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Popular Article

Importance of Early Nutrition in Commercial Chicken Production

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Introduction

Broilers nowadays reach slaughter weight comparatively at a younger age and the embryonic period as well as the first week post-hatching represents 45 % of the whole life span. The first 14 post-hatch days represent approximately 25-33% of the growth period for broilers, 12.5% of the pullet development period in layers, and 10-14% of the life of a market turkey. Thus, pre-hatch as well as the transitional post-hatch period must be achieved efficiently. It is known that body weight is increased three to four-fold during the first week and considerable changes in gut, muscle weight and morphology are observed. Meat type broilers are capable of achieving 70g/d till 40 d. This achievement requires emphasis on early phase nutrition. Delayed access to feed and water was found to reduce starting weight at placement whereas early access to feed generally improved it. Each gram of additional weight at 7 d of age translates to 5g of extra body weight at 49d (Leeson and Summers, 2001). Therefore, delayed feeding in the first few days of life reduces final Body weight (Kidd et al., 2007) and it probably affects immunological capacities (Dibner et al., 1998). Early nutritional strategies offer the promise of sustaining progress in production efficiency and welfare of commercial broiler chicken. In order to develop efficient early feeding techniques, it is necessary to understand the physiological and metabolic changes which occur in the pre- and post-hatch period. Birds that have been given access to food immediately after hatch have been observed to exhibit more rapid development of the intestine during the immediate post hatch period.

Transition from a Pre-Hatch Period to Post Hatch Period

The perinatal period (pre-and post-hatch period) is a critical period in the development of the chick embryo because of its high caloric demand to fuel hatching process and basal metabolism Maintaining sufficient glycogen reserves is of vital importance for surviving the demanding hatching process and for making the transition from endogenous nutrition before hatching to the exogenous nutrition after hatching. The last phase of incubation is characterized by oral consumption of the amnion by the embryo, accumulation of glycogen reserves in muscle and liver tissues and glycogenolysis, initiation of pulmonary respiration, abdominal internalization of remaining yolk, shell pipping, and emergence. During this time frame dramatic physiological and metabolic changes occur, and any disturbances at this stage may markedly affect embryonic survival and subsequent performance. Some of the important metabolic pathways prior to hatch are described in a recent review (De Oleveira et al., 2008) which emphasizes the liver, pectoral muscle, hatching muscle and intestine, as most affected by changes toward hatch. The immediate post-hatch period is critical for intestinal morphological development in order to digest feed and assimilate nutrients.

In ovo technology

One of the useful tools for precision poultry farming and production is the in ovo technology for transforming the situations within the egg through the application of vaccines, nutrients and other bio actives. With this technique, one can deposit a definite quantity of cautiously chosen material into a particular location inside an incubating egg. In ovo technology is targeted for the most decisive time in the chick's development, that is, the perinatal period. The perinatal period extends from the last days of the egg's incubation to the initial few days post-hatching. At this time, the embryo needs to adjust to a change in food, which is from the fat-rich to the carbohydrate rich, as well as contact with environmental microbes. In commercial settings, the hatching window is a necessary evil and so unavoidable. Because of these various factors, in ovo method has been developed to facilitate manipulation of the chicken embryo before hatching. In principle, this technology is basically dependent on the delivery of matters by mechanical means straight inside the incubating egg. First, in ovo inoculation was used for the vaccination purpose against Marek's disease (MD) on the 18th day of incubation and observed better immunization (Sharma and Burmester, 1982). In ovo, immunization is mainly used for MD, Gumboro, Ranikhet and Avian Influenza. However, in ovo technology as a tool of prenatal nutrition is still an area of exploration, and its application is being investigated to deliver carbohydrates, peptides, vitamins, prebiotics, probiotics, synbiotics, etc. Such precise manipulation of the embryo may develop the vigor and resilience

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of the hatched chicks, which contributes to their further post hatching growth.

In ovo feeding

In order to overcome the described physiological limitations and to improve intestinal functionality and nutritional status of hatchlings, a methodology for "feeding the embryo" (inovo feeding) was developed. In ovo feeding is a technique of providing essential nutrients in the egg itself. Early nutrients access has a fundamental function in the initial stage of growth and utilization of nutrients by chicks. Rapid development, feed utilization efficiency, getting early to marketable bodyweight (Bakyaraj et al., 2012), increased perinatal development (Ferket and Qureshi, 1992) can be achieved with in ovo method of feeding. The supplementation of macro and micronutrients and probiotics also causes a valuable outcome on hatchability as well as disease resistance of hatchlings (Uni and Ferket, 2003).

Different routes of in ovo feeding

In ovo feeding of nutrients is done via intraembryonic and extraembryonic routes. The intra-embryonic route involves direct inoculation of nutrients into embryonic tissue. in extraembryonic routes, nutrients are inoculated into different extraembryonic contents, viz. yolk sac, albumen, amnion, allantois and chorion and air cell, from where nutrients are absorbed by various mechanisms.

