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Influence of Delayed Access to Feed on Gastro Intestinal Tract Development in Japanese quail *(Coturnix japonica)*

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Abstract

Neonatal chicks for the practices like sexing, vaccination, packaging and transport from after hatching until located in the farm deprived of feed and water for about 48–72h. Delaying access to feed and water mobilizes body reserves to support metabolism and thermal regulation which resulted in retardation of gastro intestinal development and body weight and impairment of overall performance. This study conducted to evaluation the effect of post-hatch delayed feed intake on gastro-intestinal tract development in Japanese quail. One hundred and twenty newly hatched Japanese quail chicks were placed in three treatments with four replications of 10b each. The experiment was arranged with three treatments in a complete random design, birds delay access to feeding for 3, 24 and 48h immediately after hatch. The chicks subjected to fasting for 48h showed significantly (P<0.05) lower live body weight, GIT organs relative weight and blemish small intestinal epithelium than those fed with up to 3 and or 24 h delayed after hatching. The results of this study revealed that up to 48h delayed access to feed after hatch has adverse effects on Japanese quail chick gastrointestinal tract development.

Keywords: quail, fasting, gastro intestinal tract development

Introduction

In newly hatch chicks, delay in feed access is considered to be the times spent in the hatchery after hatch and transportation to the farm. In commercial operations, a large proportion of chicks remain without feed for more than 36h after removal from the incubator because of hatchery processing and transportation as placement on the farm. Thus, in practice, newly hatched chicks spend substantial time without access to feed or water, causing poor viability and slow (Bigot, 2003 #428)Several authors have reported that delayed access to feed decreased post-hatch performance (Latour et al., 1994; Noy and Sklan, 1999a; Noy et al., 2001; Gonzales et al., 2003).Growth of birds during the first days post-hatch is paramount importance for ultimate performance of poultry.

Recently, more attention has been given to the effect of feeding procedure after hatching on the performance of chicks during post hatch period, but the physiological basis remains completely to be elucidated (Noy and Pinchasov, 1993; Pinchasov and Noy, 1993; Noy and Sklan, 1998b; Sklan and Noy, 2000). Noy et al., (2001) observed that post-hatch deprivation of feed and water for 48 -72h reduced body weight of broilers by 7.8% over those fed immediately after hatch. Early access to feed and water stimulates rapid growth of the gastro-intestinal tract (GIT) and its absorptive capacity, improves chick's immune system (Pinchasov and Noy, 1993), faster utilization of yolk suck (Bigot et al., 2003) and improves gut integrity and subsequent performance (Noy et al., 2001; Bigot et al., 2003).

Japanese quail are kept for their eggs and meat. Because of its small size, inexpensive rearing requirment, rapid maturation compared with outher domesticated poultry and adaptability to a wide range of husbandry conditions Japanese quail have been used in many studies including behavioural (Mills and Faure, 1991), developmental (Le Douarin et al., 1997), physiological (Balthazart et al., 2003), genetic (Jones et al., 1991) and inbreeding (Mizutani, 2002).

This study was designed to assess effect of delayed access to feed on gastro-intestinal tract organ relative weight and small intestine morphology in Japanese quail.

Materials and Methods

Birds, Housing and Care

A total of 120 newly as hatched Japanese quail (Coturnix coturnix japonica) chicks were obtained from commercial hatchery, transported to the study area within 3h. The chicks were divided into three groups; each group was further divided into four replicates pens of 10 chicks each. The chicks were raised on conventional deep litter system, with windows less house, equipped by inlet for ventilation. Each pen was 0.5 squares meter and, covered with wood shaving. The house temperature and humidity were initially maintained at 35-37ºC and 60-70% respectively and after 3 days gradually decreased (temperature 0.5ºC every day and humidity decreased to 50-60%). The lighting program was constant (23 Light: 1 Dark) with 25-35 lx light intensity. The chicks in each pen were allowed free access to feed from a handing feeder and fresh water from a handing drinker throughout the experiment. The whole house work include house cleaning, adding new food and refresh water do ones daily.

Experimental Design and Diets

A completely randomized design experiment of three treatments, which presents starved for 3, 24 and 48 hours was used to study. Diets were formulated according to the recommended nutrients by the NRC (1994) for Japanese quail and were offered in mash form. The composition of the diet is presented in Table 1.

