the administration of the commonly used antibiotics in the past 12 months. Use of veterinary antibiotics ranged from 87.5% in Anambra North to 100% both in Anambra Central and Anambra South. Only 5% of all the farms in Anambra State reported not using antibiotics in the past one year. Farms that used antibiotics statistically differs ($p< 0.05$) from those that did not. Table 3 also shows how farmers accessed the antibiotics used. Farms that bought antibiotics from veterinary outlets ranged from 37.5% in Anambra North to 42.9% in

Anambra South. Channels in which farmers accessed antibiotics differed significantly (p=0.013).

No farm (0%) in Anambra South reported to had sought professional advice in the use of veterinary antibiotics (Table 3). There is a statistical difference (p< 0.05) between those that sought professional advice and those that did not in the senatorial zones. The difference in the reason for use of antibiotics in the treatment of diseases is not statistically significant (p>0.05) in the three senatorial zones. Modes of administration of antibiotics to pigs in the senatorial zones are as presented in Table 3. They range from 60% to 68.75% in administration through injection in the three senatorial zones. Administration of antibiotics through feed was highest in Anambra North (56.25%) but least through water. The difference in the mode of administration of antibiotics is statistically different (p< 0.05) in the Senatorial zones. Only 10% of the farms have knowledge of antibiotic resistance in all the farms studied. Statistically, there is a significant difference (p< 0.05) between farms that have knowledge of antibiotic resistance and those that do not. 2.5% of farms in the whole study zones observed antibiotic withdrawal period as against 97.5% of farms which neither had knowledge of or observed antimicrobial withdrawal period before selling out their pigs after administering antibiotics.

Table 3: Reported Practices Related to the Administration of Commonly used Antibiotics from February 2018- January 2019

Variables	**Category**	**AN (n=16)**	**AC (n= 10)**	**AS (n= 14)**	**Total**
		No. (%)	**No. (%)**	**No. (%)**	**No. (%)**
Have you used veterinary antibiotics in the past months?	Yes	14(87.5)	10(100)	14(100)	38(95)
	No	2(12.5)	0(0)	0(0)	2(5)
How did you access the antibiotics?	Veterinary drug store	6(37.5)	5(50)	6(42.9)	17(42.5)
	Pharmacy/drug store	8(50)	8(80)	4(28.6)	20(50)
	Veterinarians	1(6.25)	0(0)	0(0)	1(2.5)
	Animal Feed Sellers	4(25)	9(90)	6(42.9)	19(47.5)
	Neighbouring Farms	0 (0)	4(40)	0(0)	4(10)
	Company	0(0)	0(0)	0(0)	0(0)
	Yes	3(18.75)	1(10)	0(0)	4(10)
Do you seek professional advice on how to use veterinary antibiotics	No	13(81.25)	9(90)	13(92.85)	35(87.5)
Which channel did you get the advice?	Veterinarian	2(12.5)	0(0)	0(0)	2(5)
	Pharmacy/drug store	14(87.5)	9(90)	9(64.3)	32(80)
	Other farmers	6(37.5)	8(80)	2(14.3)	16(40)
	Drug packages	3(18.5)	2(20)	3(21.4)	8(20)
Reason for drug use	Treatment of diseases	16(100)	7(70)	12(85.7)	35(87.5)
	Prevention of diseases	12(75)	8(80)	13(92.9)	33(82.5)
Mode of administration	Injection	11(68.75)	6(60)	9(64.3)	26(65)
	In feed	9(56.25)	4(40)	3(21.4)	16(40)

Variables	Category	AN (n=16)	AC (n= 10)	AS (n= 14)	Total
		No. (%)	No. (%)	No. (%)	No. (%)
	In water	3(18.75)	4(40)	4(28.6)	11(27.5)
Have you heard of antibiotics resistance?	Yes	1(6.25)	1(10)	2(14.3)	4(10)
	No	15(93.75)	9(90)	12(85.7)	36(90)
Do you observe antimicrobial withdrawal period before selling your pigs	Yes	1(6.25)	0(0)	0(0)	1(2.5)
	No	15(93.75)	10(100)	14(100)	39(97.5)
	Have no knowledge	15(93.75)	10(100)	14(100)	39(97.5)

Key - AN: Anambra North, AC: Anambra Central, AS: Anambra South

Antibiotics Used in the Farms in the three Senatorial Zones

Antibiotics used in the farms in the three senatorial zones are presented in Table 4. It can be observed that all the senatorial zones made use of the different brands of antibiotics. However, ciprofloxacin was the least used antibiotic in all the zones. Erythromycin and ciprofloxacin were not used by the farms in Anambra South and Anambra North respectively. A univariate analysis of variance shows significant difference in the use of the different active ingredients in the senatorial zone (p value< 0.05). There is however, no significant difference (p value> 0.05) in the use of chlortetracycline and gentamicin in the studied senatorial zones.

