

PERFORMANCE AND HEALTH STATUS OF ARBOR
ACRES BROILER CHICKENS RAISED WITH ROUTINE
ADMINISTRATION OF FLUOROQUINOLONES

ABSTRACT

Aim: The study was carried out to evaluate the effect of routine administration of fluoroquinolones on performance, haematology, and serum biochemistry indices of Arbor Acres broiler chickens.

Study Design: The experiment employed a completely randomized design; all data generated were subjected to analysis of variance, $P=0.05$.

Place and Duration of Study: The study was carried out at the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria, between February and March, 2014.

Methodology: One hundred and eighty unsexed one-day old Arbor Acres broiler chicks were used in a 48-day study. Broiler chicks were distributed into four experimental treatments viz; control, enrofloxacin, ciprofloxacin and norfloxacin. Birds were administered with 10 mg/kg body weight of the selected fluoroquinolones for 3 days on week 2, 4, and 6. On Day 39, 3 birds per treatment were randomly selected and blood collection was done through jugular puncture. Selected haematological and serum biochemistry parameters were analyzed to determine the health status of the birds. Growth Performance of the experimental birds were evaluated on day 48.

Results: Performance results of the experimental birds showed significant differences ($P\leq 0.05$) for daily weight gain, daily feed intake and feed conversion ratio. The group supplemented with ciprofloxacin had the best performance. Selected fluoroquinolones had no influence on haematological indices evaluated. Serum indices showed significant ($P\leq 0.05$) differences for Aspartate Amino Transferase (AST) among the treatments. Control had the highest mean value for AST (85.32 ± 5.12 I.U/L) compared to other treatments.

Conclusion: The results obtained in this study indicated that routine administration of fluoroquinolones had effect on some performance and health status indices of Arbor Acres chickens when compared with the control.

Keywords: Ciprofloxacin, norfloxacin, performance, blood profile, broilers

36 1. INTRODUCTION

37 Recently, broiler out-growers are pressurized to increase the growth rate, feed efficiency and
38 size of breast muscle with the use of Antibiotics Growth Promoters (AGPs) [1, 2]. Antibiotic
39 growth promoter may destroys or inhibits bacteria when administered to broilers as
40 prophylaxis [3]. Antimicrobial agents could be used and as feed additives as well as with
41 drinking water for not only therapeutic but also prophylactic purposes [4]. Antibiotics promote
42 growth by interacting with intestinal microbial population and stimulating feed intake [5].
43 Another important benefit of antibiotic growth promoters lies in their ability to control
44 important zoonotic pathogens such as *Salmonella* spp., *Campylobacter* spp. and *E. coli* [6].

45 One of the most commonly used groups of AGPs in Nigerian broiler industry is
46 fluoroquinolone [7]. Fluoroquinolones are bactericidal agents, they are effective against
47 Gram-negative organisms and some mycobacteria [8]. Introduction of the first fluorinated
48 quinolone, norfloxacin lead to the development of other members of this group, such as
49 enrofloxacin and ciprofloxacin [9]. Ciprofloxacin has wide clinical applications, better safety
50 profile and good in vitro effectiveness against resistant pathogenic organisms as compared
51 to other classes of antibiotics [10].

52 Fluoroquinolones are often recommended for respiratory tract infections, gastrointestinal
53 tract infections and urinary tract infections caused by *Campylobacter*, *E. coli*, *Haemophilus*,
54 *Mycoplasma*, *Pasteurella* and *Salmonella* species [11, 12]. The routine administration of
55 enrofloxacin, ciprofloxacin and norfloxacin to broilers during growth may lead to changes in
56 blood profile. The report on the effects of fluoroquinolones on growth performance and health
57 status of Arbor Acres broiler chickens is limited in Nigeria. The study was carried out to
58 evaluate the effects of routine administration of fluoroquinolones on performance,
59 haematology, and serum biochemistry indices of Arbor Acres broiler chickens.

