ON-STATION PERFORMANCE EVALUATION OF IMPROVED TROPICALLY ADAPTED CHICKEN BREEDS FOR SMALLHOLDER POULTRY PRODUCTION SYSTEMS IN NIGERIA

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Abstract
Availability of appropriate genetics is important for the development of Smallholder Poultry (SHP). The biological potential of improved dual purpose chicken germplasms was evaluated in Nigeria. A total of six breeds (*Fulani*, *FUNAAB Alpha*, *Kuroiler*, *Noiler*, *Sasso*, *and ShikaBrown*) were tested on-station, in deep litter houses at two test centres (Public and Private facility) for 504 days. Birds were fed *ad libitum* for the first 140 days after which restricted feeding was practised. Lowest and highest hatchability of eggs set was 55% (*FUNAAB Alpha*) and 89% (*Sasso*), respectively. At 140 days, male live weights were 200 % - 300 % higher than the local chickens (975g) except *ShikaBrown* (152%) and *Fulani* (135%). Lowest ($p<0.05$) age at first egg were 119 days for *ShikaBrown* and 120 days for *FUNAAB Alpha* and *Kuroiler.* Highest hen-housed egg production was 192 for *ShikaBrown*, and feed intake per dozen eggs was lowest ($p<0.05$) for *ShikaBrown* (3.0 kg) and *FUNAAB Alpha* (3.1 kg). Mortality rate of the breeds was significantly different ($p<0.05$) during brooding, growing and laying. The genotype by environment interaction effect on the performance of the breeds was largely due to management practices at the test centres. Results from this study indicate that all the breeds are more suitable as dual-purpose birds compared to the local chickens.
Keywords: Germplasms, Nigeria, smallholder-poultry, on-station, dual-purpose

Introduction

Smallholder poultry (SHP) is defined as poultry keeping by households using family labour, locally available feed resources obtained largely through scavenging by a flock of less than 100 birds, of unimproved or improved breed. (Sonaiya, 1990). The low productivity of the SHP production systems (as characterized by high mortality, low egg numbers, and poor live performance) has resulted in the demand by SHP producers for "better and bigger" birds in Nigeria (ACGG Nigeria baseline data 2016, http://data.ilri.org/portal/dataset). Such "better" birds are best provided not by commercial/industrial poultry germplasms, but by SHP-specific hybrid germplasms (SHP-SHG) which are improved dual purpose birds that incorporate genes for higher productivity and performance into the hardiness of locally adapted chickens.
The introduction of SHP-SHG has been successfully tested in Bangladesh for the Sonali chickens (FAO, 2015) and in Uganda with the *Kuroiler* (Galukande *et al.*, 2016; Sharma *et al.*, 2015). The objective of this study was to evaluate the growth performance, egg production and survivability of selected, improved SHP-SHG for the SHP production systems in Nigeria.

Material and Methods

Study locations: The on-station test was replicated at two centres located within the derived savanna: Fol-Hope Farms, Ibadan, Oyo State, and Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State. The testing of the birds commenced in May 2016.

Experimental birds and management: A total of 1,939 day old chicks of both locally sourced breeds (*Fulani*, *FUNAAB Alpha*, *Noiler* and *ShikaBrown*) and imported breeds (*Kuroiler* and *Sasso*) were brooded from 0 to 42 days (d). The chicks were hatched on-station, from hatchable eggs sourced from the respective breeder farms. The birds were sexed at 42d, and grown separately until 140d for males, and 504d for females. The population density was 10 chicks/m^2, 7 birds/m^2, and 5 birds/m^2 during brooding, growing and laying phases, respectively. Commercial feed (Chick mash: 2,993 kcal ME/kg, 22.3% CP; Grower mash: 3,013 kcal ME/kg, 17% CP) and water were available *ad libitum* during brooding and growing phases. During the laying phase (Layer mash: 2,500 kcal ME/kg, 16.5% CP, 3.6% Ca), hens were restricted to a maximum of 120g feed/hen/day. Standard biosecurity measures and vaccination schedules were observed at the test centres.

Data collection and analysis: Fertility and hatchability percentages were determined from hatchery performance record taken at day 1 (eggs set), day 18 (candling), and day 21 (hatching)**.** Data on feed intake, egg production, and mortality were taken daily. Body weights were measured every 14d. For males, bodyweights were taken until 140d when they were exited from the test. For females all measurements were taken up till 504d. The study was conducted independently in each of the test stations as a completely randomized design with a minimum of 4 replicates per strain. Growth rate, feed conversion ratio (FCR), hen housed egg production (HHEP), hen day egg production (HDEP), and mortality rate were analysed using analysis of variance of SAS student edition. Differences between breed means and stations means were separated using Duncan Multiple Range test.

