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# The role of amino acids deficiency in broiler chick's infection, with Newcastle disease: A review

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**Abstract:**

The chosen birds growing fast are kept in cages with high stocking densities in intensive poultry production systems. According to estimates, genetic selection accounts for 85-90% of performance gains, with management and nutrition improvements accounting for the remaining 10 to 15%. Newcastle disease, which has a prevalence rate of 28.9%, is the most common viral infections in poultry, affecting both domestic and wild bird types. Immune modulation, vaccination, and a healthy diet are the major strategies that may be utilized to build immunity in hens in order to stop and manage the development of illness. Chickens immune systems directly affect their health, and help them grow into healthier birds. Most essential amino acids are thought to be vital components for cytokine synthesis and immunological function

***Keywords: Amino acids; Deficiency; Broiler; chick's; Newcastle disease; Immunity.***

## Introduction

The majority of livestock, or about 30% of total animal protein, is comprised of poultry. Nevertheless, only 20% of all poultry are used for this production, primarily coming from commercial birds (Pemin *et al*., 2001). Genetic selection is thought to be responsible for 85 to 90% of performance advances, with management and nutrition improvement accounting for the remaining 10 to 15%. (Haven-stein *et al*., 2003).

Newcastle disease, which has a prevalence rate of 28.9%, is the most common viral infection in poultry, influencing both domestic and wild bird types (Adene, 2004). In order to stop and manage the spread of infections in hens, the three primary strategies for boosting immunity are immunological modulation, vaccination, and appropriate diet. (Pangasa *et al*., 2007).

The quality of the eggs laid by laying chicken and body growth of broilers chick are greatly influenced by their nutrition (Wang *et al*. 2017). According to Kidd et al. (2004), performance was positively impacted and healthy broiler chicks reacted well to high dietary inclusion of amino acids. For several purposes, including development, immunology, tissue turnover, enzymatic activity, and egg production, poultry require protein (Beski *et al*., 2015). Commercially accessible amino acids levels are often raised to keep up with further growth (Corzo *et al*., 2002). The creation of amino acid supplements makes it possible to satisfy EAA requirements with little protein intake (Ojano-Dirain and Waldroup, 2002).

The main aims of this review was to determine the effect of deficiency of some essential and non-essential amino acids, which have a direct role in improving and immunizing the immune system of chickens against the Newcastle disease virus, which is considered one of the most widespread viral diseases and has major economic impacts on the raising, industry and marketing of chicken in Iraq. It causes symptoms and signs that affect various vital systems in the body and cause severe morbidity and mortality.

**Poultry diet**

Specifications for commercial broiler feeder are often updated in response to new breeds releases and modifications in nourishing regimens (Cobb-Vantress, 2020). In contrast, the NRC rules (1994) for such AA apply to feeding stages ranging from two to six weeks. However, the proteins used in chicken feed can originate from a range of sources, each with a variable amount of crude protein (such as fishmeal, soybean meal, cottonseed meal, etc.). On the other hand, low-protein diets may decrease the generation of antibodies directed against sheep erythroocytes (SRBCs) (Abbasi *et al*., 2014).

**Amino acids in the immunity**

Numerous nutrients have the ability to alter the immunity (Jankwoski *et al*., 2014). Dietary modification needs using certain nutrients to accomplish a general functional purpose (Korver, 2012). Most essential amino acids are thought to be valuable resources for immune function and cytokine production (Li *et al*., 2007). Furthermore, all animals require an adequate supply of amino acids in their diets to

maintain normal immunological competence and shield the host from certain illnesses (Beski *et al*. 2015). Supplementing with amino acids helps chickens develop their growth, immunity, feed conversion efficiency, and butyric acid synthesis with short-chain fatty acids (Chrystal *et al*. 2020; Hilliar *et al*., 2020).

According to (Calder 2006), the immunological responses of intestinal epithelial cells (IECs) and immune cells are also directly regulated by certain amino acids. In the liver, for example, where methionine is an essential signaling molecule, a reduction in the fat transporter and the accumulation of hepatic fat cause greater activation of the inflammatory cytokines (IL-1 and IL-8) in the chickens given insufficient methionine (Peng *et al*., 2018). Cysteine is a non-vital amino acid that is produced by the body from methionine and is intimately linked to the growth of immune cells (Rubin *et al*., 2007).

Accordingly, amino acids contribute to boosting overall physiological condition (Bouyeh and Gevorgyan 2016), immunize against contagious diseases (Faluyi *et al*. 2015), stabilize under non-contagious or management conditions (Saleh et al. 2018), and overall improve the performance of birds in terms of production (Ghoreyshi *et al*. 2019).

