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BEHAVIORAL RESPONSES TO OPEN FIELD TESTS IN NIGERIAN LOCAL AND NICHOLAS WHITE TURKEYS

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Individual differences in fearfulness play an important role in economically important traits in farm animal. Fearfulness in livestock is usually measured objectively and efficiently through behavioural testing. The present study was conducted to assess the behavioural response to open field tests of fear in two (light and heavy) genotypes of turkeys in Nigeria. 100 poults (50 per genotype) were randomly selected to evaluate response to six open field tests of fear in Nigerian local and Nicholas White poults at 4, 8, 12, and 16 weeks. The six open field tests of fear employed were latency to ambulate; latency to vocalize; number of vocalisations; number of squares entered; number of times defecated; and escapes attempts. The results showed that there was variation in the response of the two genotypes to the six open field tests of tests of fear. The percentage of non-responder to the six open field tests was higher in Nicholas White than the Nigerian Local poults at 4, 8 and 12 weeks. The results on latency to ambulate, vocalize and make escape attempt suggests higher fearfulness in Nigerian Local poults. Higher proportion of older birds (> 8 weeks) of both genotypes respond faster to open field tests than younger birds (≤ 8 weeks). There is the need for further study to understand the mechanisms underlying age related bahavioural response pattern to fear in turkey.

Keywords: Nicholas White, Nigerian local, Novel objects, Open field, Voluntary approach

Behavioural response is critical determinant of survival in any livestock as it governs food seeking, prey avoidance, stress, tolerance among other things. Turkeys are not the best starters in their life and will always need some tender management or care to scale through the first few weeks of life. For instance, Young poults are reluctant to eat and drink in the first few days of life due to bad eyesight and nervousness. The role of primary turkey breeder is to provide breeder stock and commercial birds with superior health, fitness and meat production characteristics. Information on the welfare of intensively managed poults would not only enhance sustainable production system; it will more importantly help to reduce losses due to poor bird performance.

Fear is a reaction to danger (Forkman *et al.*, 2007). It has also been defined as an adaptive state of apprehension to an imminent threat (Davis *et al.*, 2010). Fearfulness in livestock is usually measured objectively and efficiently through behavioural testing. The arena test (open field) and the novel object test are among the most common tests of fear in livestock species (Forkman *et al.*, 2007). The test of behaviour in livestock involves presenting an individual with a novel or startling stimulus followed by a record of one or more types of behavioural reaction. As a physiological response, more fearful animals have increased physiological responses to stressors or imminent threats (Calandreau *et al.*, 2011). Individual differences in fearfulness play an important role in economically important behaviors such as feather pecking in laying hens (Rodenburg *et al*., 2013). It has also been associated with productivity and meat quality in pig (Terlouw, 2005). For instance, a study by Terlouw and Rybarczyk (2008) showed that pigs that displayed reduced fear of humans

were less reactive to slaughter procedures, and those that were less fearful of novel objects had higher muscle pH. In a recent review, Norris *et al.* (2014) stated that steers that were classified as flighty had lower live weights, poorer feed conversion efficiency, lower carcass dressing percentages and lower initial muscle pH levels compared to less flighty steers. Study by Erasmus and Swanson (2014) showed that behavioral responses of commercial male turkeys in an OF test are repeatable when measured over a period of weeks. Nestor *et al.* (1969) reported that turkey strains differ in fear responses. However, there has been little research examining the relationship between fear responses and well-being and productivity of turkeys (Erasmus, 2015). Furthermore, there have been no previous systematically documented scientific measurements of comparative behaviour between the Nigerian local turkey and Nicholas white turkeys. There is a need to establish baseline data for each important behavioural trait to enhance systematic scientific improvement of turkey breeds. Forkman *et al.* (2007) opined that environmental strategies and genetic selection aimed at reducing fearfulness might be of economic and ethical significance for livestock production. The objective of the present study is to assess the behavioral response to six open field tests of fear in heavy (Nicholas White) and light (Nigerian local) strains of turkey in Nigeria.

MATERIALS AND METHODS

Location of Study

The study was carried out at the Animal breeding unit of the Faculty of Agriculture Teaching and Research farm, University of Ilorin, Ilorin. Ilorin is located between rainforest of the Southwest and Savannah grassland of Northern Nigeria. It has a co-ordinate of 8° 30' 0" North, 4° 33' 0" East. Ilorin lies on an altitude of 305m, 1001' above sea level; with annual rainfall, relative humidity and day temperature of Ilorin of 600-1200 mm, 65-80% and 33-37^{0}C, respectively.

Experimental Birds and Management

Two turkey strains (Nigerian local and Nicholas white) were used for the experiment. The Nigerian local turkey is a slow growing or light genotype while Nicholas White is the most common fast growing (or heavy) turkey genotype in Nigeria. A total of two hundred day-old poults (100 per genetic group) were obtained from Tolvic farm in Ibadan Oyo State. Birds were individually identified using tags which were attached the left or right wing. The poults were raised on deep litter brooder pens. The birds were supplied with clean water; and were fed *ad libitum* on starter mash (0-6 weeks), grower mash (7-16 weeks) and finisher mash (17-20 weeks) containing 28%, 24% and 20% crude protein, respectively. Routine sanitation and vaccination programs were strictly observed to prevent the occurrence of diseases

