

The genetic role of TCF21 in regulating growth traits and body composition in ross 308 broilers

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Abstract

The gene TCF21, a subject of growing interest in molecular poultry genetics being an important player in cell differentiation and muscle and adipose tissue growth regulation has been recognized as an emerging regulatory gene. The study aimed to evaluate the potential use of molecular markers in selection, breeding, and improvement programs. This study included 100 samples of ROSS 308 broiler chickens, which were reared for 40 days. Field measurements were taken weekly, including body weight, body length, and chest width every two weeks. At 20 days of age, blood was collected in K3- EDTA tubes for laboratory analysis, including DNA extraction PCR and Sequencing. TCF21 is a member of the basic helix-loop-helix (bHLH) family of transcription factors and available evidence has suggested that it presents significant biological and molecular features. It's thought to be involved with regulating the growth of muscle and fat tissue, and has been reported to influence body weight, growth rate, body composition and fat deposition capacity in broilers. On more recent reports, these polymorphisms were associated with several economically important traits, suggesting that TCF21 can be exploited as a molecular marker in contemporary selection programs aimed at improving productive performance and carcass quality in poultry. Combining genomic with phenotype information in genetic-improvement schemes is a big advance toward accurate and efficient commercial broiler production programs. The study aimed to focus on the TCF21 gene because it is one of the most prominent candidates directly related to the efficiency of production and profitability of poultry projects, given its role in regulating muscle formation, fat deposition, and some traits associated with feed conversion efficiency. The results showed the presence of several single nucleotide polymorphisms (SNPs) within the TCF21 gene. Fourteen mitochondrial loci were identified, distributed across the two primaries used (seven variants each), reflecting significant genetic diversity in the studied regions. These results confirm the health of TCF21, as it can be one of the candidate combinations that contribute to the regulation of morphology and histogenesis through its effect on the differentiation of muscle and fat cells.

Keywords: TCF21 Gene; Ross 308 Broilers; Genetic Polymorphisms; Genetic Improvement; Growth Traits; Body Composition.

1. Introduction

Over recent decades, the poultry industry has developed substantially as a result of advances in genetic improvement, nutrition, and health management. These advances have markedly enhanced the productive efficiency of modern broiler strains and improved meat-production traits. Genetic improvement is widely regarded as one of the most important factors in the development of the poultry sector. Continued selection has produced strains with high growth potential, improved feed-conversion efficiency, and greater carcass meat yield, particularly in the breast muscle, which represents a large proportion of consumable meat (1)

Rapid progress in molecular genetics and genome-analysis technologies has shifted genetic improvement beyond phenotype-based selection alone. Current breeding strategies increasingly rely on understanding the genetic

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mechanisms underlying variation in productive traits. Modern information transfer methods are also able to find genetic variations related to growth features and fat make-up in animals through advanced technologies such as SNP examination and research of the feel of different characteristics. Consequently, many candidate genes that may directly or indirectly regulate productive performance have been found in poultry (2).

TCF21, is a key regulatory gene from the bHLH transcription-factor family in this group. GAMT is involved in regulating gene expression, cell differentiation and tissue development and is expressed in a number of tissues, with increased activity in muscle and adipose tissue. Associations between polymorphisms at TCF21 gene and productive traits in broilers have been reported to date, including body weight, body composition and fat deposition. This makes its consideration as a candidate gene for use in modern breeding programmes encouraging (3-5)

The Ross 308 strain has been one of the most popular commercial broiler strains around the world and it has also emerged as an important genetic and genomic model for growth- and meat-production-related traits (6,7). The fast growth and high adaptation of Meishan pigs to local climates make them an ideal model for studying the effects of TCF21 correlating polymorphisms on the growth and body compositions. Such studies may help clarify the genetic determinants of these traits and evaluate the potential of TCF21 as a molecular marker for modern selection programs. this study aims to refine the SNPS for these traits and evaluate the feasibility of using TCF21 as a partial name in modern genetic selection programs.

