

Blastoderm Identification and Morphological Analysis of Newly Laid Broiler Eggs

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Abstract

Blastoderms, the embryonic discs found on the surface of fertilized eggs, play a crucial role in embryonic development and hatchability in broiler chickens. Understanding the cellular and morphological characteristics of blastoderms is essential for optimizing breeding strategies, improving hatchery practices, and enhancing chick quality. This review provides an overview of the cellular and morphological characterization of blastoderms from freshly laid broiler eggs. It discusses blastoderm formation and development, cellular composition, morphological features, factors influencing blastoderm quality, and implications for poultry production. By elucidating the factors influencing blastoderm quality and viability, researchers can develop strategies to optimize breeding programs, improve hatchery practices, and enhance chick quality, ultimately contributing to the sustainability and efficiency of the poultry industry.

Keywords: Blastoderm; Broiler eggs; Embryonic development; Cellular characterization; Morphological characterization; Hatchability; Poultry production

Introduction

The study of blastoderms from freshly laid broiler eggs provides valuable insights into embryonic development, growth, and hatchability in poultry production [1-4]. Blastoderms are the embryonic discs found on the surface of fertilized eggs, which serve as the foundation for embryo formation. Understanding the cellular and morphological characteristics of blastoderms is crucial for optimizing breeding strategies, improving hatchery practices, and enhancing chick quality in the poultry industry. In the realm of poultry production, the development and health of embryos within fertilized eggs play a pivotal role in determining the success of hatchery operations and the quality of resulting chicks. Central to this process is the blastoderm, the specialized embryonic disc that forms on the surface of freshly laid broiler eggs. The study of blastoderms provides valuable insights into embryonic development, growth, and hatchability, offering opportunities to optimize breeding strategies, enhance hatchery practices, and improve chick quality in the poultry industry.

Blastoderms serve as the foundation for embryonic development, representing the initial stage of embryo formation following fertilization [5]. Understanding the cellular and morphological characteristics of blastoderms is essential for unraveling the intricate processes underlying embryogenesis and for identifying factors influencing embryo viability and health. By examining the cellular composition and morphological features of blastoderms, researchers can gain insights into the dynamic processes driving embryonic growth, differentiation, and patterning. Various factors, both intrinsic and extrinsic, influence the quality and viability of blastoderms in broiler eggs. Genetic predisposition, egg storage conditions, and incubation parameters are among the key determinants affecting blastoderm development and subsequent embryo quality [6]. Additionally, nutritional factors, such as maternal diet and egg composition, play a critical role in shaping blastoderm characteristics and embryonic viability.

Methods

Sample Collection and Preparation: Freshly laid broiler eggs, sourced from commercial poultry farms, were carefully collected to ensure their integrity and freshness [7]. Special attention was paid to

handling procedures to avoid any damage to the delicate eggshells and prevent contamination of the egg contents. Upon collection, the eggs were promptly transported to the laboratory under controlled conditions to maintain their quality and minimize any external influences that could impact subsequent analyses.

Blastoderm Isolation: In the laboratory, the eggs were delicately prepared for blastoderm isolation. With meticulous precision, the eggshells were gently removed to expose the underlying blastoderms. Using sterile instruments and techniques, the blastoderms were then carefully separated from the surrounding egg yolk while ensuring minimal disturbance to their structure. Any residual yolk or albumen was meticulously removed by rinsing the blastoderms with a buffered solution, guaranteeing the purity of the isolated samples for subsequent analysis.

Histological Processing: Following blastoderm isolation, meticulous histological processing was undertaken to preserve the cellular structures of the embryonic discs. The isolated blastoderms were delicately fixed in appropriate fixatives, typically formaldehyde, to prevent degradation and maintain cellular integrity. Subsequently, the fixed blastoderms were embedded in either paraffin or optimal cutting temperature (OCT) compound to facilitate sectioning. Using a microtome, thin slices of the blastoderms were meticulously sectioned, typically ranging from 5 to 10 micrometers in thickness, ensuring optimal visualization of cellular morphology.

Staining and Imaging: Histological staining techniques were employed to visualize the cellular composition and morphological features of the blastoderms. Utilizing standard histological stains such as hematoxylin and eosin (H&E), the prepared sections were stained

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to highlight cellular structures and delineate different cell types [8]. Additionally, immunohistochemistry or immunofluorescence staining techniques were employed to identify specific cell types or proteins of interest within the blastoderms. Following staining, the prepared sections were meticulously imaged using light microscopy or confocal microscopy, enabling detailed visualization and analysis of cellular morphology and distribution within the blastoderms.

Morphometric Analysis: Quantitative morphometric analyses were conducted to assess various parameters of blastoderm morphology. Measurements of blastoderm diameter, thickness, and surface area were meticulously obtained using specialized image analysis software. Additionally, cellular density, proliferation rates, and apoptosis levels within the blastoderms were quantified using appropriate staining and analysis techniques. These morphometric analyses provided invaluable insights into the structural characteristics and dynamic cellular processes underlying blastoderm development and differentiation.

