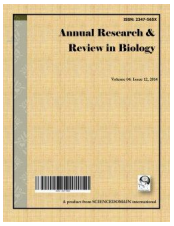

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Screening of Antimicrobial Residue in Commercial Eggs in Maiduguri Metropolis, Borno State

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Authors' contributions

This work was carried out in collaboration between all authors. All the authors read and approved the final manuscript.

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ABSTRACT

The objectives of the study were to screen for antimicrobial residue in table eggs in Maiduguri metropolis. Multistage sampling technique was used based on the 4 major district of Maiduguri Metropolis Viz; Bolori, Gwange, Kyarimi park and Shehuri North. Four hundred commercial egg samples were collected for the study. One hundred and sixteen table eggs were sampled from 35 randomly selected poultry layer farms and 284 were obtained from 37 randomly selected egg commercial retail outlets. The antimicrobial screening of eggs was carried out using the disc diffusion method where *Bacillus cereus* ATCC 14579 from spectra medics' laboratory in Ogun state was used as the test organism. One hundred and sixteen (116) table eggs collected from farms across the study district, 36 (31%) were each from Bolori and Gwange, 39 (33.6%) from Kyarimi

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Park and 5 (4.3%) from Shehuri North. A total of 49 positive samples were obtained which include 17 (47.2%), 21 (58.3%), 10 (25.6%) and 1 (20%) from Bolori, Gwange, Kyarimi Park and Shehuri North respectively (Fig. 2). There was no significant difference (P=0.095) among the clusters. Out of the 284 egg samples collected from the retail outlet, 201 (70.1%) samples were from Jos and 83 (29.2%) from Ibadan. A total of 100 (35.2%) samples were positives for antimicrobial screening which comprises of 71 (35.32%) and 29 (34.94%) from Jos and Ibadan respectively. With no significant difference between the two sources (P=0.902). From this study, it was concluded that: There is small flock size (backyard) farm in Maiduguri with 94.3% of the farmers holding equal or less than 500 birds in their farms. Antimicrobial residue detected in the study area is alarming.

Keywords: Table egg; Bacillus cereus; Maiduguri metropolis; antimicrobial residue.

1. INTRODUCTION

Egg contains carbohydrate, protein and other essential substances required for human existence [1]. The low caloric value, edibility and nutrient content makes egg significant foodstuff for many dietary regimes [2]. The hen's egg is a 'self-contained unit for starting a new life [3]. The egg is a major food source, providing good quality balanced nutrient to billions of people throughout the world, the world's total hen production in 2011 was 70.5 million tonnes, which is 8 million tonnes more than beef production for the same year [3]. Poultry is an essential component of the Nigerian economy, providing income for peasant farmers and a good source of high-quality protein for the ever growing population of Nigeria [4]. In livestock production, poultry occupies a prominent position in the provision of animal protein and this account for about 25% of local meat production in Nigeria [4]. The annual production capacity of commercial eggs in Nigeria is estimated at 8, 216, 208, 000 eggs equivalent to 273, 873, 600 crates of eggs [5].

Antibiotic usage has facilitated the efficient production of poultry, allowing the consumer to purchase at a reasonable cost, high-quality meat and eggs as well as reduce the impact of disease outbreaks [6,7]. They are used by the poultry industry to enhance growth, feed efficiency and reduce bacterial disease [6]. In layer hens, antimicrobials are only used to treat and prevent bacterial infections. Some of the antimicrobial classes used in treating layers include aminoglycosides, tetracyclines, beta-lactams, quinolones, macrolides, polypeptides, amphenicols and sulphonamides [8]. Through the years the issue of antibiotic residue from farm animals and their effect on human health has been a significant concern [9].

The consequences of the substantial use of antimicrobials in laying hens is residue accumulation in egg [10]. Very few antibiotics are approved for use in laying hens [11]. In Maiduguri, the study area, antibiotics are freely marketed without veterinary prescription [12], and despite a report of misuse of antibiotics, there is paucity of information regarding the level of antibiotic residue in commercial eggs meant for human consumption in the Maiduguri Metropolis.

