



Review On The Genetic Potential of Nigerian Local Chickens

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Abstract

This review paper aims at the genetic potential of Nigerian local chickens (NLC) and highlighted the breed types, characteristics, and distribution which includes Fulani ecotypes and Forest savannah (Yoruba) ecotypes. The paper also explained the management and production systems of NLC which comprise extensive and semi-intensive systems. Furthermore, the genetic diversity and potentials were not left out and it shows that there is a presence of genetic diversity within and among breeds of local chicken that are responsible for their differences in phenotypic appearance. Approaches towards the improvement of genetic potentials were elaborated such as the development of improved indigenous lines, crossbreeding, within-breeds selection, and introgression and cockerel exchange. These approaches showed a significant result on genetic improvement. Additionally, the importance of indigenous breeds of chicken was emphasized as a source of animal protein, income revenue, religious activities, and job creation. However, the challenges towards the genetic improvement of NLC were also incorporated, for example, low productivity, late sexual maturity, disease occurrence, and lack of research. Moreover, the local chickens are of great importance because their contribution to the national economy is enormous with huge future prospects.

Keywords: Nigerian local chickens, genetic diversity and potential, genetic approaches, challenges

Introduction

According to FAOSTAT (2011), the estimated population of poultry is about 172 million. This figure comprises of approximately 160 million of chickens, guinea fowl 8.3 million, ducks 1.7 million and local turkeys 1.05 million. Ajayi (2010) explained the characteristics of Nigerian local chickens (NLC) as small bodied, slow growth, poor feed converters, and poor meat animals. However, these chickens have good genetic potentials that made them survive in their environments such as heat tolerance, meat quality, hardiness of the body and the capacity to scavenge (Petrus, 2011). Minga et al. (2004) reported that the major area of interest for selection of local chickens are based on the ability to adapt and resist diseases which in turns allowed them to thrive in their harsh environment rather than production traits. They added that an improvement in growth traits is one of the important factors that should be considered towards genetic upgrading.

Adene and Oguntade (2006) highlighted the significance of indigenous chickens' production in the household system as a source of food security in terms of product quality and quantity derived from poultry meat and eggs. They

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recognized that the local chickens supply meat and eggs as a protein source for the rural dwellers. They also included that the chicken products are suitable protein and equally cheap, which can be harvested and managed in large quantities.

Nevertheless, Mack et al. (2005) explained that the rapid growth of poultry business around the globe indicated that more than 80% of the poultry production takes place in the village family level system. In addition, it has been estimated that the family level system of production constitutes about 90% of the overall poultry products in several countries. They added that the integration of rural chicken production and the commercial system has the ability to alleviate poverty and malnutrition. They also expressed that the combination of the two systems of production is the most effective way to achieve massive poultry products for both urban and rural dwellers. Additionally, poverty reduction campaign can be achieved by focusing on the small-scale family system of production. They mentioned that this system of production is also gaining a lot of attention with fast adoption. Furthermore, poultry species as part of livestock have proved a useful and effective means of reducing poverty in the rural areas. Moreover, local chickens have a ready market and act as a source of revenue for the rural dwellers or farmers (Mack et al., 2005).

According to Osei-Amponsah et al. (2010) and Dana et al. (2011) indicated that many studies have reported that African chickens' exhibit high variation in their genetic makeup within their population. Thus, high genetic diversity is an indication of high genetic potential which encourages quick improvement through selective breeding. In addition, designing of a suitable breeding plan and goals for genetic improvement of NLC requires a deep understanding of their genetic parameters. The knowledge of genetic parameters of NLC cannot be underestimated in the breeding plan. Many studies have reported estimation of genetic parameters in NLC for growth-related traits. Estimated heritabilities for body weight of two 3 way crosses (YA x LC x GL, YA x GL x LC) and the local crosses (LC2 x LC1 x LC1) have been reported as 0.35 to 0.74, 0.31 to 0.89 and 0.27 to 0.49 respectively (Asuquo and Nwosu, 1987). Under the molecular viewpoint, some of the important genes have been reported among indigenous chickens which are responsible for stress factors. These genes enable the local breeds to survive in the tropical or harsh environment (Host, 1989; Mathur and Horst, 1990). More so, the identification of a gene responsible for distribution of feather, naked gene (Na) and feather structure gene, frizzle (F) are some of the major genes. Currently, in the modern breeding systems, the major genes are economically important and useful as a genetic marker such as sex marker and disease resistant factors. These genes are responsible for decreased heat stress in the tropical region. The reduction of heat stress increased the capacity of the birds for convection in turns to improve their performance and feed conversion ability. Therefore, the objective of this paper is a review of the genetic potential of Nigerian local chickens.

