

Early nutrition enhances growth and speeds up gut development

Early feeding has a great effect in triggering the right momentum of growth in broiler hatchlings. It not only utilises the residual yolk faster but also increases body weight gains and enhances the gastrointestinal tract development in neonatal broiler chicks.

By A K Panda, G. Shyam Sunder, S V Rama Rao and M V L N Raju, *Project Directorate on Poultry (ICAR), Hyderabad, India*



Commercial broiler poultry breeding programmes have been imposing high selection pressure for achieving rapid genetic gain per unit time at the earliest possible age. Today, broiler chicks weighing 45-50 g at one day of age, show 40-45 times increase in body weight by 40 days of age. This enormous magnitude of growth makes every day important for ensuring the full genetic potential of the bird. The time from hatching until receiving nutrition is the critical period to trigger the right momentum of growth in broiler hatchlings. Several reports claim that residual yolk is used for maintenance whereas exogenous energy is utilised for growth. The initiation of growth in neonatal chicks could be improved by early nutrition. Access to nutrients initiates growth 24 hours after ingestion. A delay in nutrient intake can slow down the development of gastrointestinal and immune systems, resulting in decline in early weight gains and subsequent breast yield.

Yolk utilisation

In the later stages of embryonic development, yolk remains the sole source of

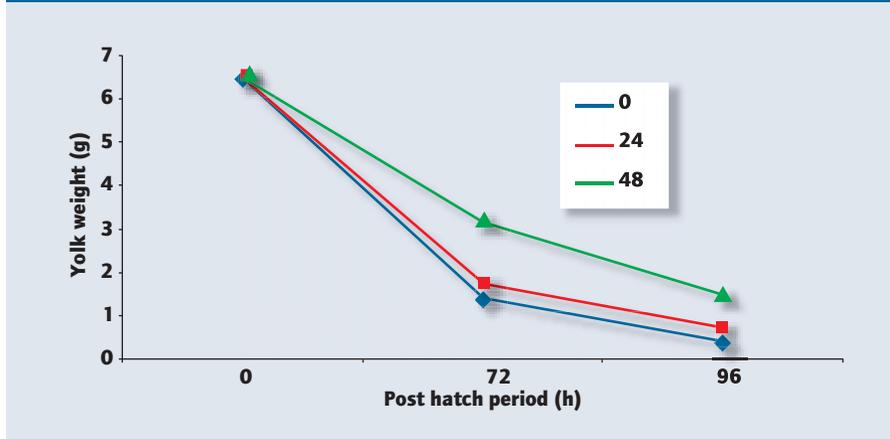
energy supply. During hatching, yolk comprises about 20% of the body weight of chicks and contains 20-40% lipids and 20-25% protein. Towards the end of incubation the remaining yolk is internalised in the abdominal cavity. Thus, for the newly hatched chick, yolk provides immediate post-hatch energy and protein for maintenance and growth. The residual yolk may be sufficient to keep chicks alive for the first 3-4 days without feed, but will not support development of the gastrointestinal tract and immune system, nor will it help to increase body weight. Further, most of the protein contains valuable biomolecules such as maternal antibodies that are better used for passive immunity than as a source of amino acids. On the other hand the lipid fractions of yolk consist predominantly of triglycerides and phospholipids with a small amount of cholesterol esters and no free fatty acids. In the hatching chick, yolk is utilised either by endocytosis of yolk contents into the circulation or by transport through the yolk stalk into the small intestine. Anti-peristaltic movements transfer the yolk to the proximal small intestine where acyl-lipids are digested by pancreatic lipase and absorbed.

Early feeding utilises the residual yolk faster

The residual yolk is usually used up within four days of hatching. Recent studies indicate that the residual yolk is used up more quickly by chicks that have access to feed immediately after hatching than those fasted for 48 hours. The remaining yolk weight in broiler chicks at the time of hatching was 6.5g, which was reduced to 0.4g within 96 hours in those chicks that were fed immediately after hatch. However, the remaining yolk weight was 0.7 and 1.5g after 96 hours in chicks fasted for 24 or 48 hours, respectively (*Figure 1*).

This is because the anti-peristaltic movement that transfers the yolk from yolk stalk to the duodenum appears to be stimulated by the presence of feed in the gut. However, in commercial poultry operations, poultry hatching is drawn out over a two-day period and chicks get transferred from the incubator only once the majority of them have cleared the shell. Following removal from the incubator, other practices such as sexing, vaccination and packaging are usually carried out before they are boxed for transportation. Thus, in practice, chicks may often

Figure 1 - Effect of early and late (0-48h) feeding on residual yolk weight of chick



spend considerable time without any access to feed or water, which causes poor viability and retarded growth. Thus, the period immediately after hatching is a critical period for the development and survival of commercial chicks.