Methods of Data collection

100 poults (50 per genotype) were randomly selected to evaluate response to tests of fear in the two strains at 4, 8, 12, and 16 weeks. poults were individually moved to the squared test apartment which has a concrete floor with a grid of 48 squares. The walls of the test room were high enough to prevent successful escapes of birds. Each bird was placed in the centre of the test room for 5 minutes. Direct observation and video recordings (Super circuits model, PCx100xs) were used to obtain six real time behavioural data. The six open field tests of fear employed were (i) latency to ambulate; (ii) latency to vocalize; (iii) number of vocalisations; (iv) number of squares entered; (v) number of times defecated, and (vi) escape attempt. Latencies to ambulate and to vocalise were measured in seconds. Ambulation was defined as two or more steps in rapid (within 4 seconds) succession. A bird was considered to have entered a square if at least 67% of the bird's feet were in the same square. An escape attempt was defined as the bird endeavour to jump and/or fly out of the test arena. Birds that rapidly exit the pen were described as High Responders (HR) while those that are reluctant to exit were described as Low

Responders (LR). Birds that did not respond to the OF tests are classified as No responder (NR).

Statistical Analysis

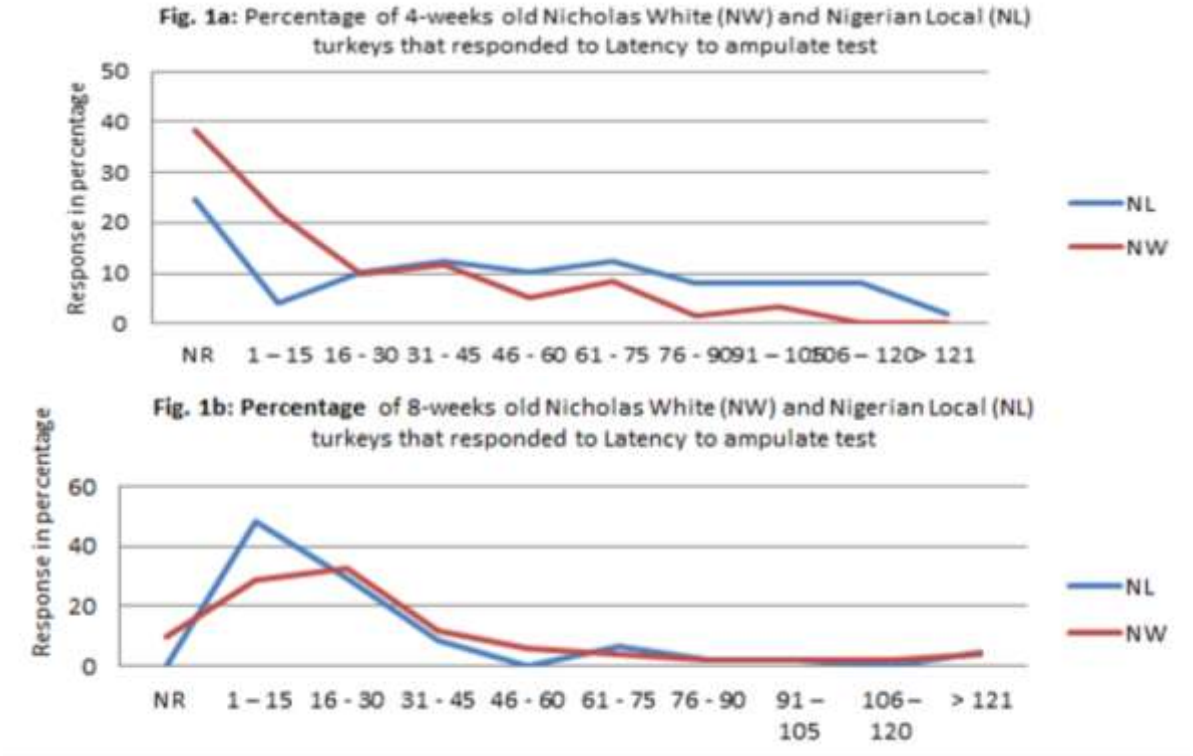
Data collected from the study was subjected to descriptive statistics of Statistical Analysis System program (SAS, 2002).

RESULTS

The latency of Nicholas White and Nigerian local poults (%) to ampulate at 4, 8, 12, and 16 weeks of age are presented in Figures 1a, b, c, d. The proportion (%) of non-responders or birds that failed to ampulate was higher in Nicholas White than in Nigerian local poults at all ages. Generally Nigerian local has higher proportion of early responder (within 30 minutes of test) than Nicholas White poults. The proportion of birds that responded to ampulation test increased with age. For test conducted at 4 weeks, only 14.3 percent of Nigerian local turkey ampulated within the first 30 seconds, while 80 percent ampulated within the same period among 16 weeks old birds. Ampulation generally occurred within 45 seconds in older birds (> 8 weeks), while a wider variation (≥ 121 second) was observed among young birds (≤ 8 weeks) in both genotypes.

Figures 2a, b, c, d show the response of the two genotypes to latency to vocalise test at 4, 8, 12, and 16 weeks of age. Nicholas white had higher percentage of birds that failed to vocalise at 4, 8, 12, and 16 weeks of age. There were higher percentages early responders (within 30 minutes of test) among Nigerian local turkey than Nicholas white at 8, 12, and 16 weeks of age. Response to Latency to vocalise test increased with the age of birds. For test conducted at 4 weeks, only 42.9 percent of Nigerian local turkey vocalised within 30 seconds, while 100 percent vocalised within the same period among 16 weeks old birds. Vocalisation generally occurred within 75 seconds in older birds (> 8 weeks), while a wider variation (≥ 121 second) was observed among young birds (≤ 8 weeks) in both genotypes.