Breeds types, characteristics, and distribution of local chickens in Nigeria

Nigerian local chickens are known as the native breeds which are found in different geopolitical zones in the country. They are commonly known as Nigerian indigenous chicken and the names given to them are based in the region where they are found. Their classification based on location is into two breeds namely, the Fulani ecotypes and Forest savannah (Yoruba) ecotypes. The Fulani ecotypes are found in some parts of Nigeria mainly; Sahel and Guinea savannah, the cattle Kraals and Montane parts of northern Nigeria. They are known as the heavy type and their mature weights are between 0.9kg and 2.5kg respectively. However, the Yoruba ecotype is located around the Rainforest, Swamp, and Derived savannah areas. They are characterized by low body weight which ranges from 0.68kg to 1.5kg respectively. There is a presence of phenotypic variation between the two breeds. The Fulani ecotype is heavier than the Yoruba type. Based on the appearance of their feathers they are classified as normal feathered and frizzled feather

breeds. Furthermore, based on their morphological structure they are also classified as naked neck and dwarf chicken types (Host, 1989; Odubote, 2015).

Management and production systems

Dunya et al. (2014) explained that local chickens are scavengers and they have the ability to move around during the day in order to search for feed while in the night they assembled themselves into a basic shelter. In many localities, the shelter or huts for the chickens are built with moveable woods while some are constructed with muds. Furthermore, in some households, the shelter is attached beside the kitchen or corridors in order to monitor the chickens properly. In the survey they conducted in the management and production systems of NLC among the farmers, they reported that about 65.8% of the farmers are involved in extensive management system while 34.2% practice semi-intensive type. This indicated that the majority of the local chickens move freely in search of feed for themselves. However, both extensive and semi-intensive systems of management have some negative effect during the planting season. In their quest in search of feed, they eat up the newly planted crops which is a heavy loss to the farmer. In some cases, the farmers protect their farms with a local fence to prevent the chickens from damaging the crops (Halima, 2007).

Genetic diversity and potentials

Genetic diversity or differences are the basis for genetic improvement. Therefore, conservation of genetic resources should be the paramount component that will enable the researchers to understand the genetic theory of the local breeds (FAO, 1986). Among the livestock breeds in the country, the Nigerian local chickens show a lot of phenotypic differences compared with other indigenous species of livestock. This indicates that there is a presence of genetic variation among the chicken population. They are characterized morphologically by their body size, plumage color, and high variation of feather appearances and distribution which made them different from each other. Nonetheless, they are regarded as or possess unimproved small body size. Unfortunately, the potential of these local chickens is yet to be fully exploited. Early studies have shown that many indigenous chickens are found within the humid tropical region. Perhaps they possess some unique characters that made them of great importance (Host, 1989; Mathur & Horst, 1990; Padhi et al., 1999; Padhi et al., 2001; Anonymous, 2013).

The Nigerian local chickens possess good genetic potentials for laying trait although they are characterized as a low producer type of birds (Nwosu & Omeje, 1985; Momoh *et al.*, 2007). However, a proper breeding scheme has not been put in place in order to harvest the genetic potentials of those breeds. Henceforth, providing deep knowledge and a good understanding of the genetic potential, and the pattern of variation within and among breeds is worthwhile. This report supports those of Muchadeyi *et al.* (2007) and Halima *et al.* (2009), who stated that within breeds of local population there is an existence of both phenotypic and genetic variation. Thus, selection within breeds' variation will buttress and enhance the selective breeding system in order to improve the genetic make-up of the local chickens. They also revealed that the best way to maximize the production of local chickens is to improve their genetic potential. Strandberg and Malforms (2006) reported that for an effective and sustainable genetic improvement, there is a need for selection within breed populations which can yield positive results. They added that increase in the number of desirable genes through selection encourages quantitative traits improvement. Hence, the best approach and the more profitable venture are to incorporate the development of pure breeds and within breeds' selection in a proper breeding plan. The best approach of selection also encourages harvesting of those genes that are responsible for disease resistance traits because of their variability within and among the population. This will help the local chickens to have the capacity to counter-attack

disease pathogens and survive in their environment (FAO, 2010).