60 2.0 MATERIALS AND METHODS

61 Location and Duration of the Study

62 The study was carried out at the broiler unit of the Teaching and Research Farm, University
63 of Ibadan, for a period of 48 days.

64 2.1 Management of birds and Experimental Design

65 A total of one hundred and eighty (180) one day old Arbor Acres broiler chicks procured from
66 a commercial farm in Ibadan, Oyo State, were used for the study. The birds were reared on
67 deep litter in an open-sided poultry house. One hundred watt electric bulbs were used as
68 source of heat and lighting. Feed and water were given *ad-libitum*. Medication, vaccinations
69 and other routine management practices were given to birds according to recommendations.

70 The chicks were distributed randomly into four experimental treatments viz; control,
71 enrofloxacin, ciprofloxacin and norfloxacin respectively. Experimental treatment contained 45
72 birds, 3 Replicates per treatment and 15 birds per replicate. All birds were treated alike
73 except from the type of antibiotics used.

74

75 2.2 Administration of Antibiotics

76 Birds were administered with the selected fluoroquinolones on week 2, 4, 6 for 3 days. The
77 treatments were for prevention purposes and administered at 1ml / 2 litres of drinking water
78 for 3 days (10 mg /kg body weight). Birds in the control group received water without
79 antibiotics throughout the experiment. The treatments were used in a likely way that Nigerian
80 broiler farmers administered it to their birds. However, withdrawal period of 10 days was
81 observed, which was sufficient enough in reducing concentration of the drugs in blood and
82 tissues below Maximum Residue Limits according to recommendations by drug
83 manufacturers.

84

85 **Table 1. Gross composition of experimental diet (%)**

| Ingredients | Starter 1-21 d | Finisher 22-48 d |
|----------------|-------------------|---------------------|
| Maize | 57.00 | 61.00 |
| Soybean meal | 32.00 | 29.00 |
| Fish meal | 2.50 | 0.00 |
| Wheat offal | 5.50 | 7.00 |
| DCP | 2.00 | 2.00 |
| Salt | 0.25 | 0.25 |
| DL-Methionine | 0.20 | 0.20 |
| L-Lysine | 0.05 | 0.05 |
| Broiler premix | 0.25 | 0.25 |
| Mycofix | 0.25 | 0.25 |
| Total | 100.00 | 100.00 |

86 Calculated Nutrients: Crude Protein: 22.79% and 19.47%; Digestible
87 Energy (kcal/kg): 3005 and 3229; Calcium (%) 0.95 and 1.02;
88 Available Phosphorus%: 0.45 and 0.50 for starter and finisher phases
89 respectively.

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93 **2.3 Feed intake**

94 The feed consumed was obtained by weighing the feed given per replicate and the leftover.
95 Daily feed intake was calculated by the difference in feed intake and left over. Weekly
96 records of feed consumption per bird were obtained for each replicate by dividing the total
97 amount of feed consumed by the number of birds in each replicate.

98 **2.4 Body weight and weight gain**

99 The chicks were weighed at the beginning of the trial and were subsequently weighed
100 weekly throughout the experimental period. The weekly weight gain was obtained by
101 subtracting the weight of the preceding week from that of the present. The value gave the
102 weekly weight gain per chick and from this; the daily weight gain was calculated.

$$103 \text{ Average daily body weight gain} = \frac{\text{Weekly weight gain} \times \text{Number of birds in the group}}{7}$$

104

105 **2.5 Feed Conversion Ratio**

106 This was calculated as the ratio of feed consumed to the body weight change

$$107 \text{ FCR} = \frac{\text{Average Daily Feed Intake}}{\text{Average Daily body weight gain}}$$

108

109 **2.6 Mortality**

110 Death in each replicate was recorded against the replicate.

111

112 **2.7 Haematological Indices**

113 Twenty four hours after the last dosage (Day 39), 3 birds per treatment were selected
114 randomly and blood collection was done through jugular puncture into heparinized and non-
115 heparinized bottle. The red blood cell (RBC) and white blood cell (WBC) counts were
116 determined by haemocytometer method using Natt-Herrick solution. Haematocrit (Hct) or
117 packed cell volume (PCV) and haemoglobin (Hb) values were measured by
118 microhaematocrit and Sahli's methods [13] respectively. The percentages of peripheral
119 blood leukocyte were determined using blood smears stained by May Grunwald-Giemsa
120 stain [13]. Data were presented as mean \pm SE and were analysed statistically by ANOVA.

