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Review Article

Characterisation and approaches to the conservation of the Nigerian local duck population: A Review

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Abstract

Research, development, and breeding of ducks in Nigeria are on the rise and continuous breeding of ducks needs basic information on their production environment, genetic background, and diversity. Nigerian local ducks (NLD) have been phenotypically characterised based on morphological characteristics which have provided a reasonable representation of their genetic difference. Morphological and morphometric variations exist among indigenous ducks of Nigeria and mottled plumage colour is preponderant. Low genetic diversity exists among Nigerian duck populations implying that ducks are in close genetic relationships irrespective of distinctive and varying phenotypic, biochemical, and physiological characteristics, whereas the phylogenetic tree revealed clustered relationships. Large-scale duck farming is uncommon; rather, ducks are kept as a pastime business. The scavenging feeding system is majorly practiced among small flock sizes which are highly predominant. NLDs lay between 100 and 125 eggs yearly when reared under an intensive system of management and also have a high hatching rate of above 70% even though high environmental temperature affects their reproductive performance. There are no organised duck markets in Nigeria. Duck eggs are rarely consumed or sold; rather they are majorly used for breeding purposes. Myths, poor funding, lack of standard laboratories, and lack of skilled workforce are among the factors affecting the development and conservation of indigenous ducks in Nigeria. Introducing improved breeds of duck and establishing conservation programmes will help promote greater duck production and conservation. Duck business is a profitable but seasonal business and can efficiently bridge the noticed protein gap in rural communities.

Keywords: Poultry; conservation; production; indigenous; diversity; genome; improvement

INTRODUCTION

Duck is an important avian species and is ranked next to chicken for egg, meat, and feather production with global duck meat production put at 1.3 million tons between 2000 and 2011 (Sultana et al., 2016). The Nigerian duck population is estimated at about 9.5 million birds (NBS, 2012). Local ducks are native to any area where they have evolved (Adeolu and Oleforuh-Okoleh, 2014) and they denote valuable resources for livestock development because of their varied genetic diversity, which encourages the rearing of these ducks in diverse environmental settings. Ducks are reared for the production of meat and egg at small-scale levels and are also kept with other poultry or livestock when practising backyard farming (Kadurumba et al., 2019), and because they are very

resilient, they acclimatise easily in any environment with less or minimal management. Ducks also have the capacity to forage on feed materials that otherwise are not retrievable by chickens and other animals. Again, low mortality, laying more eggs, and lengthier lifespan have also been reported among ducks (Jha and Chakrabarti, 2017).

However, the loss of genetic diversity has been on the increase in recent times as more than 50% of well-known livestock breeds, particularly poultry birds are now threatened or at risk of extinction (Shittu et al., 2016). The Nigerian local ducks are not left out as their dwindling numbers in recent times attest to the fact that they are disappearing coupled with the fact that they have not been properly characterised (Oguntunji et al., 2020) in different ecological zones where they are found and data about their genetic resource is paltry (Kadurumba et al., 2022).

The study of genetic diversity within and between populations is a precondition for the sustainable utilisation of domestic species. Comprehensive genomic data with high precision have been produced for most animals using molecular genetics as compared to data obtained from pedigree relationships and trait phenotypes (Adeola et al., 2022). Various researchers have studied the morphology, physiology, biochemistry, and phenotype of the NLDs (Kadurumba et al., 2021; Okeudo et al., 2003; Oguntunji and Ayorinde 2015a; Ewuola et al., 2020) although these methods are less expensive and each parameter is easier to determine, they still do not provide accurateness and precision for selective breeding and commercial selection. The use of molecular genetics has heightened the detailed characterisation and identification of molecular marker-related genes such as single nucleotide polymorphisms (SNPs) that may be applicable in marker-assisted selection (Baena et al., 2018).

The genetic uniqueness of an animal provides the base for differentiating it among different animal genetic resources and for evaluating the existing diversity. Studying the genetic background and relationships among populations of Muscovy duck will provide information on the relationship within their local family, between location interactions and relationships, ancestral lineage, and the rate of genetic diversity within and between different populations. It could assist the breeders by providing useful information for a planned breeding programme as duck owners practiced random mating in Nigeria (Sola-Ojo et al., 2021). Understanding the genetic diversity and origin of NLDs is critical for its characterisation as an animal genetic resource (AnGR). High genetic diversity has been reported among NLDs and the high genetic diversity is attributed to differences in agroecology, climate, and various reasons for rearing these ducks (Adeolu and Oleforuh-Okoleh, 2014) by farmers.