Results

Table 1 shows the hatchery performance. Hatchability of fertile eggs (HFE) was over 70% in all the breeds with *Noiler* being the highest (89%).

Table 1. Hatchability of eggs of the six breeds

Breeds	Eggs Set*	Number Fertile	Hatchability % of eggs set (HES)	Hatchability % of Fertile eggs (HFE)
Fulani	8,187	6,275	55	72
FUNAAB Alpha	13,688	9,153	55	82
Kuroiler	24,480	20,521	67	80
Noiler	11,905	11,190	84	89
Sasso	93,992	79,629	71	84
ShikaBrown	23,157	20,911	77	85

*Total number of eggs set for both on-station and on-farm test.

Table 2 shows the live weight performance of the breeds. Bodyweight gain and FCR of the breeds differed ($p<0.05$) significantly during brooding, growing and laying. *Noiler* had the

lowest FCR at brooding (2.2) but did not differ from *Sasso* during growing for males. Male bodyweight gain for *Sasso* (2,962g) and *Kuroiler* (2,894g) were higher ($p<0.05$) than *Noiler* (2,599g), while *FUNAAB Alpha* (2,097g) differed ($p<0.05$) from *ShikaBrown* and *Fulani*. At 504d, *Sasso* had the highest ($p<0.05$) live weight.

Table 2. Body weight and feed performance (LSM±SEM) of the six breeds tested on-station

Parameters	Fulani		FUNAAB Alpha		Kuroiler		Noiler		Sasso		Shika Brown	
Brooding	Both Sexes (70)		Both Sexes (353)		Both Sexes (408)		Both Sexes (310)		Both Sexes (408)		Both Sexes (400)	
Day-old BW,g	24±0.9^{d}		31±0.9^{b}		40±0.6^{a}		37±0.7^{ab}		39±0.9^{a}		28±0.3^{c}	
42-d BW, g	202±14.8^{d}		378±11.7^{c}		598±22.3^{b}		744±10.6^{a}		494±8.9^{b}		279±4.5^{cd}	
42-d FI, g/bird	777±9.7^{e}		1093±9.1^{d}		1735±18.4^{a}		1575±9.2^{b}		1385±21.1^{c}		1047±8.0^{d}	
FCR	4.4±2.1^{d}		3.2±1.7^{b}		3.1±1.8^{b}		2.2±0.5^{a}		3.0±1.2^{b}		4.2±1.4^{c}	
Growing	M	F	M	F	M	F	M	F	M	F	M	F
	(20)	(46)	(113)	(180)	(130)	(141)	(148)	(151)	(190)	(181)	(194)	(197)
56-d BW, g	366±25.8^{e}	325±10.5^{c}	685±18.3^{c}	594±15.8^{b}	970±22.3^{b}	834±25.5^{a}	1179±19.8^{a}	978±15.5^{a}	921±15.4^{b}	855±11.7^{a}	502±8.9^{d}	472±6.4^{bc}
140-d BW, g	1321±84.7^{e}	1028±63.4^{c}	2097±62.6^{c}	1635±54.5^{b}	2894±51.0^{a}	2421±38.6^{a}	2599±51.0^{b}	2071±38.3^{a}	2962±48.9^{a}	2353±15.2^{a}	1688±27.3^{d}	1340±8.3^{bc}
84-d FI, g/bird	10660±32.1^{e}	9131±28.2^{c}	15868±35.7^{b}	15162±41.7^{a}	17598±25.2^{a}	15448±38.4^{a}	11609±53.3^{d}	10307±40.0^{b}	16943±62.7^{b}	14490±78.5^{a}	13432±33.3^{c}	10962±19.3^{b}
FCR	11.2±3.8^{c}	13.0±3.2^{cd}	11.2±2.2^{c}	14.6±4.6^{d}	9.1±1.3^{b}	9.7±3.7^{b}	8.2±1.8^{a}	9.4±2.1^{a}	8.3±1.6^{a}	9.7±3.4^{b}	11.3±4.0^{c}	12.6±2.7^{c}
Laying	F		F		F		F		F		F	
	(31)		(161)		(130)		(141)		(179)		(191)	
504-d BW, g	1740±48.2^{d}		2131±22.6^{c}		2422±30.1^{b}		2332±25.9^{b}		2635±34.0^{a}		2045±18.6^{c}	

BW=Bodyweight, FI=Feed Intake, FCR=Feed conversion ratio, M=Male, F=Female, ( )=Figures in parenthesis are number of observations at the start of the phase. $^{a-e}$Means with different superscripts on the same row were significantly different at $P < 0.05$, LSM=Least square mean, SEM=Standard error of the mean

Table 3 shows the laying performance. The mean age at first egg, egg weight and HHEP in 364 days were 125 days, 52g and 141, respectively. *ShikaBrown* had the lowest ($p<0.05$) age at first egg (119 days). *Noiler* and *ShikaBrown* had the highest ($p<0.05$) egg weight (56g) which was not significantly different from that of *Kuroiler* and *Sasso*. The lowest and highest HDEP was observed in *Sasso* (35%) and *FUNAAB Alpha* (75%), respectively. Feed intake per dozen eggs was lowest ($p<0.05$) for *ShikaBrown* (3.0 kg) and *FUNAAB Alpha* (3.1 kg).

