**Journal of Bioscience and Biotechnology Discovery**
Volume 10(2), pages 1-7, April 2025
Article Number: xxx
ISSN: 2536-7064
https://doi.org/10.31248/JBBD2025.205
https://integrityresjournals.org/journal/JBBD

*Full Length Research*

# Relationship between prolactin genetic polymorphisms and growth performance trait in Nigerian indigenous chickens

**Ige, A. O.[1], Hammmed, O. O.[2], Ajibulu, J. O., Salawu, H. O.[1], Matt-Obabu, A. D.[1]*, Akinniran, K. O.[1] and Gbadebo, O. J.[1]**

[1]Department of Animal Nutrition and Biotechnology, P.M.B. 4000, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.
[2]Department of Animal Production and Health, P.M.B. 4000, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

*Corresponding author: abimboladeborah3103@gmail.com; Tel: +2347032440603.



Received 27th January 2025; Accepted 15th March 2025

**ABSTRACT:** The two experiments were conducted to determine the qualitative trait between Normal and Frizzle feathered chickens. The second experiment compares the genotypic and allelic frequency of prolactin gene polymorphism in Normal (NF) and Frizzle feathered (FF) chickens. Plumage colour is a notable qualitative trait in the Nigerian indigenous chickens. Three plumage colour were observed through visual appraisal which are multi-coloured, white and black. Blood was collected and released on a Fast Technology Analysis (FTA) paper and was taken to a laboratory. The results of the present study showed the presence of polymorphism for the prolactin (PRL) gene which shows two alleles and genotype; I, D and ID respectively in FF chicken and two alleles (I and D) and three genotypes (II, DD and ID) in NF chicken. Frequency and percentage of each colour were carried out. The frequency and percentage of each colour in the NF chicken is multi-coloured (48 and 92.31%), white (3 and 5.77%) and black (1 and 5.77%) respectively. No appearance of white colour was seen in FF chicken, however, the frequency and percentage of black is (1 and 1.25%) and multi-coloured (7 and 87.5%) respectively. Three genotypes were observed including II, ID and DD which consequently have two alleles I and D during gel electrophoresis using agarose gel after specific primer have been amplified using PCR machine with specific temperature degree needed by manual/direct counting. Conclusively, prolactin gene can be used as marker in the genetic improvement of Nigerian indigenous chickens due to the presence of polymorphism.

**Keywords:** Gene, growth, indigenous, polymorphisms, prolactin.

## INTRODUCTION

The prolactin (PRL) gene plays a critical role in regulating several physiological and reproductive functions in birds, including egg production, parental behavior, and growth (Angelier, 2024). It is a pivotal hormone in avian species, influencing various physiological processes, including growth performance and reproductive traits. Genetic polymorphisms within the PRL gene have been the subject of numerous studies aimed at elucidating their associations with these traits. In Nigerian indigenous chickens, research specifically linked PRL gene polymorphisms to growth performance traits. However, in Nigerian indigenous chickens, polymorphism is indicated in the Pituitary-Specific Transcription Factor (PIT-1) gene, which regulates PRL expression (Akpan *et al*., 2025).

In Nigerian indigenous chickens, polymorphisms in the prolactin gene have been identified as genetic markers with potential impacts on growth traits and body weight (Zhu and Li, 2024). The Nigerian indigenous chickens are known for their genetic diversity, adaptability to harsh environments, and economic importance to rural households (Olaniyan *et al*., 2024). Exploring prolactin gene polymorphisms offers insights into improving productivity and sustainability in the Nigerian indigenous chicken populations (Goli *et al*., 2024). Prolactin gene polymorphisms are variations in the DNA sequence that can influence the gene's function or expression (Kubba *et*

*al*., 2024). In chickens, such polymorphisms are often linked to traits like body weight at specific ages, feed efficiency, and reproductive performance. The utility of single nucleotide polymorphisms (SNPs) within the PRL gene as markers for selective breeding is being researched (Hoda *et al*., 2024). Specific PRL SNPs have been associated with body weight differences, with notable variation between heavy and light ecotypes of Nigerian indigenous chickens (Hoda *et al*., 2024).

