Comparative behaviour of local and exotic chickens in tests of fearfulness, anxiety and cognition

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Abstract

Behaviour affects performance and productivity of poultry birds especially chickens, some behavioural traits are advantageous in a particular production system and may be of disadvantage in another production system. The present study compared behavioural of Nigeria Local Chicken, NLC (two separate samples of 11 Yoruba Ecotype) and its Exotic counterparts (11 Broilers and 11 Pullets) by use of the Open Field (OFT), T-Maze, Forced Approach, and Voluntary Approach Tests (FAT and VAT respectively) during two phases of growth (0-4 Weeks, and 4 – 8 weeks age respectively). The former group (NLC) is better adapted to extensive management in the Nigerian Guinea savannah than the latter. Results showed that Yoruba NLC issued a significantly ($p < 0.05$) higher number of distress calls than the Exotic genotypes in the OFT at age 7 and 48 days, and the NLC issued significantly more calls at 7 days age. Broilers exhibited significantly lower OFT Latency at 7 and 48 days, and Broilers traversed fewer squares and spent less time ambulating than other genotypes at 48 days age. In a T-maze, Broilers showed significantly ($p < 0.05$) lower exploratory behaviour than other groups (higher latency to leave the start box). In the FAT, NLC showed lower latency to flight ($p < 0.05$) than the Exotic genotypes. Ethological test results indicate differences in the behavioural characters exhibited by Yoruba NLC and Exotic Chickens and such differences could embody the basis of anecdotal differences in the rates of survival under extensive management conditions, and may be subjected to quantitative genetic selection in the ongoing effort to produce improved chickens that incorporate a combination of desirable traits from both Local and Exotic chickens.

Keywords: local-chicken; exotic-chicken; behaviour; fearfulness; anxiety; cognition; adaptation.

Introduction

Local chickens constitute 80% of poultry raised in Nigeria (FAOSTAT, 2007), form a large proportion of poultry raised in many other developing countries (Gondwe, 2004), and contribute significantly to the fulfilment of recommended daily allowance of animal protein consumption in such populations (Gueye, 2003).

The socioeconomic rationale for encouraging chicken production within the extensive management system (an

instrument of sustainable poverty alleviation in rural communities, and an animal protein source and reserve) remains, Local chickens are however poorly productive relative to exotic chickens (Gondwe, 2004), and there is an increasingly pressing need to develop a breed/strain of chickens which is highly adapted to the locale specific conditions of the Guinea Savannah and are simultaneously highly productive, in effect merging the desirable advantages of the

local and exotic breeds. One solution lies in the systematic application of science to improvement of local chickens through selection and/or crossbreeding to exotic breeds (Ikani and Annatte, 2000). Equally, it may be possible to promote adaptation of the highly productive exotic chickens to diverse climates and management conditions through creation of stocks, each of which is tailored in behaviour to suit a particular environment and management condition (Pedersen, 2002; Gondwe, 2004). The application of such a systematic improvement programme requires an initial identification of traits which require improvement and are amenable to manipulation through breeding, and the establishment of baseline data upon which genetic manipulation will be required to build. One such trait which is presumed to determine survival and therefore overall productivity is behaviour which is under genetic control.

The survival of local and exotic chickens differs in the context of the extensive management system of chicken husbandry in the Nigerian Guinea Savannah (Nwosu *et al.*, 1980), with the former group exhibiting superior survival over the latter (Nwakpu *et al.*, 1999). Poor survival of the exotic chickens reduces overall return on initial investment and therefore restricts the farmer's ability to realise the economic benefit promised by the high genetic productivity of exotics. One school of thought is that behaviour (which may govern food seeking, prey avoidance, stress tolerance *et.c.*) is a critical determinant of survival in the context of extensive management, though additional factors such as innate immunity may also be important determinants (Nwakpu *et al.*, 1999). Lewis *et al.* (1997) and Castellini *et al.* (2002) reported greater locomotory behaviour in slow than fast growing

chickens. It was suggested that lower ambulation of the fast-growing chickens leaves more energy available for growth (Schutz and Jensen (2001), it is therefore a positive trait for production, but may be detrimental in respect of predator evasion through running.