121 Duncan multiple range test was used to test the significance of differences between the
122 experimental groups ($p \leq 0.05$).

123

124 **2.8 Serum Biochemistry**

125 The blood was allowed to clot and the serum was separated immediately by
126 centrifugation at 2000 revolutions per minute for 10 minutes. Total protein was estimated by
127 the biuret reaction [14]. Creatinine was determined by the Jaffe reaction method [15]. Serum
128 concentration of cholesterol were determined using the procedure described by Kaneko [16].
129 Alanine transaminase (ALT), aspartate transaminase (AST) and alkaline phosphatase were
130 determined calorimetrically using reagent kits (Randox Lab., Ltd., Co. Antrim, UK). Sodium
131 oxalate fluoride was used for glucose preservation. The blood glucose was determined by
132 enzymatic colorimetric test (GOD-PAP method) Quimica Clinica Aplicada, S.A. Kit.

133 **2.9 STATISTICAL ANALYSIS**

134 The experiment was arranged in a completely randomized design. Data collected were
135 subjected to analysis of variance (ANOVA) using SAS v. 9.3 (2011) package [17]. Significant
136 difference was set at 5%. The means were compared using Duncan multiple range test of
137 the same software.

138 **3.0 RESULT AND DISCUSSION**

139 **3.1 Performance of the experimental birds**

140 Table 2 shows the effect of fluoroquinolones on the performance of Abor Acres broiler chicks
141 over a period of 48 days. There was significant ($P < 0.05$) difference in average daily feed
142 intake, average daily gain and feed conversion ratio amongst the treatments. T4 had the
143 best FCR (1.88) followed by T2 (1.90). The control was not significantly ($P > 0.05$) different
144 from T3 (2.06). T3 (2508g) had the highest average weight gain. The control had the lowest
145 mean value (43.45 ± 0.72) for average daily gain when compared to other treatments.

146 Performance results (Table 2) from the present study indicated that supplementing T2, T3,
147 and T4 in water for Abor Acres broiler chicks had no effect on final body weight. These
148 observations are in accordance with [18] who indicated that antibiotics are known to produce
149 no significant improvement on growth performance under cleaner environment despite
150 administration in low doses. The result from the study may be due to strict biosecurity
151 measures followed during the experiment. Further, [19] documented that ciprofloxacin did
152 not have any influence on body weight in healthy broilers and suggested that
153 fluoroquinolones has influence in increasing body weight only in infection, not in healthy

154 condition. Also it was reported by [20] that enrofloxacin administration through drinking water
 155 did not have any effect on mean body weights and feed conversion ratio. However, the best
 156 feed conversion ratio shown in T4 is in agreement with study of [21], which indicated that
 157 antibiotic group showed superior FCR compared with the control and probiotics used. Also,
 158 the significant effect of antibiotics observed on FCR in this study, were in agreement with the report
 159 of [22](Mehdi, 2011). This may be due to the broad spectrum antibacterial effect of T4 and T2,
 160 leading to a more balanced micro flora population in gut, greater feed efficiency and improved
 161 FCR.