Table 3. Age at first egg, egg weight, hen housed egg production, hen day egg production and feed intake per dozen eggs (LSM±SEM) of all the breeds tested on-station

Parameters	Breed						Station	
	Fulani	FUNAAB Alpha	Kuroiler	Noiler	Sasso	Shika Brown	Fol-Hope	FUNAAB
Age at first egg, d	126±1.1^{c}	120±0.9^{b}	120±1.3^{b}	130±1.8^{d}	133±0.6^{d}	119±0.3^{a}	128±0.9^{a}	120±0.8^{b}
Egg weight, g	40±0.9^{c}	49±0.4^{b}	54±1.0^{a}	56±0.7^{a}	55±1.2^{a}	56±0.4^{a}	52±0.3^{a}	52±0.3^{a}
HHEP, count	88±3.4^{d}	190±2.8^{a}	127±4.2^{c}	173±2.1^{b}	75±5.6^{e}	192±0.7^{a}	140±1.8^{a}	107±2.1^{b}
Maximum HDEP, % (days)	68±0.8 (175)	75±0.5 (182)	60±0.5 (175)	61±0.6 (238)	35±0.8 (182)	71±0.9 (245)	63±1.1 (203)	53±1.4 (238)
Feed/dozen eggs, kg	4.6±2.1^{c}	3.1±1.3^{a}	4.6±1.8^{c}	3.6±0.9^{b}	8.5±1.1^{d}	3.0±1.8^{a}	6.6±1.7^{b}	4.1±1.2^{a}

HHEP=Hen housed egg production, HDEP=Hen day egg production. $^{a-e}$Means with different superscripts on the same row were significantly different at $P < 0.05$, LSM=Least square mean, SEM=Standard error of the mean.

Table 4 shows the mortality rate of the breeds. Mortality during brooding ranged from 3.6% (*Noiler*) to 33.6% (*Kuroiler*). *Noiler* (13.5%), *Kuroiler* (18.5%) and *Sasso* (25.8%) had higher male mortalities during growing than *Fulani* (0%), *ShikaBrown* (2.6%) and *FUNAAB Alpha* (7.9%), but for females, *Fulani* had the highest mortality (32.6%) while *Sasso* was lowest (1.1%). *FUNAAB Alpha* had the highest (24.8%) mortality during laying, followed by *Sasso* (24%), *Noiler* (21.7%), *Fulani* (19.4%), *Kuroiler* (19.2%), and *ShikaBrown* (16.8%).

Table 4. Mortality rates (LSM±SEM) of the six breeds tested on-station

Phases	Breed						Station	
	Fulani	FUNAAB Alpha	Kuroiler	Noiler	Sasso	Shika Brown	Fol-Hope	FUNAAB
Brooder, Mortality %	5.7±0.7^{c}	16.9±1.0^{e}	33.6±2.9^{f}	3.6±0.6^{b}	9.1±1.8^{d}	2.3±0.1^{a}	8.4±1.3^{a}	15.6±1.7^{b}

Grower, Male Mortality, %	0[a]	7.9±1.4[c]	18.5±4.2[e]	13.5±2.1[d]	25.8±3.6[f]	2.6±0.8[b]	11.4±1.9[b]	7.9±1.0[a]
Grower, Female Mortality, %	32.6±0.9[e]	10.6±2.5[d]	10.6±4.9[d]	6.6±1.8[c]	1.1±0.1[a]	3.1±0.0[b]	10.8±2.4[a]	9.6±2.0[a]
Layer, Mortality, %	19.4±1.3[a]	24.8±4.4[c]	19.2±4.0[a]	21.7±3.1[b]	24.0±2.2[c]	16.8±1.1[a]	33.9±3.8[b]	27.3±2.7[a]

[a-e]Means with different superscripts on the same row were significantly different at $P < 0.05$, LSM=Least square mean, SEM=Standard error of the mean.