**Table (1):- Data available regarding the optimal amino acid profile for broiler chicks**

| Amino acid | Baker (1996a,b) | | NRC (1994) | | Austic (1994) | CVB (1996) |
|---|---|---|---|---|---|---|
| | 0-21 d | 21-42 d | 0-21 d | 21-42 d | 0-21 d | 0-42 d |
| Lys. | 100 | 100 | 100 | 100 | 100 | 100 |
| Meth. | 36 | 36 | 45 | 38 | 38 | 38 |
| Meth. + Cys. | 72 | 75 | 82 | 72 | 72 | 73 |
| Thre. | 67 | 70 | 73 | 74 | 62 | 65 |
| Arg. | 105 | 108 | 114 | 110 | 96 | 105 |
| Val. | 77 | 80 | 82 | 82 | 69 | 80 |
| Ileu. | 67 | 69 | 73 | 73 | 65 | 66 |
| Leu. | 109 | 109 | 109 | 109 | 92 | ND* |
| Try. | 16 | 17 | 18 | 18 | 18 | 16 |
| His. | 32 | 32 | 32 | 32 | 24 | ND* |

***ND: Not determined**

## Newcastle disease virus (NDV)

Newcastle disease ranks 4$^{th}$ among chicken infections in terms of livestock units lost, after infectious bronchitis, high and low pathogenic avian flu (Anonymous,

2011). The infection is known as newcastle disease virus (NDV) is brought on by virulent strains of avian paramyxovirus-1 (AMPV-1) (OIE, 2012). More than 236 bird species have been documented to get the newcastle virus (Kaleta and Baldauf, 1988). As well as, deadly (vNDV) strains are also often detected in pigeons and double-crested cormorants, in addition to poultry species (Pchelkina *et al*., 2013). They are also sporadically detected in a number of other wild bird species (Kaleta and Kummerfeld, 2012).

**Immunity**

The host system of immunity, which is formed of both acquired (adaptive and specific) and innate (natural and non-specific) system, defends the body against a variety of diseases (Calder, 1995). Regulate the innate and acquired immune system is controlled by the most interactive network of chemical communications, which also involves the production of cytokines, immunoglobulins, and antigen-presenting machinery (Calder, 2006; Lima and Kasim, 2020). The production of these proteins and peptides, as well as other compounds of great biological significance, depends heavily on the availability of enough amino acids for both immune systems (Kim *et al*., 2007).

A overview of the formation and operation of the humoral immune system in chickens was published by (Glick 1977). (Glick 1977) pointed out that our knowledge of the immunity in birds is limited because of the ways in which the environmental affects immunity. This prompted studies on the humoral (Glick *et al*., 1981) and cellular (Glick *et al*., 1983) immune system in hens under calorie-protein deficit. Acute dietary reduction in branched-chain amino acids by 50% of the control level was assessed by (Konashi *et al.,* 2000), who also noted a decrease in the relative volume of the bursa and thymus. Reduced or increased dietary protein or amino acids intake was demonstrated to modify immunological responses (Kogut, 2009, Emadgh *et al*., 2020)

**Vaccination**

The immunization program for broiler chickens typically concludes four weeks after hatching, but it typically lasts eighteen weeks for laying hens. Immunomodulants may be advantageous, particularly during the NDV vaccination period in broilers, as research indicates that the combination of inflammatory chemicals, such as poly I:C, or LPS, might boost the efficiency of the vaccine (Kannaki *et al*., 2019), can be beneficial, especially at the time of vaccination in broilers. Suppression of the inflammatory response during vaccination is known to cause in lower antibody

titers (Lee *et al*., 2017), highlighting the significance of inflammation in promoting and maximizing vaccine effectiveness.

There are two types of vaccinations for Newcastle disease “live” or “kill” forms: live vaccines must be applied to birds in a cold chain as they are delicate and have strict usage guidelines. If the birds still have leftover antibodies, it is less effective. According to (Reeve *et al*., 1974), as the pathogenicity of the live vaccination grows, so does the immune response. In general, vaccination against NDV elicit an immune response that lowers or eliminates clinical morbidity and mortality caused by NDV, lowers the quantity of virus discharged into the environment, and raises the quantity of virus required to infect the vaccinated animal (Miller *et al*., 2009).

Newcastle disease is controlled and prevented by vaccines. There are several inactivated and live ND vaccines accessible right now in the globe (Shim *et al*., 2011; Xiao *et al*., 2013). While a thorough vaccine shields birds from clinical symptoms, it cannot stop the virus from replicating and shedding that is where the illness originates (Chukwudi *et al*., 2012, Alaa *et al*., 2020).

## Conclusions

Newcastle disease virus caused by avian paramyxovirus type I (APMV-1) represents a continuing threat to the development of poultry farming, especially the traditional type in developing countries. Protein is an essential component of all animal body tissues and has a significant impact on the growth performance of birds. Therefore, amino acids are required for the synthesis of a variety of private proteins (including antibodies and cytokines) and organization key metabolic pathways for the improving and immunizing against infectious pathogens.

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