The results on the number of vocalization (Figures 3a, b, c, d) show that Nicholas



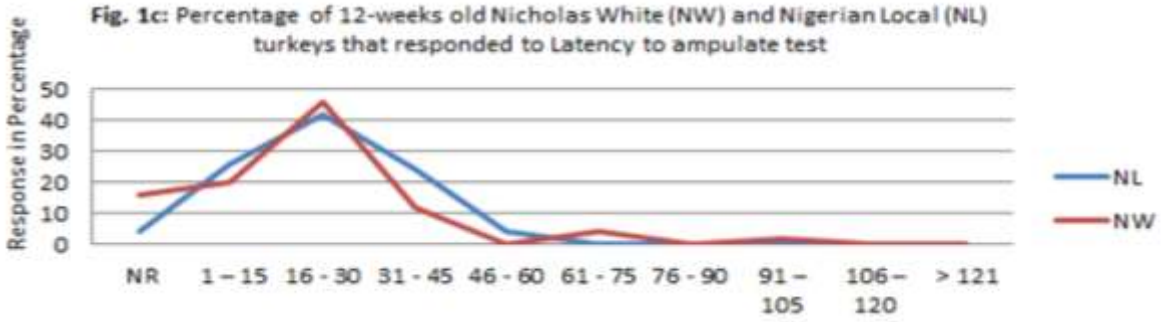


Fig. 1c: Percentage of 12-weeks old Nicholas White (NW) and Nigerian Local (NL) turkeys that responded to Latency to ampulate test

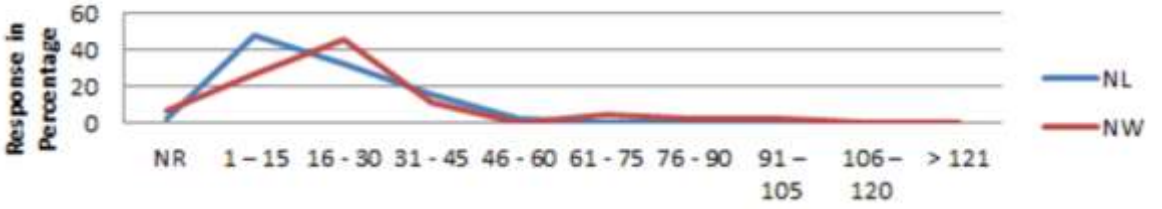


Fig.1d: Percentage of 16-weeks old Nicholas White (NW) and Nigerian Local (NL) turkeys that responded to Latency to ampulate test

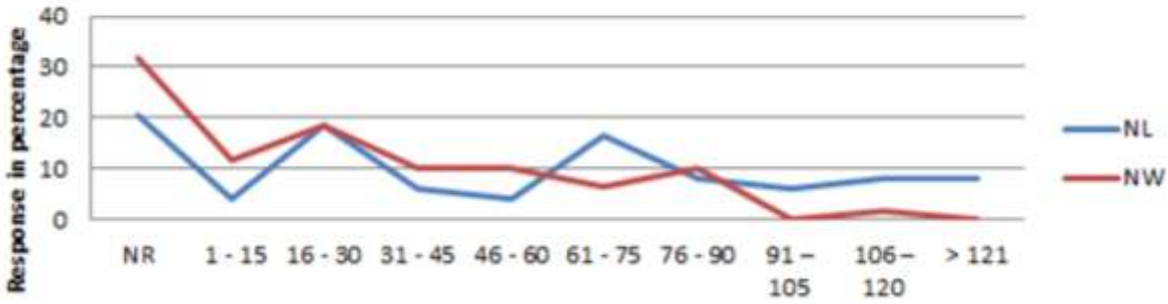


Fig.2a: Percentage of 4-weeks old Nicholas White (NW) and Nigerian Local (NL) turkeys that responded to Latency to vocalise test

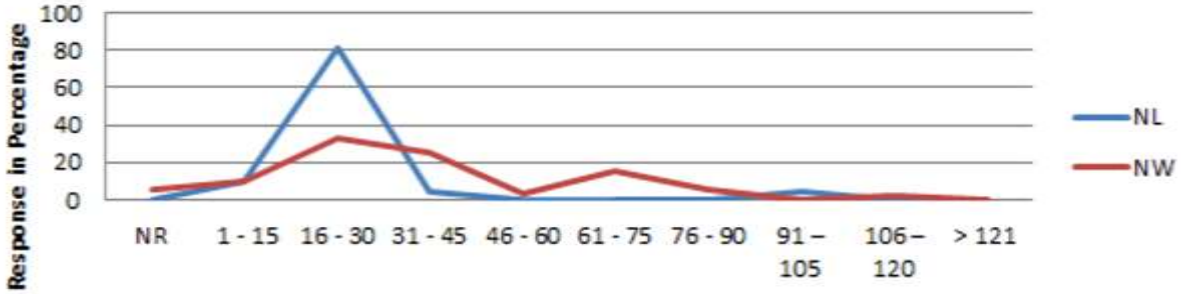


Fig. 2b: Response (%) of 8-weeks old Nicholas White (NW) and Nigerian Local (NL) Turkeys to latency to vocalise

white had higher percentage of non-responders than Nigerian local poults at 4, 8, and 12, 16 weeks of age. Majority of the tested birds had between 1 and 20 vocalisation at 4, 12 and 16 weeks of age (i.e. 73.1% and 66.0%; 84.0% and 68.0% and 76.0% and 81.8% for NL and NW, respectively). The proportion of birds with 11-20 vocalisation was more in Nigerian local than Nicholas White at 4, 8 and 12 weeks of age. Although there is is no consistency in the effect of age on the number of vocalization, generally ≤ 2 percent of birds older than 8 weeks vocalized more than 20 times.

