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Review article

In ovo EARLY FEEDING FOR ADVANCED FEED UTILIZATION IN CHICKS

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Abstract: Normally in commercial hatchery 90% of chick's hatches around 36 to 48 hr time interval, it takes another 48 hr to reach the rearing farm till that time chicks will be deprived of feed. Early feed access to chicks after hatching had significant impact on the growth and development, increases feed utilization efficiency. Due to unavoidable procedure like vaccination and transportation it is not possible to feed chicks immediately after hatching. Alternative to early feed access *in ovo* feeding is developed, where essential nutrients are directly injected in to developing embryo. This review is made to enlighten the effect of different nutrients over the hatchability, growth and development of chicks after *in ovo* feeding.

Keywords: *In ovo* feeding, hatchability, growth, feed utilization, injection.

Introduction

Poultry birds are precocial young ones in the sense young ones after hatching are mature enough capable of mobile and feeding on its own. Perinatal period few days before and after hatching is a crucial period for chick's growth and development, during this period rapid growth of gastrointestinal tract accurse which is very important for chicks to adopt for external feeding environment from egg nutrient utilization (Ferket et al., 2012). Early development of GIT depends on the early feed access, however some of the practical problems delaying feed access impede the growth. Once the eggs are set for the incubation hatching happens around the 21 days. Even though we are incubating all the eggs at a time 95% of chicks comes out 36 to 48 h time difference. Chicks which are hatched early and late were taken out at a time, further they are deprived of feed for another 48 to 72 h till they reaches the rearing farm. Egg yolk rich in fat, protein, minerals and vitamins saves the chicks till it gets the proper feed and water. Research studies focused on this delayed time interval revealed the fact, chicks which had delayed feed access resulted in decreased growth rate, feed conversion efficiency, extended the time for reaching the marketing bodyweight,

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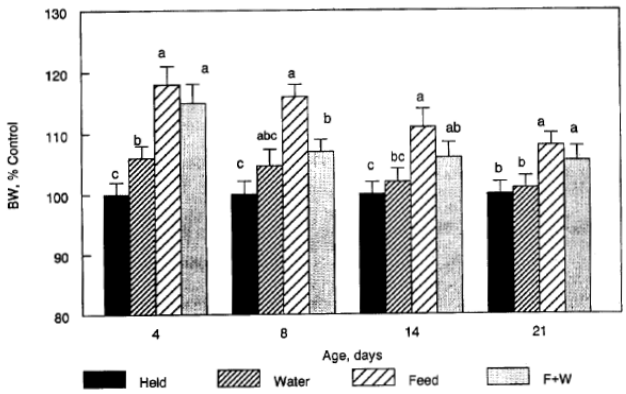
mortality in chicks, impaired muscle growth and carcass weight (Noy, and Sklan, 1999; Nir, and Levanon, 1993; Willemsen et al., 2010). Early access to feed place a major role in development of the gastrointestinal tract (GIT). GIT grows rapidly than the any other system in the early stage of chicks which is critical. Delayed feeding negatively affect the function of the GIT. Research studies demonstrated augmented nutrient absorption and growth in chicks offered feed immediately after hatching. Trend of decreasing days to marketing of broilers every year is further refined by early feeding. Research result (fig.1.) showed that immediate access to feed and water had significant positive impact on bodyweight of the broiler, however it is difficult practically to provide feed and water at commercial level. Time consuming process like removing chicks from the incubator after cleared from the egg shell, sexing, vaccination, packaging and transportation further delays the feed access. Alternative approach to early feeding is through *in ovo* feeding.

Fig.1. significance of chicks having immediate access to feed and water, control group held for 48hr without feed and water (Source: YaelNoy and DavidSkla, 1999).