2. Materials and Methods

2.1. Study Design and Sample Collection

This study was conducted from 10/10/2025 to 14/1/2026 100 aunts of the 308-ROSS breed were reared. The necessary operations were performed on them, including measuring weight, body length, and breast width (Table 1)

- -At 20 days of age, blood was drawn from all birds from the vein and collected in EDTA tubes and preserved by freezing.
- -Samples were prepared for the purpose of conducting laboratory analyses to determine the genetic structures of the genes.
- -The instructions for the kit supplied by Geneaid were followed to extract DNA from blood samples in the Agricultural Molecular Biology Laboratory
- -The DNA extraction process included 4 stages.
 - Analysis and bone stage: Performed in Anasphere Immendorff, GB Buffer solution, proteinase enzyme, and blood samples.
 - Precipitation and binding stage: Cold ethanol was added, and the sample was transferred to GD filter columns. The central aperture was collected for one minute
 - Washing stage: Add W1 Buffer to the GD columns, then centrifuge to remove proteins and hemoglobin residues. Add wash buffer and centrifuge for 1 minute.
 - Final extraction stage: Transfer to Endron tubes, add Elution Buffer solution, then centrifuge to collect DNA samples. Store at 20°C - Performing agarose gel electrophoresis on the extracted DNA samples to verify the quality and integrity of the DNA using the gel electrophoresis technique

2.2. Selection of primers for the TCF21 gene

Table 1 Primer sequences used for amplification of the TCF21 gene and targeted SNP regions.

Primer	Sequence (5'-3')	Fragment Size (bp)	Annealing Temperature (°C)
Primer 1 (F)	TACTTTTCGTTTCCAACTCACCAGG	536	60
Primer 1 (R)	GACATCTTGTAACAGTGC GGTTTCATAAC		
Primer 2 (F)	CTGAAATAGTTGGATTTTCCCCTGCC	389	61
Primer 2 (R)	CTGATGGAGTCGAAGAGGGGTTTTA		

The use of these primer pairs enabled accurate amplification of the targeted TCF21 regions and facilitated the identification of genetic polymorphisms potentially associated with growth traits, body weight, carcass composition, and fat deposition in commercial broiler strains.

-Preparation and formulation of primers. Following the manufacturer's protocol for solution preparation Performing centrifugation and adding nuclease-free distilled water to each of the four primer tubes (F1, R1, F2, R2), mixing thoroughly, and storing them at -20C as a stock solution.

2.2.1. -PCR (Polymerase Chain Reaction):

- -Mixing the Master Mix, Pf, DNA, and Nuclease-free water, then blending them using a vortex mixer (vortexing device).
- -Thermal gradient experiment \leftarrow to identify and determine the optimal temperature that yields the clearest band and the highest amplification efficiency.
- -Performing electrophoresis.
- -Preparing TBE buffer solution, agarose gel, and prepar
- -Heating the mixture in the microwave until boiling, and adding Ethidium Bromide dye.
- -Loading the samples using loading dye with the DNA samples.
- -Examining the PCR products. Loading the products into the wells.
- -Examining the gel, then using a UV light imaging system .
- -Sequencing process: Shipping the samples to Korea, and the PCR sample results have been obtained.
- -Performing statistical analysis using the SAS program.

3. Results and Discussion

The DNA sequencing results of the amplified fragment of the TCF21 gene revealed the presence of 7 single nucleotide polymorphism (SNP) sites (Table 2).

- The presence of seven main sites (SNP1-SNP7) within the first primer SNP1.
- The presence of a significant effect of the first primer on body weight and weight gain.

Table 2 Relationship of TCF21 gene genotypes SNP1/126 T>C variation for the first primer of Ross308 broiler chickens.

Significance Level	Standard +_Mean			Traits
	CC	TC	TT	
N.S	127.8 ±3.84	137.76 ±7.71	127.28 ±6.32	Body Weight 1st Week g
*	303.12 ±6.28 a	267.00 ±18.67 b	287.72 ±8.30 ab	Body Weight 2nd Week g
*	743.96 ±12.55 a	673.07 ±33.29 b	713.08 ±17.34 ab	Body Weight 3rd Week g
*	1314.48 ±19.36 a	1213.85 ±51.12 b	1271.00 ±25.37 ab	Body Weight 4th Week g
*	2030.52 ±24.40 a	1908.85 ±66.25 b	1975.40 ±31.15 ab	Body Weight 5thWeek g
*	175.28 ±7.97 a	129.23 ±20.90 b	160.44 ±10.20 ab	Weight gain-2nd Week g
*	440.84 ±6.33 a	406.07 ±14.93 b	425.36 ±9.10 ab	Weight gain-2nd Week g
N. S	570.52 ±6.92	540.76 ±18.12	557.92 ±8.19	Weight gain-2nd Week g
N.S	716.03 ±5.3	695.00 ±15.36	704.40 ±6.22	Weight gain-2nd Week g
*	1902.67 ±25.35 a	1771.08 ±67.51 b	1848.12 ±31.48 ab	Total weight gain g
*	22.43 ±0.24 a	21.12 ±0.67 b	21.94 ±0.31 ab	Body length-2nd week cm
N.S	8.82 ±0.13	8.26 ±0.36	8.52 ±0.18	Breast width 2nd week cm
N.S	27.95 ±0.28	26.73 ±0.74	27.34 ±0.32	Body length 4th week
N.S	10.51 ±0.12	9.93 ±0.33	10.25 ±0.7	Breast width 4th week cm
Means with different letters within the same column are significantly different from each other; * (P≤0.05) N.S..				