There is presently a conspicuous absence of systematically documented scientific measurements of comparative behaviour between the Yoruba Nigerian Local Chicken and exotic chickens towards identifying the sub-phenotype determinants of claimed differences in behaviour.

If systematic scientific improvement of local and/or exotic chickens as proposed here is to succeed, there is a need to establish baseline data for each important trait (including behaviour) upon which instruments of improvement (selection and cross breeding) may act to create change in the desired direction, or to preserve desired traits. In many scenarios of systematic genetic improvement including those highlighted here, there is opportunity to positively select for desirable behaviours which impact on production/productivity, and to prevent unwitting erosion of desirable traits including behaviour through evaluation and monitoring.

Cross-evaluation/comparative evaluation of local and exotic chickens in ethological tests offers the potential for establishing formal scientific evidence of differences between the two genotype classes, establishing tests of behaviour that are relevant and may be applied in the context of breeding programmes, and identifying sub-phenotypes of behaviour that can extend understanding of the underlying sub-properties of behaviour which contribute to overall survival in the extensive management system. Where differences are established, such tests may

permit examination of pharmacomodulatory approaches to management of behaviour in ways that create desired outcomes which are relevant to the field production setting in ways that translate to higher survival and productivity and therefore profitability of poultry farming.

The specific aim of this study was to use objective tests of behaviour (ethological tests) in a controlled setting (ethology laboratory) to determine whether and to what extent there are differences in behavioural characters between strains of Local and Exotic chickens. Chickens from Local strains which consist of Yoruba Ecotype Nigerian local chicken (NLC) and chickens from Exotic strains which consist of Broilers and Layers were reared, raised under shared feeding management and husbandry conditions, and were examined by the use of defined ethological tests.

Materials and Methods

The experiments were carried out at the Animal Production Pavilion of the Teaching and Research Farm, Faculty of Agriculture, University of Ilorin, and were in compliance with institutional guidelines on the care and use of animals in research.

In accordance with the 3Rs principles (Refinement, Reduction, and Replacement) all effort was taken to minimize the number of animals used and their suffering.

Experimental Animals Housing, and Management

A total number of 44 birds consisting of 22 local birds and 22 exotic birds were used for the experiment which ran for a period of 8 weeks. Exotic breed (11 Hubbard breed broiler and 11 Isa Brown breed layer) day old chicks were purchased from Zarm Farms in Ilemona, Kwara State, Nigeria. To obtain local chickens for the experiment, a total of 40 Yoruba Ecotype local chicken eggs were obtained from Ile- Apa community, Ilorin

East Local Government Area of Kwara State. The eggs were sorted, cleaned, incubated for 21 days at the Department of Animal Production, University of Ilorin. At hatch 11 chicks were selected to serve as the local strain Group 1. Another set of 11 Yoruba Ecotype NLC chicks of the same hatch day was obtained from the same Ile- Apa community and the chicks served as the local strain Group 2. All birds were housed in a conventional cage system consisting of 4 compartments, each containing 11 birds. All animals were fed with a standard diet (Top Feeds, Ilorin, Nigeria). Feed and drinking water were supplied *ad libitum*. All standard routine vaccinations were administered as and when appropriate.

Apparatus and Procedures

All chicks were examined by the use of four (4) separate tests, including: an open- field test, a T- maze test, and Forced and Voluntary Approach Tests (Figure 1).

Open field behaviours were registered in one 10 minutes session when chickens were 7 days old (1 wk). Between the age of 12 and 16 days (2-3 wks), all birds were tested individually on 5 consecutive days in a T-maze apparatus as described previously (Nordquist *et al.*, 2011). Animals were tested in the Voluntary Approach Test and Forced Approach Test at 26 and 28 days age respectively (4 wks).

A repeat of the above tests was performed when the birds were 6-8 weeks old (OFT at 6wks, T-maze at 7 wks and VAT & FAT at week 8).

Each test had its own apparatus (Figure 1) constructed from Medium Density Fibre-board (MDF).

For all tasks, testing order was randomized for each trial. Experiments took place between 09:00 h and 16:00 h.

Open Field Test

The open field consisted of an observation

pen measuring 122cm × 122cm × 74cm (width × length × height) of Medium Density Fibre-board (MDF) (see Figure 1A).The floor was covered with a black rubber mat, and white chalk lines divided the area equally in a 5 × 5 pattern of squares as described previously by Nordquist *et al.* (2011).

