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# Role of Lymphocyte in Growth and Immunity in Gut Protozoa-Infected Poultry Birds

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## Introduction

The gastrointestinal tract of poultry is much more than a digestive organ. Besides breaking down feed and absorbing nutrients, it serves as a major defensive barrier against the enormous number of microorganisms encountered daily through feed, water, litter, and the environment. Reynolds (2003) described the intestine as the primary interface between the bird and its environment, where nutrient absorption and immune defence occur simultaneously. Among enteric diseases affecting poultry, coccidiosis remains one of the most economically devastating diseases worldwide. The disease is caused by intracellular protozoan parasites of the genus *Eimeria*, which invade and multiply within intestinal epithelial cells. According to Williams (2005), and Khukhodziinai *et al*. (2024) the resulting tissue damage causes reduced nutrient absorption, poor feed conversion efficiency, decreased body weight gain, and increased susceptibility to secondary bacterial infections such as necrotic enteritis. To combat these pathogens, poultry rely heavily on their immune system, particularly the gut-associated lymphoid tissue (GALT), which contains large populations of lymphocytes. These immune cells not only protect birds from disease but also help maintain intestinal integrity and productivity.

## Lymphocytes: The Immune Defenders of the Poultry Gut

Lymphocytes are specialized white blood cells responsible for recognizing and eliminating pathogens. Reeba *et al*. (2020) reported that lymphocytes constitute approximately 18-42% of circulating leukocytes and represent one of the most important cellular components of the immune system. The intestine contains a remarkably large immune cell population because it is continuously exposed to foreign antigens. Befus *et al*. (1980) observed that nearly 80% of intestinal leukocytes in chickens are lymphocytes, highlighting their importance in maintaining gut health.

The development of intestinal immunity begins early in life. Wickramasuriya *et al*. (2022) reported that lymphocytes can be detected in the intestine as early as four days after hatching, with their numbers increasing rapidly during the first few weeks of life as the immune system matures. This early immune development is particularly important because young chicks are highly susceptible to enteric diseases. Lymphocytes are concentrated within gut-associated lymphoid tissue, including cecal tonsils and lymphoid aggregates

distributed throughout the intestine. Lillehoj and Trout (1996) emphasized that these tissues act as surveillance centers that continuously monitor the intestinal environment for invading pathogens.

**Types of Lymphocytes and Their Functions**

**T Lymphocytes: The Cellular Defenders**

T lymphocytes commonly referred to as T cells are responsible for cell-mediated immunity. According to Al-Shura and Niambi (2020), these cells recognize infected cells and directly destroy them while coordinating other components of the immune response. T cells are particularly important in protecting poultry against intracellular parasites such as *Eimeria*, which spend much of their life cycle within intestinal epithelial cells.

Once infection occurs, T cells migrate to the site of infection and initiate mechanisms that limit parasite multiplication and reduce tissue damage.

The importance of T cells in coccidiosis has been demonstrated repeatedly. Rose and Long (1970) showed that birds with impaired T-cell function exhibited greater susceptibility to coccidial infection. Similarly, Lillehoj (1987) demonstrated that suppression of T-cell activity severely reduced protective immunity against *Eimeria* species. Trout and Lillehoj (1996) further reported that CD4+ helper T cells and CD8+ cytotoxic T cells actively participate in controlling parasite development within the intestine.

**B Lymphocytes: The Antibody Producers**

B lymphocytes are responsible for humoral immunity through the production of antibodies. According to Al-Shura and Niambi (2020), activated B cells differentiate into plasma cells that release antibodies capable of recognizing and neutralizing pathogens. Lillehoj and Trout (1996) reported that chickens produce three major classes of antibodies: IgM, IgA, and IgY. IgM is generally associated with early immune responses, whereas IgA plays an important role in mucosal immunity by protecting the intestinal surface. IgY, considered the avian equivalent of mammalian IgG, provides systemic protection against infections.

The importance of maternal antibodies was highlighted by Rose (1972) and Wallach (1997), who demonstrated that IgY antibodies transferred through egg yolk provide newly hatched chicks with temporary protection during the early stages of life when their own immune systems are still developing.