The TCF21 gene acts as a transcription factor involved in regulating cell differentiation in tissues. No significant differences were found in the second primer SNP1 regarding body weight and weight gain, because this site is not located within active regulatory regions and does not affect gene expression (25,32) (Table 3).

Table 3 Relationship of genotype variations of the TCF21 gene variation SNP1/100:G>A second primer with the traits of Ross-308 broiler chickens.

Significance level	Mean+ _ Standard Error			Traits
	AA	GA	GG	
N. S	145.2 ±10.23	123.34 ±5.48	130.56 ±3.69	Body weight 1st week g
N. S	268.4 ±14.04	290.82 ±10.24	295.97 ±6.23	Body weight 2nd week g
N. S	673 ±30.81	715.65 ±20.80	731.5 ±12.08	Body weight 3rd week g
N. S	1206 ±46.35	1274.13 ±31.68	1297.28 ±18.32	Body weight 4th week g
N. S	1898 ±54.53	1983.91 ±40.31	2007.79 ±22.98	
N. S	123.2 ±22.01	167.48 ±8.87	165.41 ±8.07	Body weight 5th week g
N. S	404.6 ±16.83	424.82 ±10.61	435.53 ±5.94	Weight gain 3rd week g
N. S	533 ±15.70	558.47 ±11.03	565.78 ±6.36	Weight gain 4th week g
N. S	692 ±8.45	709.78 ±8.84	710.51 ±4.97	Weight gain 5th week g
N. S	1752.8 ±62.27	1860.57 ±37.78	1877.24 ±24.27	Total weight gain g
N. S	21 ±0.69	22.04 ±0.39	22.19 ±0.23	Body length 2nd week cm
N. S	8.12 ±0.22	8.55 ±0.24	8.73 ±0.12	Breast width 2nd week cm
N. S	26.6 ±0.66	27.5 ±0.55	27.71 ±0.26	Body length 4thweek cm
N. S	9.88 ±0.31	10.26 ±0.21	10.42 ±0.11	Breast width 4thweek cm
N. S Non Significant.				

3.1. Broiler Industry and the Importance of Productive Traits

Among the components of animal production, the broiler sector is one of the most advanced and widely disseminated branches. This represents an important supply of prime quality animal protein, with comparatively decrease relative price than many different kinds of meat. Global growth is driven by many advantages of the production models, including a short production cycle, low feed conversion rates and compatibility with goals linked to intensive systems of management Broiler production has already seen significant improvements in productive performance and economic efficiency over recent decades from major advances in genetics, nutrition, and health management (5).

International reports also demonstrate that the poultry sector is one of the sectors showing the fastest global animal production growth. In many places where few to no alternative protein available give animal protein, it plays a crucial role in food security (6).

Poultry breeding has benefited considerably from selection pressures applied through genetic-improvement programs. As a result, the productive characteristics of modern chicken strains have changed markedly. Modern broilers can reach high market weights within a short period, usually 5-7 weeks, while demonstrating improved feed-conversion efficiency and increased carcass meat yield. Comparative studies of older and modern strains have shown substantial increases in final body weight and reductions in the time required to reach market weight, thereby improving production efficiency and reducing costs (7).

Several studies have reported that continuous genetic improvement in broiler strains has produced faster growth rates and lower feed consumption per unit of production, which has positively affected the efficiency of commercial broiler farming (8).

Broiler-production efficiency is determined by a set of functional traits that reflect the bird's ability to grow and convert feed into meat within a relatively short period. These include traits such as body weight, growth rate, feed-conversion efficiency and carcass characteristics. Since they are intimately connected with profitability of production, these traits

are among the primary targets for inclusion in genetic-improvement strategies envisioned to enhance productivity while minimizing costs.

