The influence of early feeding on intestinal development and performance of broiler chickens

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Abstract. In the first days after hatch, the development of organs such as the gastrointestinal tract, and the growth performance may be affected by the time in between hatch and first feed intake. In current practice, time between hatch and moment of first feed intake may take long time because of variation in hatch time, chick handling, and transportation time. Feed deprivation, especially during the first days after hatch, depresses intestinal development on the short and long term, reflected by a lower intestinal weight, shorter length, lower enzymatic activity, altered villi and crypt cell density, and lower crypt depths and villi heights and finally, depressed growth. The objective of this study was to investigate effects of the moment of first feed intake after hatch on intestinal development and growth performance of broiler chickens. A total 60 unsexed day-old Lohmann broiler chicks were randomly assigned into 3 treatments of 20 chicks each in four replicates (5 chicks each). The treatments were time first feed and water access after hatch, including 12, 42 and 72 hours. Body weight gain and feed intake were recorded weekly and the intestinal development were sampled at 12 days for the measurement of ileum histology and length of gastrointestinal tract. Results obtained were as follows: Time between hatch and moment of first feed intake had no significant effect (P> 0.05) on width of the villi. However, the height of villi, depth of the crypt dan length of the gastrointestinal tract were significantly affected by treatment. The longer delay in the provision of feed and water in day-old chick were lower height of villi and depth of the crypt, dan shorter length of the gastrointestinal tract. Statistically, performance parameters had any difference among treatments, except for feed conversion. The final body weight and feed intake decreased with increasing time between hatch and moment of first feed intake. The results suggest that early delivery of first feed can influence development and growth of gastrointestinal tract. It is also beneficial to improve posthatch growth performance of broiler chickens.

1. Introduction

Post hatch is a critical time in the development and growth of the broilers chicken. In the first day, the chicks need enough energy to replace the energy lost during the process of shells breaking, handling in the hatchery and during transportation. Hence, the chicks need a fast nutritional intake, to restore energy that has been lost by providing feed and water. In current practice, time between hatch and moment of first feed intake may take long time. In some cases it normally takes more than 24 hours to deliver the chicks to grow out facility. Provision of feed and water earlier is important for maturation and development of the gastrointestinal tract reflecting by overall length and weight as well as villi and crypt length and area [1]. It also improve the function of the digestive tract, accelerated digestive tract cell
division, increasing of feed absorption and immune response, thereby able to accelerate the absorption of egg yolk [2]. Egg yolk found in the body is used in a short time but it can increase body weight and increase the development of the digestive tract after hatching [3]. On the other hand, the longer delay in the provision of feed and water in day-old chick shows a negative influence on the development and function of the digestive tract [4] decreasing the immune response, high mortality at the beginning of life and decreasing performance [3].

In stimulating the development of gastrointestines tract of newly hatched chicken, feeding must contain nutrients that are easy for the chicks to digest. However, the digestive system of newly hatched chickens has not yet optimal to digest feed due to morphological and enzymatic aspects. Therefore, the initial feed must include ingredients that are easily digested due to the limited digestive capacity of newly hatched chickens [5]. The faster digestive tract reaches its functional capacity, the broiler chicken can utilize faster the nutrients in the feed so that it can efficiently reach its genetic potential [6].

The development of intestine chicks that have been stimulated by providing feed earlier can increase body weight gain and feed consumption. On the other hand, Feed deprivation, especially during the first days after hatch, depresses intestinal development on the short and long term, reflected by a lower intestinal weight, shorter length, lower enzymatic activity, altered villi and crypt cell density, and lower crypt depths and villi heights and finally, depressed growth. The objective of this study was to investigate the effects of the time of first feed intake after hatch on intestinal development and growth performance of broiler chickens.

2. Method

A total of 60 unsexed day-old Lohmann broiler chicks were randomly assigned into 3 treatments of 20 chicks each in four replicates (5 chicks each). The treatments were the duration time between hatch and first time the chicks access feed and water, including 12, 42 and 72 hours. Twelve hours after hatching, the chicks were put into the plot of 1× 1× 1 m and treated with feed and water. The time interval of 30 hours, the remaining chicks then put in the plot and accessed feed, and the last 30 hours the chicks were treated for the first feed access of 72 hours. The chicks were weighed before realised in to the plots and during the study the chicks were given commercial feed with protein levels ranging from 20-22%.

