

Animal nutrition and immunology

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In the last 40 years, the genetic performance potential of poultry has been considerably improved. New knowledge on nutrition and metabolism as well as on growth and reproduction processes has accumulated and genetically determined differences between stocks which influence nutritional needs and feed conversion have been discovered. Moreover, considerable progress has been made in veterinary medicine. Better diagnostic tools, improved vaccination programmes, more efficient drugs and, even more important, improved communications (for example, in epidemiology) all contribute to assist livestock farmers.

Breeding companies regulate the procedural methods for laying, breeding and fattening in order to achieve maximum performance.

However, in modern poultry farming, higher mortality rates, due to the consequences of increased and variable stress, reduce economic returns. Stress has a direct negative impact on animal's immune system resulting in more frequent occurrence of disease and impaired development.

Therefore, effective control of disease is important in intensive animal farming. Prevention must be given highest priority. This includes hygienic measures, immunisation programmes and disinfection.

Often, however, protection of the animals by the use of vaccines and clean grow out facilities is not sufficient. Chemotherapeutics or antibiotics are widely used for both treatment and prophylaxis, but the use of drugs should be the option of last resort, even without consideration of today's widespread public

concern about chemically tainted meat.

Despite the progress that has been made, it is more and more evident that the competence of natural immunity is still the most essential element in the control of disease.

No pharmaceutical intervention can be invariably successful if the animal's immune system is not simultaneously enhanced in order to increase resistance to disease. Still little is known about the influence of nutrition on immunity although some trace elements (for example, chromium) and vitamins (for example, vitamin E) can exert a direct impact on the immune system.

Biogenic enhancers

RNA/nucleotides do not fit into the classical definition of an essential nutrient. Nutrients required for normal systemic functioning that cannot be synthesised by the organism and, therefore, must be obtained from a dietary source, are classified as essential nutrients.

In the meantime, such essential nutrients have been defined and nutritionists inflexibly include vitamins, amino acids and minerals into diets for poultry in the various growth stages. As a consequence, performance and feed utilisation has been markedly improved.

It was believed that all organisms can, via the recycling of nucleotides from dead cells supply sufficient amounts of nucleotides to meet their physiological demands.

However, we have now learned that this is probably not true.

The most important functions of nucleotides are the storage of

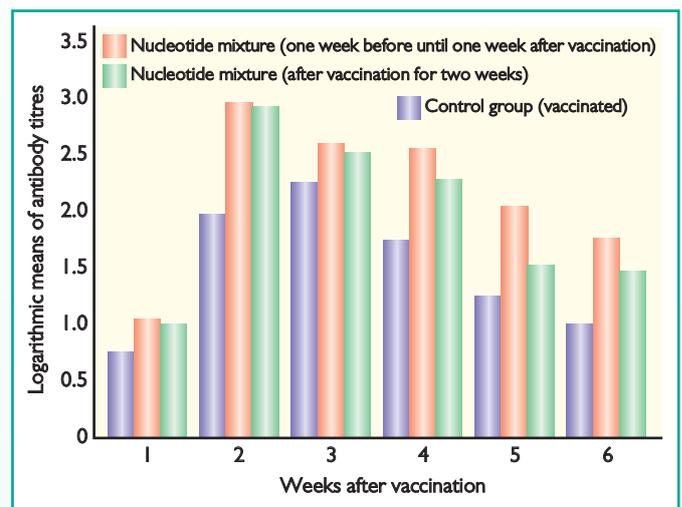


Fig. 1. Effect of nucleotide mixture on antibody titres of chickens vaccinated with NDV.

genetic information required for identity, optimum physiology and function and for the multiplication of cells. Cell proliferation, imperative to the life of all organisms and fundamental to their biological functions, is wholly dependent on these nucleotides. For just one single cell division, approximately three billion nucleotides are required.

When considering the fact that living organisms must produce millions of new cells every second in order to simply maintain the status quo, it is quite easy to understand that during times of extraordinary stress, such as growth, reproduction, disease, environmental abnormalities and recovery from injury, trillions of additional nucleotides must be readily available. However, the incessant production of nucleotides is slow and metabolically taxing, negatively affecting the overall performance of an organism.

Thus, the role of nucleotides in helping surmount the effects of single, multiple or simultaneous stress factors merit their re-evaluation from non-essential dietary RNA/nucleotides to semi-essential or conditionally essential nutrients.

Nucleotides are chemical compounds that consist of three components: a heterocyclic base, a sugar and one or more phosphate groups.

In the most common nucleotides, the base is a derivative of purine or pyrimidine and the sugar is a five carbon sugar (pentose). RNA and nucleotides provide basic building blocks for cell proliferation in fauna and flora.