Slaughter and Sampling

At 1, 3 and 6 d of age, one birds/pen, close to the average pen weight was selected, weighed and slaughtered. The digestive tract, from the pro-ventriculus to the end of the intestine, was excised. The crop, pro-ventriculus and gizzard were emptied and weighed. The small intestine was divided into three segments: duodenum (from gizzard to pancreo-biliary ducts), jejunum (from pancreo-biliary ducts to Meckel's diverticulum), and ileum (from Meckel's diverticulum to the ileo-caecal junction). Then, the total segments of small intestine and large intestine were emptied and weighed. Weight of the digestive tract organs were expressed to body weight. After clearing the intestinal contents, a portion (about 0.5 cm in length) of intestine was taken from the midpoint between the bile duct entry and Meckel's diverticulum, flushed with 0.9% saline to remove the contents and then were fixed in 10% neutral buffered formalin solution for histological study.

Tale1: Composition of the experimental diet

Ingredients	**(%)**
Corn	49.5
Soybean meal	44.7
Soybean oil	2.7
Limestone	1.3
Di Ca- phosphate	0.7
Sodium chloride	0.4
Vit- min premix*	0.5
Hcl- lysine	0
DL-Methionine	0.1
Theronine	0.1
Calculated nutrients	
ME, (KCal/kg)	2900
CP, %	24
Ca, %	0.80
Av. P, %	0.30
Na, %	0.15
Lys, %	1.33
Met, %	0.49
Met + Cys, %	0.87
Theronine	1.01

*Supplied per kilogram of diet: vitamin A, 11000 IU; vitamin D3, 1800 IU; vitamin E, 36 mg; vitamin K3, 5 mg; vitamin B12, 1.6 mg; thiamine, 1.53 mg; riboflavin, 7.5 mg; niacin, 30 mg; pyridoxine, 1.53 mg; biotin, 0.03 mg; folic acid, 1 mg; panthotenic acid, 12.24 mg; choline chloride, 1100 mg; etoxycoin, 0.125 mg; Zn-sulfate, 84 mg; Mn- sulfate, 160 mg; Cu-sulfate, 20 mg; Se, 0.2 mg; I, 1.6 mg; Fe, 250 mg.

Gut Histological Measurements

Intestinal samples were transferred from formaldehyde, after dehydration by passing tissue through a series of alcohol solutions, cleared in xylene were embedded in paraffin. Intestinal samples were sectioned at 5 µm thickness using an auto microton[1], placed on glass slides, prepared and processed for staining with Hematoxylin and Eosin (H& E). All chemical was purchased from sigma chemical company. Micrographs were taken with an Olympus microscopic2, BX41 (Olympus, Tokyo, Japan). Morphometric measurements were performed on 9 villi chosen from each sample; magnification was 5 for villi and 10 for crypts. Morphometric indices included were villus height (VH) from the tip of the villus to the crypt, crypt depth (CD) from the base of the villi to the submucosa, villus width (VW; average of VW at one-third and two-third of the villus) and muscular thickness (MT) from the submucosa to the external layer of the intestine (Geyra et al., 2001). Apparent villus surface area (AVSA) was calculated by the formula: [(VW at one-third + VW at two-thirds of the height of the villus) × (2) -1× villus height × 2π], according to Solis et al. (2007).

1 - Model Leica RM 2145
2 - Model U- TV0.5 XC-2, Olympus corporation, BX41

Statistical Analysis

The data were tested for effects of starved for 3, 24 and 48 hours. Analysis of variance was performed using a randomized complete design experiment. All percentage data were transformed to arc-sin before statistical analysis. All data were analyzed by ANOVA using the GLM procedure of the SAS 9.1 software (SAS Institute, 2003). Means were compared for significant differences using Dancan multiple range test (P<0.05).

Results and Discussion

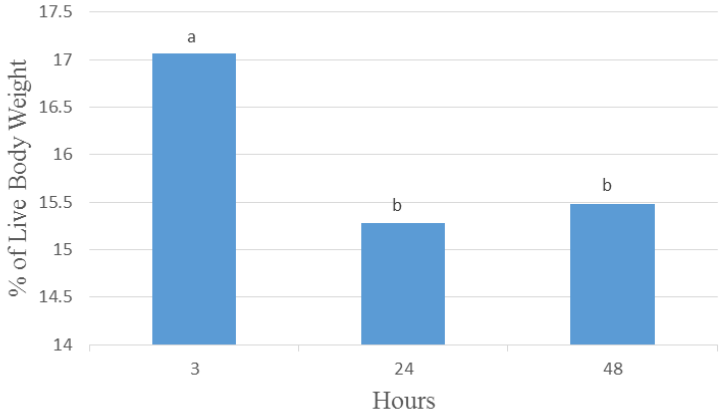
The changes of gastrointestinal tract weight (GITW), small and large intestinal weight (S&LIW) and residual yolk weight (RYW) of birds at 24 and 72h age from hatched time shown in table 2. There were no significant (P>0.05) differences in RYW but the GITW and S&LIW were significantly (p<0.05) differed between birds with 3h delayed access to feed compared to birds that fed 24 and 48h after hatching. The GITW and S&LIW numerically decreased with increased delayed access to feed time, the highest weight observed in the birds that fed 3h after hatching and lowest weights observed in the birds that fed with a 48h post-hatch delayed.

