Effects of post-hatch feeding time and pre-starter feeds on growth performance and relative weight of visceral organs in slow-growing chickens

Phung T. K. Bui*, Tran P. U. Cao, Khang N. Duong, & Tung M. Che
Faculty of Animal Science and Veterinary Medicine, Nong Lam University, Ho Chi Minh City, Vietnam

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***Corresponding author**

Bui Thi Kim Phung
Email: phung.buithikim@hcmuaf.edu.vn

ABSTRACT

The objective of the experiment was to evaluate effects of post-hatch feeding time and two different pre-starter diets on growth performance and relative weight of visceral organs and yolk sac in slow-growing chickens. A total of 480 one-day-old chicks (Luong Phuong breed) were randomly assigned into 4 treatment groups in a completely randomized design of 2 × 2 factorial arrangement with 10 chicks per pen. The two factors consisted of post-hatch feeding time (immediate access to feed after hatching (0 h) and delayed access to feed for 30 h after hatching) and pre-starters (Vi-start and Commercial 1). Birds were fed 2 different pre-starter diets from 0 to 7 days of age, and then all birds were fed the same commercial diets from 8 to 56 days of age. The results showed that during 0 - 7 days of age, chicks that were not fed for 30 h after hatch were significantly lower in body weight, average daily feed intake, average daily gain and feed efficiency (FE) than those fed immediately right after hatch ($P < 0.05$). In this period, chicks fed Vi-start had better growth performance and FE than those fed Commercial 1. Over a 56-d study, there were no main effects of post-hatch feeding time or pre-starter feed on growth performance of chickens ($P > 0.05$). However, the post-hatch feeding time × pre-starter feed interaction was significant for final BW at 56 days of age ($P = 0.01$), suggesting that within commercial feed, delayed access to feed for 30 h increased the final BW of chickens as compared with immediate access to feed after hatch. In brief, Vi-start fed to chicks improved the growth performance of chicks during the first week after hatch. Feeding pre-starter feeds to chicks immediately right after hatch would be beneficial.

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1. Introduction

In contrast to newborns of other species, the newly hatched chicks do not receive any direct nutritional support from their mothers. Particularly in commercial hatchery production, the hatching time could last from 24 to 48 h. Therefore, the first hatched chicks will not be exposed to feed and water for a long time. Recent studies have said that delaying chick using feed for 48 h can reduce the body weight of chickens at finished age (Gonzales et al., 2003; Bhanja et al., 2009; Abed et al., 2011). Moreover, the gastrointestinal tract of newly hatched chicks is immature and in a process of development. According to Nitsan (1991), the growth rate of the digestive system during the first week is three to five times faster than the rest of the chick's body. The markedly rapid development occurs in duodenum, colon and pancreas. Thus, after hatching, chicks have very high nutritional requirements to meet their potential growth and development of digestion and immune systems, help them achieve optimal productivity (Noy & Sklan, 2001). However, there is no evidence on effects of delayed feeding or pre-starter feeds on growth performance and intestinal mor-

phology of chickens, especially for slow-growing local breeds of chickens in Vietnam. Therefore, the objective of the experiment was to evaluate the effects of post-hatch feeding time and two different pre-starter diets on growth performance and relative weight of visceral organs and yolk sac in slow-growing chickens from 0 to 56 days of age.

2. Materials and method

2.1. Materials

The experimental protocol was reviewed and approved by the Animal Ethics Committee of Nong Lam University of Ho Chi Minh City (NLU), Vietnam. The experiment was conducted at the Applied Research Farm of Department of Animal Production at NLU.

2.2. Experimental design

A total of 480 day-old unsexed chicks (Luong Phuong breed; initial BW: 42.36 ± 0.18 g/chick) were used in this experiment. Chicks were randomly assigned to each of four treatments in a 2 x 2 factorial arrangement (feeding time after hatching: immediate access to feed vs. delayed access to feed for 30 h; Pre-starter diet: Vi-start vs Commercial 1) in a completely randomized design. There were 12 replicate cages per treatment and 10 birds per cage. Birds were exposed to different pre-starters during 0-7 days of age (Vi-start, Commercial 1) and then all birds were fed the same commercial diets from 8 to 56 days of age (Commercial 2 and 3) (Table 1).

The Vi-start feed was obtained from the Department of Animal Production of Nong Lam University Ho Chi Minh City and Vi-Start diet was formulated and mixed at the Applied Research Farm located on the campus of Nong Lam University (Table 2). Vi-start's chemical composition (crude protein, crude fiber, phosphorous, calcium and ether extract) and other ingredients were analyzed at the Upscience company, Binh Duong province, Vietnam. The commercial feeds 1, 2, 3 were supplied by Cargill Feed Company, Dong Nai province, Vietnam. Birds were reared in multi-tiered cages (120 cm × 50 cm × 40 cm) in an open-sided house for eight weeks, and each cage had a feeder and a drinker.