The identification and genotyping of these SNPs involve molecular techniques such as PCR-RFLP (polymerase chain reaction-restriction fragment length polymorphism) and DNA sequencing (Fakhr *et al*., 2024; Kaur *et al*., 2024). These techniques allow researchers to explore genetic diversity within and between chicken ecotypes, providing a basis for understanding the evolutionary adaptation of these birds to local environments (Kaur *et al*., 2024). By aligning these genetic variations with phenotypic data, researchers have observed significant associations between certain PRL SNPs and growth traits, including body weight at various life stages and reproductive traits like egg production and hatchability (Kar *et al*., 2024). The role of prolactin gene polymorphisms in growth and body weight emphasizes the potential for genetic improvement programs targeting Nigerian indigenous chickens. These programs can leverage the genetic variability within local populations to enhance productivity while maintaining adaptability and disease resistance. This genetic approach aligns with global efforts to increase the efficiency of small-scale poultry farming in developing countries. This study aims to investigate the relationship between prolactin gene polymorphisms and key growth performance traits in Nigerian indigenous chickens, in order to identify potential genetic markers that can inform selection strategies for improved growth and productivity in local poultry breeds.

## MATERIALS AND METHODS

### Experimental site

This research work was carried out at the Poultry Unit of Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Ogbomoso is located in the derived savannah zone of Nigeria on the longitude 4°15′ East and latitude 8°15′ North East of the Greenwich Meridian (Google Earth Map, 2024). The laboratory experiment was carried out at the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.

### Experimental birds and their management

Total of eight four (84) birds belonging to three genotypes were used for the experiment. The two genotypes include; Normal (28), Naked Neck (28) and Frizzle feathered chickens (28) respectively.

### Data collection

Data were collected on the following growth parameters: body weight, body length, breast circumference, shank length, plumage colour, thigh length, beak length, comb length and comb height.

#### *Growth parameters*

**Body weight:** It was measured with the use of high-precision digital kitchen scale in grams.

**Body length:** It was measured as the distance from the wing joint to the vent with the use of tape rule (cm).

**Breast circumference:** It was measured as the circumference of the breast around the deepest region of the breast with the use of a tape rule (cm).

**Shank length:** It was measured as the length of the tarso-metatarsus from the hock joint to the metatarsal pad with the use of a tape rule (cm).

**Thigh length:** It was measured as the length between the mid region of the thigh hip bone and that of the knee (genu) with the use of a tape rule (cm).

**Plumage colour:** physical colour appraisal was used.

**Beak length:** It was measured as the distance between the base of the beak to the tip of the beak.

**Beak height:** It was measured as the vertical distance from the base of the beak to the top of the beak.

**Comb length:** It was measured as the horizontal length of the part of the head that the comb covered.

**Comb height:** It was measured as the distance from the base of the comb on the chicken to the highest part of the comb.

#### *Blood collection and storage*

Blood samples were collected from the wing vein of each bird using a syringe and needle for individual birds in order to avoid contamination of the blood. Five (5) ml of blood was collected and transferred into an FTA paper from the ACUTIG Laboratory, FUNAAB, Abeokuta, Nigeria.

### Experimental design

The data collected was in a completely randomized design.

**Table 1.** Qualitative trait (plumage colour) frequency occurrence in normal and frizzle feathered Nigerian indigenous chickens.

| Trait | Breed | Characteristics | Frequency | Percentage (%) |
|---|---|---|---|---|
| Plumage Colour | Normal Indigenous Chicken (NIC) | Multicoloured | 48 | 92.31 |
| | | White | 3 | 5.77 |
| | | Black | 1 | 1.92 |
| | | Total | 52 | 100 |
| | Frizzle feather | Multicoloured | 7 | 87.5 |
| | | White | 0 | 0 |
| | | Black | 1 | 12.5 |
| | | Total | 8 | 100 |

**Table 2.** Genotypic frequency and percentage of prolactin gene polymorphism in normal and frizzle feathered Nigerian indigenous chickens.

| Breed | Genetic diversity | Frequency | Percentage (%) |
|---|---|---|---|
| Normal | ID | 43 | 84.31 |
| Indigenous | DD | 4 | 7.84 |
| Chicken (NIC) | II | 4 | 7.84 |
| Total | | 51 | 99.99 |
| | | | |
| Frizzle | ID | 8 | 100 |
| Feather | DD | - | - |
| Chicken | II | - | - |
| Total | | 8 | 100 |

## Statistical analysis

Data collected were subjected to Two-Way Analysis of Variance using the procedure of SAS (2003), and significant mean was separated with Duncan Multiple Range Tests. The following model was adopted.

### *Model for growth traits*

$Y_{ijk} = \mu + G_i + e_{ijk}$

Where: $Y_{ij}$ = individual observation, $\mu$ = overall mean, $G_i$ = fixed effect of $i^{th}$ genotype (i = 1, 2), $e_{ijk}$ = experimental errors which is evenly distributed

## RESULTS

Table 1 revealed the occurrence of plumage colour in Normal and frizzle-feathered Nigerian indigenous chickens. There are three different plumage colours observed in the population of both chickens. The Normal feather chickens had a higher multicoloured frequency, 92.31%, while Frizzle feathered chickens had 87.5%. Normal feather chicken has 5.77% white colour, whereas no white colour was observed in the Frizzle feathered chickens. Frizzle feathered chicken had 12.5% black colour while Normal feathered chicken had 1.92% black colour.