The development of egg-laying birds after hatching is improved through feeding a subject before hatching. The subject should be fed with nutrients or an enteric modifier. The nutrient composition preferably should have a minimum of one amino acid, protein, peptide, or carbohydrate. A favourite enteric modulator is hydroxymethyl butyrate. Feeding may be done by giving the nutrients and/or enteric modulator in the amnion where these are orally consumed by the subject (Uni et al., 2003). Therefore, the nutrients can be better supplemented to the developing embryo via the amniotic sac at the later phase of growth, i.e. 18 days of incubation to give a nonstop supply of vital nutrients during the first few days (3- 4 days) of the after-hatch period, so facilitating enteric development and metabolism. The three crucial determinants for in ovo feeding include route of injection, the timing of injection and dose of nutrients (Ohta and Kidd, 2001). Presently 18 to 24 G needles or specialized Inovoject systems are used for injecting the nutrients. After the injection of the egg with the sterile needle under the controlled environment, the site of injection is closed with the paraffin film and the egg is placed into an incubator. The ideal time to administer nutrients in an in ovo feeding programme is 456 hours from fertilization that is roughly e 19 through the amniotic route (Kornasio et al., 2011).

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In-ovo **feeding method**

Using sterile microliter injection kit and needles under a controlled environment nutrients are injected into the egg shell by creating a small hole without damaging the membrane. Paraffin film is used to seal the injection site aseptically and the egg is placed back in the incubator.

Advantage

- Better hatchability and increased body weight at hatch.
- Improved growth rate, body weight and feed efficiency.
- Increased total digestive tract capacity.
- Improved response to enteric pathogens and immune status.
- Reduced post hatch morbidity and mortality.
- Increased breast muscle yield.
- Reduced incidence of skeletal muscle disorder.

Limitations

- Requirement of skilled person to complete the operation.
- High maintenance cost. Therefore, suitable for large commercial farm only.

Nutrients for in ovo feeding

The main purpose of in ovo feeding is to make the embryo able for faster post-hatch growth. Supplying the embryo with exogenous nutrients would allow the GIT to build up the structures and functionality to correctly digest and absorb nutrients instantaneously when an exogenous nutritional supplement is provided after hatch. These exogenous nutrients, together with the yolk sac reserves, can contribute not only to maintaining the systems and metabolism already established but also to continuing growth, development, and proper nutritional condition. Feeding of carbohydrates, proteins, and amino acids, vitamins or other modulators through in ovo injection have been evaluated. Carbohydrates commonly act as a glucose source and are essential for the process of hatching and hatchling development (Uni et al., 2003). With eggs inoculated with carbohydrates such as, maltose, sucrose and dextrose, it was observed that the extra source of energy improved the development of goblet cells and augmented the surface area of villi in the intestine. Nutrients that can be used in ovo feeding include carbohydrates, all amino acids, fatty acids, vitamins, and other modulators.

In ovo feeding and gut development

Early access to feed does a key job in the development of the gut (GIT). The critical thing is that the digestive tract grows faster than any other body system in the earlier life stage of chicks. The method of in ovo feeding permits the deliverance of a range of supplements

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straight into chicken embryos; facilitate the early founding of a healthy gut microbiome prior to it is exposed to any pathogenic bacteria

In ovo feeding and immune response

In ovo feeding may also stimulate immunocompetence during early stages by enhancing the protective function of enteric mucosa. The primary defence against gut infection is the mucus gel layer of the intestinal epithelium. in ovo feeding perhaps will be helpful for improving the colonization resistance of enteric pathogenic organisms of newborn and young chicks.

In ovo stimulation and embryonic microbiome

The key notion of the in ovo stimulation is centered on stimulating the colonization of the embryonic gastrointestinal tract with its native microbiota that will help in establishing the optimal microbiota already existing during the incubation of the egg. It is shown that delivering 0.2 mL volume of dissolved bioactive stimulus right on day 12 of incubation of egg can kick off an entire flow of incidents on various phenotypic concentrations, from modulation of gene expression to growth performance. In ovo stimulation is especially significant in the industrial production of chicken with a poor microbial profile leading to enteric microbial infestation and infectious disease.

In ovo feeding and postnatal performances of chicks

In ovo feeding of 200 g/L maltose solutions to the chicken embryo can promote the development of the jejunum villus, benefit due to enhancement in the absorption of nutrients and thus increase the weight of hatching (Jia et al., 2011).

In-ovo feeding is expected to yield several advantages, among them reduced posthatch mortality and morbidity; greater efficiency of feed-nutrient utilization at an early age; improved immune response to enteric antigens; reduced incidence of developmental skeletal disorders; improved hatchability; increased muscle development and breast-meat yield and finally shortened the period required to reach target market weight These benefits will ultimately reduce the production cost per kg of the consumable poultry meat.

Conclusion

The delay in feeding of chicks has detrimental ce as well as immune competence of the birds. In ovo approaches need to be standardized for ensuring earliest of the earliest feeding to harness production potential of the poultry to its utmost. More research into standardizing the techniqueseffects on the growth & immune competence of poultry birds. This is because of delayed maturation of gut and enzymatic system. ‘Early Feeding’ is a potent managemental intervention that can improve growth, performan of in ovo nutrition & feeding need to be taken

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up to use this novel technology for enhancing the post hatch performance of birds on one hand and improving the immune status of the birds on the other.

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