Nicholas white had higher percentage of non-responders to NSE test than Nigerian local poults at 4, 8, and 16 weeks of age (Figures 4 a, b, c, d). Higher proportion of Nigerian local poults entered 7-12 squares than Nicholas White at 4 and 8 weeks of age (44.9 vs. 21.7 percent and 77.1 vs. 44.3

Fig. 2c: Response (%) of 12-weeks old Nicholas White (NW) and Nigerian Local (NL) Turkeys to latency to vocalise

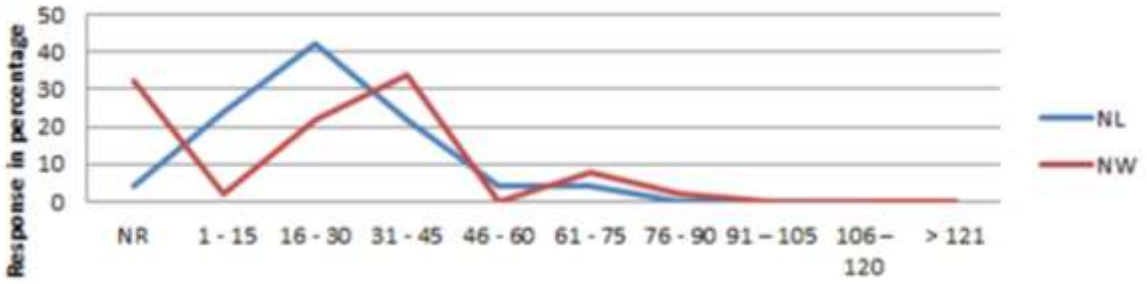


Fig. 2d: Response (%) of 16-weeks old Nicholas White (NW) and Nigerian Local (NL) Turkeys to latency to vocalise

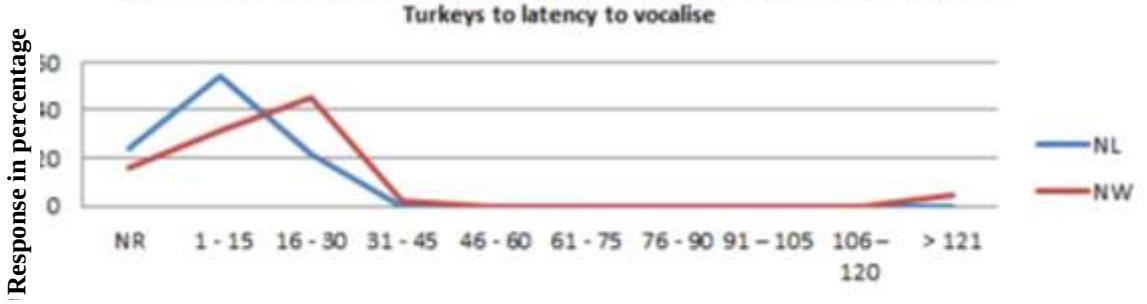


Fig. 3a:Response 4-weeks old Nicholas white (NW) and Nigerian local (NL) to number of vocalisation test