The genotypic frequency and percentage of prolactin gene polymorphism in Normal and Frizzle-feathered chickens are revealed in Table 2. Three genotypes were observed in Normal indigenous chicken (II, DD, ID), whereas one genotype was observed in Frizzle feathered chickens. The gene with higher frequency and percentage is the ID gene, which is the dominant gene for phenotypic expression of Normal indigenous chicken, with the frequency of 43 and 84.31%, whereas the II and DD genotype has the same frequency and consistently have similar statistical values of frequency 4 and 7.8%, respectively. The Frizzle feathered chickens have an ID genotype, the dominant has gene with a frequency of 8 and 100%, which is responsible for phenotypic expression in Frizzle feathered chickens. Frizzle feathered chickens had a higher percentage of ID genotype (100%) compared to Normal feathered chickens (84.31%).

Table 3 indicates the allelic frequency of prolactin gene polymorphism in Normal and Frizzle-feathered chickens. Two alleles (I, D) were deduced from three genotypes observed (II, ID, DD) in both chickens. In the Normal and Frizzle feathered chickens, both I and D allele have similar

**Table 3.** Allelic frequency of prolactin gene polymorphism in normal and frizzle feathered Nigerian indigenous chickens.

| Breeds | Allele | Frequency |
|---|---|---|
| Normal Feather Chicken | I | 0.36 |
| | D | 0.36 |
| **Total** | | **0.72** |
| Frizzle Feather Chicken | I | 0.33 |
| | D | 0.33 |
| **Total** | | **0.66** |

**Table 4.** Mean body weight and linear body measurements for normal feather, frizzle feather and naked neck chickens.

| Parameters | Nf | Ff | Nn |
|---|---|---|---|
| BW (g) | 1229±396.08220[b] | 1739±827.15052[a] | 1256±354.81496[b] |
| BL (cm) | 18.48654±2.21439 | 19.62500±3.96187 | 19.50741±2.73115 |
| CC (cm) | 26.81346±4.037547 | 27.37500±4.36504 | 26.5000±2.15906 |
| BKL (cm) | 3.10385±0.34865 | 3.37500±0.44320 | 3.09630±0.54029 |
| SL (cm) | 7.85769±1.21516 | 8.18750±1.22292 | 7.78519±1.5376 |
| CL (cm) | 4.03269±2.77501 | 6.56250±3.21200 | 5.15926±3.20568 |
| CH (cm) | 1.78452±1.95312 | 3.08750±1.191344 | 2.66296±1.82886 |
| TL (cm) | 14.67115±2.55606 | 15.18750±2.63137 | 15.20741±3.68760 |

statistical values for frequency at 0.36 and 0.33, respectively. The result showed that the Normal feathered chickens had a higher frequency compared to Frizzled feathered chickens.

Table 4 indicates the mean value of body weight and linear body measurements for Normal feather, Frizzle feather and Naked Neck chickens. There are significance ($p<0.05$) differences between the two genotypes and the prolactin gene in relationship to body weight and linear body measurements including body length (BDL), beak length (BKL), chest circumference (CC), beak height (BKH), shank length (SHKL), comb length (CL), comb height (CH) and thigh length (THL). The Frizzle feathered chickens had higher body weight (1739 g), while the Normal feather and Naked Neck chickens had similar statistical values of 1229 and 1256 g for body weight, respectively. There were no significant differences in the BL, CC, BKL, SL, CL, CL, CH and TL of the three breeds of chickens studied.

Genotype frequency and percentage among Normal feather, Frizzle feather, and Naked Neck chickens are as shown in Table 5. Three (ID, DD and II) genotypes were observed for the prolactin gene. The Normal feather chicken had genotypic frequencies for ID (32%), DD (4%) and II (64%), respectively. However, Frizzled feather chickens had a genotypic frequency of 100% for ID, whereas there was no occurrence of DD and II in Frizzle feather chickens, which may be a result of adaptation, natural selection or uneven population of the breeds used in this study. Naked Neck chicken had genotypic frequencies of ID (14.72%), DD (0.64%), and II (84.6%), making a total of 100%.

Table 6 shows the allele frequency of the prolactin gene in the three Nigerian indigenous chickens. The alleles (D and I) are the same in the breeds studied, which is 0.5, 0.5, respectively, which is equal to 1 in line with Hardy-Weinberg equilibrium.