**Lymphocytes and Coccidiosis**

Coccidiosis causes extensive damage to intestinal epithelial cells and disrupts normal digestive processes. According to McDougald (1998, 2003), parasite multiplication within intestinal tissues results in impaired nutrient absorption, reduced weight gain, and poor feed conversion. The host immune response begins shortly after infection. Both humoral and cellular immune responses are activated, but evidence suggests that T-cell-mediated immunity plays the dominant role in protection against coccidiosis. Daugschies and Najdrowski (2005) reported that both cellular and humoral immunity contribute to resistance against coccidial infections. However, T-cell responses are considered the primary protective mechanism. Yun *et al*. (2000) observed marked changes in intestinal lymphocyte populations following *Eimeria tenella* infection, while Martin *et al*. (1994) demonstrated increased production of interferon-gamma (IFN-γ), an important cytokine involved in parasite control. Birds with strong lymphocyte responses generally exhibit lower oocyst shedding, reduced lesion scores, and faster recovery following infection (Khukhodziinai *et al*., 2024).

**Relationship Between Immunity and Growth Performance**

The intestine is responsible for nutrient digestion, absorption, and utilization, making gut health directly linked to production performance. Sanderson (2003) emphasized that the

gastrointestinal tract must balance nutrient absorption with immune defense. During coccidial infection, this balance is disrupted. Intestinal damage reduces digestive enzyme activity, impairs nutrient absorption, and alters microbial populations within the gut. Lu *et al*. (2021) reported that coccidial infections negatively influence protein digestion, carbohydrate metabolism, and nutrient utilization. Consequently, infected birds often exhibit reduced body weight gain and poorer feed conversion efficiency. Strong lymphocyte responses help preserve intestinal integrity and reduce tissue damage, allowing birds to maintain productive performance despite infectious challenges. Thus, immune competence and growth performance are closely interconnected in modern poultry production systems.

**Factors Affecting Lymphocyte Function**

**Bird Genetics**

Immune responsiveness varies among poultry breeds and commercial strains. Lotvedt *et al*. (2017) and Cheema *et al*. (2003) demonstrated considerable differences in immune responses among genetically distinct poultry lines.

**Environmental Stress**

Stress is a major suppressor of immunity in poultry. Webster and Glaser (2008) reported that stress decreases lymphocyte proliferation and antibody production while increasing disease susceptibility. Heat stress is particularly detrimental in tropical and subtropical regions. Niu *et al*. (2009) observed reductions in lymphoid organ development and immune competence in heat-stressed broilers.

**Nutrition**

Proper nutrition is essential for maintaining immune function. Perween *et al*. (2016) highlighted the importance of balanced diets for immune development and disease resistance.

Wang *et al*. (2000) and Singh *et al*. (2006) reported improvements in lymphoid organ development and immune function following supplementation with vitamins, minerals, fatty acids, and phytogenic additives.

**Infectious Diseases**

Continuous exposure to pathogens places additional pressure on the immune system and diverts nutrients away from growth toward immune responses, ultimately reducing productivity.

**Strengthening Immunity Through Alternative Strategies**

The global reduction in antibiotic usage has stimulated interest in alternative methods for improving gut health and disease resistance. According to Gadde *et al*. (2017), and Khukhodziinai *et al*. (2024) probiotics, prebiotics, organic acids, phytogenic compounds, and essential oils can enhance immune responses and improve intestinal health. Lillehoj and Lee (2012) proposed that modulation of innate immunity may become one of the most effective approaches for reducing dependence on antibiotics and anticoccidial drugs in poultry production. Such strategies not only support lymphocyte activity but also contribute to improved welfare, sustainability, and production efficiency.

**Conclusion**

Lymphocytes are indispensable components of the poultry immune system and play a central role in protecting birds against coccidiosis and other intestinal diseases. Through both cellular and humoral immune responses, these cells preserve gut integrity, improve nutrient utilization, and support growth performance. Strengthening lymphocyte function through nutrition, management, and disease prevention strategies is essential for sustainable poultry production and improved flock health.

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