Table 2: Effect of delayed access to feed of post-hatch on change of live body weight, gastro intestinal tract weight, intestinal weight and yolk weight (g) compared with hatch time measured at 24 and 72h of age.

		Change weight at 24 h age				Change weight at 72h age			
Item	Weight at hatch time	F0	F24	F48	SEM	F0	F24	F48	SEM
	(g)		(g)				(g)		
LBW	10.4±0.25	0.94[a]	-0.36[b]	-0.53[b]	0.33	9.60[a]	6.30[ab]	3.06[b]	1.23
GIT	1.04±0.41	0.58[a]	-0.06[b]	-0.22[b]	0.07	2.50[a]	1.60[ab]	1.3[b]	0.34
Intestines	0.28±0.03	0.42[a]	0.15[b]	0.06[b]	0.02	1.28[a]	1.01[ab]	0.8[b]	0.13
Yolk	1.29±0.34	-0.67	-0.31	-0.61	0.18	-1.12	-1.15	-1.15	0.03

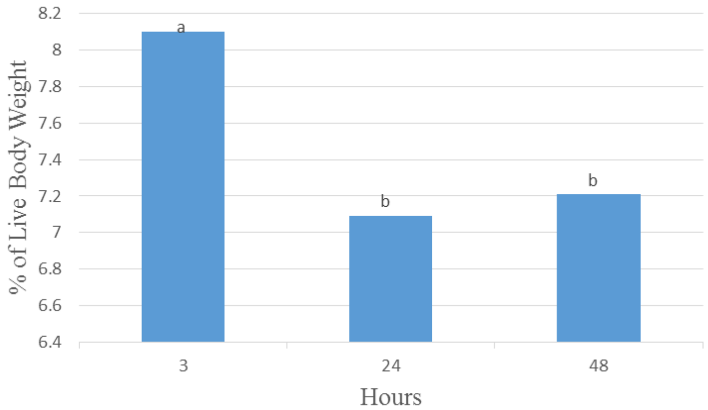
The results confirmed that delay in feed access caused weight loss during holding time (table 2). The decreased in the initial body weight of quail chicks is in line with reports of Noy at al., (2001); Pinchasov and Noy, (1994); and Saki, (2005) who reported that body weight of chicks decreased linearly after hatch in the hatching trays between 0.14 and 0.17 g h^{-1} and delaying placement increases this body weight reduction. According to the research of Noy and Sklan (1998a , 2001), the lack of feed in the very early stages of birds development could cause a negative effect on initial performance due to an inadequate use of the yolk sac, which seemed to be caused by low stimulation of GIT. Lower weight gain exhibited with increasing fasted period (24-48h) could be attributed to poor development of digestive tract. Significantly better early development of GIT and intestine and higher duodenum relative weights (%LBW) and insignificantly higher of other GIT organs relative weights (%LBW) was indicated a slight tendency of better GIT development in quail chicks that fed 3h delayed post-hatch opposite birds fed 48h delayed post-hatch. The negative effect of fasting on performance traits was related to inadequate development of the GIT, particularly of the duodenum and jejunum, at a very early stage of postnatal life (Kuhn et al., 1996). Geyra et al (2001) reported that when feed consumption starts soon after hatch, the nutrients provided by feed are complementary to the yolk nutrients and this would trigger rapid growth rate in birds. Initiation of feed consumption as close to hatch as possible is essential to support early GIT development. The poor FCR of birds starved for 48h is in line with earlier findings by Murakami et al. (1988) that feeding broiler in the first days of life is one of the priority factors that could affect growth, feed efficiency, uniformity and economic benefit.

The average relative weight (weight as a percentage of LBW) of GIT and small intestine of quail chicks measured at 6 d of age is shown in figure 1 and 2. As increased the time of chick starvation the relative weight of GIT and small intestine numerically decreased.



Curve 1: Effect of delayed access to feed of post-hatch on relative live body weight of gastro intestinal tract at 6 d of age.