Frequency of occurrence of qualitative trait (plumage colour) of Normal feather, Frizzle feather and Naked neck chickens was revealed in Table 7. Normal feather chickens had a higher frequency of multi-coloured frequency of 48 (92.31%), while Frizzle feather chickens recorded the least values of multi-coloured frequency of 7 (87.5%).

Table 8 revealed the mean values of the effect of prolactin on body weight and linear body measurements of some selected Nigerian indigenous chickens. Normal feather chicken had higher body weight (1502.00 g) compared to the Frizzle feathered and Naked Neck chickens. However, Normal feathered chicken recorded higher body length (20.20cm), chest circumference (28.16cm), shank length (8.50 cm), comb length (7.66cm), and comb height (4.04 cm).

Table 9 indicates the mean values of genotype effect on body weight and linear body measurements of some selected Nigerian indigenous chickens. There were significant ($p<0.05$) differences observed in the body

**Table 5.** Genotype frequency and percentage among normal feather, frizzle feather and naked neck chickens.

| Breeds | Genotype | Frequency | Percentage (%) |
|---|---|---|---|
| Normal Feather | ID | 43 | 32.0 |
| | DD | 4 | 4.0 |
| | II | 4 | 64.0 |
| | Total | 51 | 100 |
| Frizzle Feather | ID | - | - |
| | DD | 8 | 100 |
| | II | - | - |
| | Total | 8 | 100 |
| Naked Neck | ID | 23 | 14.72 |
| | DD | 1 | 0.64 |
| | II | 1 | 84.6 |
| | Total | 25 | 100 |

**Table 6.** Allelic frequencies of normal feather, frizzle feather and naked neck chickens.

| Breeds | Allele | Number of Allele | Allele frequency |
|---|---|---|---|
| Normal Feather | I | 47 | 0.5 |
| | D | 47 | 0.5 |
| | Total | 94 | 1 |
| Naked Neck | I | 24 | 0.5 |
| | D | 24 | 0.5 |
| | Total | 48 | 1 |
| Frizzle Feather | I | 8 | 0.5 |
| | D | 8 | 0.5 |
| | Total | 16 | 1 |

**Table 7.** Frequency of occurrence of qualitative trait (plumage colour) among normal feather, frizzle feather and naked neck chickens.

| Trait | Breeds | Characteristics | Frequency | Percentage (%) |
|---|---|---|---|---|
| Plumage Colour | Normal feather | Multicoloured | 48 | 92.31 |
| | | White | 3 | 5.77 |
| | | Black | 1 | 1.92 |
| | | Total | 52 | 100 |
| | Frizzle feather | Multicoloured | 7 | 87.5 |
| | | White | - | - |
| | | Black | 1 | 12.5 |
| | | Total | 8 | 100 |
| | Naked neck | Multicoloured | 22 | 81.48 |
| | | White | 4 | 14.81 |
| | | Black | 1 | 3.71 |
| | | Total | 27 | 100 |

**Table 8.** Mean values of effect of prolactin on body weight and linear body measurements of some selected Nigerian indigenous chickens.

| Genotype | Breeds | BW | BL | CC | BKL | SL | CL | CH | TL |
|---|---|---|---|---|---|---|---|---|---|
| ID | FF | 1275.56±53.4 | 18.74±0.301 | 26.66±0.42 | 3.12±0.05 | 7.83±0.15 | 4.44±0.34 | 2.08±0.22 | 14.69±0.34 |
| DD | NN | 1192.40±205.49 | 19.80±1.17 | 26.50±1.62 | 3.18±0.20 | 7.80±0.59 | 3.36±1.31 | 1.42±0.85 | 16.80±1.30 |
| II | NF | 1502.00±205.49 | 20.28±1.17 | 28.16±1.62 | 3.14±0.20 | 8.50±0.60 | 7.66±1.31 | 4.04±0.85 | 15.96±1.30 |
| P.value | | 0.5122 | 0.3299 | 0.6612 | 0.9544 | 0.5441 | 0.0431 | 0.0609 | 0.2099 |

BW = body weight, CC = chest circumference, BL = beak length, SL = shank length, CL = comb length, TL = thigh length, FF = Frizzle Feather, NN = Naked Neck, NF = Normal Feather.