After being caught gently and placed in the middle of the open field, the 10 minutes observation started. After the 10 minutes observation the bird was immediately returned to its home pen. All tests and observations were performed between 9.00 h and 15.00 h. The sessions were viewed via a camera hung above the apparatus, allowing the observer to score behaviour from a video screen in an adjacent area.

The video recorder hung above the apparatus was focused on the test area, and set to record all activity within the test area throughout the period of the test, including: Latency to cross the first square; Total time spent walking; Total number of squares crossed, and: Total number of distress calls.

T- Maze Test

The T- maze apparatus (Figure 1B) was made from MDF, and consisted of a starting chamber (A), a corridor (B) and a perpendicular arm (C). At the junction of the T corridor a mirror with a diameter of 16 cm (M) was situated to facilitate movement of the chick from the starting chamber toward this point. Linked to the perpendicular arm were two compartments (D1 and D2) that were in open contact through a wire mesh to a box (E1 and E2) respectively (Figure 1).

Birds were allowed to habituate to the maze for 5 minutes on 3 consecutive days prior to the initial experiment. During the habituation phase, no companion birds (con-specifics of the test bird) were present. Each bird was tested individually on 5 consecutive days. On test days 1-4, two

con-specific animals were present in one of the two compartments E (Figure 1); the other compartment E remained empty. It was determined randomly which of the two E compartments contained two companions of the same line as the bird that was tested during the test. For each individual bird, the choice of Compartment E in which with companion bird was placed remained the same on all experimental days.

Companion birds were also experimental birds housed together with the test bird and thus familiar with the test animal. On the fifth day, the experimental procedure was the same except that no companion animals were present in the test setup.

At the start of the test, the test bird was caught gently and placed in the starting chamber. The actual test started following the removal of a partition between the starting chamber and corridor. A single session lasted 10 minutes in which latency to leave the start box, time needed to find con-specifics and time spent with con-specifics were recorded. Immediately after the end of a session the chicken was removed from the T-maze apparatus and returned to its home pen.

Approach Tests

Two versions of approach test have been developed to measure the fear response in farm animals to humans, which are the "Forced Approach Test" or "Sudden Approach Test" (FAT), and the "Voluntary Approach Test" (VAT), (Forkman *et al.*, 2007).

In the Forced Approach Test, the animal is approached by a human, whereas the animal is free to approach a human in the Voluntary Approach Test (VAT), (Forkman *et al.*, 2007). Both the VAT and FAT were used.

All chickens were individually subjected to the VAT and FAT when they were 26 days

old and a repeat test was done when the birds were 8 weeks age. The VAT and FAT arena measured 244cm × 244cm × 74cm (length × width × height).

A chicken was placed in the far left corner (Figure 1) and was left undisturbed for 1 minute. Then, the experimenter entered the arena in the lower right corner and knelt down presenting bait in his hand, consisting of a small amount of their normal feed and one worm. Latency to peck at food in the experimenter's hand was measured using a stopwatch. A trial had a time limit of 2 minutes.

Data Collection

All data were collected from the videos from the camera hung above the apparatus for the Open Field Test and T-maze test while data for Voluntary Approach Test and Forced Approach Test were obtained from a stop watch used by the experimenter.

Statistical Analysis

Data collected were subjected to nonparametric one way analysis of variance, by use of SPSS 17 (SPSS, IBM).

Results

Results of early tests of behaviour as measured in the T-Maze

No significant difference between genotypes was observed in latency to find con-specifics in sessions 1 - 5 (Table 1).

No significant difference between genotypes was found in the time needed to find con-specifics in session 1 and 2. The Session 3 data showed that the Broiler chicken displayed a lower level of sociality and cognition in the time needed to find con-specific than the other genotypes, and significant difference ($p < 0.05$) was found between NLC-1 and Broiler genotypes in the time needed to find con-specifics (NLC-1 154.33 s > Broiler 35.22 s). In the same session, the Isa Brown layer's and NLC-2

did not differ from each other in the time needed to find con-specifics, and also did not differ from either NLC-1 or the Broiler Genotype (Table 1).

No significant difference between genotypes was found between genotypes in the time needed to find con-specific in session 4 and 5.