Key productive traits, particularly body weight and feed-conversion efficiency are among the most important determinants of the economic profitability of poultry-production systems (9).

3.2. Ross 308 Broiler Strain

The Ross 308 strain is one of the most widely used commercial broiler strains worldwide. It has been selected for rapid growth, efficient feed conversion, high breast-meat yield, and overall productivity. Because breast meat represents a major proportion of edible carcass yield, substantial selection pressure has been directed toward improving breast-muscle development while maintaining carcass quality. The strain has been refined over many years through intensive genetic-selection programs designed to maximize production efficiency in modern commercial systems (10).

Ross 308 has been developed through structured genetic-selection programs focused on growth rate, feed-conversion efficiency, and carcass quality. These characteristics have contributed to its widespread use in global commercial broiler production (11).

Genetic improvement in modern broiler strains, including Ross 308, has been repeatedly associated with higher growth rates and improved feed efficiency compared with traditional strains (12).

3.3. Productive Traits Studied in Broilers

Broiler-production efficiency is determined by a combination of productive traits that quantify the bird's capacity for growth and its ability to convert feed into muscle tissue within a short rearing period. These traits are primary indicators used by researchers and breeders to evaluate the productive performance of different strains. They include body weight at different ages, weight gain, carcass traits such as breast-muscle weight, and body measurements that reflect the development of the musculoskeletal structure (13)

Accurate assessment of productive traits is the basis of genetic evaluation because it allows breeders to identify differences among birds and select individuals with superior productive efficiency (14).

Productive traits in broilers are quantitative and polygenic; their expression is influenced by many interacting genes as well as environmental factors such as diet, temperature, flock health, and management. Therefore, differences in productive performance among birds of the same strain should be evaluated by considering both genetic and environmental variation (15).

Quantitative-trait analyses in poultry have shown that multiple genes and environmental factors interact to determine productive performance. This complex genetic architecture requires the use of advanced polygenic models for accurate genetic evaluation and effective improvement (16).

3.4. Weekly Body Weights

Body weight is one of the most important productive traits because it reflects the bird's genetic capacity for growth during different rearing stages. Although environmental factors such as nutrition, management, and climate also influence this trait, body weight is generally considered a quantitative trait controlled by multiple genes (17). Body weight at early ages has been used to predict final productive performance in broilers and is considered a key trait in genetic-selection programs (18). Early body weights are important indicators of broiler efficiency because they are positively correlated with later productive performance. These traits generally have moderate to high heritability, making them useful candidates for genetic improvement and early selection (19). Studies of modern broiler strains indicate that body weight during the first weeks after hatching is a reliable predictor of growth efficiency. Birds that are heavier at early ages often remain heavier at the end

3.5. Weekly and Total Weight-Gain Rates

Weight gain (WG), defined as the difference between body weight at two consecutive time points, is a key index for evaluating growth rate in broilers. Weekly weight gain reflects growth efficiency during individual rearing stages, whereas total weight gain indicates overall growth performance across the production period (21). Weight-gain rate is an important measure of growth efficiency because it is closely associated with the speed at which feed is converted into live body mass. Weight-gain rate is strongly affected by the bird's genetic background, feed quality, environmental conditions, and rearing system. This trait also shows moderate heritability, indicating that it can be improved through

selection programs that favor birds with superior growth capacity (22). Because of intensive selection for growth and meat-production traits, modern broilers show substantially higher weight-gain rates than older strains. Comparative studies across commercial strains and production periods demonstrate that these increases are largely the result of sustained genetic selection and breeding programs (23).

3.6. Breast Muscle Index

The breast muscle is one of the major components of the broiler carcass and represents a large proportion of edible meat. Therefore, breast-muscle development is an economically important trait in the poultry industry. The breast muscle index can be calculated from breast-muscle weight or as a percentage relative to morphometric indicators such as body length or breast width (24). Breast-muscle size is one of the most important carcass-quality traits in broilers because it represents a major proportion of the consumable muscle mass (25). Because of its economic importance, modern genetic-improvement programs have focused strongly on increasing breast-muscle yield. Studies have shown favorable genetic correlations between breast-muscle weight and final body weight, indicating that selection for body weight may also improve carcass traits and meat yield (26). Studying breast-muscle development helps clarify patterns of muscle-mass allocation in the body and supports breeding strategies aimed at improving carcass quality in modern broiler strains.