Discussion

The HFE of all the breeds, except *Fulani* is within the range (80-90%) reported by MALDM (1993) for dual purpose chicken breeds. The fertility and HFE of *Fulani* were low compared to the report by Adedeji *et al.* (2015) for *Fulani* chickens tested on station (Fertility 85%, HFE 84%), but it was similar to that reported by Dunya *et al*. (2014) for local chickens. The growth performance of the breeds, shows the group of *Kuroiler*, *Noiler* and *Sasso* to have better performance than the group of *FUNAAB Alpha* and *ShikaBrown* when compared with *Fulani*. At 42d, *Noiler* was the most efficient at converting feed to muscle with 50% reduction in FCR compared to *Fulani*. Comparing the male live weights of the breeds with the mean male live weight (975g) of the Nigerian local chickens raised on-station (Ajayi, 2010; Nwosu and Asuquo, 1984; Akinokun, 1975), *Sasso*, *Kuroiler*, *Noiler*, *FUNAAB Alpha*, *ShikaBrown* and *Fulani* were higher by 304%, 297%, 267%, 215%, 173% and 135%, respectively. This shows a cluster of fast (*Sasso*, *Kuroiler*, *Noiler* and *FUNAAB Alpha*) and slow (*ShikaBrown* and *Fulani*) growing breeds. There was a 22% reduction in the mean age at first egg of the improved breeds compared with the locals (160 days) and a 39-50% increase (*Noiler*, *FUNAAB Alpha* and *ShikaBrown*) in HHEP over the local chickens (128 days) reared on-station (Ajayi, 2010; Adedokun and Sonaiya, 2002). *ShikaBrown* and *FUNAAB Alpha* were the most efficient at converting feed to eggs. Overall, the locally sourced breeds had a lower mortality rate than the imported breeds which suggests that the locally sourced breeds were more adaptable to the environment than the foreign breeds.

Conclusion and Recommendation

All the breeds performed comparably better than the local, unimproved chickens. At 140d, *Kuroiler* and *Sasso* had over 200% increase in bodyweight while *Noiler* had over 150% increase compared with the local chickens. *ShikaBrown* had the highest (50%) increase in HHEP compared with the local chickens. The overall ranking (i.e. highest to lowest) of the breeds based on hatchability, growth and laying performance, and survivability is *ShikaBrown/Noiler, Kuroiler/Sasso, FUNAAB Alpha* and *Fulani*.

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References

Adedeji, T.A, Amao, S.R, Popoola, A.D, and Ogundipe, R.I. (2015). Fertility, hatchability and egg

quality traits of Nigerian locally adapted chickens in the derived savanna environment of Nigeria. J. *Biol. Agric. Healthcare*, 5(17): 36-42

Adedokun, S.A. and Sonaiya, E.B. (2002). Crossbreeding Nigeria indigenous with the Dahlem Red chickens for improved productivity and adaptability. *Archiv Tierzucht Dummerstorf*, 45(3): 297–305.

African Chicken Genetic Gains (ACGG) Nigeria baseline data (2016). http://data.ilri.org/portal/dataset.

Ajayi, F.O. (2010). Nigerian indigenous chicken: A valuable genetic resource for meat and egg production. *Asian J. Poult. Sci*., 4:164-172

Akinokun, O. and Dettmers, A. (1979). Genotype X environment interactions in an exotic commercial egg strain and the local chicken of Nigeria. *Ife J. Agric*., 1:57-62.

Dunya, A.M., Husa, H., Yusuf, S.Z., Usman, Y. and Makinta, A.A. (2014). Fertility and hatchability in local chicken of Borno state, *Nigeria J. Agric. Sci. Applic*., 3: 20-23.

FAO (2015). Comparative performance of Sonali chickens, commercial broilers, layers and local non-descript (deshi) chickens in selected areas of Bangladesh. *Animal Production and Health Working Paper*. No. 14. Rome.

Galukande, E., Alinaitwe J. and Mudondo, H. (2016). Improving livelihoods of the urban poor in

Kampala city through Kuroiler chicken production. *Proc. Conference on International Research on Food Security, Natural Resource Management and Rural Development*, Tropentag 2016, Vienna, Austria.

Leitner, G., Heller. E.D. and Friedman, A. (1989). Sex-related differences in immune response and survival rate of broiler chickens. *Vet. Immunol. Immunopathol*., 21(3-4):249-60.

Ministry of Agriculture Livestock Development and Marketing (MALDM) Kenya (1993). *Animal*

Production Division. Annual Report.

Nwosu, C.C. and Asuquo, B.O. (1984). Heritability estimates of bodyweight in the local chickens. *Proc. of the 9th Ann. conf. Nig. Soc. Anim. Prod*., pp 41-48.

Sharma, J., Xie, J., Boggess, M., Galukande, E., Semambo, D. and Sharma, S. (2015). Higher weight gain by Kuroiler chickens than indigenous chickens raised under scavenging conditions by rural households in Uganda. *Livestock Res. for Rural Dev*. 27 (9). Accessed Oct. 2017. http://www.lrrd.org/lrrd27/9/shar27178.html.

Sonaiya, E.B. (1990). Poultry husbandry in small rural farms. *Entwicklung + ländlicher raum* 4: 3-6.