No significant difference between genotypes was found between genotypes in the time spent with con-specific in session 1, 2, 3, 4 and 5.

Results of early tests of behaviour as measured in the Open Field Test

Significant difference ($p < 0.05$) was found between genotypes in latency to cross the first square (Broiler 106.64 s > Layer 57.27 s, NLC-2 53.09 s, NLC-1 40.45 s), Table 1.

No significant difference between genotypes was found in the number of squares crossed, total time spent walking around the test apparatus (time ambulating) and total time resting.

Significant difference ($p < 0.05$) was found between genotypes in number of distress calls (NLC-1 42.55 > NLC-2 37.64 > Broiler 32.09, Layer 31.27s) made during the test period. Thus, the local chicken showed increased fearfulness than the Exotic chickens as measured by the number of distress calls displayed.

No difference was found between the Local chickens and Layer chickens in the latency to cross the first square; each was significantly lower than observed for the Broiler chicken, indicating that the latter has a lower level of anxiety than the former two genotypes.

Results of early tests of behaviour as measured in the Voluntary Approach Test

No significant difference ($p < 0.05$) was found between genotypes in latency to approach humans (Table 1).

Results of early tests of behaviour as measured in the Forced Approach Test

Table 1. Performance of young chickens (1-4 weeks old) in ethological tests.

Sn.	Variable	Yoruba NLC 1	Yoruba NLC 2	Hubbard Broiler	ISA Brown layer
I. T-Maze	LATENCY S1	30.91 ± 16.79 (11)	51.45 ± 13.39 (11)	38.55 ± 11.07 (11)	58 ± 16.42 (11)
	LATENCY S2	77.91 ± 24.93 (11)	64.18 ± 12.53 (11)	56.45 ± 13.73 (11)	56 ± 19.17 (11)
	LATENCY S3	81.33 ± 15.59 (9)	41.11 ± 9.82 (9)	43.33 ± 12.18 (9)	63.44 ± 11.54 (9)
	LATENCY S4	62.09 ± 12.15 (11)	54.64 ± 13.86 (11)	56.55 ± 17.76 (11)	41.45 ± 10.44 (11)
	LATENCY S5	39.91 ± 8.12 (11)	36.64 ± 7.11 (11)	67.18 ± 12.75 (11)	39.09 ± 6.62 (11)
	TIME NEEDED S1	138.27 ± 57.5 (11)	152.91 ± 65.38 (11)	54.18 ± 25.12 (11)	88.64 ± 33.28 (11)
	TIME NEEDED S2	162 ± 61.59 (11)	162.64 ± 49.23 (11)	78.91 ± 33.51 (11)	59.45 ± 25.53 (11)
	TIME NEEDED S3	154.33 ± 50.3 (9) ^a	71.44 ± 31.18 (9) ^a	35.22 ± 23.52 (9) ^a	113.89 ± 37.46 (9) ^a
	TIME NEEDED S4	82.09 ± 29.54 (11)	147.45 ± 52.8 (11)	81.64 ± 29.41 (11)	89.27 ± 29.51 (11)
	TIME NEEDED S5	60 ± 19.6 (11)	64.55 ± 17.96 (11)	60 ± 26 (11)	45.91 ± 17.02 (11)
II. Open Field Test	TIME SPENT S1	126.73 ± 52.23 (11)	65.27 ± 30.46 (11)	164 ± 69.45 (11)	174.18 ± 61.78 (11)
	TIME SPENT S2	103.73 ± 42.07 (11)	143.36 ± 44.74 (11)	139.27 ± 58.55 (11)	147.82 ± 62.18 (11)
	TIME SPENT S3	126.22 ± 41.72 (9)	172.11 ± 70.76 (9)	98.11 ± 64.98 (9)	198.11 ± 66.02 (9)
	TIME SPENT S4	179 ± 62.85 (11)	163.45 ± 59.18 (11)	188.64 ± 65.63 (11)	216.18 ± 66.31 (11)
	TIME SPENT S5	115.55 ± 33.74 (11)	127.55 ± 33.37 (11)	67 ± 28.73 (11)	96.45 ± 33.69 (11)
	LATENCY	40.45 ± 10.82 (11) ^a	53.09 ± 6.85 (11) ^a	106.64 ± 6.83 (11) ^b	57.27 ± 7.18 (11) ^a
	NO OF SQUARES	62.73 ± 10.07 (11)	55.09 ± 7.02 (11)	48.36 ± 3.34 (11)	48.45 ± 3.07 (11)
	TOTAL TIME Ambul	422.45 ± 20.28 (11)	380.82 ± 29.04 (11)	388 ± 13.01 (11)	380.45 ± 13.76 (11)
	TOTAL TIME rest	177.55 ± 20.28 (11)	219.18 ± 29.04 (11)	212 ± 13.01 (11)	219.55 ± 13.76 (11)
	NO OF DISTRESS CALLS	42.55 ± 1.41 (11) ^c	37.64 ± 1.3 (11) ^b	32.09 ± 1.61 (11) ^a	31.27 ± 1.58 (11) ^a
III. Voluntary Approach Test	VAT	0 ± 0 (11)	0 ± 0 (11)	0 ± 0 (11)	20.55 ± 13.79 (11)
IV. Forced Approach Test	FAT	10.09 ± 10.09 (11)	29.73 ± 15.38 (11) ^c	25.55 ± 13.38 (11)	42.27 ± 14.83 (11)