Table 1. Nutrient contents of Vi-start and Commercial for different stages*

Constituents	Vi-start[1] (0-7 days)	Commercial 1[2] (0-7 days)	Commercial 2[3] (8-21 days)	Commercial 3[4] (22-56 days)
Dry matter, %	89.11	89.14	88.73	89.19
Protein, %	20.88	21.53	16.84	14.31
Crude fat, %	5.02	4.26	5.57	6.04
Crude fiber, %	0.70	2.59	3.20	4.43
Total mineral, %	4.42	5.40	5.16	4.89
Calcium, %	1.08	0.82	0.65	0.57
Phosphorus, %	0.49	0.62	0.56	0.51

(*)Chemical composition (crude protein, ether extract, crude fiber, phosphorous and calcium) of Vi-start and feed Commercial 1, 2, 3 which were used in this experiment were analyzed at the Upscience company, Binh Duong province, Vietnam

(1)Vi-start diet was formulated and mixed at the Applied Research Farm located on the campus of Nong Lam University, Vietnam

(2,3,4)Commercial feeds 1, 2 & 3 were supplied by Cargill Feed Company, Dong Nai province, Vietnam.

Table 2. Ingredient composition of Vi-start diet used in the experiment*

Feed Ingredients (%)	Vi-start
Corn	6.00
Broken rice	55.10
Soybean meal	14.60
Egg powder	17.00
MCP (15.23)	1.21
Limestone	1.90
Salt	0.20
Mineral premix	0.10
Vitamin premix	0.10
Phytase	0.02
Lysine, 78.8%	0.26
Dextrose	3.00
Antioxidants	0.10

*Vi-start diet was formulated and mixed at the Applied Research Farm located on the campus of Nong Lam University, Vietnam.

2.3. Data collection and sampling

After hatching, chicks were weighed and randomly allocated into treatment groups. Subsequent weights of chickens and feed consumption were recorded at 7, 28, 42 and 56 days of age. The average body weight (BW), average daily gain (ADG), average daily feed intake (ADFI) and feed conversion ratio (FCR) were calculated on a per-cage basis. At 7 and 56 days old, 12 birds were randomly selected from each treatment for measurements of relative weight of visceral organs. Feed was withdrawn 10 h before slaughter, but birds were allowed free access to water. Right after slaughtering, abdominal cavity of each bird was opened for collection of visceral organs and then their weights were measured.

2.4. Statistical analysis

Data were analyzed as a completely randomized design with a 2 × 2 factorial treatment arrangement by ANOVA using the general linear model (GLM) procedure of SAS (SAS/STAT Version 9.2, SAS Institute Inc., Cary, NC) to determine the effects of post-hatch feeding time and two different pre-starter diets and their interaction. Treatment effects were considered significant at $P < 0.05$.

3. Results and discussion

3.1. Average body weight, average daily body weight gain, average daily feed intake, feed conversion ratio

The chickens' weight increased gradually, consistent with the development stages of poultry (Table 3). At 7 days of age, BW of birds fed right after hatching was significantly higher than that of birds held 30 h and birds fed Vi-start pre-starter which weighs more than that fed Commercial 1, corresponding (9.73%, 5.08%, respectively). However, there was no statistically significant effects of between two post-hatch feeding time or two pre-starter feeds on BW of chickens at 56 days old although their interaction was found ($P < 0.05$). Chickens fed Commercial 1 pre-starter later post-hatching (30 h) were heavier than that exposed the same pre-starter at 0 h ($P < 0.05$) whereas with Vi-start × 0 h, BW of birds was equivalent with Commercial 1×30 h treatment ($P > 0.05$). This result showed that, if the chickens were fed early, they should choose the right pre-starter feed and the nutrient of Vi-start was suitable for early and late feeding.

From the results of Table 4, at stage 1 - 7 days of age; the ADG, ADFI and FCR of birds fed Vi-start were significantly better ($P < 0.01$) than that of birds fed the Commercial 1 diet. Although average daily feed intake was low, daily weight gain of chicken in Vi-start was better than in Commercial 1, so the ability metabolize of feed was quite good, proving that the Vi-start with high nutritional would promote early stimulation of intestinal development.