3.7. Body Weight-to-Body Length Ratio

The body weight-to-body length ratio is an important index for assessing body conformation and carcass composition in broilers. This biometric indicator reflects how much body mass is present relative to body length. Higher values generally indicate greater tissue and muscle development, particularly in the breast and thigh regions (27). This ratio has also been reported to reflect the balance between skeletal and muscular growth, which is an important criterion for evaluating production quality in contemporary broiler strains. Research has demonstrated a positive relationship between this ratio and major carcass traits, including breast-muscle weight and total carcass weight. Accordingly, it is a useful indicator for comparing productive performance among broiler strains (28). Studying this ratio also helps clarify the relationship between skeletal growth and muscle development. Balanced skeletal and muscular growth is an important determinant of high productive performance and desirable carcass quality (Table 4).

Table 4 Main Productive Traits Used in Broiler Evaluation

Productive Trait	Definition	Productive Importance
Weekly body weight	Body weight measured at specific ages during the rearing period.	Direct indicator of growth rate and growth potential.
Weight gain	Difference between body weights measured at two time points.	Reflects growth rate and feed-utilization efficiency.
Breast muscle index	Indicator of breast-muscle development in the bird.	Indicates the proportion of consumable meat and carcass value.
Body weight-to-body length ratio	Relationship between body weight and body length.	Reflects body conformation, body composition, and muscle development.

3.8. Candidate Genes Associated with Growth Traits in Poultry

Significant progress in poultry genetics, molecular biology, and genome-analysis techniques has enabled researchers to identify genes associated with economically important productive traits, including growth rate, body composition, and feed-conversion efficiency. This progress has led to the identification of candidate genes, which are genes expected to have direct or indirect effects on economic traits because they regulate physiological processes related to growth and metabolism (29). The identification of candidate genes is an important step in understanding the genetic basis of quantitative traits because it links genetic variation with productivity in farm animals.

3.9. Growth Hormone Gene (GH)

The growth hormone (GH) gene is one of the most important genes associated with growth traits in farm animals. It encodes growth hormone, which is secreted by the pituitary gland and regulates body growth and metabolic processes. GH stimulates cell division and protein synthesis in different tissues and promotes skeletal and muscle growth (30). Studies have shown that polymorphisms in the GH gene are significantly associated with growth rate and increased

body weight in poultry, making it one of the major genes considered in genetic-selection programs. Associations have been reported between SNPs in the GH gene and productive traits such as body weight, growth rate, and feed-conversion efficiency in chickens. Certain GH genotypes have also been linked with improved productive performance and faster growth in broilers (30).

3.10. Insulin-Like Growth Factor-1 Gene (IGF-1)

The insulin-like growth factor-1 (IGF-1) gene is a major growth-related gene in animals and has been widely studied because of its role in stimulating cell growth and differentiation. It functions within a hormonal pathway associated with growth hormone: GH stimulates the liver and other tissues to synthesize IGF-1, which in turn supports muscle and bone growth (31). IGF-1 is considered a key regulator of muscle and bone development, and genetic variation in this gene has been associated with improved carcass-composition traits in broilers. Genetic variants of IGF-1 have been studied in relation to important productive traits, including body weight, growth rate, and feed-conversion ratio. Certain genotypes have been correlated with increased meat yield and favorable carcass traits in broiler chickens (31).

3.11. Leptin Receptor Gene (LEPR)

The leptin receptor (LEPR) gene has important regulatory roles in energy balance, appetite regulation, and feed intake. It is involved in metabolic processes and fat deposition, and is therefore related to major productive traits in chickens, including feed intake and feed-conversion efficiency (29). Studies have shown that LEPR contributes to the regulation of food intake and fat deposition, both of which are directly associated with poultry-production efficiency. Evidence suggests that mutations within the LEPR gene may influence fat deposition and affect growth and body-composition traits in broilers (27).

3.12. Melanocortin Receptor Gene (MC4R)

The melanocortin receptor gene (MC4R) is one of the key genes involved in regulating feed intake and energy balance. It participates in appetite regulation and feed-consumption control, thereby indirectly influencing growth rate and feed-conversion efficiency in chickens (30). MC4R has also been linked to feeding behavior and appetite regulation, which may contribute to faster growth and improved feed conversion in birds (26).