Table 4: Antibiotics used in Pig Farms Studied in the Three Senatorial Zones

Active ingredient of antibiotics	Number of brands	Number of farms in senatorial zones			
		AN (n=16)	AC (n=10)	AS (n=14)	Total
		No. (%)	No. (%)	No. (%)	No. (%)
Procaine / benzathine benzylpenicillin	5	12(75)	9(90)	13(92.88)	34(85)
Dihydrostreptomycin	8	7(43.75)	8(80)	12(85.71)	27(67.6)
Chlortetracycline	1	9(56.25)	9(90)	10(71.42)	28(70)
Gentamicin	1	7(43.75)	8(80)	13(92.85)	28(70)
Sulphadimidine	8	10(62.5)	6(60)	11(78.57)	27(67.6)
Trimethoprim	1	4(25)	5(50)	5(35.71)	14(35)
Oxytetracycline	8	16(100)	7(70)	13(92.88)	36(90)
Enrofloxacin	4	4(25)	2(20)	3(21.4)	9(22.5)
Erythromycin	2	2(12.25)	3(30)	0(0)	5(12.5)
Ciprofloxacin	1	0(0)	1(10)	1(7.14)	2(5)
Amoxicillin	1	16(100)	6(60)	13(92.88)	35(87.5)
Iron Supplements including antibiotics	3	10(62.5)	2(20)	6(42.88)	16(40)

Key - AN: Anambra North, AC: Anambra Central, AS: Anambra South

DISCUSSION

Pig production offers an opportunity to contribute to meeting the key sustainable development goals of ending poverty, hunger and promoting good health (Oloso *et al*., 2018). Some socio-cultural characteristics of pig farms may be predisposing factors for diseases

infestation of pig farms and the resultant use and abuse of antibiotics in farms (Strom *et al*., 2018b).

Pig farms are owned or managed by either males or females. In the present study more men (77.5%) were involved in pig farming than females (22.5%), which is similar to the work of Mulugeta and Berhan (2015). Sex of farmers may have effect on antibiotic use. Strom *et al*. (2018b) stated that male respondents in their study, more often stated that they had heard about antimicrobial resistance than female respondents. This could be a consequence of men generally attaining a higher level of education than women. Only male farmers in our study area could engage us on informed discussion concerning antibiotics and their uses in piggery. The result of our study agrees with the work of Ajala *et al*. (2007), who reported mean age of famers to be 38years. While younger farmers may be more economically active, the work of Strom *et al*. (2018b), noted that the prevalence of resistance to several antimicrobials, including multidrug resistance (MDR), was lower on farms operated by older farmers, possibly as a consequence of more experienced farmers having better disease control practices than use of antibiotics. Formal/high level of education among pig farmers could improve farms management such as adequate biosecurity practices and antibiotic use significantly. Encouraging farmers to take up training in animal husbandry will not only improve productivity but will educate farmers on the proper use of antibiotics (Hallenberg *et al*., 2020).

Farmers' years of experience have been associated with the use of antibiotics for prevention of diseases in farms. Experienced farmers do have an established protocol or programme of using antibiotics without a detailed examination of animals' health conditions (Fischer *et al.*, 2019; Lekugal *et al*., 2020).

40% of all the farms studied in the three senatorial zones had more than 50 sows in their farms. Previous studies have shown a positive association between farm size and the use of antibiotics, potentially due to a greater disease pressure on farms with a high density of animals (Hallenberg *et al*., 2020).

This study found that 52.5 % of all the farmers kept other animals in their farms apart from pigs. Rearing other animals in the same farm environment is a serious biosecurity problem, since cross contamination of pathogens between different species has been previously observed and reported (Wall *et al*., 1995; Chea *et al*., 2020). Disease outbreak resulting from cross contamination from other animal species in farm will result in more antibiotic usage. Only 7.5% of all farmers in the studied area accepted using only kitchen wastes in feeding their pigs. 85% reported using both kitchen waste and convectional feed.