The results indicated that some indicators (ADG, ADFI) have increase trend when comparing with bird feeding after 30 h hatching with $P < 0.001$ (Table 4). This is consistent with previous studies, in the early stage after hatching, the loss weight of chick was approximately 4 g per 24 h, because of moisture loss as well as yolk and pectoral muscle utilisation (Halevy et al., 2003; Tona et al., 2003; Careghi et al., 2005). Other authors argued that birds did not access to feed for initial 48 h or more which could have lasting adverse effects (Batal and Parsons, 2002; Noy and Sklan, 2001; Juul-Madsen et al., 2004), despite no FCR significant correlation was detected ($P > 0.05$) at this stage. The results of this study did not find any correlation between post-hatch holding time and starter feeds on ADG, ADFI and FCR

Table 3. Average body weight of chickens at different ages* (g/bird)

Age	0 day	7 days	28 days	56 days
Pre-starter feeds				
Vi-start	42.41	101.82[a]	563.13	1534.35
Commercial	42.36	96.65[b]	566.24	1558.77
SEM[1]	0.037	1.384	7.387	14.472
P	0.331	0.000	0.756	0.215
Post-hatch feeding times				
0 h	42.36	104.31[a]	573.77	1554.3
30 h	42.40	94.16[b]	555.56	1538.8
SEM[1]	0.053	1.043	7.146	14.613
P	0.506	0.000	0.078	0.428
Interaction				
Vi-start × 0 h	42.37	106.88	579.50	1566.9[ab]
Vi-start × 30 h	42.44	96.76	546.66	1541.8[ab]
Commercial × 0 h	42.36	101.74	568.03	1501.8[b]
Commercial × 30 h	42.36	91.55	564.46	1575.8[a]
SEM[1]	0.038	1.289	10.085	19.422
P	0.525	0.979	0.154	0.014

*Mean values represent averages each pen (Pre-starter feeds, n=24; Holding times, n=24; Interactive effects, n=12)
[1]SEM = Standard error of means
[ab] Means within the same column without common letters are statistically different ($P < 0.05$).

of chickens at stage of 0 - 7 days ($P > 0.05$).

At stage 8 - 28 days of age (Table 5), effect of ADG, ADFI and FCR of chicken in the use of starter feeds, feeding time and the interaction between the two experimental factors was unknown ($P > 0.05$). However, chicks that were held 30 h had lower ADG, ADFI and FCR.

The ADG of birds fed Vi-start (26.16 g/d) was lower than that of birds fed the Commercial 1 (26.49 g/d) and that of the birds that were fed immediately after hatching (26.36 g/d) had a higher than those chicks held for 30 h (26.28 g/d) during the experimental period, but all different were not statistically significant ($P > 0.05$) (Table 6). Similarly, the final ADFI, FCR of chicken in the use of starter feeds, post-hatch feeding time and the interaction between the two experimental factors were unknown ($P > 0.05$) at stage 0 - 56 days of age.

3.2. Heart, liver and yolk sac

As presented in Table 7, at 7 days and 56 days of age, the relative weight (%) of heart, liver and yolk sac were not statically different ($P > 0.05$). There has been study showing that 30% of the nutrients for maintenance and growth come from yolk sac (O'Sullivan et al., 1991). On day 7th of the experiment, although the difference was not statistically significant, the survey resulted that yolk sac utilization of starter feed Vi-start was faster than that of treatment Commercial 1. Besides, the yolk sac of birds that was fed immediately after hatching was disappeared faster than that of birds feeding late, too. As Feher & Gyuru (1971) reported the consumption of feed increases gastrointestinal activity and bird metabolism, this helps to explain that when the birds were fed, the yolk sac contents would be excreted through the vitelline duct to enter the intestines. So combined ADFI results, our yolk sac results are also consistent with this report.

There was a trend of higher relative weight of heart and liver in chickens which consumed Vi-start pre-starter than another (1.03 vs 0.99%, and 4.95 vs 4.98%) but the differences were not significant ($P > 0.05$). The impacts of Pre-starter diets on heart and liver weight also changed depending on the feeding time post-hatching at early period (1.03 vs 0.99% and 5.06 vs 4.88%, respectively) although the impact was not clear ($P > 0.05$), and at day 7th, there were interaction between the experimental factors on relative weight of heart, specifically, chickens that were fed Vi-start at 0h had relative weight of heart which was higher than that at 30h ($P > 0.05$) (Table 7). There has an evidence that first two weeks after hatching, heart growth is more variable than other (Phelps et al., 1987). Post-hatching at five

Table 4. Effects of post-hatch feeding times and pre-starter feeds on ADG, ADFI and FCR of chickens from 0 to 7 days*

Age	ADG, g/d	ADFI, g/d	FCR
Pre-starter feeds			
Vi-start	8.38[a]	9.64[b]	1.15[b]
Commercial	7.76[b]	10.10[a]	1.31[a]
SEM[1]	0.197	0.677	0.011
P	0.003	0.004	0.000
Post-hatch feeding times			
0 h	8.75[a]	10.65[a]	1.22
30 h	7.39[b]	9.09[b]	1.24
SEM[1]	0.152	0.416	0.019
P	0.000	0.000	0.427
Interaction			
Vi-start × 0 h	8.99	10.31	1.15
Vi-start × 30 h	8.50	10.98	1.30
Commercial × 0 h	7.76	8.96	1.16
Commercial × 30 h	7.03	9.23	1.31
SEM[1]	0.198	0.270	0.015
P	0.560	0.196	0.673

*Mean values represent averages each pen (Pre-starter feeds, n = 24; Holding times, n = 24; interactive effects, n = 12)
[1]SEM = Standard error of means.