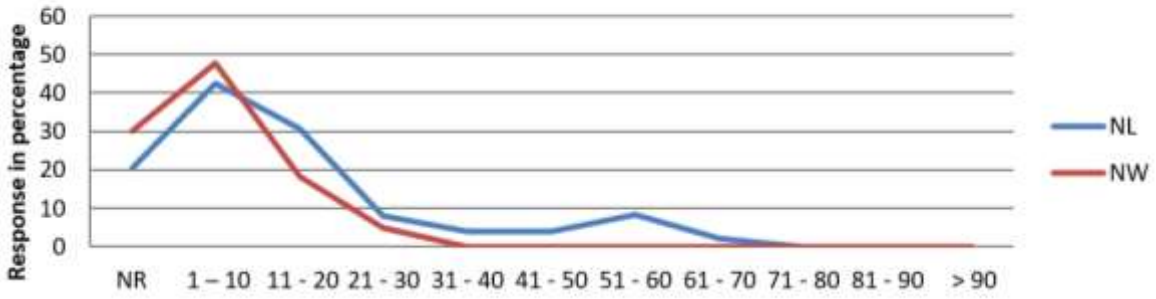
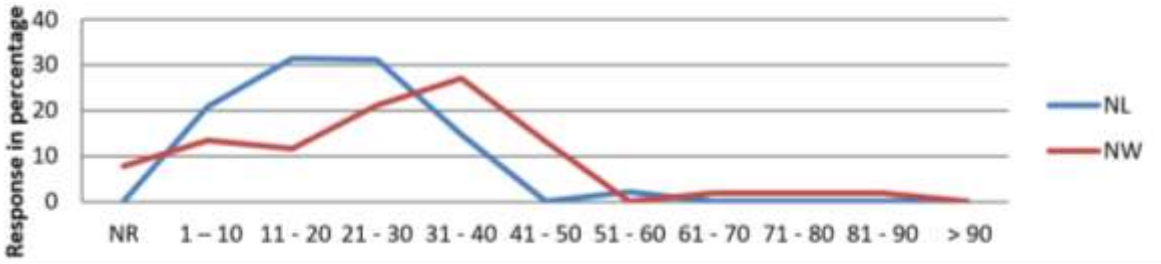
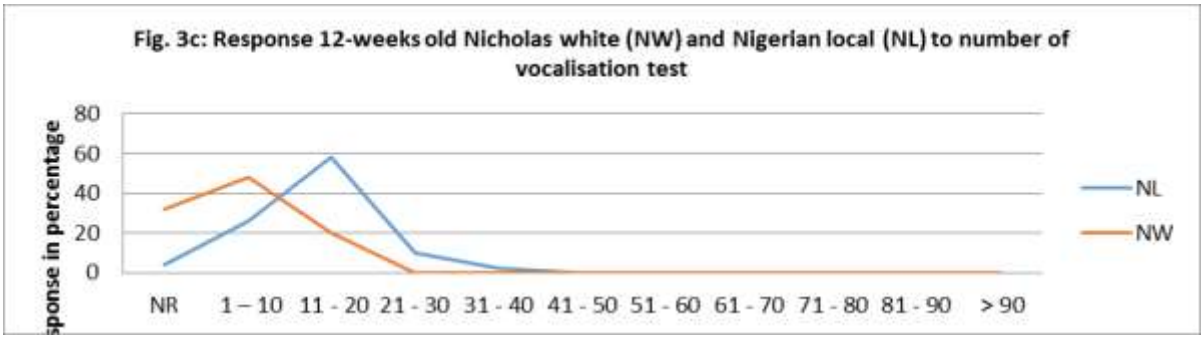
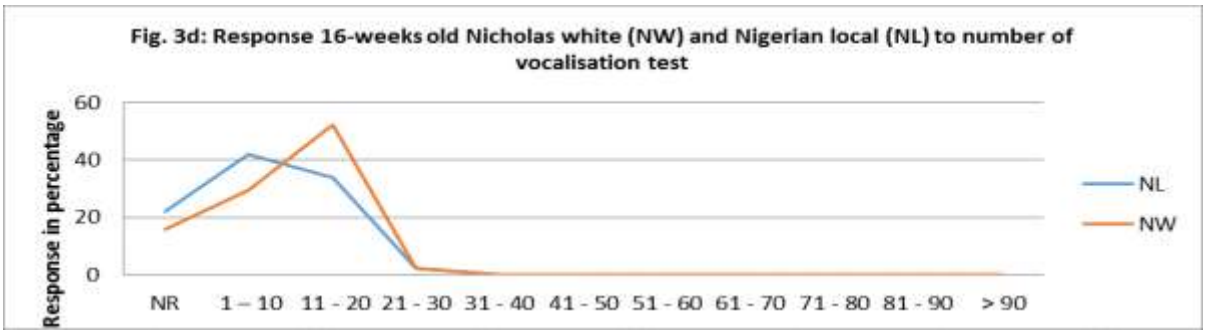


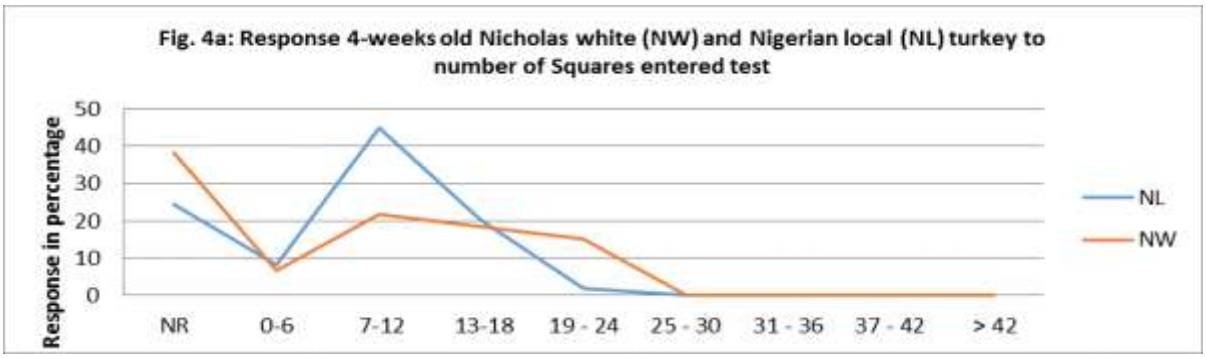
Fig. 3b: Response 8-weeks old Nicholas white (NW) and Nigerian local (NL) to number of vocalisation test