GENETIC APPROACHES TO IMPROVE PERFORMANCE OF NIGERIAN LOCAL CHICKENS

Development of improved indigenous lines

Osinbowale (2017) explained the journey so far towards genetic improvement of indigenous chicken across the rural households in Nigeria. Their research was supported by Bill and Melinda Gates' Foundation. The experimental birds were 6 pullet lines, 1 dual purpose, and 1 broiler meat line was selected between 2014 and 2016 in order to distribute and for testing both on-station and on-farm basis across the rural dwellers. This foundation is responsible for germplasm conservation, genetic evaluation, multiplication, subsequent crossing, and genomic evaluation. At the base population development, the naked neck and frizzled feathered birds were utilized to develop broiler lines due to their quality of carcass traits. Microsatellite techniques were applied to the genetic make-up of the naked neck chickens in order to differentiate between the homozygosity and heterozygosity among them. Osinbowale (2017) reported a higher number of eggs with an increased percentage of hatchability which is found among the heterozygous naked neck chickens. In contrary, low fertility, high mortality rate, and hatchability with a higher number of dead in the shell were found in homozygous genotypes. Additionally, two lines were developed from the gene pool or base population namely; grandparents (GPS) and parents (PS) lines. These two lines are improved indigenous commercial breeds which are made up of 37.5 to 62.5% indigenous blood. Furthermore, the lines which comprise of broiler and dual-purpose layer lines are ready for distribution to the rural farmers in Nigeria in order to evaluate their performances. Additionally, many researchers have reported genetic potentials of local chickens in terms of their reproductive performance and adaptability (Ikeobi, et al., 1996; Peters 2004; Adebambo et al., 2009; Adeleke et al., 2015; Osinbowale 2017).

Crossbreeding

Dhanda (2001) defined crossbreeding as a means of mating different livestock breeds to achieve desirable traits and augmenting deficiencies in one breed by that of the other. The effectiveness of this improvement is realized when the crossbred animals are a combination of breeds genetically distantly related to each other. Sometimes the efficiency is further enhanced through the use of specialized sire and/or dam lines. It is known that the physical make-up of animals is the combination of the genetics besides those of the genotype by environmental interaction among the traits. In Nigeria, crossbreeding experiment has been conducted between different exotic breeds with NLC. Most of the type used is the egg-laying hens, for example, the Gold-link breed (Akinokun & Dettmers, 1977; Nwosu & Omeje, 1985). Nwosu (1990) observed the effect of crossbreeding between exotic cocks with indigenous hens above 12th weeks of age. In his findings, he reported that at the age of 12th weeks the maternal effect has no influence on the body weight which is associated with the increased growth of the crossbreds. Omeje and Nwosu (1984) indicated that local chickens possess the genetic materials for early age at first egg and can be transferred when crossed with exotic hens. Adedokun and Sonaiya (2002) reported significant improvement in daily weight gain, a number of eggs and egg weight on crossbreeding of Nigerian indigenous with the Dahlem Red chickens (German breed). This indicates that exotic cock transmits the gene for higher egg production and weight gain. This corresponds to the results of those of (Nwosu and Omeje 1985), who observed higher egg production between the cross (exotic, gold link (GL) X Nigerian local chicken

(LC)) compared to (LC x GL) on the average per hen. These results showed that there are opportunities and profits towards an improvement of Nigerian local chickens. Many researchers have reported crossbreeding as a vehicle for improvement of native chickens (Padhi et al., 1999; Padhi et al., 2001; Chatterjee et al., 2007; Khan, 2008; Magothe et al., 2012; Anonymous, 2013), with Rhode Island Red, White Leghorns, Light Sussex, Black Australorp, and other synthetic breeds. Magothe et al. (2012) reported increased egg and meat production between a cross of European breeds and native type. They also expressed that fast genetic improvement can be achieved by upgrading system between exotic and indigenous breeds in order to achieve hybrid vigor. High performance was also observed among crossbred of Fulani ecotype and exotic egg type compared to the native Fulani ecotype (Benbrook, 1965), a similar observation was made by (Saidu et al., 1994) in which crossbreds outperformed the native chickens.