Consequently, detailed data on the genetic diversity and structure of NLDs are vital to its characterisation, management, and further improvement (Adeola et al., 2022). Within the framework of their particular production systems, these indigenous ducks, if improved, will compete favourably with improved duck breeds and perform better in terms of productivity and disease tolerance/resistance. Hence this study aims to review the socio-environmental conditions and approaches to conservation of the Nigerian indigenous ducks to improve its productivity.

Phenotypic characterisation of local ducks in Nigeria

Phenotypic description aids in evaluating the physical traits of species and also indicates the significance and importance of such traits in their natural environment (Oguntunji and Ayorinde 2014). The relationship between phenotypic traits provides vital information on the performance and carcass characteristics of animals. These traits usually measured in the form of size and shape, are vital for determining genetic parameters in breeding programmes Chineke et al. (2002). To ensure successful conservation and sustainable use of the genetic diversity of indigenous breeds, phenotypic characteristics and performances must be assessed in their breeding zones and under traditional management conditions (Zarate, 1996).

NLDs have been phenotypically characterised based on morphological characteristics (Figure 1) which have provided a reasonable representation of their genetic differences. Ducks from the rainforest agro-ecological zone were reported to be larger (2.2 kg) than those from the guinea savannah zone (2.0 kg) (Yakubu et al., 2011), even though reported average body weight for mature males and females ducks of 1734.46 g and 1438.28 g, respectively, was reported for ducks in Southeastern Nigeria (Kadurumba et al., 2021). Similarly, black and multicoloured were the major plumage colours among North Western (Hassan and Mohammed, 2003) and North Eastern (Raji et al., 2009), and Southeastern (Kadurumba et al., 2021) Nigeria ducks, respectively. Oguntunji et al. (2020) equally reported that plumage colour (Table 1) affected the choice of duck and the number of ducks as distinctly coloured ducks like solid black and solid white are associated with rituals in Nigeria. The predominance of black shank, feet, bill, and caruncle colours among male local ducks is probably due to the influence of sex hormones

Figure 1. Variations in plumage colour of Nigerian Muscovy ducks.
Source: Kadurumba et al. (2021)

Table 1. Phenotypic characteristics of adult Muscovy ducks in Nigeria

		Agro-ecological zone (%)		
	Class	**Forest (203)**	**Derived Savannah (519)**	**Guinea Savannah (298)**
Plumage pattern	White	5.91	12.14	12.08
	Black	28.08	39.38	27.87
	Ash	7.39	9.44	11.74
	Blue	-	0.77	-
	Mottled	58.62	37.76	48.32
Skin colour	white	83.74	94.03	81.88
	Yellow	16.26	5.97	18.12
Shank colour	Yellow	39.41	54.91	48.66
	Black	36.95	28.32	37.58
	Slate	20.69	13.68	11.74
	Ash	2.96	3.08	2.01
Bill colour	Red	8.87	20.42	22.15
	Black	58.62	55.88	61.41
	Ash	8.87	17.92	4.03
	Brown	1.47	3.47	6.04
	White	2.96	2.31	2.01
	Yellow	10.34	0.77	2.35
	Slate	8.87	-	2.01
Caruncle colour	Red	88.18	84.39	78.86
	Red-black	5.91	14.07	19.13
	Light yellow	4.43	-	-
	Black	1.48	1.54	2.01

Source: Oguntunji and Ayorinde (2014)

(Kadurumba et al., 2021). Oguntunji and Ayorinde (2014a) reported a major association between plumage colour, skin colour, and body weight among Nigerian Muscovy ducks. High and positive correlations were also reported between body measurements and body weights among ducks. Thus the higher phenotypic variations reported among traits promise a sufficient selection response that will respond positively to the selection of traits of economic importance (Kadurumba et al., 2021).