n, b, c - across each row, means with different superscripts are significantly ($p < 0.05$) different, while values without superscripts are similar ($p > 0.05$).

S1 - Session 1

Ambul - Ambulating

S3 - Session 3

S5 - Session 5

Time spent - Time spent with con-specifics.

* Latency to traverse the first square in the test apparatus.

No significant difference ($p < 0.05$) was found between genotypes in latency to avoid humans (Table 1).

Results of repeat tests of behaviour as measured in the T-Maze

No significant difference between genotypes was found between genotypes in latency to leave the start box in session 1 and 2 (Table 2), whereas significant difference ($p < 0.05$) was found between genotypes in sessions 3 and 4; specifically, the broiler group (Hubbard genotype) displayed the highest latency to leave the start box in all four sessions. It can therefore be deduced that the Broiler displays a lower sociality and higher anxiety as measured in the latency to find con-specifics in the T-maze at 6-8 weeks.

Results of repeat tests of behaviour as measured in the Open Field Test

Significant difference ($p < 0.05$) was found between genotypes in the latency to cross the first square, Total Number of squares crossed, Total time ambulating, Total time resting and the Total Number of distress calls (Table 2). Chickens of Local and Layer genotypes showed significantly lower latency to cross the first square relative to the Broiler chickens, which shows that they were less anxious.

Also chickens of Local and Layer genotypes showed lower fearfulness and anxiety as measured by their higher locomotion (higher total time ambulating and lower time resting) than broilers.

Paradoxically, the Local and Layer chickens issued more distress calls than the Broiler which suggests greater anxiety in the former two groups. However, the distress call may be interpreted as a pro-survival pro-social instinct which is desirable.

Results of repeat tests of behaviour as measured in the Voluntary Approach Test

No significant difference ($p < 0.05$) was

found between genotypes in latency to approach humans (Table 2).

Results of repeat tests of behaviour as measured in the Forced Approach Test

Significant difference ($p < 0.05$) was found between genotypes in latency to avoid humans.

Results show that the Local groups (NLC-1 and 2) show a higher level of fearfulness than the other genotype groups when approached by a human. This can be interpreted as a pro-survival instinct which is desirable e.g. Fear of a potential predator.

Indications of Habituation

A trend of behaviour was observed across the 5 day period of the T-maze tests performed at 2 weeks and also at 7 weeks. In each case, latency to find con-specifics reduced in successive days across the five daily sessions, thus implying that the chickens were habituating in the test and exhibiting linked cognitive ability. At 2 weeks age, there was a sharp reduction in the exotic strains' latency to find con-specifics between Session 3 and Session 5, but, their latency was still higher than that exhibited by the Nigerian Local Chicken groups 1 and 2 which showed a less marked reduction over the same period (Figure 2). At 6 – 8 weeks age, habituations effects were also observed in the time needed to find con-specifics between genotypes over the test duration (Figure 3).

