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# Vaccination and Treatment of Local Poultry Kept under Different Management Systems

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***Authors' contributions***

*This work was carried out in collaboration between both authors. Authors AA and PA designed the study and performed the laboratory analysis. Author AA performed the statistical analysis and managed the literature searches and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.*

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## ABSTRACT

**Aims:** In Africa, local poultry production is main source of meat and eggs though disease is a major constraint. This study appraised the influence of management on local poultry exposure to infection and their response to vaccination and medication through feed.
**Study Design:** Local poultry were sampled, before intervention with vaccines and medication. After intervention the local poultry were monitored every fortnight.
**Place and Duration of Study:** The local poultry were sampled in Zaria, Nigeria and the samples were analyzed at the Faculty of Veterinary Medicine Laboratories at Ahmadu Bello University, Zaria.
**Methodology:** Flock information was obtained through a structured questionnaire and poultry blood, feacal samples and ectoparasites were collected after physical examination. Pack cell volume, Salmonella, Newcastle and Gumboro disease antibodies were analyzed by microhaematocrit method, rapid plate agglutination, haemagglutination inhibition and quantitative agar gel precipitin tests respectively. Haemoparasites, ectoparasites and endoparasites infecting the local poultry were assessed.

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**Results:** The total number of all farmers kept chickens but some also kept ducks, turkeys, guinea fowls and pigeons. The mean flock size for local poultry, chickens and ducks managed extensively, semi-intensively or intensively were 37.6 ± 6.3, 26 ± 7 and 2.4 ± 1.7 respectively. *Menacanthus stramineus* infested chickens were controlled with Coumaphors. *Emeria* species, *Raillietina* species, *Plasmodium gallinaceum* and *Aegyptianella pullorum* parasites were identified and treated. Local poultry had antibodies to Salmonella, Newcastle and Gumboro disease and their antibody response to vaccination varies with age, species, management and time of vaccination. Prior to vaccination, the mean Newcastle disease antibody titre of adult chickens was ≥ 4 log2 though that for growers was < 4 log2.

**Conclusion:** Disease control in local poultry is feasible when vaccination is concurrently conducted with medication but further studies are needed to establish the most appropriate intervention time to ensure minimal number of intervention for optimal result.

*Keywords: Disease control; local poultry; management; treatment; vaccination.*

## 1. INTRODUCTION

The role of local poultry (LP) in developing countries to provide the local population with daily protein requirement at affordable prices has led to the persistent efforts of some governments [1] to improve their productivity. Ownership and management of these birds are mainly by women and children [2]. Village poultry has the potential to improve food security while assisting in poverty alleviation and mitigating the adverse economic impact of HIV/AIDS for rural populations [3].

The poultry population in Nigeria was estimated at 150 million (m) of which 102.8 m are local chickens [4], 44 m guinea fowls [5], one million turkeys and one million ducks [6]. Local poultry forms the bulk of the sources of poultry meat and eggs in Nigeria [7,8]. They are kept in small numbers in villages and scavenge for their daily rations keeping them in constant contact with pathogens. A study reported the average flock size of 30 local chickens per household [2] and the flock structure consisting of chicks, growers, cocks and hens. The major constraints to LP production are disease such as Newcastle (ND) and Gumboro (GD) disease, poor nutrition, poor housing and predation [9]. Local poultry production can be improved through improving the methods of husbandry, nutrition and disease control [10]. Much research has been done on improving local poultry production through improved husbandry and nutrition but little on disease control.

This study was undertaken to assess the influence of management on local poultry exposure to infection and their response to vaccines and medication administered in maize bran feed. The data obtained could serve as a pilot for planning a more extensive study aimed at designing an effective holistic disease control program for local poultry.

## 2. MATERIALS AND METHODS

### 2.1 Flocks of Local Poultry (LP)

Five LP flocks raised under different management systems were randomly selected for the study from February to March, 2017. The combined flock size was 400 birds from which five birds were randomly chosen from each species of poultry in a flock to comprise a cock, hen, grower and chick in the case of chickens.

### 2.2 Questionnaire

A structured questionnaire designed to collect information on management practices and disease in each flock was administered to the owners of selected flocks.

### 2.3 Vaccines

The live attenuated vaccines used were 500 doses of Newcastle Disease (La Sota) vaccine; 500 doses of Gumboro Disease vaccine; 500 doses of Fowl Pox vaccine.