Selection within indigenous breeds

Horst (1989) explained that within Africa and Asia, the potential of indigenous chickens cannot be underestimated. He also added that 80% of the national flocks are made up of local chickens. Indigenous chickens have great genetic potentials in disease resistance and have the ability to thrive in harsh environmental conditions compared to the commercial strains under village production system. They are characterized by slow growth rates and egg production but could uphold greater performance in poor nutrition and shortage of feed. Selection within breeds requires proper sampling of indigenous chickens in order to select the best genetic materials within that country. These selected samples will form the base population which will be crossed among them or with other populations. The responses of the base population determine the progress and achievement of within-breed selection. Notwithstanding, that selection within a breed is characterized by slow genetic advancement but then the improvement is steady and progressive compared to a crossbreeding system (Nwosu & Omeje, 1985a,b; Adedeji et al., 2008; Adebambo et al., 2009). Vivian Oleforuh-Okoleh et al. (2012) reported improvement of Nigerian local chicken ecotype for body weight at first egg (BWFE), egg number (EN), and egg weight (EWT) through selection base on the index using BWFE, EN, and EWT as the selection criterion traits. Many researchers have reported increased in BWFE, EWT, EN, age at first egg (AFE), and age at sexual maturity (ASM) regards to selection within Nigerian local chickens (Omeje and Nwosu, 1983; Barbato, 1999; Okpeku et al., 2003; Tule, 2005; Ndofo-Foleng et al., 2010; Ogbu and Omeje, 2011).

Introgression and cockerel exchange

Another strategy for improving the performance of local populations is through introgression of genetic material. Backcrossing or cockerel exchange methods can be used to accomplish the introduction of desirable genes in a population. Besbes (2008) reported that increased levels of alternative feed, enhanced management, and control of diseases are contributing factors for a sustainable backcross scheme due to increases in a number of exotic genes in the population. He added that the effective means to observe the results of cockerel exchange method is to distribute the improved cocks to the smallholders. He also stated that quite a lot of findings have reported the effect of cockerel exchange in terms of their contribution in plumage variation without changing their base populations. These findings correspond to those of Kayitesi (2015), who reported an increased mean of hatchability and chick survival rate between Kuroiler chicken breed and their crossbreds with local hens under restricted range conditions in Rwanda.

Importance of indigenous breeds of chicken

The most well-known poultry regardless of culture and areas are chickens (Al-Nasser et al., 2007; Dessie et al., 2012).

They have more different uses and advantages in the family unit in the developing nations. The utilization of local chickens in the tropics varies from one place to another. Some people keep indigenous chickens for their social-religious activities. This is done on the account of an obligation of an individual to specific activities or religious celebrations which is assessed by the nature of the chicken that fulfills unique morphological features requested by the collector (Dessie et al., 2012). Nonetheless, local chickens are slow in growth rate but they contribute a lot to the national economy of the developing nations. It has integral parts in enhancing the nutritional balance, revenue, sustenance security, and livelihood of numerous smallholders due to its minimal production cost (FAO 1997; Gondwe, 2004; Abdelqader 2007; Abubakar et al., 2007). McAinsh et al. (2004) described the importance and numerous roles of local chickens in terms of traditions, religious and different activities, and acts as an essential part of an animal protein source for humans. Additionally, they are well known as one of the principal sources of revenue for the rural dwellers (Swatson et al., 2001; McAinsh et al., 2004; Muchadeyi et al., 2005; Besbes et al., 2007; Mtileni et al., 2009). According to Grobbelaar et al. (2010), local chickens are kept by the farmers to produce meat and eggs likewise to supplement their income. They also mentioned that the farmers always like to keep chickens that can produce adequate meat and eggs, end up broody and bring forth their own chickens. This situation helps the farmers to be independent in order to provide animal protein source. Besbes et al. (2007) explained that the indigenous chickens are generally spread throughout the world and their involvement differs in different regions. Especially, in the developing nations, they are of countless importance. They serve as a source of job creation and income to the members of the family during off planting season (Mandal et al., 2006). Kingori et al. (2010) reported similar points as those of Mandal et al. (2006), in terms of job creation. Poultry keeping additionally provides jobs for some different classifications of individuals which consist of; primary and secondary dealers, processors and food providers; in this way advancing financial improvement.

CHALLENGES ON GENETIC IMPROVEMENT OF NIGERIAN LOCAL CHICKENS

Low productivity

This is one of the characteristics of Nigerian local chickens. In spite of the fact that the outcomes of indigenous chickens are typically acquired with low inputs, production outputs, for example, weight gain and number of eggs/hen/year are likewise generally low (Ahlers et al., 2009). This has created a lack of interest in the village poultry production in respect to the commercial system in terms of improvement schemes. In the previous years, improvement schemes in the area of poultry in the developing nations, including Nigeria, were generally geared towards the introduction of exotic breeds, crossbreeding and intensification (NAERLS, 2000). This supports the reports of Ndofor-Foleng et al. (2015), who observed the lowest egg weight by the light ecotype chicken on the evaluation of growth and reproductive traits of Nigerian local chicken and exotic chicken. They suggested that the lowest egg size observed might have been due to their small body size including the non-hereditary and genetic factors.