Discussion

The result of this study show for the first time by use of objective measures of behaviour in the Open Field that differences in behavioural characters exist between the Nigerian Local chicken and Exotic chicken at 6 weeks of age. In as much as all chickens examined in the present study were raised, housed and managed under identical conditions, it can be deduced that the observed differences in behaviour are determined by genetic factors. These results

Table 2. Performance of young chickens (6-8 weeks old) in ethological tests.

Sn.	Variable	Yoruba NLC 1	Yoruba NLC 2	Hubbard Broiler	ISA Brown layer
I. T-Maze	LATENCY S1	60.44 ± 7.61 (9)	43.78 ± 7.58 (9)	74.67 ± 16.16 (9)	54.22 ± 4.83 (9)
	LATENCY S2	41.67 ± 9.1 (9)	50.22 ± 5.78 (9)	98.11 ± 23.35 (9)	38 ± 5.78 (9)
	LATENCY S3	34.33 ± 7.73 (9) ^a	43.22 ± 9.12 (9) ^b	119.67 ± 14.72 (9) ^b	34.11 ± 6.79 (9) ^a
	LATENCY S4	31.67 ± 6.01 (9) ^a	37.22 ± 7.68 (9) ^b	68.11 ± 10.81 (9) ^b	27.56 ± 6.88 (9) ^a
	LATENCY S5	29.44 ± 5.79 (9)	36.89 ± 5.34 (9)	45.22 ± 6.88 (9)	23.56 ± 6.02 (9)
	TIME NEEDED S1	81.44 ± 33.36 (9)	47 ± 24.93 (9)	74.44 ± 29.96 (9)	106.44 ± 34.65 (9)
	TIME NEEDED S2	103.11 ± 42 (9)	149.89 ± 60.78 (9)	104.44 ± 53.17 (9)	87.11 ± 29.25 (9)
	TIME NEEDED S3	86.89 ± 34.73 (9)	143.11 ± 46.24 (9)	113.78 ± 45.37 (9)	87.56 ± 23.48 (9)
	TIME NEEDED S4	80.78 ± 32.2 (9)	67.78 ± 34.16 (9)	84.11 ± 33.35 (9)	69.78 ± 23 (9)
	TIME NEEDED S5	52.44 ± 18.34 (9)	52.11 ± 21.13 (9)	43.89 ± 18.1 (9)	41.11 ± 13.36 (9)
	TIME SPENT S1	130 ± 53.5 (9)	137.78 ± 70.8 (9)	192.22 ± 76.19 (9)	228.78 ± 73.4 (9)
	TIME SPENT S2	163.56 ± 65.44 (9)	100.89 ± 40.82 (9)	106.67 ± 55.2 (9)	217.11 ± 69.96 (9)
	TIME SPENT S3	176.33 ± 69.92 (9)	178.11 ± 58.2 (9)	152.89 ± 60.73 (9)	289.89 ± 74.21 (9)
	TIME SPENT S4	184.11 ± 72.85 (9)	128.44 ± 64.32 (9)	178.67 ± 70.64 (9)	248.33 ± 79.87 (9)
	TIME SPENT S5	127.44 ± 40.71 (9)	91.11 ± 36.89 (9)	95.11 ± 38.06 (9)	91.56 ± 29.94 (9)
II. Open Field Test	LATENCY*	29.27 ± 4.73 (11) ^a	31.09 ± 3.25 (11) ^a	61.27 ± 4.78 (11) ^b	23.82 ± 2.03 (11) ^a
	NO OF SQUARES	31.6 ± 3.22 (10) ^b	30.9 ± 2.48 (10) ^b	20.82 ± 1.47 (11) ^a	30.44 ± 1.37 (9) ^b
	TOTAL TIME Ambul	402.3 ± 19.25 (10) ^b	397.9 ± 18.97 (10) ^b	280.91 ± 13.92 (11) ^a	373.89 ± 9.21 (9) ^b
	TOTAL TIME rest	197.1 ± 19.47 (10) ^a	202.1 ± 18.97 (10) ^a	319.09 ± 13.92 (11) ^b	226.33 ± 9.29 (9) ^a
	NO OF DISTRESS CALLS	26.4 ± 1.81 (10) ^b	26.8 ± 2.2 (10) ^b	18.55 ± 1.3 (11) ^a	25.22 ± 2.33 (9) ^b
III. Voluntary Approach Test	VAT	0 ± 0 (11)	0 ± 0 (11)	0 ± 0 (11)	9.18 ± 9.18 (11)
IV. Forced Approach Test	FAT	0 ± 0 (11) ^a	15.73 ± 10.64 (11) ^b	37.82 ± 15.88 (11) ^b	46 ± 15.97 (11) ^a

a, b, c - across each row, means with different superscripts are significantly ($p < 0.05$) different, while values without superscripts are similar ($p > 0.05$).