In 12 days, the intestines were sampled for measuring intestinal length and necropsy examination. One mile chick for each unit treatment was randomly selected and slaughtered. Measurement of intestinal length was conducted by expanding the small intestine starting from the duodenum, jejenum, and ileum. Then the samples were cleaned from the feces and measured with a ruler. Fresh ileum samples that have been obtained were cut 2 cm long pieces and then fixed in 10% buferformalin, left to soak for 24 - 48 hours, and then made histological preparations. The tissues were then dehydrated with increasing concentrations of ethyl alcohol (70%, 90%, 96% and 100%), cleared in xylene and embedded in parafin. Using a microtome, the samples were sliced thinly and stained haematoxylin-eosin. Histology preparations were put in the glass object than observed and measured using a light microscope. Representative fields of the samples were photographed and digital images were captured for morphometric analysis. A computer morphometric program was used for morphometric measuring the ileum villi height and base width of the villi. The villus height was measured as the distance from the apex of the villus to the junction of the villus and crypt depth was measured from the base of the villus to the mucosa. The experiment was conducted for 32 days and body weight gain and feed intake were recorded weekly.

The data were subjected to analysis of variance procedures appropriate for a completely randomized design using SPSS software. The significant difference between treatment means was determined by Duncan's multiple test with a probability level of 0.05 (P <0.05).

3. Results and discussion

3.1. Morphometry of gastrointestinal tract.
The effects of feed restriction in the early day of hatch on histology and morphometry of intestinal of 12 days broiler chickens are shown in the figure 1 and table 1. Delayed access to feed significantly decreased villi heights, crypt depths and intestinal length. Compared with the 12 hours delay in feed treatment, it appears that increasing duration of feed access for 42 and 72 hours causes a decrease in villi heights by 116 and 349 µm, respectively. The same thing was shown in the crypt depths and intestinal lengths, where the depth of the crypt decreased to 82.46 and 245.46 µm and length of intestine shortened by 18.85 and 28.85 cm along with the delay of feed for 42 and 72 hours, respectively.

![Figure 1](image)

**Figure 1.** The morphology of intestinal villi and crypt of broiler chickens fed 12 (A), 42 (B) and 72 (C) hours after hatch.

### Table 1. The morphometry of gastrointestinal tract in different time of first feed access after hatch.

| Parameters          | Time of first feed access after hatch (hours) |
|---------------------|---------------------------------------------|
|                     | 12                      | 42                      | 72                      |
| Villi heights (µm)  | 559.33±14.10\(^a\)     | 442.40±62.83\(^b\)     | 209.57±35.66\(^c\)     |
| Crypt depths (µm)   | 362.83±30.72\(^a\)     | 280.37±50.38\(^b\)     | 117.37±29.90\(^c\)     |
| Intestinal length (cm) | 175.95±1.19\(^a\)    | 157.10±5.93\(^b\)     | 149.73±13.84\(^bc\)    |

\(^a,b,c\) Values within a row with different superscripts differ significantly at P ≤ 0.05.

These findings indicated that delaying time of feed access resulted in decreased development and growth of broiler gastrointestinal tract. This means that giving feed as early as possible to chicks after hatching will stimulate the development of the digestive tract so as to accelerate the morphology of intestinal growth which was shown from the increase in villi heights, crypt depths and intestinal length. The results of this study also revealed that the development of the digestive tract was directly related to the presence of rations in the intestine. Although the preferential growth of small intestine occurs in the presence and absence of rations, absolute and relative growth of the intestine remains slow due to the absence of external rations [2]. Therefore, broiler chickens require rations immediately after hatching for the growth of the small intestine, and the absence of rations in the intestine results in impaired development that can affect optimal function of the intestinal.

### 3.2. Growth performance.

The effects of feed restriction in the early day of hatch on final body weight, broiler chickens during the experiment are shown in the table 2. The final body weight was significantly affected by delaying access of feed in the early hatch. The final body weight increased with decrease of time feed access. These results related to the finding in intestinal growth. The broiler chickens were not grow properly due to the inhibition development and function of the digestive tract. If the activity of enzymes in the digestive tract is low during the first week of a chick's life, it will inhibit the digestive process and consequently the growth of chickens becomes slow [7]. This means that giving rations as early as possible to chicks after hatching is more important for the development of the digestive system. The results of this study
are also supported by Halevy [8] who stated that chickens that were late to give rations for up to 48 hours after hatching had significantly lower body weight at ages 2 and 41 days compared to those given direct rations.