Unhindered cell proliferation is a prerequisite for growth, repair, disease resistance, healing and pre-emptive function of organs and regulatory systems (for example, the immune system).

Nutritional improvement

Fundamentally, immunity is the ability to establish an effective defence against pathogens by maintaining the dermal barrier, producing specific antibodies, stimulating phagocytic cells and expressing various types of defence proteins. The first line of defence is the rapid assembly of skin and mucous membranes on the outer surface as well as the intestinal tract to prevent the penetration of pathogens into the organism.

Lesions permit the unhindered infiltration of pathogens and need to be repaired as fast as can be.

Another reason for the success of RNA/nucleotide supplementation of diets besides sustaining peripheral

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Table 1. Intestinal development of chicks.

Length of intestinal villi			
Age (days)	RNA/nucleotides	Control	Difference (%)
10	170.626 ± 0.270	121.594 ± 0.276	+ 40.32
14	179.179 ± 0.106	170.030 ± 0.160	+ 5.37
Area of intestinal villi			
Age (days)	RNA/nucleotides	Control	Difference (%)
10	23.18 ± 3.65	15.62 ± 3.72	+ 48.39
14	24.88 ± 5.57	24.96 ± 5.10	+ 0.00

Continued from page 15 barriers is the intensified and accelerated response of the immune system. Acquired immune response comprises memory based reactions of specific cells in the organism which are assembled during or after the initial contact of the animal with a bacterial, viral or parasitic antigen.

In general, the immune response is activated through the production of millions of specialised cells. This process, as well as the activation of specific protein expression, is accelerated when more nucleotides are made available.

Additionally, a strong immune response is equally important to address stress factors, such as injuries, environmental changes, physical exertion, growth and disease. Every burden taxes the immune system and the organism's ability to survive or adequately react to changes during its lifetime.

Intestinal development

The development of the intestinal tract upon dietary RNA and nucleotides was studied in various species.

Day old chicks fed a diet containing RNA and nucleotides for 10 days showed an advance of four days in the development of intestinal villi structures compared to control ani-

mals (see Table 1). This not only increases the active surface of the gastro-intestinal tract and the effectivity of intestinal enzymes but also supports the assembly and maintenance of the intestinal barrier to parasites and pathogens.

Immune system and status

In numerous trials in poultry, the effects of RNA/nucleotides on the immunological status of the birds were confirmed. For instance, the effect on antibody titres after vaccination against NDV was determined in Hubbard chicks (Fig. 1).

Administering the RNA/nucleotides resulted in a more rapid increase in the antibody titre compared to the control, irrespective of dispensing RNA/nucleotides before or simultaneous to vaccination.

Moreover, the antibody titre persisted longer compared to the control. However, the effect was more pronounced when RNA/nucleotides were added before the vaccination.

In the same experiment, there was an added challenge with virulent NDV. 65% of the vaccinated control animals were protected from infection with NDV. In the RNA/nucleotide test groups the protection increased to 90 or 80% respectively.

This experiment demonstrates the highly positive effects of RNA/nucleotides on immunological parameters. The vaccinated animals fed a RNA/nucleotide fortified diet were more rapidly and thoroughly protected from an infection with virulent NDV.

A trial, purely designed to test the efficiency of RNA/nucleotides on performance of broiler breeders, unexpectedly turned into a health challenge experiment after the outbreak of coccidiosis followed by an IB variant and an acute Marek infection.

Even under these challenges, the performance in the trial group receiving RNA/nucleotides was remarkably improved compared to the control group receiving a normal diet. The mortality was reduced by 67.6%, the egg production was increased by 13.8% and the hatchability rose to 11.6%.

This indicates that the bird's general health was supported by the addition of a balanced formulation of RNA/nucleotides to the feed.

The birds coped with the infections and at the same time maintained an admissible performance.

The support of the immune system results in stabilised performance and productivity and consequently in increased profit to the producers.

From a physiological point of view, the immune system is one of many

systems that must be in balance with other systemic functions. Health impediments tax the organism and the animal's natural drive to survive reduces performance and productivity and thus the financial return to the producer.

Summary

RNA/nucleotides are the building blocks for life and involved in diverse cellular processes. They facilitate immune response by supporting the crucial proliferation of cells involved in cellular and humoral defence mechanisms. RNA/nucleotides are natural substances, which, when purified and balanced accordingly, will not stimulate innate or acquired immunity, as do Beta Glucans and cannot be overdosed.

By providing the resource for unhindered cell proliferation, gene expression and signalling, they quickly and proficiently react to health challenges without creating undesirable side effects like resistance.

The use of RNA/nucleotides is not restricted to species or applications and their universally successful use and diverse functions in every living organism make them an ideal management tool to control and diminish stress, improve performance, and modulate disease. ■