S1 - Session 1

S2 - Session 2

S3 - Session 3

S4 - Session 4

Time spent - Time spent with con specifics.

Time needed - Time required to find con-specifics.

support the findings of Buitenhuis *et al.* (2004) that behaviour has a genetic component which is responsible for the differences in open field behaviour of different genotypes of chickens.

Age did not influence Open field test performance although it indicated a reduction in fearfulness and/or increase in exploratory behaviour with increasing age of the chickens. These results are in accordance with the findings of Albentosa *et al.*, (2003) on the effect of age and genotype on behaviour in chickens.

Behavioural patterns observed in the Open field test are comparable to behavioural patterns classified by Faure *et al.*, (1983) who classified behavioural patterns into two phases which are the Panic or immobility and distress vocalization or ambulating/jump.

Changes in natural environment of an animal can cause a significant change in some behaviours (e.g. food and shelter finding and predator protection), including but not limited to expression of anxious behaviours which are in accordance with the observation of Newman (1994) and Price (1999), and which explain some behavioural changes in the chickens during exposure to ethological test paradigms such as the Open Field Test.

In the Open-field test the Nigerian Local chicken shows more vocalization than their Exotic counterparts which can be interpreted as a pro-survival pro-social mechanism in an anxiogenic environment which is in accordance with observation of Jones (1983) that fear response in domestic chickens is a function of the social environment.

High number of distress calls showed by the Nigeria Local chicken in the Open Field Test suggests a tendency to seek to reinstate contact with con-specifics, and/or to warn the same of possible danger and/or to

maximise chances of survival by alerting the group of a need to tackle uncertainty jointly in the face of possible predation which is comparable with Gallup and Suarez (1980) who observed that chickens tested in open-field were found to display reinstatement behaviours (e.g. distress calling and escape attempts) and prolong behaviours that serve to minimize detection (e.g. freezing). In the present study, reinstatement behaviour was more prominent in the Nigerian local Chicken, whereas, detection minimizing behaviour was more prominent in the broiler genotype examined (Hubbard) which may indicate genetic differences in pro-survival behaviour during exposure to the same stimulus in the two groups. In the context of the extensive environment in which the Nigerian local Chicken is reared, its higher vocalisation acts to create greater flock awareness of predators, and should therefore minimise overall flock losses in such circumstances. This is consistent with their better survival than the exotic chickens in the extensive system of management in which many losses occur due to hawk, snake, feral cat and dog, and even human poacher attacks.

The results obtained from the T-maze test show that there is variation in time taken by chickens to transverse a T-maze and thereby reinstate contact with their companions at 7 week age but differences between genotypes were not significant perhaps due to substantial within genotype variation for the parameter.

Fear response of the Nigeria Local Chicken in both the Voluntary Approach Test and the Forced Approach Test can be interpreted as an anti-predator behaviour when compared to the Exotic chicken that shows lower fearfulness which in line with Collias and Collias (1967). In the context of the extensive environment in which the

A. Open Field Test

B. T-maze

C. Approach Test

———— Removable partition (between A and E)

----- Wire mesh (between D and E)

———— Boundary between compartments

Figure 1. Schematic representation and dimensions of the Open Field, T-maze and Approach test apparatus.

S1 – Session 1

S2 – Session 2

S3 – Session 3

S4 – Session 4

S4 – Session 4

S5 – Session 5

NLC 1– Nigerian Local chicken group 1

NLC 2– Nigerian Local chicken group 2

Figure 2. Latency in time required to find con-specifics in the T-maze test at 2 weeks age. Habituation is indicated by the reduction in latency over 5 consecutive test sessions (S1 – S5).

Figure 3. Latency in time required to find con-specifics in the T-maze test at 6-8 weeks age. Habituation is indicated by the reduction in latency over 5 consecutive test sessions (S1 – S5).