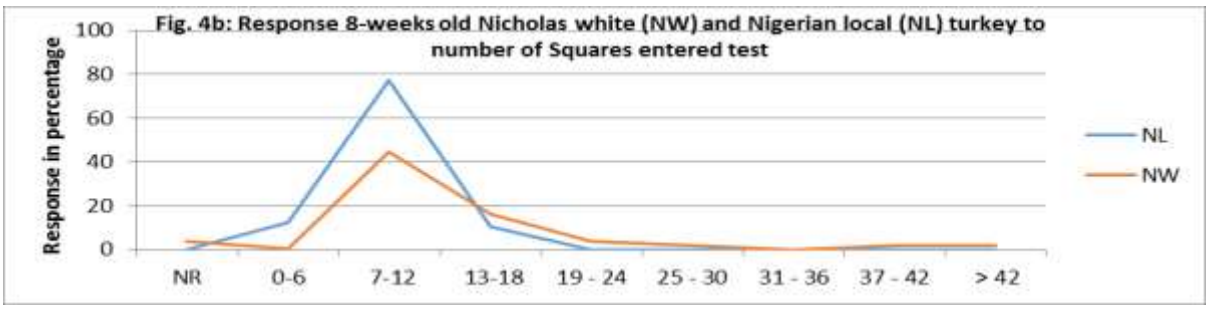


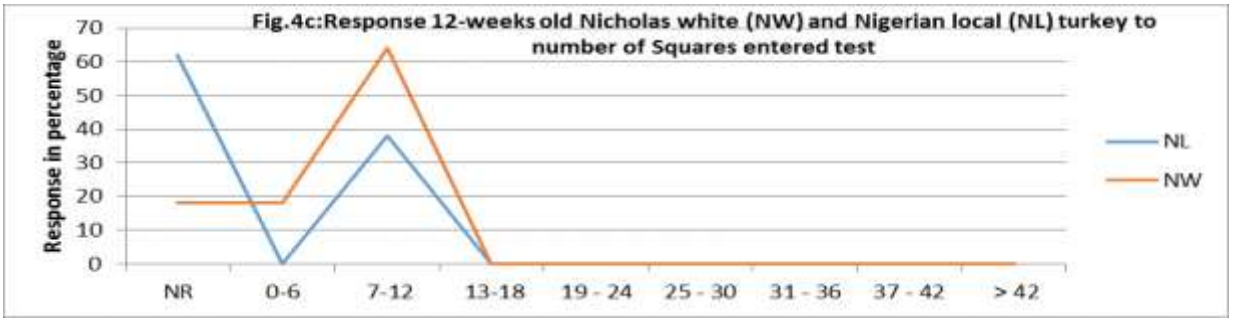
percent for Nicholas White and Nigerian local poults, respectively). There was no consistent effect of age on the number of squares entered by Nicholas White and Nigerian local poults, but birds older than 8 weeks entered only ≤ 12 squares. Results of Escape Attempt test showed that higher proportions (%) of Nigerian Local poults made escape attempts at 4, 8 and 12 weeks of age (Figures 5). More birds made attempt to escape with increase in age. Majority of the birds defecated once (Fig. 6). There was genotype difference in the response of birds to defecation test. The defecation increased with age in Nicholas White poults of 4 to 12 weeks of age. However, while it decreased with age in Nigerian local poults of the same age range.