**Table 9.** Mean values genotype effect on body weight and linear body measurements of some selected Nigerian indigenous chickens.

| Breeds | BW | BL | CC | BKL | SL | CL | CH | TL |
|---|---|---|---|---|---|---|---|---|
| Frizzle | 1433.18±8.8$^{b}$ | 19.44±0.66 | 27.19±1.02 | 3.16±0.11 | 8.23±0.30 | 5.75±0.45 | 2.85±0.29 | 15.81±0.74 |
| Naked Neck | 1398.47±118.77$^{b}$ | 20.14±0.66 | 26.61±1.02 | 3.11±0.11 | 9.95±0.30 | 6.21±0.45 | 3.29±0.29 | 15.86±0.74 |
| Normal | 1881.63±169.37$^{a}$ | 20.05±0.94 | 27.72±1.45 | 3.37±0.16 | 8.30±0.43 | 7.26±0.64 | 3.52±0.42 | 15.87±1.06 |
| P.value | 0.0170 | 0.4295 | 0.6881 | 0.2846 | 0.5068 | 0.0438 | 0.910 | 0.9960 |

BW = body weight, CC = chest circumference, BL = beak length, SL = shank length, CL = comb length, TL = thigh length.

weight among the breeds studied. This indicates that the prolactin gene has an effect only on the body weight of the three breeds studied.

## DISCUSSION

The growth and body weight traits of Nigerian indigenous chickens are influenced by both genetic and environmental factors, with prolactin (PRL) gene playing a crucial regulatory role. Polymorphisms in the PRL gene, particularly single-nucleotide polymorphisms (SNPs), are associated with key phenotypic traits such as body weight, growth rate, and reproductive efficiency. Understanding these polymorphisms provides insights into the genetic basis of variation in these traits and offers opportunities for targeted genetic improvement programs. The prolactin gene is responsible for encoding prolactin, a hormone involved in growth regulation, metabolism, and reproductive functions. In Nigerian indigenous chickens, PRL gene polymorphisms are linked to variations in hormonal pathways that influence body weight and growth rate (Hoda *et al*., 2024). Specific SNPs within regulatory and coding regions of the PRL gene can alter gene expression or protein function, impacting growth traits. Prolactin polymorphisms have been associated with differences in body weight at critical growth phases, such as at sexual maturity or 16 weeks of age (Wang *et al*., 2024). The result in this study is similar to the findings of Kulibaba *et al*. (2024), who work on the molecular diversity of Ukrainian native chicken breeds, and the study by Gao *et al*. (2023) and Huang *et al*. (2023).

Nigeria's indigenous chickens are divided into ecotypes, such as heavy and light varieties, which display genetic and phenotypic diversity due to adaptations to local environments. Prolactin gene SNPs are more prevalent in heavy ecotypes, correlating with higher body weight, while light ecotypes may have distinct SNP profiles linked to reproductive traits (Gao *et al*., 2023). These findings suggest that prolactin gene polymorphisms could be used as genetic markers to differentiate and selectively breed for desirable traits across ecotypes (Huang *et al*., 2023). Association studies conducted on Nigerian chickens have shown significant links between prolactin gene polymorphisms and growth traits. However, polymorphisms in the PRL receptor gene (PRLR5a and PRLR6) were found to influence body weight and egg production traits (Huang *et al*., 2023). By aligning genotypic data with phenotypic performance, researchers have identified potential genetic markers for improving body weight and overall productivity. These findings underscore the dual role of the prolactin gene in growth and reproduction.

The identification of prolactin gene polymorphisms has important implications for breeding programs aimed at enhancing the productivity of Nigerian indigenous chickens. These polymorphisms can serve as molecular markers in marker-assisted selection (MAS), allowing for the efficient identification of superior genotypes. Incorporating genetic tools into traditional breeding systems can help balance productivity improvements with the conservation of the genetic diversity and adaptability of these chickens (Oyebanjo *et al*., 2023). While the role of prolactin gene polymorphisms in growth and body weight is evident, challenges remain in translating these findings into practical breeding strategies. The genetic architecture of growth traits is complex, involving multiple genes and gene-environment interactions.

## Conclusion

The findings of this study demonstrate a significant association between prolactin gene polymorphisms and growth performance traits in Nigerian indigenous chickens. Specific allelic variations in the prolactin gene were found to correlate with improved body weight and growth rates indicating that prolactin plays a contributory role in regulating growth-related physiological process. The results highlight the potential of prolactin gene markers as valuable tools in marker-assisted selection programs aimed at enhancing the genetic potential of indigenous chicken breeds. Integrating these genetic markers into breeding strategies could lead to the development of more productive and resilient poultry lines, thereby supporting food security and sustainable livestock production in Nigeria.

## Recommendation

Further research is needed to validate the identified SNPs across larger and more diverse chicken populations, as well as to understand their interaction with other genes involved in growth and metabolism. Additionally, integrating these findings with genomic selection strategies could accelerate genetic gains in local chicken populations.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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