2. MATERIALS AND METHODS

2.1 Study Area

Maiduguri Metropolis, a major city in the Northeastern part of Nigeria, is located between latitudes 11º04'N and 11·44'N; and between longitudes 13·04'E and 13·44'E. It covers a total land area of 543 km^2, which makes it the largest city in the Northeastern region of Nigeria [13,14]. Maiduguri city now extends to four Local Government Areas: Maiduguri Metropolitan, Jere, Konduga and to a smaller extent part of Mafa local government areas [15]. The climate of Maiduguri is characterized by a long dry season with high evaporation rate from October to May and a short Wet season for the remaining part of the year [14]. There are four identified seasons in the area which include the *Rainy Season*, (June to September) *Harvest Season* (September to November), *Harmattan or Cool Season* (December to February) and *Hot Season* (March to May) [16]. It has a population estimated at 1.275 million people according to the 2006 census [17]. With an annual growth rate of about 3.5% and a density of 1145 persons per square km which makes it the most densely populated city in North Eastern Nigeria [14,16]. Crop production and livestock farming are the predominant occupation of the people in the study area [18]. Poultry layer production is a profitable business in Maiduguri Metropolis [18].

2.2 Study Design

2.2.1 Sampling technique

Multi stage sampling method was used for sample collection.

Maiduguri metropolis was divided into 4 major district by Borno state water board namely Bolori, Gwange, Kyarimi Park, and Shehuri North. In this study, these areas were taken as the primary sampling units. Laying poultry farms and egg retail outlets located in each of the primary sampling units above were taken as secondary sampling units. Fifty per cent of farms and 10% of egg retail outlets were randomly selected. One egg was collected from 50 laying hens in each selected laying farm and 1 egg out of a crate in the retail outlets was taken as tertiary sampling unit. Geographical coordinates of the sampled areas were taken and recorded. A spatial distribution analysis of the layer farm sampled were constructed (Fig. 1).

2.2.2 Sample size determination

The determination of sample size for table eggs collection was based on the formula given by [19] for simple random sampling method.

$$n = \frac{z^2pq}{d^2}$$

Where:

n= sample size
z=desired confidence 1.96
p=prevalence= 3.6% by [20] in Jos plateau state.Nigeria
q= 1-p
d=allowable error 5%

Thus a total sample size of 180 table eggs was determined and was rounded up to 200 samples for convenience. The sample size was inflated 2 times to increase precision (2 x 200) reaching 400 table eggs to be sampled for the study [21].