This gene has been investigated in poultry genetic-improvement programs because some studies have reported associations between MC4R variants and productive traits, including body weight, growth rate, and fat deposition (Table 5).

Table 5 Main Candidate Genes Associated with Growth Traits in Chickens

Gene	Biological Function	Associated Traits
GH	Regulates growth-hormone secretion and growth processes.	Body weight and growth rate.
IGF-1	Stimulates cell, muscle, and bone growth.	Growth rate and carcass traits.
LEPR	Regulates appetite, energy balance, and fat deposition.	Feed intake and fat deposition.
MC4R	Regulates feed intake and energy balance.	Growth and feed-conversion efficiency.

Investigating candidate genes for growth traits is an important step toward understanding the genetic basis of productive performance in poultry. With advances in genomic research, increasing attention has been directed toward transcription factors that regulate the expression of genes involved in proliferation and cell differentiation. TCF21 is one such transcription factor and is therefore the focus of this review, which examines its relationship with productive traits in broiler chickens.

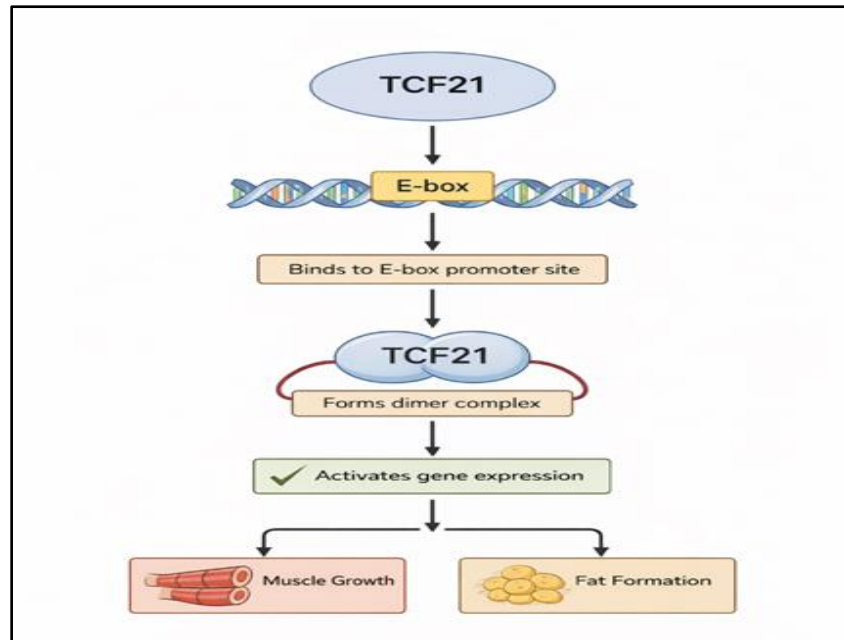


Figure 1 Diagram illustrating the proposed mechanism of TCF21 gene action in regulating gene expression.

The TCF21 gene encodes a transcription factor that regulates the expression of several genes involved in tissue-lineage development and cellular differentiation. It is considered a regulatory gene involved in biological processes such as tissue growth and organ development during early embryogenesis. 32

TCF21 has been reported to control the transcription of multiple genes related to cell differentiation and may therefore contribute to the regulation of muscle and adipose tissue development in vivo. 32

The TCF21 protein acts as a transcription factor that regulates genes involved in mesenchymal-cell differentiation. Mesenchymal cells contribute to the formation of several tissues, including connective tissue, muscle, and adipose tissue. Therefore, TCF21 may be involved in regulating muscle growth and fat deposition in animals. 32

In chickens, TCF21 is expressed in multiple tissues, including the heart, testes, and adipose tissue, indicating that it may have important physiological roles in tissue growth and development. Differences in TCF21 expression among genetic lines may be associated with variation in performance-related traits such as body weight and body composition. 32

3.13. Gene Location and Molecular Structure

In the chicken genome, TCF21 is located on an autosomal chromosome and includes coding regions (exons), non-coding regions (introns), and regulatory regions that influence gene expression. Changes at specific sites within this gene can produce DNA-sequence variation that may alter gene activity or expression level (32). Polymorphisms, particularly single-nucleotide polymorphisms (SNPs), within TCF21 may affect gene expression and may therefore be reflected in productive traits in birds (32). Genomic variation is a major source of individual differences among birds and can influence many productive traits. SNPs are among the most common types of genetic variation and involve the replacement of a single nucleotide at a specific position in the DNA sequence. Such changes may affect gene activation, gene expression, or the structure and function of gene products, ultimately contributing to differences in productive performance among individuals.