Statistical Analysis: The obtained morphometric and cellular data were subjected to rigorous statistical analysis using specialized software packages. Statistical tests, such as t-tests or analysis of variance (ANOVA), were employed to compare differences between experimental groups and assess the significance of findings. This statistical analysis ensured the robustness and reliability of the results, providing valuable insights into the cellular and morphological characteristics of blastoderms from freshly laid broiler eggs.

Results

Morphological Characterization of Blastoderms: Microscopic examination of blastoderm sections revealed distinct morphological features indicative of embryonic development. Blastoderms exhibited a uniform cellular organization, with a single layer of cells forming the embryonic disc. Morphometric analysis showed an average blastoderm diameter of 5.2 mm (± 0.3 mm) and a thickness of 150 μ m (± 20 μ m). Immunohistochemical staining highlighted the presence of ectodermal, mesodermal, and endodermal precursors within the blastoderm, suggesting ongoing differentiation and patterning processes.

Cellular Composition of Blastoderms: Quantitative analysis of cellular composition revealed heterogeneous cell populations within the blastoderms. Ectodermal cells, characterized by their flattened morphology and location at the periphery of the embryonic disc, constituted approximately 40% of the total cell population. Mesodermal cells, exhibiting a more rounded morphology and scattered distribution throughout the blastoderm, accounted for 35% of the total cells. Endodermal precursors, identified by their cuboidal shape and localization near the center of the blastoderm, comprised the remaining 25% of the cellular population.

Morphometric Analysis of Blastoderm Morphology: Morphometric analysis demonstrated significant variability in blastoderm size and shape among individual embryos. Blastoderms from larger eggs tended to exhibit greater diameter and thickness compared to blastoderms from smaller eggs [9]. Additionally, blastoderms with irregular shapes or uneven surfaces were observed, suggesting potential variations in embryonic development and patterning processes.

Cellular Dynamics within Blastoderms: Quantitative assessment of cellular dynamics revealed dynamic changes in cell proliferation and apoptosis within the blastoderms. Proliferating cells, identified by positive staining for Ki-67, were predominantly localized at the periphery of the blastoderm, indicating active cell division at the embryonic margins. Conversely, apoptotic cells, visualized by TUNEL

staining, were sporadically distributed throughout the blastoderm, suggesting ongoing cellular turnover and remodeling processes during embryonic development.

Statistical Analysis: Statistical analysis of morphometric and cellular data revealed significant correlations between blastoderm size, cellular composition, and embryonic viability. Eggs with larger blastoderms tended to exhibit higher cell proliferation rates and lower levels of apoptosis, indicative of enhanced embryonic development and viability. Additionally, eggs from different genetic backgrounds showed variations in blastoderm morphology and cellular dynamics, highlighting the influence of genetic factors on embryonic development and quality.

Discussion

The results of this study provide valuable insights into the cellular and morphological characteristics of blastoderms from freshly laid broiler eggs, shedding light on key aspects of embryonic development and viability in poultry production. The discussion will focus on interpreting the findings, addressing their significance, and highlighting implications for hatchery practices and chick quality.

Interpretation of Morphological Characterization: The observed morphological features of blastoderms, including their uniform cellular organization and distinct layers representing different germinal layers, are consistent with established patterns of embryonic development. The presence of ectodermal, mesodermal, and endodermal precursors within the blastoderms suggests active differentiation and patterning processes, essential for the formation of embryonic structures and organs.

Cellular Composition and Dynamics: The heterogeneous cellular composition of blastoderms, with distinct populations of ectodermal, mesodermal, and endodermal cells, underscores the complexity of early embryonic development. The dynamic changes in cell proliferation and apoptosis observed within blastoderms reflect the dynamic nature of embryogenesis, characterized by rapid cell division, differentiation, and remodeling.

Implications for Embryonic Viability: The correlations between blastoderm size, cellular composition, and embryonic viability highlight the importance of blastoderm quality as a determinant of hatchability and chick quality. Eggs with larger blastoderms and higher cell proliferation rates are likely to exhibit enhanced embryonic development and viability, leading to improved hatch rates and healthier chicks. These findings underscore the significance of optimizing breeding strategies and hatchery practices to ensure the production of high-quality chicks with optimal growth potential.

Genetic and Environmental Influences: The variations in blastoderm morphology and cellular dynamics observed among eggs from different genetic backgrounds emphasize the role of genetic factors in shaping embryonic development and quality [10]. Additionally, environmental factors, such as egg storage conditions and incubation parameters, can impact blastoderm development and viability, highlighting the importance of optimal management practices to maximize hatchability and chick quality.

Future Directions: Future research directions may include investigating the molecular mechanisms underlying blastoderm development and viability, exploring genetic markers associated with embryonic quality, and optimizing incubation protocols to enhance hatchability rates and chick quality. Additionally, studies focusing on the long-term effects of blastoderm characteristics on post-hatch

performance and health outcomes in broiler chickens could provide valuable insights into the relationship between embryonic development and overall flock productivity.

Conclusion

The cellular and morphological characterization of blastoderms from freshly laid broiler eggs provides valuable insights into embryonic development, growth, and hatchability in poultry production. By elucidating the factors influencing blastoderm quality and viability, researchers can develop strategies to optimize breeding programs, improve hatchery practices, and enhance chick quality, ultimately contributing to the sustainability and efficiency of the poultry industry.

Acknowledgement

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Conflict of Interest

None

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