Nutrient utilization by developing embryo

Developing chick embryo derives its nutrient requirements from albumin (consists of 88% water 12% protein and 0.5% carbohydrates) and yolk (50% water, 15% protein, 33% fat, and less than 1% carbohydrates). Composition fertile egg is not constant in all eggs it depends on the size of the egg, genetic strain, and hen age. Initial period of incubation embryo uses carbohydrates as a source of energy fallowed by protein in the mid incubation and fat in the last weeks of incubation. Yadgary *et al*., 2013 from their research studies informed less fat content in 30 week old broilers breeders fertile egg may expected to affect the chick growth. Last two to three days of hatching due to insufficient oxygen fatty acids do

not undergo oxidation to produce the required energy. So necessary energy is derived from anaerobic catabolism of glucose from glycogen stores and gluconeogensis from the amino acids, glycerol etc. these findings gives an idea that developing embryo needs special concern regarding energy supply and needs external supply of macro nutrients for better development. When we look at the micronutrients utilization by the developing embryo it relay on albumin yolk and shell. Yolk is the major source for P, Zn, Cu, Mn, and Fe, albumin is rich in Na and K and Ca in shell. Highest consumption of minerals occurs between 11 to 17 days of incubation and it is expected that embryo may suffer from mineral deficiency in the last few days of incubation. Compared to other minerals Zn is less efficiently absorbed than other miners from the yolk in last days of incubation (Yairand Uni. 2011).This implies that there is a need to enrich the eggs with minerals and energy to meet the increased metabolic demands of the developing chicks.

***In ovo* feeding**

First *in ovo* injection was used for the vaccination purpose for Marek's disease (MD) at 18th day of incubation and observed better immunization (Sharma and Burmester, 1982). Later after enlightening the knowledge over the embryo development and insignificance of delayed feeding extended to enrich the fertile egg to improve the chick development and production. Normally *inovo* injection for MD vaccination is performed between the 17 to 19 days of incubation. Site of injection may be through air cell, allantoic sac, amniotic sac, embryo or yolk sac route. After injection of egg with the sterile needle under the controlled environment site of injection will be closed with the paraffin film and replaced to incubator. Other than health benefits to chicks in commercial hatcheries *in ovo* vaccination had advantages like reducing labor cost, ensures the uniform and accurate dosage, avoids the cross contamination between the eggs, reduced stress for chicks due to handling during vaccination and ensures the early immunity. Earlier it was thought that egg is sterile free from pathogenic and non pathogenic bacteria but researchers found possibilities of transmission of *Salmonella* (Gantois *et al., 2009*) and some non pathogenic beneficial microorganisms. Starvation of chicks for 48 to 74hr approximately hinders the intestinal villi height and crypt depth even it was demonstrated that slower rate of passage of yolk content from yolk stalk to intestine due to lack of peristaltic movement which is actually initiated by exogenous feed. The *in ovo* feeding allows the delivery of various supplements directly to chicken embryos, facilitate early establishment of a healthy GIT microbiome before it is exposed to any pathogenic bacteria. Various research results utilizing different feed supplements

demonstrated the effect on hatchability, growth rate, feed conversion efficiency, immunity are summarized in table.1. Among the different sites of injection commonly used one is amniotic route, embryo consumes the amniotic fluid and its contents are exposed to the intestines and the enteric cells. Therefore, substances administered to this region will be consumed along with the amniotic fluid and presented to enteric tissues.

Fig. 2. *In ovo* injection sites in eggs (Source: Roto *et al.,* 2016)