The effects of feed restriction on feed intake of broiler chickens during the experiment are shown in the table 2. The feed intake was significantly affected by delaying access of feed in the early hatch, showing the feed intake decreased with increase of duration between hatch and first feed access. Impaired absorption of egg yolk has an impact on nutrient disorders seen in slower growth. In addition to its role as a nutrient reserve, the remaining yolk seems to stimulate the maturation of digestive system and intestinal absorption function [9]. Chickens that immediately get feed after hatching, show a decrease faster in yolk weight [10]. This shows that the higher utilization of egg yolk in chicks is due to the presence of food in the intestine. Therefore, Chickens that are immediately fed after hatching clearly have a better digestive tract function. These can be seen from the development of intestinal morphology and physiological functions of digestion which were indicated by villi height and intestinal length (table 1). Increased villi height and villi width, and the ratio of villi height and crypt depth are associated with a wider surface of villi for absorption of nutrients [11,12] and increased feed absorption is increased feed consumption.

Table 2. The performance of broiler chicken in different time of first feed access after hatch.

| Parameters                | Time of first feed access after hatch (hours) |
|---------------------------|---------------------------------------------|
|                           | 12              | 42              | 72              |
| Final body weight (g/b)   | 1888,7±171,23a | 1788,00±278,45b | 1634,67±218,37c |
| Feed intake (g/b/w)       | 680,02±93,40b  | 635,20±293,40b  | 548,80±586,07c  |
| Feed conversion           | 1,86±0,15      | 1,87±0,38       | 1,77±0,22       |

Values within a row with different superscripts differ significantly at P ≤ 0.05.

The effects of feed restriction on feed conversion of broiler chickens during the experiment are shown in the Table 2. The results show that feed conversion was not affected by delaying feed access, indicating the value of feed consumption coincided with the growth rate. The similarity of feed conversion among the treatments reflected that the utilization of chicken rations fed for 72 hours after hatching was proportional to the rate of growth. This means that the amount of feed needed to increase body weight per unit weight was not affected by delaying time of feed access. Chickens that get rations immediately after hatching have a better intestinal mucosal development so that they have a better intestinal conversion.

4. Conclusion

The results of this study indicate that early delivery of first feed can influence development and growth of gastrointestinal tract. It is also beneficial to improve posthatch growth performance of broiler chickens.

References

[1] Uni Z, Noy Y, and Sklan D 1999 Posthatch development of small intestinal function in the poult Poult. Sci. 78 215-22
[2] Sklan D 2001 Development of the digestive tract of poultry World's Poult. Sci. J. 57 415-27
[3] Madsen H R J, Su G and Sorensen P 2004 Influence of early or late start of first feeding on growth and immune phenotype of broilers Br. Poult. Sci. 45 210-22
[4] Dibner J and Knight C 2003 Early Nutrition: Effect of Feed and Water on Livability and Performance. (USA: Novus International Inc.)
[5] Esmailzadeh L, Hivazad M, Sadeghi A A and karimirshizim M 2016 Performance, intestinal morphology and microbiology of broiler chickens fed egg powder in the starter diet Braz J. Poult. Sci. 18 (4) 705-10
[6] Noy Y and Uni Z 2010 Early nutritional strategies World’s Poult. Sci. J. 66 639-46
[7] Nir I and Levanom M 1993 Effect of posthatch holding time on performance and on residual yolk and liver composition Poult. Sci. 72 1994–97
[8] Halevy O, Nadel Y, Barak M, Rozenboim I and Sklan D 2003 Early posthatch feeding stimulates satellite cell proliferation and skeletal muscle growth in turkey poults. J. Nutr. 133 1376-82
[9] Careghi C, Tona K, Onagbesan O, Buyse J, Decuyper E and Bruggeman V 2005 The effects of the spread of hatch and interaction with delayed feed access after hatch on broiler performance until seven days of age Poult. Sci. 84 1314-20
[10] Noy Y, Geyra A, and Sklan D 2001 The effect of early feeding on growth and small intestinal development in the posthatch poult Poult. Sci. 80 912-19
[11] Bhanja S K, Anjali D C, Panda A K and Shyam S G 2009 Effect of post hatch feed deprivation on yolk-sac utilization and performance of young broiler chickens Asian-Aust. J. Anim. Sci. 22 1174-79
[12] Gonzales E, Kondo N, Saladanna E S P B, Loddy M M, Careghi C dan Decuypre E 2003 Performance and physiological parameters of broiler chickens subjected to fasting on the neonatal period Poult. Sci. 82 1250-56