### 2.4 Drugs

Drugs used include an anti-parasitic drug (20% amprolium and 20% Furaltadone); antibiotic (Oxytetracycline); anti-helmintic agent (Mebendazole) and acaricidal powder (5% wetable Coumaphors).

### 2.5 Vaccination and Treatment

Vaccination against Newcastle Disease (ND), fowl pox (FP) and Gumboro Disease (GD)

together with treatment against ectoparasites, helminths and haemoparasites were the intervention strategy in this study. The LP were vaccinated and treated after collection of blood, feacal samples and ectoparasites. The vaccination and treatment was repeated two weeks later except treatment with the acaricide.

Four hundred doses of each vaccine were dissolved in 1,000 ml of sterile distilled water. Each LP received 2.5 ml of solution equivalent to a dose of each vaccine. All the drugs were also dissolved in the sterile distilled water containing dissolved vaccines forming a cocktail used to convert two kilogram of maize bran to paste form. The quantity of each drug in the treatment cocktail was calculated based on manufacturer's recommended dose and duration for treatment. The treatment cocktail contained 9 g of anti-parasitic drug, 26.25 g of Oxytetracycline and 120 mg of mebendazole. The maize bran paste containing the vaccines and drugs were to the poultry early in the morning.

Coumaphors was administered by rubbing the powder under the wings and base of the tail feathers of each bird in all flocks.

## 2.6 Antigens

Salmonella antigens used was commercially produced. GD antigen was prepared from known infected bursa while ND antigen was live ND LaSota strain vaccine.

## 2.7 Sample Collection and Laboratory Procedures

Faeces, ectoparasites and blood were collected prior to intervention and every two weeks after the first intervention for a month.

Poultry were examined for external parasites by checking under the wings and tail feathers, under the breast and back feathers. Ectoparasites found were collected and placed into sample bottles containing 70% alcohol and transported to the entomology laboratory of Ahmadu Bello University, Zaria- Nigeria for identification.

Fresh faeces were collected from each flock into labeled polythene bags and examined for helminths eggs, coccidia oocyts and other endoparasites by simple floatation [11].

Two milliliter of blood collected through brachial vein of poultry using 21 G sterile hypodermic needles and 2 ml syringes carefully observing asepsis was collected into two set of sample bottles with one containing ethylene diamine tetra acetic acid (EDTA) while the other set did not.

Part of blood collected in EDTA was used to prepare a thin blood smear, stained with Giemsa and observed under the microscope for identification of blood parasites. The PCV was determined after centrifuging in a microhaematocrit tube and measured on a microcapillary reader [12].

The blood collected without EDTA was allowed to clot at room temperature and sera obtained were used for serology to determine antibodies for Salmonella, GD and ND by rapid plate agglutination, quantitative agar gel Immunodiffusion precipitin (QAGP) and haemagglutination inhibition (HI) tests respectively [13,14].

# 3. RESULTS AND DISCUSSION

## 3.1 Results

### 3.1.1 Flock description

The study revealed that local chickens were kept by all the farmers, 40% of farmers kept ducks and turkeys while 20% kept guinea fowls and pigeons. The mean flock size of local poultry was 37.6 ± 6.3 with mean flock size among the poultry species ranging from 26 ± 7 for chickens, 2.4 ± 1.7 for ducks, 6 ± 5.3 for turkeys, 1 ± 1 for guinea fowls and 2.2 ± 2.2 for pigeons. Among local chickens, mean chick flock size was 5.8 ± 3.1 with growers, hens and cocks having mean flock sizes of 7.4 ± 3.6, 10 ± 4.9 and 2.8 ± 0.8 respectively. The local poultry were managed extensively, semi-intensively or intensively with other management features in individual flocks as described in Table 1.

### 3.1.2 Ectoparasites

All flocks were infested with *Menacanthus stramineus* prior to treatment with Coumaphors. All flocks were free of lice infestation a month after intervention.

### 3.1.3 Endoparasites

Prior to intervention, 75% of the flocks were infected with *Emeria* species with non of the flock infected with helminths. Two weeks post intervention, 25% and 20% of flocks were infested with *Emeria* species and *Raillietina* species respectively though after four weeks post

intervention, all flocks were free of *Raillietina* species but were re-infected with *Emeria* species.