Molecular characterisation of local ducks in Nigeria

Genetic characteristics using molecular markers provide a large unbiased basis for estimating similarities and/or differences among breeds/ecotypes. Molecular markers and DNA sequencing have been used as ideal markers to classify the taxonomy and phylogenetic relationships among species, and the complete genetic information of animals is obtainable with high precision (Sola-Ojo et al., 2021). Molecular markers such as restriction fragment length polymorphism (RFLP) and DNA fingerprinting (DFP) have so far proved to be useful in establishing genetic relationships among livestock populations including poultry (Hillel et al., 1992). Arbitrary amplification of polymorphic DNA sequences, termed random amplification of polymorphic DNA (RAPD) analysis or Arbitrarily Primed PCR typing (Williams et al., 1990) as with other molecular markers, has been shown to lead to new approaches for genetic analyses of livestock species, and has been used for estimating genetic similarity in livestock animals (Appa-Rao et al., 1996).

Reports of recent studies by Adeola et al. (2020; 2022) revealed low genetic diversity between and within Nigerian Muscovy ducks. In another study, Adebambo et al. (2017) equally reported a relatively high genetic diversity and differentiation among Nigerian ducks using the mitochondrial DNA (mtDNA) D-loop region. Likewise, Ogah et al. (2017) equally discovered low genetic diversity in Nigerian Muscovy ducks using the mitochondrial D-Loop sequence while Sola-Ojo et al. (2021) reported a wide genetic merger among Nigerian Muscovy ducks while using the nuclear DNA CYP2U1 gene.

Furthermore, high similarity (0.86%) and small genetic distance (0.14) indicating common ancestry and small variation due to distribution have been reported in Nigerian ducks (Ogah and Momoh, 2014) while using identified RAPD markers. This RAPD marker could also be positively used to evaluate and identify DNA polymorphisms of Nigerian indigenous Muscovy duck. In another related study, Sola-Ojo et al. (2021) reported the Muscovy duck found in the 15 locations of studies was distributed into 32 haplotypes with haplotypes diversity of 79.25% and this is an indication of the existence of the contribution of multiple maternal lineages across the location. Muscovy ducks were in close genetic relationships irrespective of distinctive and varying phenotypic, biochemical, and some physiological characteristics, while the phylogenetic tree revealed a clustered relationship.

NLD Production environment

Duck statistics and distribution in Nigeria

NLDs are ranked third with a projected population of 9,553,911 after chicken (101,676,710) and guinea fowl (16,976,907) in Nigeria, out of which about 10,588 ducks are being slaughtered annually (NBS, 2012). In a recent report, FAO estimated the duck population in Nigeria to be at 13.7 million in 2020 (How to start duck farming, 2023). Local ducks are an important part of the poultry sector in Nigeria and are predominantly found in rural areas reared by smallholder farmers (Oguntunji and Ayorinde, 2014b) scattered all over the agro-ecological zones (FLDPCS, 1992). Currently, there is scanty literature or records on how ducks came into Nigeria, but Jacob (2012) reported that the breeds of domestic ducks that are reared in Africa were imported from foreign countries. For example, Blench (1995) and Oguntunji and Ayorinde (2014) suggested that these ducks were probably introduced by the Portuguese slave traders and explorers in the fifteenth century). Studies by various authors in the northern (Duru et al., 2006), western (Oguntunji and Ayorinde, 2015a), and eastern (Kadurumba et al., 2019) parts of Nigeria clearly showed that the Muscovy duck commonly known as the local duck is the predominant duck genus species in Nigeria. These Muscovy ducks represent 10% of the local poultry population and 74% of ducks raised in Nigeria (Yakubu, 2013), even though the dwindling population of Muscovy ducks in recent years attests further to its utter neglect.

Current duck farming approaches

Ducks in Nigeria are poorly managed. This is demonstrated in the prevalence of extensive management systems, feeding ducks with low-quality feed, provision of substandard housing, lack of routine veterinary care, the prevalence of endemic local diseases claiming a substantial proportion of the flock, and poor performance (Oguntunji and Ayorinde, 2015b). The majority of duck farmers practice self-medication using ethnoveterinary drugs to treat ducks (Kadurumba et al., 2019; Oguntunji

Table 2. Effect of season and climate on egg production in ducks as affected by climate