Effect on body weight gain

A recent study of broiler chicks immediately after hatching revealed that chicks with early access to feed gained significantly more weight compared to those deprived of feed for 48 hours (Figure 2). However, no difference in body weight could be found between chicks fed either immediately after hatching or 24 hours later. It was also reported in other studies that chickens without access to feed and water for 48 hours after hatching decreased in body weight by 7.8 % compared to those fed immediately after hatch. In other experiments it was noticed that fasting pullet and broiler chicks for 48 hours or more retarded both body weight gain and intestinal growth, decreased intestinal absorption area and limited the uptake capacity of essential nutrients, thus contributing to decreased growth later in life. Early access to feed increased the percentage of breast meat yield by 7-9% compared to fasted birds. This could be due to the differential development of

the skeleton and muscles or long term effects initiated by the early feeding.

Effect on gastro-intestinal tract

At hatching, the digestive system of chicks is anatomically immature and its functional capacity is not fully developed. The gastrointestinal tract undergoes morphological changes (increase in intestinal length, villus height and density) and physiological changes (increased production of pancreatic and digestive enzymes) including increased surface area of digestion and absorption during the post-hatch period. In the immediate post-hatch period, the small intestine increases in weight more rapidly than the whole body mass and this continues for a maximum of up to 6-10 days of age. However,

the digestive organs like the gizzard do not show parallel-enhanced changes in relative size. The presence of nutrients in the intestinal lumen stimulates the growth of villi and crypts. However, the morphology of intestinal epithelium is particularly affected by the absence of food. It is reported that villus height in the duodenum and the cell turnover of intestines are significantly reduced in birds exposed to 24 hours fasting. It was reported that feed and water deprivation for 24, 48 and 72 hours after hatching affected intestinal villus development. Thus, some of the enhanced growth effects of early nutrition may be explained by changes in intestinal tract development.

Research data revealed that early post-hatch feeding (within 24-48 hours) influenced the gastro-intestinal tract development (Table 1).

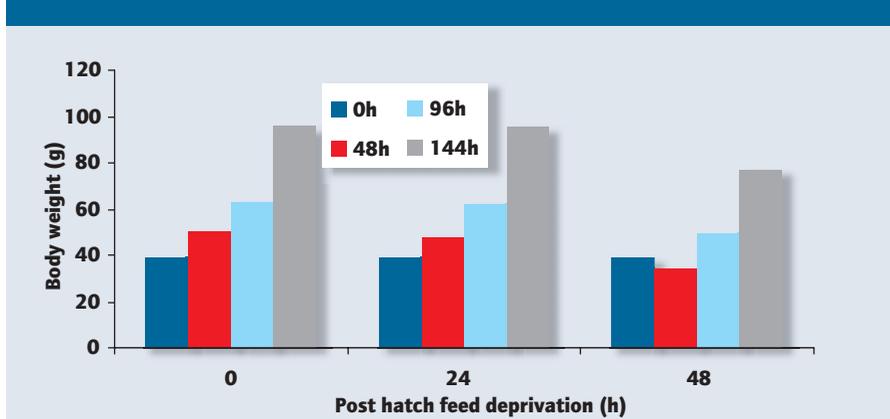
Birds with early access to feed had an enhanced intestinal absorptive surface, leading to greater nutrient assimilation and growth. The preferential growth of the small intestine occurs both in the presence and absence of feed; although in the absence of exogenous feed both absolute and relative growth is slower. The production of pancreatic enzymes is triggered by feed intake and secreted at relatively constant amounts per feed intake as the chick grows. Chicks ingesting feed show increases in the total intestinal trypsin, amylase and lipase activities that were correlated with intestinal weights and body weights. Uptake of nutrients such as glucose and methionine is low

Table 1 - Effect of post-hatch feed deprivation on weight of certain organs (% Body weight) at four days of age

Post-hatch feed deprivation (h)	Liver	Proventriculus with gizzard	Pancreas	Duodenum	Jejunum	Ileum
0h	3.76 ^a	7.91	0.38 ^a	2.94	2.82 ^a	2.12 ^a
24h	3.71 ^a	8.03	0.36 ^a	2.89	2.85 ^a	2.07 ^a
48h	3.24 ^b	7.80	0.20 ^b	2.78	2.39 ^b	1.65 ^b

^{a, b} means with different superscript in a column differ significantly (P<0.05)

Figure 2 - Effect of post hatch feed deprivation (0-48h) on body weight of broiler chicks at 48h interval



(20-35%) during the immediate post-hatch period. Feeding of diet containing low sodium decreased the intestinal uptake of nutrients suggesting the importance of specific nutrients to be fed during early post-hatch period. The Pancreas, liver and small intestine develop rapidly after hatching, emphasising the importance of these organs to the newly hatched chick. Early access to feed stimulates the growth of these organs and the digestive and absorptive capacity of the intestine. The total digestive enzyme activity tends to increase during the early post-hatch period because of the rapid increase in weight of pancreas and intestines and the activity responds to the presence of food in the intestine. ■