162

163 **Table 2. Performance of the experimental birds raised with routine**
 164 **administration of fluoroquinolones.**

| Parameters | T1 | T2 | T3 | T4 | SEM |
|---------------------------------|--------------------|--------------------|---------------------|--------------------|-------|
| Average Initial Body weight (g) | 48.00 | 47.00 | 50.00 | 46.00 | 1.16 |
| Average Final Body weight (g) | 2135.00 | 2358.00 | 2508.00 | 2450.00 | 13.14 |
| Average Weight gain(g) | 2087.00 | 2311.00 | 2458.00 | 2404.00 | 9.63 |
| Average Daily Feed Intake(g) | 89.42 ^b | 91.38 ^b | 105.83 ^a | 94.08 ^b | 1.65 |
| Average Daily Gain(g) | 43.45 ^b | 48.14 ^b | 51.21 ^a | 50.08 ^b | 0.72 |
| Feed Conversion Ratio | 2.06 ^a | 1.90 ^b | 2.06 ^a | 1.88 ^b | 0.08 |

165 ^{a-c} Means along the same row with similar superscripts are not significant (P>0.05). T1=
 166 Control; T2= Enrofloxacin; T3= Ciprofloxacin; T4=Norfloxacin

167 **3.2 Haematological indices of the experimental birds raised with routine**
 168 **administration of fluoroquinolones.**

169 Haematological constituents usually reflect the physiological responsiveness of the animal to
 170 its external or internal environments and thus serve as a veritable tool for monitoring animal
 171 health. The impact of fluoroquinolones on the haematological indices of Arbor Acres broilers
 172 is shown in Table 3. There were no significant (P>0.05) differences in the parameters
 173 amongst the treatments. The PCV, Hb and WBC values in this study were similar to those
 174 reported by [23] for 40 days old broilers treated with enrofloxacin at dose of 10 mg/kg body
 175 weight. The non-significant monocyte values in this study are higher than those reported by
 176 [24] for Arbor Acres broilers. The haematologic profile observed in this study may be as a
 177 result of high correlation between age and haematological parameters contents of broiler
 178 strains as described by [24] and indicate that blood profiles of chickens is affected by age.
 179 The result of haematological parameters shown in Table 3 indicated that the birds in all
 180 treatments were healthy and not severely influenced by the routine administration of
 181 fluoroquinolones. However, the non-significant increase in mean value for basophil in T1, T2
 182 and T4 treated birds may indicate infection and inflammation. Basophils play a role in both
 183 parasitic infections and allergies. However, it is usually found in the peripheral blood of a
 184 healthy broiler chicken within the range of 0.0% to 2.0%. Birds in T3 had 0.0% basophil,

185 which indicates non-significant levels of infection and may be as a result of broad spectrum
 186 antimicrobial activities of T4. Heterophil and Lymphocyte value are considered as sensitive
 187 haematological indicators of stress response among chickens' populations [25] and as a
 188 general biomarker relevant to immune function [26] in poultry. The non-significant
 189 lymphocyte values in this study were similar to those reported by [27] and may be indicative
 190 of heat stress during the day and exposure to yellow light from 100 watt bulbs used as heat
 191 source at night.

192

193

194 **Table 3. Haematological indices of the experimental birds raised with routine**
 195 **administration of fluoroquinolones.**

| PARAMETER | T1 | T2 | T3 | T4 | SEM |
|------------------|--------|--------|--------|--------|------|
| PCV (%) | 22.00 | 26.00 | 23.67 | 28.67 | 1.16 |
| RBC(10^6 /ul) | 3.64 | 3.68 | 3.45 | 3.43 | 0.06 |
| WBC(10^3 /ul) | 19.23 | 19.13 | 18.28 | 19.38 | 0.35 |
| Hb | 7.33 | 8.67 | 7.90 | 9.57 | 0.39 |
| Heterophil (%) | 68.23 | 71.05 | 70.85 | 67.95 | 1.98 |
| Lymphocyte(%) | 67.33 | 70.67 | 69.67 | 66.67 | 1.94 |
| Monocyte (%) | 1.67 | 2.33 | 2.67 | 3.33 | 0.36 |
| Eosinophils(%) | 3.00 | 3.33 | 3.33 | 2.67 | 0.43 |
| Basophils(%) | 0.33 | 0.67 | 0.00 | 0.67 | 0.19 |
| Platelet(%) | 120.67 | 130.00 | 138.00 | 136.33 | 5.17 |