Table 5. Effects of post-hatch feeding times and pre-starter feeds on ADG, ADFI and FCR of broiler chicks from 8 to 28 days*

Age	ADG, g/d	ADFI, g/d	FCR
Pre-starter feeds			
Vi-start	21.29	44.53	2.10
Commercial	21.65	45.05	2.08
SEM[1]	0.313	0.510	0.014
P	0.422	0.467	0.502
Post-hatch feeding times			
0 h	21.58	45.25	2.10
30 h	21.36	44.33	2.08
SEM[1]	0.314	0.504	0.014
P	0.611	0.210	0.240
Interaction			
Vi-start × 0 h	21.73	45.32	2.09
Vi-start × 30 h	21.43	45.17	2.11
Commercial × 0 h	20.85	43.73	2.10
Commercial × 30 h	21.87	44.94	2.06
SEM[1]	0.440	0.659	0.020
P	0.143	0.351	0.140

*Mean values represent averages each pen (Pre-starter feeds, n = 24; Holding times, n = 24; interactive effects, n = 12)
[1]SEM = Standard error of means.

Table 6. Effects of post-hatch feeding times and pre-starter feeds on ADG, ADFI and FCR of broiler chicks from 0 to 56 days*

Age	ADG, g/d	ADFI, g/d	FCR
Pre-starter feeds			
Vi-start	26.16	62.15	2.38
Commercial	26.49	63.03	2.38
SEM[1]	0.277	0.195	0.009
P	0.390	0.321	0.870
Post-hatch feeding times			
0 h	26.36	62.72	2.38
30 h	26.28	62.46	2.38
SEM[1]	0.279	0.120	0.009
P	0.846	0.767	0.761
Interaction			
Vi-start × 0 h	26.56	62.93	2.37
Vi-start × 30 h	25.75	61.37	2.39
Commercial × 0 h	26.16	62.52	2.38
Commercial × 30 h	26.82	63.55	2.37
SEM[1]	0.385	0.881	0.013
P	0.066	0.149	0.224

*Mean values represent averages each pen (Pre-starter feeds, n = 24; Holding times, n = 24; interactive effects, n = 12)
[1]SEM = Standard error of means.

Table 7. Effects of post-hatch feeding times and pre-starter feeds on the ratio of heart, liver and yolk sac (%)

Age	7 days			56 days	
	Heart	Liver	Yolk sac	Heart	Liver
Pre-starter feeds					
Vi-start	1.03	4.95	0.73	0.59	1.91
Commercial	0.99	4.98	0.82	0.54	1.89
SEM[1]	0.024	0.186	0.233	0.021	0.039
P	0.219	0.901	0.767	0.132	0.711
Post hatch times					
0 h	1.03	5.06	0.70	0.56	1.88
30 h	0.99	4.88	0.85	0.57	1.91
SEM[1]	0.024	0.185	0.233	0.022	0.039
P	0.148	0.499	0.643	0.564	0.658
Interaction					
Vi-start × 0 h	1.09[a]	4.98	0.82	0.57	1.88
Vi-start × 30 h	0.96[b]	4.93	0.63	0.61	1.93
Commercial × 0 h	0.97[b]	5.14	0.57	0.54	1.89
Commercial × 30 h	1.01[ab]	4.83	1.08	0.54	1.89
SEM[1]	0.031	0.267	0.332	0.031	0.056
P	0.010	0.626	0.296	0.478	0.643

*Mean values represent averages each pen (Pre-starter feeds, n = 24; Holding times, n = 24; interactive effects, n = 12)
[1]SEM = Standard error of means
[ab]Means within the same column without common letters are statistically different ($P < 0.05$).

to six days later, heart growth rate will be at peak then stabilizes. This explains our results at day 56^{th}. The results of relative weight of heart were almost similar.

4. Conclusions

During 0 - 7 days of age, feed consumption and weight gain of chicks were improved if they were fed immediately after hatching. The Vi-start pre-starter diet given to chicks for one week enhanced their growth rate and feed efficiency only during the first week after hatching as compared with a commercial pre-starter diet. Over a 56-d study, however, post-hatch feeding time and pre-starter diet did not clearly affect the growth performance of slow-growing chickens.

Conflict of interest

The authors declare no conflict of interest.

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