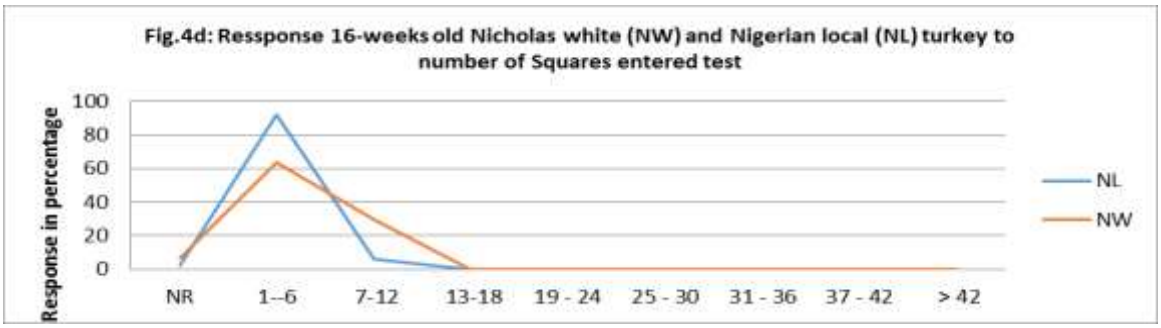


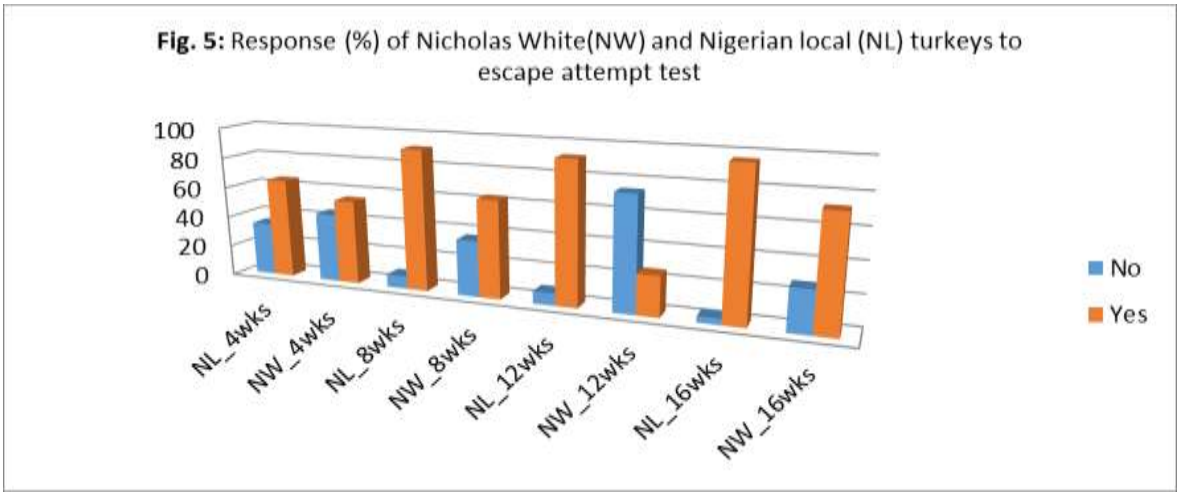


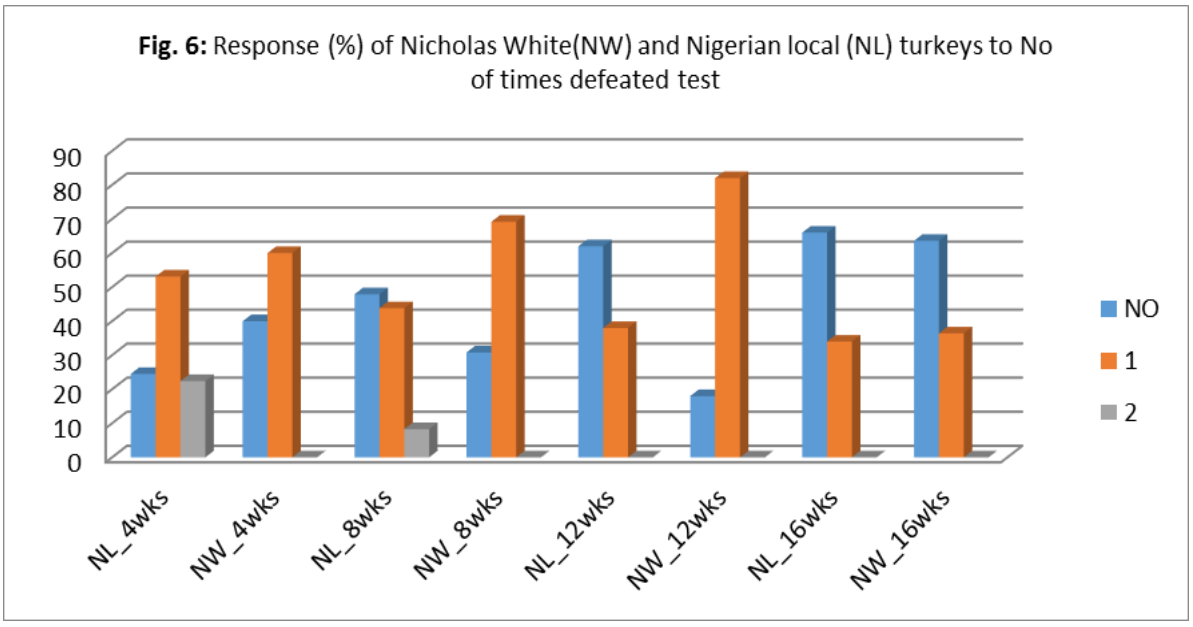












DISCUSSION

The present results suggest a marked variation in the response of Nicholas White and Nigerian Local poults to the various open field tests. The higher percentage of response among Nigerian Local poults to latency to ampulate, latency to vocalize, number of vocalization, entering of squares and escape attempt tests suggest a higher level of fearfulness and physiological activity in the Nigerian local turkey. The present result agrees with the work of Nestor *et al*. (1969) which showed that turkey strains differ in fear responses. According to Jones (1989) and Calandreau *et al.* (2011), animals that are more fearful have increased physiological responses to stressors compared to less fearful animals. However, the differences in proportion of response to each test may also suggest the level of

variation in the manner in which individuals within the same strain respond to the object of fear in the test. According to Erchard *et al*. (1999), behavioural patterns related to fear vary greatly in challenging situations and this may include active defense (attack, threat) or active avoidance (flight, hiding, escape) and passive avoidance (immobility). Winblad von Walter (2010) stated that it is the stimulation of sympathetic nervous system that prepares the individual for fight, flight or fright. The higher tendency of the light strain (local turkey) birds to ampulate, vocalize, move between squares and make escape attempt suggest that it is more frightful than the exotic turkey. Earlier works have shown that fear is not only a negative affective state, but it is associated with adverse effects on productivity and welfare of animal including increased injury (Reed *et al*., 1993), reduced production (de Haas *et al*., 2013) and depressed growth (Schütz *et al*., 2004). Norris *et al.* (2014) in a review of the impact of fearfulness on livestock productivity stated that flighty steers had lower live weights, poorer feed conversion efficiency, lower carcass dressing percentages and lower initial muscle pH levels compared to less flighty steers. There is therefore the need to select Nigeria local turkey for reduce frightfulness as this may be responsible for its smaller growth performance and adult body weight. There are a number of strategies on the mitigation of fearfulness in domestic animal species. These include batch rearing. Jones and Merry (1988) observed that chicks tested individually in an open field showed significantly higher levels of activity, vocalization, defaecation and plasma corticosterone but took longer to ambulate and preened and pecked significantly less than their paired counterparts. They then concluded that social motivation is an important variable influencing the chicks' open field fear strategy. In another report, Jones and Carmichael (1997) stated that chicks tested individually in an open field were unaffected by the presence or width of lines. Conversely, pair-tested chicks paced and pecked more when the floor was delineated. Forkman *et al.* (2007) therefore called for environmental strategies and genetic selection aimed at reducing fearfulness in livestock species for both economic and ethical reasons.

The observed increase in the proportion of birds that ampulate, vocalise or make escape attempt with increased age suggest an increased sense of fear among older poults. Boivin *et al.* (1992) reported that older calves are more active in open field tests than younger ones. Never the less, there is the need for further study to understand the mechanisms underlying age related bahavioural response pattern to fear in turkey. Forkman *et al.*, (2007) stated that such change in perception of arena may be expected when the tests are repeated close in time.

CONCLUSION

It is concluded from the study that marked variations exist between Nicholas White and Nigerian Local poults in their response to open field tests with the latter displaying a higher frightfulness. The increased tendency of older poults to ampulate, vocalize and make escape attempt require further study to understand the mechanisms underlying age related bahavioural response pattern to fear in turkey. There is also the need to select the Nigeria local turkey for reduce frightfulness to enhance its commercial production.