Late sexual maturity

Early sexual maturity is paramount in terms of progress in poultry breeding. To some extent, late sexual development is demonstrated among the local chicken populations. The average period of local cockerels at first mating and pullets at first egg were 24.6 and 27.5 weeks respectively. Comparable studies by different authors additionally reported that sexual maturity period of female indigenous chickens were 32 weeks in Sudan (Wilson, 1979), 24 weeks in Mali

(Kassambara, 1989), 28 - 36 weeks in Benin (Assan, 1990), 25 weeks in Senegal (Sall, 1990), 28 weeks in Tanzania (Katule, 1992), and 24 weeks in Nigeria (Sonaiya and Olori, 1998). Study of Moges et al. (2010) showed late maturity among the local chickens, and this is in conformity with the findings of Abera (2000), that one of the expressions of low productivity of local chicken ecotypes was late maturity.

Diseases and predators

The occurrence of diseases is one of the limiting factors affecting the genetic improvement of local chickens. High prevalence of diseases is a major constraint towards the health and economic status of local chicken production. Moges et al. (2010) reported Newcastle disease as one of the diseases that cause a lot of damage in the poultry production. They also mentioned other constraints that affect both reproduction and production ability of local chickens; which includes predation, the poor productivity of local chickens and absence of appropriate agricultural services. These factors affect the farmer towards chicken husbandry and management practices. Halima (2007) observed the negative impact of predation in North West Ethiopia as one of the major factors affecting local chicken production. Mapiye and Sibanda (2005) and Alfred et al. (2012) likewise reported that a large number of local chickens were being lost because of predators in some African nations. Nnadi and George (2010) reported a wide range of parasitic infestations among village chickens in their study. They emphasized that ectoparasites were higher out of which lice infestation was outstanding. Their result is in agreement with earlier studies (Bishop, 1942; Adene and Dipeolu, 1975; Saidu et al., 1994; Nnadozie, 1996), in America, South Africa, and Nigeria.

Lack of research

Most of the farmers lack appropriate records of production and reproductive performances which in turns hinders the evaluation of local chickens. Research cannot be conducted without a proper pedigree record because correct information of the animals are needed to be known to enable accurate evaluation of their genetic parameters. However, this link is missing from the local chicken production system. Kolawole (2015) explained that the reports on the performance of local chickens' on-farm experiment are not available in the country. He added that structured questionnaires are the major ways of getting the production performance records of indigenous chickens from the rural farmers. Among the rural farmers, nevertheless, do not keep records. Many of them depend on their memory for giving out information and the precision of such reports are full of errors and limited. Therefore, it is important that the performance of chickens are measured in the rural areas in order to obtain precise figures. Above all, research on local chickens become difficult.

Future prospects

The contribution towards the genetic potential of Nigerian local chickens cannot be overemphasized with regards to their involvement in the rural economy. However, production per chicken might be regarded to be extremely low. But indigenous chickens have countless importance to the poor dwellers in spite of their low productivity. Though, they are confronted by some factors towards enhancing their productivity. Also, improvement of their stocks could profit them and serve as food security and attract market possibilities. Biological point of views, local chickens are characterized by slow growth and sometimes egg production is sporadic in nature. Furthermore, undesirable inbreeding may occur due to random mating within the population. However, the limited application towards improved management of local chickens is in existence. This situation led to indigenous chickens to move around in search of feed. Even though in

their search for feed they have the ability to convert feed protein and energy into human food. Moreover, they are characterized by a high reproduction rate and utilize low capital. Also, the presence of low labour and space which enables individuals to practice chicken production (Muchadeyi et al., 2007). The contributions and importance of local chickens are numerous, this includes good quality meat and eggs, income revenue, social-cultural activities and serve as a financial security for the rural poor. Assan (2015) reported lack of attention towards local chickens' genetic resources in Zimbabwe which can contribute for the standard of living in the rural population. He added that in spite of the indigenous chicken's dual selection in terms of meat and egg purposes, there remains a significant and a great extent of unexploited genetic potential for massive production. Many families, communities, and cities in Nigeria are made up of different plumage colours and alleles of local chickens. These chickens have the capacity to search for their sustenance with less attention or medical help from the farmers or owners. This report is a substantial proof that Nigeria is heavily gifted with numerous natural assets that will make her independent in the production of animal protein, and can also make Nigeria become one of the major exporters of a wide range of animal products (Ohagenyi et al., 2012).

Conclusion

There is no doubt that Nigerian local chickens are endowed with genetic potentials which can be improved in a developing economy like Nigeria. Thus, urgent attention is needed to exploit these huge potentials that can drive the economy in research areas thereby generating income and creating jobs among the populace.

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