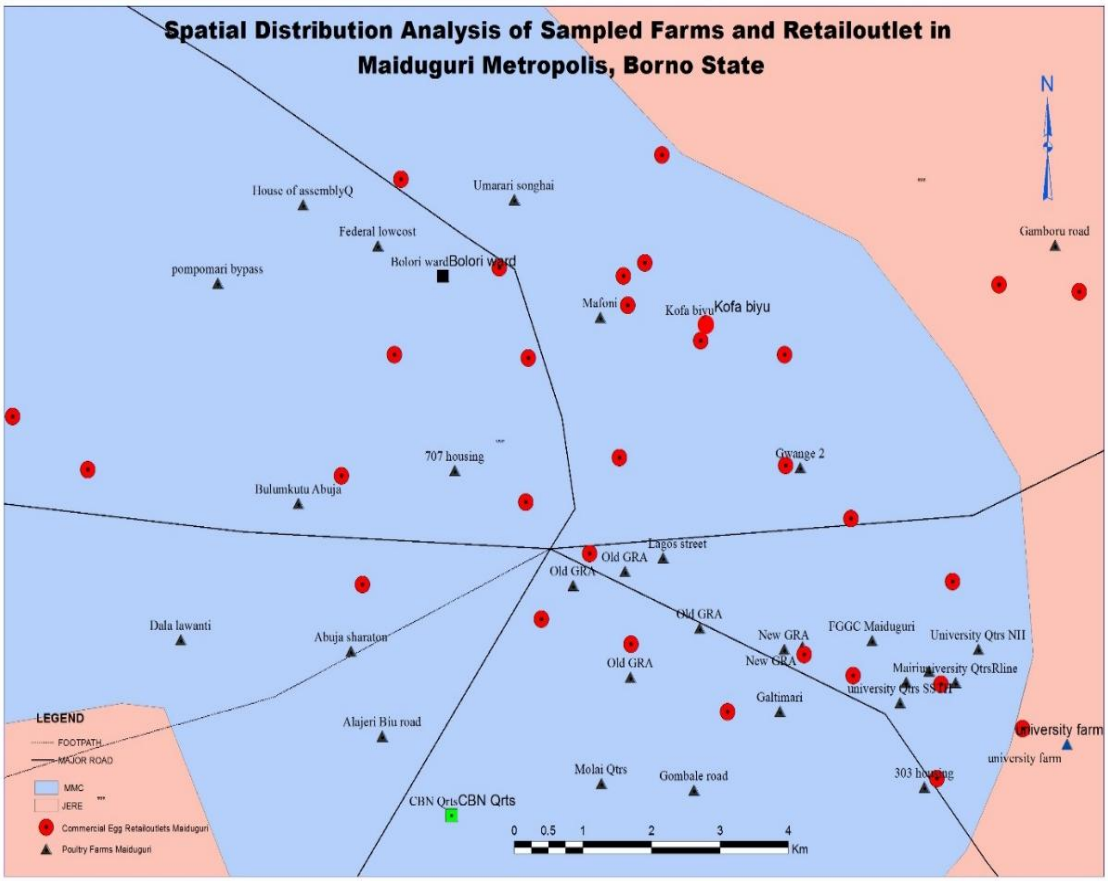

Fig. 1. Map showing sampled areas in Maiduguri metropolis, Borno state, Nigeria

2.2.3 Sample collection

A total of four hundred table egg samples were collected, out of which 116 samples were from 35 layer poultry farms and 284 table eggs were from 36 retail outlets in the four major areas of Maiduguri Metropolis. Fifty percent of layer farms and 10 % retail outlets were selected from each cluster. One table egg was collected in each fifty laying hens from the selected farms and the sampling covered a period of 3 weeks. One table egg was collected from each crate containing 30 eggs from selected retail outlets and the sampling covered a period of 2 weeks. The Table eggs collected were arranged in a clean crate, labeled and transported to the veterinary medicine laboratory immediately for processing.

2.2.4 Sample processing

The antimicrobial screening of eggs was carried out using the disc diffusion method where *Bacillus cereus* ATCC 14579 from spectra medics' laboratory in Ogun state was used as the test organism. An 18 hour culture of the test organism in 10 ml nutrient broth (Oxoid Basingstoke, Hampshire, UK) was used to inoculate Mueller Hinton agar plates. The egg surface was thoroughly cleansed using sterile cotton wool soaked in 70% alcohol. Sterile forceps were used to puncture the egg at the tip to create a small opening from where the yolk were carefully drained out into a sterile beaker and mixed with Phosphate Buffer Saline pH 7.4 and then thoroughly homogenize, then 10 milliliter was transfer to a clean sterile test tube and was centrifuge for 10 minutes at 4000 x g. Two milliliter of the supernatant was transferred to sterile petri dish [20,22].

2.2.5 Qualitative screening

Using a clean sterile forceps Whatman® filter paper disc 0.6 cm in diameter was dipped into 2 mm of the egg supernatant in the Petri dish, until it is soaked and then were exposed to temperature of 80°C for 10 minutes to in activate inhibitory substance and placed gently on the Mueller Hinton agar plate that has already been inoculated with the test organism according to the method of [23]. This was then incubated at 37°C for 24 hours after which the plates were viewed for the presence or absence of zones of inhibition of the test organisms around discs. Any disc with a zone of inhibition greater than 1 mm around the disc was considered positive [22].

2.2.6 Data analyses

The data was compiled and analysed with Statistical Package (SPSS statistical package version 21). Chi-square was used to determine association between variables at significant level of $P< 0.05$.