Chea *et al*. (2020) suggested cooking these wastes at a standardized temperature before feeding pigs with it but these were not in practice in the farms studied. Conventional feeds also contribute to antibiotics consumptions in the farms, as feed producers add sub-therapeutic quantities of antibiotics in feed for livestock growth promotion (Lekugal *et al*., 2020).

The main stay of waste disposal in the farms studied was recycling in crop production process (85%).

Quarantining of new sows before mixing with herd was poorly practiced in our study locations and this was not observed in Anambra South and Anambra Central. Exchange of animals among farms is one of the most rapid ways for disease dissemination, because an animal may appear healthy while it may be experiencing chronic disease or within incubation time-frames for microbial pathogens (Kouam *et al*., 2020). Implementation of biosecurity measures leads to more financial profit, reduced usage of antimicrobials, and improved technical performance in pig production (Laanen *et al*., 2010; Ajewole and Akinwumi, 2014).

Presence of diseases in a farm is the major reason for antibiotic use and in most cases misuse. Kouam and Moussala (2018), indicated that among the factors limiting pig productivity, diseases have the lion's share. Purchasing antibiotics from human medicinal shops was the highest response adopted by farmers in the studied area. This has led to the use of antibiotics not approved for veterinary purposes (Morgan *et al*., 2011; Strom *et al*., 2018b). Reported practices related to the administration of the commonly used antibiotics during the study period are recorded in Table 3. Veterinary antibiotics (95%) were used by the farmers in the past 12 months, and this is similar to other reports in Ghana and Thailand (Osei 2014; Strom *et al*., 2018b).

Most farms accessed antibiotics from animal feed sellers and pharmacy outlets. Our report is contrary to Hallenberg *et al*. (2020), who reported that majority of the small-scale farmers purchase antibiotics directly from their local veterinary drug stores and do seek advice from the staff working in the stores. The authors are of the opinion that it is likely that small-scale farmers in similar settings around the world lack easy access to the veterinary services necessary for deciding on an appropriate antibiotic treatment, and hence solely rely on their own judgement or on advice from vendors, who may not necessarily have received sufficient training to do so (Chalker *et al*., 2005). Veterinarians are likely to play a dual role as animal healthcare providers and drug distributors, leading to a conflict of interest where they make a direct profit from the sales of medical products including antibiotics. (Chalker *et al*., 2005; Kim *et al*., 2013; Hallenberg *et al*. 2020).

Modes of administration of antibiotics mostly adopted by farmers were injection (65%) and oral administration (40%) and is statistically different (p = 0.029) in the senatorial zones. Our results agree with a similar work in Thailand, which reported 57.1% of the farmers using oral and injectable antibiotics for prevention of infection (Lekugal *et al*., 2020).

Antimicrobial withdrawal period before selling the pigs (2.5%) was poorly observed similar to the work of Strom *et al*. (2018b). If withdrawal times are not respected, there is a risk of antimicrobial residues remaining in the meat at slaughter. This will result in the consumption of sublethal concentrations of the antibiotics along with the pork (Duong *et al*., 2006; Yamaguchi *et al*., 2015).

Twelve different antibiotics were in use in the farms in the studied zones. Our study identified Oxytetracycline (90%) as the most commonly used antibiotics followed by amoxicillin (87.5%) similar to the work of Osei, (2014). Beta-lactams, tetracyclines, aminoglycosides, sulfonamides, fluoroquinolones, polymyxins, macrolides, trimethoprim, spectinomycin, nitrofurans, and lincosamides are the antibiotics used in the treatment of pig infections globally (Teuber, 2001). The antibiotics used in livestock fall into all the major classes of antibiotics used in clinical practices. Several other works on the use of antibiotics in these classes are supported by our study in the treatment of pig infection (Page and Gautier, 2012; Laxminarayan *et al*., 2013; Ström *et al*., 2018a; Ström *et al*., 2018b; Hallenberg *et al*., 2020).

CONCLUSION

Some features and management practices of the studied farms could predispose them to infections leading to use and misuse of antibiotics. Education on improved farm practices, strict laws regarding the sales and use of antibiotics, and increased veterinarian interventions on the farms are important to limit the occurrence of diseases and subsequent use of antibiotics.

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