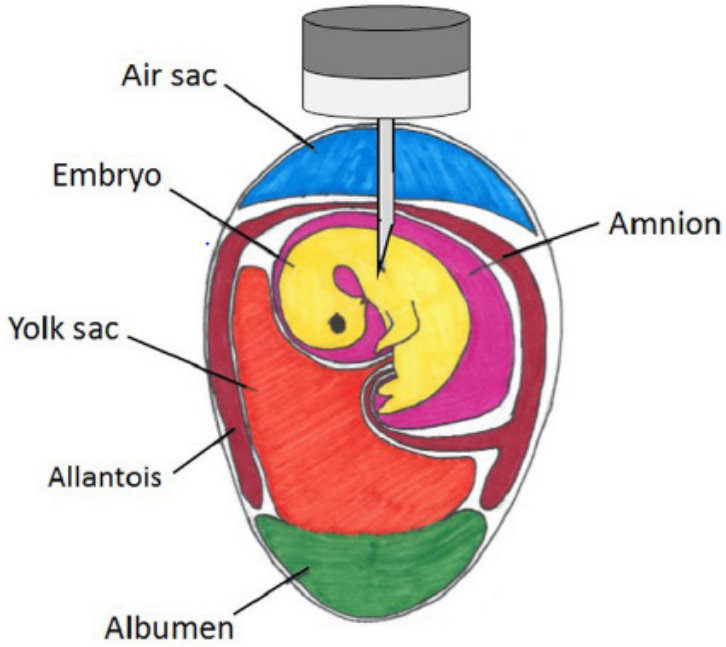


Table. 1. Effect *In ovo* feeding of feed supplements on chick growth and development.

Nutrient injected	Day of injection	Route of injection	Result	Reference
Vitamin E (15 and 30mg/egg)	14th day		Increased hatchability Increased IgM, IgA, IgG Increased feed intake	Salary et al., 2014
Nano Zn (20, 40, 60 and 80 µg/egg) Nano Cu (4, 8, 12 and 16 µg/egg) Nano Se (0.075, 0.15, 0.225 and 0.3 µg/egg)	18th day	Amniotic	No effect on hatchability Best feed efficiency at Zn-40 µg, Cu - 4 µg and Se - 0.225 µg/egg Highest breast muscle percentage at Cu 12 µg/egg	Joshua et al., 2016
Vitamin - A (100 IU) Vitamin - E (0.5 IU) Vitamin - C (50mg) Vitamin – B1 (100 µg) Vitamin – B6 (100 µg)	14th day		Higher hatchability in Vit B6 group Chick weight to egg weight ratio higher in Vit C and A Increased body weight in Vit E and B1	Bhanja et al., 2015

Glutamine (10, 20, 30, 40 or 50 mg)	7th day		Increased weight of the chick Better freed conversion efficiency increased villus height, width and crypt depth increased carcass weight	Salmanzadeh et al., 2016
Dextrose 20% Amino acid solution Albumin 20%	8.5 day 18.5 day	yolk sac (8.5 d) amnion (18.5 d)	Decreased hatchability on 8.5 d injection increased body weight and feed intake of chicks on 18.5 d injection group	Chamani et al.,2012
Dextrin (10%) and β-hydroxy-β-methylbutyrate–calcium (0.4%) salt	18th day	Amniotic	Elevated hepatic glycogen contents of chick. Increased muscle growth and bodyweight	Kornasio et al., 2011
Glucose (75mg) and magnesium (4mg)	7th day	Amniotic	improved weight gain and feed conversion ratio compared to chickens	Salmanzadeh et al., 2012
25(OH)D3 (0.60 µg)	18th dat	Amniotic	Increased hatchability	Bello et al., 2013
Probiotics (Enterococcus faecium 5 × 109 cfu/egg and Bacillus subtilis – 5 × 1012 cfu/egg)	17.5 day	Amniotic	significant reduction in the number of *Salmonella Enteritidis* in chicks	Oliveira et al., 2014
Folic acid (150 µg/egg)	11th day	Yolk sac	improved the hatchability average daily gain and feed conversion ratio increase in hepatic folate content enhanced immune function	Shizhao et al., 2016

Conclusion

Starvation of chicks after hatching for 48 to 74 hr is unpreventable until reaching the rearing farm. Early feed access has a crucial role in early development and nutrient utilization by birds. Rapid growth rate, feed conversion efficiency, reaching marketable bodyweight can be enhanced through the *in ovo* feeding. Use of macro, micro nutrients as well as probiotics also has beneficial effect on hatchability and immunity. In a commercial scale *in ovo* fed chicks can open a new marketing strategy in future with different cost for distinct feed supplements.

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