#### 3.1.4 Haemoparasites

*Plasmodium gallinaceum* and *Aegyptianella pullorum* were the only haemoparasites reported in the study. Prior to intervention, 75% and 50% of the flocks were infected with *Aegyptianella pullorum* and *Plasmodium gallinaceum* respectively. At two weeks post intervention, none of the flocks had *Aegyptianella pullorum* but 75% of the flocks were still infected with *Plasmodium gallinaceum*. *Plasmodium gallinaceum* persisted in 50% of the flocks four weeks post intervention despite the second intervention while all flocks remained free of *Aegyptianella pullorum*. Turkeys, chickens and ducks were infected with both *Plasmodium gallinaceum* and *Aegyptianella pullorum* though at the end of the study, duck were found to be infected with *P. gallinaceum.*

#### 3.1.5 Packed cell volume

The mean packed cell volume (PCV) for chickens was 25.4 ± 1.1% while that for turkeys was 23.7 ± 1.4%. Most chickens were within the PCV range of 20 – 29% while turkey range was 25 – 29%. After first intervention, chicken PCV was 25.5 ± 0.8% while turkey PCV was 27.8 ± 0.9%. Turkey and chicken PCV were 22.5 ± 1.0 and 22.5 ± 1.1% respectively four weeks post intervention.

#### 3.1.6 *Salmonella* antibodies

All flocks had antibodies to *Salmonella* though only 66.7% of the poultry sampled had antibodies to *Salmonella*. Over 83% of adult poultry had antibodies to *Salmonella* compared to 33.3% in young poultry. Ducks sero-converted fastest followed by chickens then turkeys. All birds in Flock 1 sero-converted four weeks after treatment.

#### 3.1.7 Newcastle disease antibodies

Prior to intervention, all adult poultry sampled had antibodies to ND with a mean HI titre of 4.4 ± 0.61 $\log_2$ while young birds did not have ND antibodies. Seventy-five per cent of chickens and all sampled ducks had ND antibodies with a mean titre of 4.0 ± 0.31 $\log_2$ and 7.0 ± 0.63 $\log_2$ respectively. All flocks sampled prior to vaccination had ND antibodies with prevalence ranging from 50% in Flock 1, 66.7% in flock 3 and 100% in Flock 4. The flocks mean HI titre were 4.0 ± 0.12 $\log_2$, 3.0 ± 0.37 $\log_2$ and 5.25 ± 0.21 $\log_2$ among Flocks 1, 3 and 4 respectively with prevalence among age groups, species and flocks two and four weeks post vaccination indicated in Table 2.

#### 3.1.8 Gumboro disease

Young and adult poultry both had GD prevalence of 66.7% with mean antibody titre of 2.0 ± 0.45 log2 and 1.5 ± 0.21 log2 respectively prior to vaccination. At two weeks post vaccination, young and adult poultry prevalence were 42.9% and 50.0% respectively with mean titre of 4.5 ± 0.34 log2 for young poultry and 1.6 ± 0.43 log2 for adult. The distribution of IBD precipitin antibodies and ND sero-prevalence (mean titre) among various species and flocks are represented in Table 2.

### 3.2 Discussion

The study revealed a slightly different flock composition with more farmers keeping turkeys compared to previous studies in Kaduna State though management system and mean flock size of chickens (Table 1) were similar [2].

Lice infestation irrespective of management system observed in the study is contrary to previous report and the only species reported was *Menacanthus stramineus* [15]. Dusting birds with Coumaphors kept birds free of lice infestation throughout the study period probably due to its high residual effect which last up to three weeks.

The presence of *Emeria* species in local chickens observed in the study is in conformity with similar reports in Zaria [16]. Absence of coccidia in Flock 2 was probably due to absence of species of coccidia affecting turkey as the flock was composed of mainly turkeys. The low *Emeria* load in Flock 1 also supports reports that coccidiosis is a rare clinical entity in village poultry raised extensively [17]. The study further revealed that poultry kept under semi – intensive system within a restricted area and those raised intensively, usually have higher coccidia load probably as they became re-infected by sporulated oocyts from the environment. The study revealed that amprolium, a component of the antiparasitc drug used in the study (20% amprolium and 20% Furaltadone) was effective in controlling coccidia though its persistence after second treatment might be that the amprolium was not effective against oocytes leading to re-infection after the drug has been metabolized.