Nigerian local Chicken is reared, its higher fear response to approaching humans (non-members of its species/kin-group acts to create greater individual avoidance of predators, and should therefore minimise overall flock losses in such circumstances. This is again consistent with their better survival than the exotic chickens in the extensive system of management in which many losses occur due to hawk, snake, feral cat and dog, and even human poacher attacks.

The ramifications of fear behaviour observed in the VAT extend beyond their likely impact on survival of chickens in the extensive management system, and are likely to influence behaviour under intensive agriculture. Fear plays a major role in regulating response to novel and/or startling environments i.e. Open-Field (Jones, 1983). Excessive fear is also of concern to animal producers from a production and management perspective; fearful animals are likely to grow slowly and less efficiently than non-fearful animals. In addition fearful animals are more difficult to handle and can be dangerous to their caretaker.

In conclusion, the present study provides the first objective scientific proof of similarities and differences of behaviour between Nigerian Local chickens and Exotic chickens.

It can be concluded that behavioural differences exist between the genotypes of chicken examined in the present study.

Prior to inception of the experiments reported here, there was evidence of better adaptation (survival) of the Local than Exotic chickens to the Nigerian environment (Nwosu *et al.*, 1980; Nwakpu *et al.*, 1999), and their pattern of behaviour observed within controlled tests here, including higher vocalisation and higher levels of locomotion in an anxiogenic

environment, favours group awareness of danger, may prime group support in danger, and favours active evasion of predators/danger may account for the behavioural component of the former's higher Locale-specific fitness as measured by survival.

The higher level of anxiety and fearfulness in Broilers as measured by lower locomotion in an anxiogenic environment, and their lower sociality as measured by fewer distress calls and longer latency to find con-specifics may explain their low level of adaptation and survival rate in the extensive system in Nigeria. It is unclear whether and to what extent such behaviour may favour their fitness and survival in other environments e.g. a bird with feather colour that matches the prevailing physical geography (e.g. a white feathered bird on a snowy plain) may evade predators by freezing action and staying silent, such that it is momentarily camouflaged (difficult to spot by visual and auditory signals).

The lower levels of fearfulness and anxiety as measured by locomotor activity, and the higher levels of sociality as measured by vocalisation of distress (calls), sociality and cognition exhibited by the Local chickens and Layer genotypes can be used as guides in the selection of chickens within improvement programmes.

The OFT, T-Maze and FAT ethological tests which were informative in the current study may be applied as objective indicators of desirable behaviours in crossing and selection programmes on Local chickens and hybrid products of their crossing with Exotics.

The OFT, T-Maze and FAT ethological tests which were informative in the current study may be incorporated in selection programmes designed to improve NLC (and hybrid products of their crossing with Exotics) in ways that preserve its existing

behaviour which is suited to its Locale. The same tests may also find use in programmes that are designed to introgress Locale-specific desirable behaviours into highly productive Exotic stocks. The application of additional ethological tests in comparisons of the genotypes examined in the present study will yield information on additional types of behaviour which may play a role in adaptation, including learning, cognition and memory ability, for example through the hole board tests.

Neuro-endocrine and generalized hormonal studies (for example examining the roles of sex steroids including oestrogen and testosterone, and the roles of oxytocin, Norepinephrin, Serotonin, Acetyl choline, Cortisol, GABA and Leptin) may yield clues to the fundamental biology of observed differences in behaviour between animals of the set of genotypes examined here. Additional clues may derive from chemical-genetics approaches in which the administration of anxiogenic drugs to the least anxious genotypes observed here, or anxiolytic drugs to the most anxious, offers further evidence of whether or not the behaviours observed here are based in fundamental biology which can be modulated by drugs, as opposed to random/stochastic effects. The use of genetic mapping studies should also aid the definition of the exact genes responsible for the observed differences in behaviour between genotypes, thereby facilitating direct selection at the level of DNA and also better scientific understanding of the basis of the observed behaviours which can lead to the discovery of new drugs.

Collectively, the results of the current study strengthen a case for preserving the Nigerian Yoruba Local Chicken in Conservation Programmes, because of their unique behavioural character which differed in multiple parameters from the

Exotic chickens, particularly the Broiler strain examined here.

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