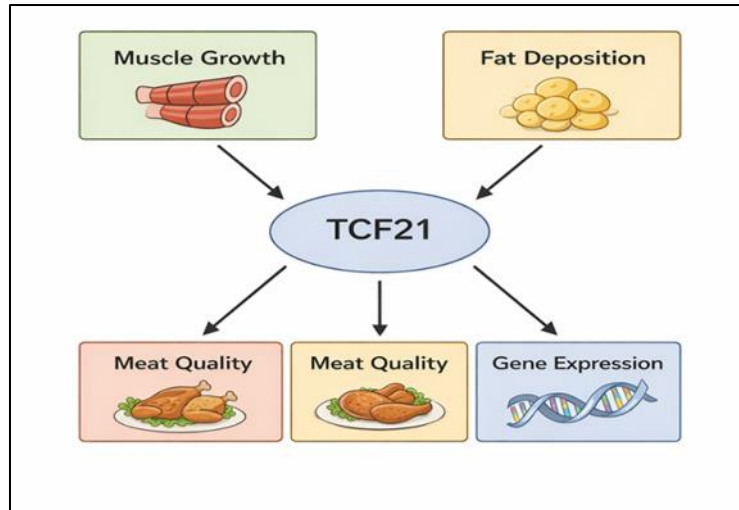


Figure 2 Proposed mechanism of TCF21 action in relation to muscle growth, fat deposition, meat quality, and gene expression.

3.14. Expression of TCF21 in Different Tissues

Molecular studies have shown that TCF21 is differentially expressed across body tissues. It is strongly associated with tissues involved in cardiovascular and connective-tissue development, as well as metabolically active tissues such as adipose tissue. Variation in TCF21 expression among tissues reflects its involvement in physiological processes related to growth and cellular differentiation (33)

Recent studies indicate that TCF21 expression may differ among chicken lines selected for different productive traits. Higher expression levels have been observed in lines with greater fat deposition compared with low-fat lines, suggesting that TCF21 may be involved in adipocyte formation in chickens. Some studies also suggest that TCF21 may be associated with the development of reproductive tissues in birds, as correlations have been observed between TCF21 expression and testicular development in male chickens (Table 6). This indicates that the gene may contribute to physiological functions related to growth and reproduction (34).

Table 6 Main Biological Characteristics of the TCF21 Gene

Characteristic	Description
Gene name	TCF21
Gene type	Transcription factor
Protein family	Basic helix-loop-helix (bHLH)
Function	Regulation of gene expression and cell differentiation
Expressed tissues	Heart, adipose tissue, and testes
Main associated processes	Tissue growth, fat formation, and development of selected organs

TCF21 is gaining increasing importance in modern poultry research because it is a regulatory gene that may influence multiple processes related to growth and body composition. Recent studies have reported associations between polymorphisms in this gene and major productive traits in broilers. These findings support the potential use of TCF21 as a candidate gene in future genetic-selection programs aimed at improving growth traits and meat production in chickens.

Accordingly, this review examines the genetic characteristics of TCF21 and its association with selected productive traits in Ross 308 broilers.

4. Conclusion

In light of the findings of the current study regarding the genetic variations of the TCF21 gene and their relationship with certain productive traits in Ross 308 broiler chickens, a set of conclusions and recommendations are presented. The study revealed the presence of several genetic variations (SNPs) within the TCF21 gene, where seven polymorphic sites were identified and distributed across the two primers used. These sites showed a clear variation in the distribution of genotypes and alleles within the studied sample. The results demonstrated that certain genetic sites, such as SNP1 in the first primer, have a clear significant effect on growth traits, as the CC genotype significantly excelled in body weights at various ages, as well as in total weight gain, compared to the other genotypes. The results showed that the effect of the TCF21 gene is not uniform across all sites; rather, it depends on the location of the variation within the gene, where the effect is distinct at certain.

Compliance with ethical standards

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Disclosure of conflict of interest

Authors have no conflict of interest related of this study.

Author's Declaration

- The author confirms that all tables included in the manuscript are original and were prepared for this research.
- As this article is a scientific review and does not involve experimental animals or human participants, ethical approval was not required.

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