Season	Month	Egg production (%)	Ambient temp. (°C)	Relative humidity (%)
Rainy	April	4.34	34.70	50.10
	May	10.25	30.60	58.30
	June	19.73	28.20	74.30
	July	29.84	28.40	72.04
	August	18.99	29.70	68.74
	September	13.92	31.30	63.84
Dry	October	5.15	33.50	56.60
	November	1.77	33.50	56.80
	December	1.01	34.20	41.60
	January	0.00	33.41	30.03
	February	0.00	36.51	29.90
	March	0.00	35.10	31.30

Source: Oguntunji et al. (2015)

and Ayorinde, 2015c). Large-scale duck farming is uncommon; rather ducks are kept as a pastime business (Adeosun and Owoade 2020), and the scavenging system of feeding is practised where flocks comprising between 5 to 20 ducks are allowed to scavenge around the markets/village squares and nearby farms where they feed on various domestic and agricultural wastes. At night these ducks roost and huddle together in the open air and/or around marketplaces where they are largely found with their owners living close by. Most duck farmers agree that ducks performed better when not in confinement hence there was no need to provide housing (Oniye and Awelewa, 1991). Similarly, many farmers keep pigs alongside ducks and do not provide supplementary feed to their ducks because pig waste serves as both food and wallow for the ducks (Kadurumba et al., 2019). Furthermore, the chickens and ducks are allowed to free range together as both have different feeding patterns.

Flock characteristics and egg production

In Nigeria, duck flock composition is determined by the goals of the farmer. Usually, preference is for the smooth-feathered and multi-coloured ducks as this serves as a camouflage for scavenging birds against predators. Foundation stock is usually obtained by inheritance (Kadurumba et al., 2021) or by purchase while hen to cock ratio of 5:1 is practiced (Sonaiya and Swan, 2004).

The reproductive performance of NLD is negatively affected by high environmental temperature (Table 2) usually experienced in dry season months (Oguntunji and Ayorinde, 2015a). Luo et al. (2018) reported that intermittent temperature caused much greater negative effects on production performance by reducing daily feed intake, egg mass, and egg weight of laying ducks. Similarly, excessive ambient temperature has been reported to distort metabolism all through the embryonic development stage and this is due to fluctuations in the chemical constituent of duck eggs under high temperature (Andrieux et al. 2022). Although small flock sizes have been reported among NLDs, the age at the first egg for these NLDs ranges between 6–8 months with about 2 to 4 production cycles per year with an average of 13 to 15 eggs per cycle (Oguntunji et al., 2015). Even though the number of eggs laid by ducks is far below global demands, NLD can lay between 60 and 80 eggs consistently per annum under scavenging settings and approximately 100 to 125 eggs yearly when reared under intensive management systems (Yakubu, 2013).

These NLDs equally serve as a means of hatching a large number of eggs with a high hatching rate of above 70% (Oguntunji et al., 2015). Thus they are known as excellent brooders since they effortlessly hatch their eggs and any other egg set under them, especially chicken eggs where incubators are not readily available (Duru et al., 2006). The small flock sizes observed among NLDs have been attributed to the high loss of newly hatched downies and ducklings during the first two months of life (Banga-Mboko et al., 2007), economic status of farmers, accessibility to feed, diseases and predation (Mogesse, 2007), non-vaccination of ducks and popularity of ethnoveterinary practices among duck farmers.

Marketing of ducks

Duck markets in Nigeria are not structured and well organised. The birds are usually sold along with other mini livestock at the small local markets held weekly in villages and along major streets in urban centres (Ikani 2003). Marketing channels involve middle-men

who collect ducks from farmers at the farm gates or village markets and then, sell them to the retailers and/or consumers which in most cases are traditional men/women who use them for ritual purposes and preparation of healing concoctions, especially in south-eastern Nigeria (Kadurumba et al., 2019). The farmer's choice to sell is totally determined by the economics of profits and availability of stocks and/or household need for cash (Upton, 2000) and since duck farmers typically have regular primary collectors, the middlemen take advantage of this situation to buy the ducks at giveaway prices to the disadvantage of the farmers.