3. RESULTS

One hundred and sixteen (116) table eggs collected from farms across the study area, 36 (31%) were each samples from Bolori and Gwange farms, 39 (33.6%) from Kyarimi Park farms and 5 (4.3%) from Shehuri North farms. A total of 49 positive samples were obtained which include 17 (47.2%), 21 (58.3%), 10 (25.6%) and 1 (20%) from Bolori, Gwange, Kyarimi Park and Shehuri North respectively (Fig. 2). There was no significant difference ($P=0.095$) among the clusters. Out of the 284 egg samples collected from the retail outlet, 201 (70.1%) samples were from Jos and 83 (29.2%) from Ibadan. A total of 100 (35.2%) samples were positives for antimicrobial screening which comprises of 71 (35.32%) and 29 (34.94%) from Jos and Ibadan, respectively (Fig.3) with no significant difference of residue of antimicrobials between the two sources ($P=0.902$).

4. DISCUSSION

Occurrence of antibiotics residue in laying hens may be due to failure to observe withdrawal period, extra label dosage, contamination of animal feed with excreta of treated animal or the use of unlicensed antibiotics. All the commercial egg samples used for the study were obtained from layer farms and retail outlets. The majority of the retailers source their eggs from Jos and Ibadan in order to compensate for the short fall from local production in the study area. Short fall is connected with low flock size in the study area. The finding of this study is similar to that of [18] who reported small flock poultry layer farming in Maiduguri Metropolis. Antibiotic residues were detected in 49 (42.2%) of the eggs samples collected from farms with lower percentage 100 (35.2%) in egg samples collected from retail outlets. The lower percentages in retail outlets might not be unconnected with the storage or variation of antibiotic use by different farms were the eggs were sourced. This is in tandem with observation of [24] in Enugu who reported 36% positive in eggs sampled from farms and 30% in retail outlets and also [25] in Sudan reported 55.4% antibiotic residue in eggs collected from

farms and 43.2% in retail outlets. There is reported higher percentage (60%) of antibiotic residue in table eggs in Bangladesh [26]. The research of [22,20] and [27] reported a lower percentage of 0.5%, 3.6% and 18.5% antibiotic residue in table eggs respectively. The reason might be due to variation in awareness of biosecurity, antibiotic residue in table eggs and public health effect of antibiotic residue.

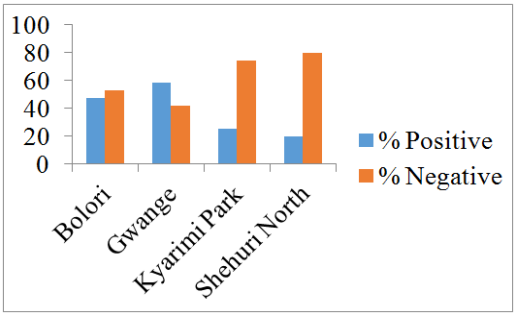

Fig. 2. Result of qualitative screening for antibiotic residues in table eggs from Poultry Layer farms in Maiduguri Metropolis, Nigeria

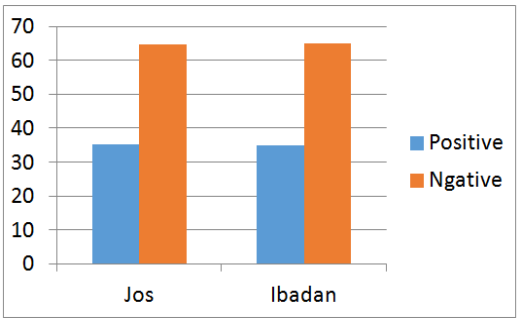

Fig. 3. Result of qualitative screening for antibiotics residues from retail outlet in Maiduguri Metropolis, Nigeria

5. CONCLUSION

From this study, it was concluded that: Most of the poultry layer farmers have small flock size (backyard) poultry farm in Maiduguri Metropolis with 94.3% of the farmers holding equal or less than 500 birds in their farms. Percentage of antibiotic residue detected were 42.2% and 35.2% in commercial egg samples collected from layer farms and retail outlets respectively.

6. RECOMMENDATION

Farmer education on the use of antibiotics and its public health implication. Antibiotics being a prescription drug should not be freely sold to farmers over the counter. More research using sensitive techniques should be carried out to quantify the residue levels of individual prohibited for use in food-producing animals. Antibiotics Legislation regarding the use of prohibited antibiotics on food animals by National Agency for Food and Drug Administration and Control.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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