196 T1= Control; T2= Enrofloxacin; T3= Ciprofloxacin; T4=Norfloxacin

197 SEM = Standard error of means

198 **Table 4. Serum biochemical indices of the experimental birds raised with**
 199 **routine administration of fluoroquinolones.**

| PARAMETER | T1 | T2 | T3 | T4 | SEM |
|------------|--------------------|--------------------|--------------------|--------------------|-------|
| TP(g/dl) | 3.31 | 3.05 | 3.19 | 3.29 | 0.11 |
| ALB(g/dl) | 1.90 | 1.80 | 1.93 | 2.04 | 0.10 |
| GLU(mg/dl) | 149.42 | 186.70 | 193.89 | 184.52 | 10.71 |
| CHOL(g/dl) | 85.55 | 100.57 | 85.10 | 95.79 | 3.82 |
| HDL(g/dl) | 38.23 | 46.68 | 48.27 | 41.63 | 2.06 |
| LDL(g/dl) | 45.73 | 48.50 | 47.13 | 54.14 | 2.75 |
| AST(I.U/L) | 85.32 ^a | 56.25 ^b | 52.46 ^b | 49.28 ^b | 5.12 |
| ALT(I.U/L) | 4.16 | 3.57 | 4.11 | 5.71 | 0.52 |

200 Means along the same row with similar superscripts are not significant ($P \geq 0.05$) different.
 201 T1= Control; T2= Enrofloxacin; T3= Ciprofloxacin; T4=Norfloxacin; GLU=Glucose; AST=
 202 Aspartate amino transferase; HDL= high density lipoprotein; ALB= albumin; CHOL=
 203 Cholesterol; LDL=Low density Lipoprotein; TP= Total protein.

204

205 **3.3 Serum analysis of the experimental birds raised with routine administration of**
 206 **fluoroquinolones.**

207 The impact of fluoroquinolones on the serum parameters of Arbor Acres broiler chicks is
208 shown in Table 3. Serum biochemical indices are used as indicators to conditions that
209 cannot be readily noticed by performance indices [28]. The Aspartate Amino Transferase
210 (AST) level of the treated groups were significantly ($P \leq 0.05$) different from the control (T1).
211 This may indicate that selected fluoroquinolones used prevented liver damage and loss of
212 liver enzyme to the peripheral blood. This view was supported by [29] who stated that
213 antibiotic prophylaxis effectively prevents not only the development of bacterial infections but
214 also further decompensation (variceal bleeding, hepatorenal syndrome) and improves
215 survival. There were no significant differences in all other parameters taken. Reported AST
216 value in this study is lower than those reported by [30], who concluded that use of
217 fluoroquinolones in broiler production may lead to elevated AST and ALT levels.
218 Also, mean values for TP, ALB, GLU, CHOL, HDL LDL and ALT in this study were
219 lower and not consistent for a 38 days old broiler chicken; higher values were
220 reported by [31] on day 35. Hepatotoxicity is indicated by the rising activities of the
221 enzymes AST and ALT as a result of the malfunction of the sites of their production [31].
222 However, the result from this study were lower but within range of a physiologically normal
223 broiler chicken. Decreased levels of these enzymes may be expressed as less liver and
224 skeletal muscle damage of fluoroquinolone used. It may also be as a result of the routine
225 mode of drug application employed during the study.

226 4. CONCLUSION

227 The study showed that routine administration of fluoroquinolones does not have negative
228 influence on the hematological and serum biochemistry parameters of treated broiler
229 chickens. Broiler chickens raised under strict biosecurity conditions may have body weight
230 gain not significantly different from those treated with antibiotics growth promoters after 48
231 days rearing period. However, there is need to further investigate the effects of selected
232 fluoroquinolones used in this study blood serum parameters.

233

234 ETHICAL APPROVAL

235

236 Author hereby declare that principle of laboratory animal care (NIH publication no. 85-23.
237 Revised 1985) were followed, as well as specific national laws where applicable.

238

239 Consent: NA

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