**Table 1. Flock management features of local poultry in Zaria, Nigeria**

| Feature | Flock 1 | Flock 2 | Flock 3 | Flock 4 |
|---|---|---|---|---|
| Management | Extensive. | Semi-intensive (Adults) and intensive (poults until 3 months old). | Semi-intensive, roaming within a fenced area. | Intensive. |
| Housing | 8 $m^2$, thatched roof with mud floor and walls. Cleaned twice monthly. | Poults - brick walls and concrete floor; Adult - mud walls with mud floor covered with wood shavings. Both houses- corrugated roofing sheets. Houses cleaned twice monthly. | Bricks with concrete floor and corrugated roofing sheets. | 12 m 2 with brick walls and concrete floor. No roof. House cleaned daily. |
| Feed | Guinea corn and guinea corn offal. | Poults – broiler finisher. Adults – millet, guinea corn or maize offal and kitchen scrap. | Maize, millet or guinea corn. | Layer or grower mash; grains or kitchen scraps. |
| Feeding | Once daily. | Thrice daily. | Once daily. | Thrice daily. |
| Source of birds to increase flock size | Hatching and purchase from village market. | Hatching and purchase from market. | Hatching. | Purchase and gifts. |
| Quarantine | Yes | Yes | No | Yes |
| Causes of Mortality | Disease and predators (dogs). | Disease and predators (humans). | Disease, predators, drowning. | Disease and predators (snakes). |
| Disease observed at time of sampling | Fowl pox (young birds). | None | Fowl pox (chicks) | None |
| Morbidity / Mortality at last disease outbreak | Not available (N/A) | N/A | Morbidity – 52%. Mortality – 36%. | Morbidity – 10.3%. Mortality – 7.7% |
| Others | Poor hatchability | Vaccinated against fowl pox and regularly dewormed | No vaccination or deworming | Vaccinated against ND, IBD and regularly dewormed. |

**Table 2. Prevalence of gumboro and newcastle disease antibodies and mean titre in local poultry by species and flock**

| Weeks post vaccination (Weeks) | Disease | Species | | | Flocks | | | |
|---|---|---|---|---|---|---|---|---|
| | | Prevalence (%)/ Mean titre ($Log_2$) | | | Prevalence (%)/ Mean titre ($Log_2$) | | | |
| | | Chicken | Turkey | Duck | 1 | 2 | 3 | 4 |
| 0 | ND | 75.0 (4.0) | NT (NT) | 100 (7.0) | 50.0 (4.0) | NT (NT) | 66.7 (3.0) | 100 (5.25) |
| | GD | 80.0 (1.6) | NT (NT) | 0 (-) | 66.7 (4.0) | 50.0 (2.0) | 100 (1.5) | 50.0 (1.0) |
| 2 | ND | 81.3 (5.4) | 100 (5.8) | 0 (-) | 75.0 (5.0) | 100 (5.4) | 66.7 (3.0) | 83.3 (5.4) |
| | GD | 62.5 (2.4) | 16.7 (+[a]) | 0 (-) | 100 (2.5) | 40.0 (2.0) | 66.7 (3.0) | 50.0 (3.0) |
| 4 | ND | 83.3 (5.3) | 83.3 (7.0) | 0 (-) | 80.0 (3.7) | 75.0 (6.7) | 66.7 (5.0) | 80.0 (7.0) |
| | GD | 33.3 (2.3) | 0 (- [b]) | 0 (-) | 25.0 (4.0) | 0.0 (-) | 33.3 (3.0) | 40.0 (1.5) |

The presence of *Raillietina* species in Flock 1 at two weeks after treatment despite its absence at first treatment with Mebendazole was probably because the birds were harboring the developmental stages of the helminth which was resistant to Mebendazole but were eliminated after the second treatment as they were fully developed after 2 weeks confirming that Mebendazole is effective against *Raillietina* infection [2,11]. The absence of *Raillietina* eggs in the other flocks was due to regular deworming (Flock 2, 4 and 5) and restricted movement (Flock 3). The study revealed that regular deworming at 2 weeks interval would keep local poultry helminths free.

Contrary to previous reports, *Ascaridia* was not reported in this study [16]. This was probably due to previous treatment of the poultry with piperazine or the season (dry season) during which the study was conducted as *Ascaridia* infection is more common in the rainy season [16].

The hemoparasites, *Aegyptianella pullorum* and *Plasmodium gallinaceum* identified in this study confirms results of other reports [2,18]. The presence of *Aegyptianella pullorum* despite the absence of larvae and nymph of *Argas persicus* on the birds might possibly be that the *A. pullorum* is being transmitted by mosquitoes within the flock. Oxytetracycline was effective in treating the *Aegyptianella* infection. The *Plasmodium gallinaceum* was treated after the second intervention by furaltadone component of the anti-parasitic drug used in the study.