The eggs of these Muscovy ducks are rarely consumed or sold by farmers. The eggs are primarily used for breeding purposes. When buying or selling live birds, prices are generally determined by the live weight, health of the bird (Njenga, 2005), sex, and age, while prices fluctuate due to market volatility. Live ducks are sold between ₦2,076.67 and ₦4500 depending on breed, sex, age, location (Jatto et al., 2020), and plumage colour as white plumaged birds fetched higher prices than mottled plumage (Oguntunji et al., 2020). While day-old duckling is sold for as high as ₦500/egg, Jatto et al. (2020) reported the average duck marketer's profit for each duck as ₦527.15 and concluded that the duck business is a profitable but seasonal business which can be used to meet up with the escalating economic hardship in the country most especially among rural dwellers.

Factors affecting the development and conservation of Nigerian local ducks

Ducks are not popular in Nigeria despite their potential to provide meat and eggs as well as their ability to adapt well to all agro-ecological zones and these have hindered their production, improvement, and conservation (Kadurumba et al. 2022). Its dwindling figure, low demand for ducks and their products, lack of commercial duck farms, and paucity of data on its characterisation, production, management, and genetic development all attest to this (Oguntunji, 2014). A number of taboos, mythologies, stigmas, and personal dislikes exert adverse impacts on its husbandry, marketing, consumption and improvement in Nigeria (Alfred and Agbede, 2012). Due to the extensive system of keeping ducks, they have remained bigoted, and their productivity has been very low (Oguntunji, 2014) and their potentials have been left untapped (Ola et al., 2003). Again, due to their scavenging feeding habits, ducks have also been erroneously indicted by the ill-informed populace for having a high load of internal worms thereby discouraging their production and consumption.

Furthermore, the shortage of ducks, incapability to slaughter the live duck, ambiguity and worry associated with the demand and sale of duck and duck products in Nigeria, hamper the acceptance, preferences, and consumption of duck meat (Oteku et al. 2006). Similarly, disease infections, mortality, theft, low prices, and low patronage have been identified as major constraints to duck marketing (Jatto et al., 2020). Additionally, Adeolu and Oleforuh-Okoleh (2014) reported poor funding for molecular conservation research such as the purchase of molecular markers, scarcity of molecular laboratories and markets for the procurement of molecular research markers, primers, equipment, and reagents as well as the lack of skilled manpower to carry out bio-techniques procedures as some of the bottlenecks hindering the conservation of ducks.

Prospects of conserving Nigerian local ducks for future breed development

The growing costs of ducks and duck products make duck rearing a viable business venture which can compare favourably with chickens. Thus, rearing ducks will be a feasible alternative that can complement other species of poultry kept and in addition, provide a cheap source of animal protein for households as well as provide an opportunity to earn supplementary income. Although duck meat has low demand in Nigeria, it can help augment the protein needs of the populace if reared by more individuals.

Conservation of indigenous animal resources can be used to prevent the loss of diversity among livestock breeds that are likely to go extinct. Conserving the local duck breeds will also be significant for the success of the duck industry in Nigeria as they could supply unique genes that can promote continuous genetic improvement and also facilitate adaptation to varying breeding objectives and environments (Notter, 1999). Furthermore, introducing exotic breeds of ducks will bring about substantial improvement in duck production and increase demand for ducks and their products as well as aid in evading the taboos, stigmas, and inadequacies linked with ducks (Oguntunji et al., 2015a). More so, the establishment of conservation programmes for the maintenance of animal genetic resources in different regions of the world (FAO 2010) could also go a long way to mitigate duck production challenges.

Awareness campaigns should be organised by relevant agencies and associations to educate the populace on the advantages of rearing and consuming duck and its products. The establishment of more duck farms and processing enterprises should be encouraged by relevant agencies in order to solve the problem of the

unavailability of duck and duck products (Adeosun and Owoade 2020). This can be achieved by empowering farmers to establish duck farms. Similarly, extension contacts should be intensified so as to remove the negative perception of the people towards duck consumption and improve production.

CONCLUSION

The Nigerian indigenous duck breeds represent a huge reservoir of duck genome which could be tapped for its improvement and conservation. Introducing improved breeds of duck and establishing conservation programmes will help promote greater duck production and conservation.

CONFLICT OF INTEREST

The authors declared no conflicts of interest with respect to the research, authorship, and publication of this article.

ETHICAL COMPLIANCE

The authors have followed ethical standards in conducting the research and preparing the manuscript.

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