REFERENCES

1. Boivin, X., Lee Neindre, P., Chupin, J.M, Garet, J.P. and Trillat, G. (1992). Influence of breed and early management on case of handling and open field bevaviour of cattle. Applied Animal behavioural Science, 32:313-323
2. Calandreau, L., Favreau-Peigné, A., Bertin, A., Constantin, P., Arnould, C., Laurence, A., Lumineau, S., Houdelier, C., Richard-Yris, M. A., Boissy, A. and Leterrier, C. (2011). Higher inherent fearfulness potentiates the effects of chronic stress in the Japanese quail. Behav. Brain Res., 225: 505-510.

Davis, M., Walker, D. L., Miles, L. and Grillon, C. (2010). Phasic vs.

sustained fear in rats and humans: role of the extended amygdala in fear vs. anxiety. Neuropsychopharmacol. Rev., 35: 105-135.

3. De Haas, E. N., Kemp, B., Bolhuis, J. E. and Rodenburg, B. (2013). Fear, Stress and feather pecking in commercial white and brown laying hen parent-stock flocks and their relationships with production parameters. Poultry Science, 92, 9: 2259-2269
4. Erasmus, M. (2015). Fear in turkeys: implications for productivity and well-being. 2015 Mid-West Poultry Convention. erasmus_marisa_-_fear_ in_turkeys_-_implications_ for_ productivity_and_well-being.pdf Erasmus, M. A. and Swanson, J. C. (2014). Temperamental turkeys: reliability of behavioral responses to four tests of fear. Appl. Anim. Behav. Sci., 157: 100-108.
5. Erchard, H.W. and Mendl, M (1999). Tonic immobility and emergence time in pigs-more evidence for behavioural strategies. Applied Animal behav. Sci., 61:227-237
6. Forkman, B., Boissy, A., Maunier-Salaün, M. C., Canali, E. and Jones, R. B. (2007). A critical review of fear tests used on cattle, pigs, sheep, poultry and horses. Physiol. Behav. 92: 340-374.
7. Jones, R. B. and Carmichael, N. L. (1997). Open-field behaviour in domestic chicks tested individually or in pairs: Differential effects of painted lines delineating subdivisions of the floor. In: Behaviour Research Methods, Instruments and Computers, 29, 3: 396-400
8. Jones, R. B. and Merry , R. J. (1988). Individual or paired exposure of domestic chicks to an open field: Some behavioural and adrenocortical consequences. Behavioural Processes, 16, 1–2: 75-86.
9. Le Neindre, P. (1989). Influence of rearing conditions and breed on social behaviour and activity of cattle in novel environments. Appl. Anim. Behav Sci., 23:129–40.
10. Miller, K.A., Garner, I. P. and Mench, I. A. (2005). The test-retest reliability of four behavioural tests of fearfulness for quail: A critical evaluation. Appl. Anim. Behav. Sci., 92:113-127
11. Nestor, K. E., McCartney, M. G. and Bachev, N. (1969). Relative contributions of genetics and environment to turkey improvement. Poult. Sci., 48:1944-1949.
12. Nordquist, R.E., Heerkens, J.L.T., Rodenburg, T.B., Boks, S., Ellen, E.D. and Staaij, F. van der (2011). Laying hens selected for low mortality: Behaviour in tests of fearfulness, anxiety and cognition. Quelle Applied Animal bahaviour Science, 131, 3-4: 110-122.
13. Norris, D., Ngambi, J. W., Mabelebele, M., Alabi, O. J. and Benyi, K. (2014). Genetic selection for docility: a review. J. Animal and Plant Science, 24: 374-379.
14. Reed, H. J., Wilkins, L. J., Austin, L. D., Gregory, N. G. (1993). The effect of environmental enrichment during rearing on fear reactions and depopulation trauma in adult caged hens. Appl. Anim. Behav. Sci., 36:39-46
15. Rodenburg, T. B., van Krimpen, M. M., De Jong, I. C., de Haas, E. N., Kops, M. S., Riedstra, B. J., Nordquist, R. E., Wagenaar, J. P., Bestman, M. and Nicol, C. J. (2013). The prevention and control of feather pecking in laying hens: identifying the underlying principles. World's Poult. Sci. J., 69: 361-374.
16. SAS (2002). Statistical Analysis System, Computer Software, Version 9: Statistics SAS Institute

Inc. Cary, NC 27513, NC 27513, USA
17. Schütz, K. E., Kerje, S., Jacobsson, L., Forkman, B., Carlborg, Ö., Andersson, L. and Jensen, P. (2004). Major growth QTLs in fowl are related to fearful behavior: possible genetic links between fear responses and production traits in a Red Jungle fowl × White Leghorn intercross. Behav. Genet., 34: 121-130.
18. Terlouw, C. (2005). Stress reactions at slaughter and meat quality in pigs: genetic background and prior experience. A brief review of recent findings. Livest. Prod. Sci., 94: 125-135.
19. Terlouw, E. M. C., and Rybarczyk, P. (2008). Explaining and predicting differences in meat quality through stress reactions at slaughter: the case of Large White and Duroc pigs. Meat Sci., 79:795–805.
20. Winblad von Walter, L. (2010). Physiological and behavioural responses to fear and discomfort in dogs and goats. Licentiate Thesis, Swedish University of Agricultural Sciences, Uppsala, 45pp. pub.epsilon.slu.se/2414/1/winblad_von_walter_1_101123.pdf