The PCV values of chicken in the study was lower than reports of previous study in local chickens in Nigeria which was probably due to hemoparasites seen but was higher than that observed for clinically sick local chickens [19].

The study further confirms the serological evidence of *Salmonella* infection in local poultry [2,18]. Adult birds were more sero-positive than young birds because their age increases their chances of coming in contact with the pathogen, hence they respond by producing antibodies.

The difference in the rate of *Salmonella* sero-conversion between chicken and turkey might be due to their differences in responding to infection which determines the amount of antibody produced. Thus turkeys were still sero-positive at 4 weeks post treatment because of their possible initial high mean antibody titre while chickens were sero – negative due to their initial low titre.

The study also further confirms serological evidence that ND and GD are endemic in local poultry [2,18]. The lack of antibodies of ND in young poultry prior to vaccination was because their maternal antibodies had weaned at the time of vaccination. This would result in the young being more susceptible to ND than adults [20]. The drop in sero-prevalence and mean HI titre of young birds after second vaccination was due either to neutralization of antibodies by vaccinal virus or a depression of humoral immune to ND vaccine caused by IBD vaccine [21]. The fall in HI titre was not noticed in adults as they do not respond adequately to orally administered IBD vaccine [21].

The study revealed that all the sampled flocks had high ND antibody titre ($log_2$ HI titre ≥ 4 $log_2$) before and after intervention (Table 2), thus were protected against disease and mortality [22]. Only Flock 4 could prevent infection and transmission prior to intervention while only Flock 5 attained flock immunity at the end of study the since more than 85% of birds had log2 HI antibody titre ≥ 4 log2 [22]. Flock 4 had a history of vaccination against ND. Prior to the second intervention only Flock 2 achieved flock immunity and the mean HI titre level was ≥ 4 $log_2$ [22]. After the second intervention, Flock 4 had antibody titre that is protective against mortality and drop in egg production due to ND though it lost flock immunity after the first and second intervention as a result of the short vaccination interval [23]. The drop in the mean ND HI titre in Flocks 1 and 5 after the second intervention was probably due to their extensive management system where birds are predispose to constant challenge by field virus while scavenging for food [24].

The poor antibody response in ducks confirms poor adaptability of ND virus in ducks hence rare clinical cases [20].

The marked drop in GD antibodies of poultry at two weeks post vaccination was probably because maternal antibodies in the young poultry which respond to oral IBD vaccination were neutralized by the vaccinal virus or due to low sensitivity of AGPT to detect low antibody titre [25].

The drop in mean GD antibody titre at four weeks post intervention (Table 2) was probably due to

either short vaccination interval or their management system [21,24]. The increased response of young birds relative to old birds after the first vaccination supports reports that adult birds do not respond adequately to orally administered IBD vaccines [21]. The poor immune response in turkey and duck to GD vaccine was probably because the vaccinal virus is less immunogenic in these species. The general decrease in the sero-positivity in the flocks might be due to low sensitivity of AGPT. The absence of antibody response of Flock 5 birds may be because the cock, turkey tom and hen might have taken the vaccine and responded poorly to the vaccine while the growers did not get enough of the vaccine because they are low in the pecking order. All the flocks lacked flock immunity as less than 85% of flock members have antibody against GD.

Most of the flocks had fowl pox infection but only the young birds were clinically affected possibly because adults were immune to fowl pox virus as reported by previous studies [17].

The poor hatchability reported in Flock 1 was probably due either the laying of infertile eggs as the cock: hen ratio was high thus cocks spend time fighting each other than mating or lice infestation disturbed the hens from incubating the eggs. The communal incubation of eggs by hens or anemia as a result of lice and haemoparasitic infection might also result in poor hatchability of the eggs [26].

## 4. CONCLUSION

The study revealed that disease control in local poultry is feasible when vaccination is concurrently undertaken with broad spectrum antimicrobials, ante-helminthics and acaricides. Further studies are needed to establish the most appropriate time of intervention within the year to ensure minimal number of intervention for best results.

Government intervention in control of diseases in LP is highly recommended as LP is necessary no only for provision of daily protein requirement for local population at affordable prices, but also has potential in alleviating poverty and contributing to disease control in commercial poultry. However, prior to government intervention, a more extensive study to design an effective holistic disease program for LP is essential.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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