Although, the difference of yolk weight between the three groups was not significant at 24 and 72h age ($P > 0.05$) but during this period, yolk weight (yolk sac plus yolk) of birds in the three groups decreased, while the decrease in fed bird was more rapid than fasted birds. This result, the yolk weight of fed birds decreased more rapidly than that of the fasted birds, was consistent with the previous study in chicks (Noy and Sklan, 2001). Early feeding after hatch, compared to delayed feeding, appears to stimulate yolk utilization (Noy and Sklan, 1998; Speake et al., 1998). This produces an initial enhancement in live body weight (Noy and Sklan, 1999b; Sklan and Noy, 2000). In the immediate post-hatch period, yolk was used for maintenance and for intestinal growth (Noy and Sklan, 1999a). This requirement possibly led birds to use their body reserves to supply the nutritional requirement for survival, which resulted in body weight reduction. A delay in the placement of chicks may cause productive losses later in the life of birds from strains selected for rapid growth indicating that nutrient supply via yolk sac is not sufficient to sustain the growth of the broiler chick after hatching. There also exist results, which indicated that an early feeding with highly digestible nutrients might retard degrading of the yolk leading to yolk sac inflammation (Uni and Ferket, 2004).



Curve 2: Effect of delayed access to feed of post-hatch on relative live body weight of small intestine at 6 d of age.

The authors concluded that the presence of feed in GIT enhanced yolk secretion to the small intestine and triggered uptake mechanisms for hydrophilic compounds. Previous studies indicated that by this anti-peristaltic movements transfer the digesta proximally toward the gizzard. These intestinal movements resulted in increased amounts of yolk content in the proximal small intestine after hatching (Noy and Sklan 1998a). In previous work, the turnover of yolk in fed chicks was more rapid than in chicks without access to feed (Noy et al., 1996). This effect could also be inferred from studies reporting yolk size following feeding in poults (Moran and Reinhart, 1980) and in earlier work with chicks (Bierer and Eleazer, 1965). The observation of Murakami et al. (1992) that yolk was absorbed independently of feed intake did not contradict these findings. This study indicated that in the presence of feed the major route of yolk utilization was via the yolk stalk into small intestine. The lack of transport to the intestine became more pronounced with time post-hatch, and thus, primarily the circulatory route in birds without access to feed apparently used yolk. Studies reported that the presence of solid nutrients as well as non-nutritious bulk appeared to stimulate growth post-hatch (Noy and Sklan, 1999a). It seems that the presence of exogenous material in GIT stimulates release of yolk through the yolk stalk. In addition, the peristaltic movements of the intestine may also enhance yolk secretion into the intestine. Furthermore, the presence of bulk within the intestine increased the physical pressure within the abdominal cavity on the yolk sac, which would also enhance secretion (Noy and Sklan, 2001).

Table 3: Effect of delayed access to feed of post-hatch on small intestinal (jejunum) morphology parameter of quail chicks measured at 24 and 72h of age.

Treatments	24 h					72 h				
(fasted hours)	VH*	VW	CD	MT	VS	VH	VW	CD	MT	VS
3	132	39[a]	35[a]	27[b]	16.8[a]	160[a]	46[a]	38[a]	37[a]	23.2[a]
24	116	30[b]	29[b]	35[a]	11.5[b]	149[b]	40[ab]	37[ab]	34[ab]	18.1[b]
48	111	30[b]	28[b]	37[a]	10.8[b]	143[b]	37[b]	34[b]	31[b]	17.7[b]
SEM	7.5	1.3	1.4	1.7	1.3	6.7	2.3	2.7	2.1	1.5

VH: Villus height (µm); VW: Villus width (µm); CD: Crypt depth (µm); MT: Muscular thickness (µm); VS: Villus surface area (1000 µm2).
a, b Means with no common superscripts in each column are significantly different ($P < 0.05$)

The average villus height (VH), villus width (VW), crypt depth (CD), muscular thickness (MT) and apparent villus surface area (AVSA) of small intestine (jejunum segment) of birds measured at 1 and 3d of age are shown in Tables 3. The VW, CD, MT and AVSA were significantly ($P<0.01$) decreased with increased fasted time at 24 and 72h of age. The highest VH, VW, CD, MT and AVSA observed in birds started to feeding expressly after post hatch. Significantly higher VW, CD and AVSA and insignificantly higher VH in the birds that started to fed at 3h post hatch compared to birds fed 24 and 48h (table 4) was indicated a tendency of better GIT development in quail chicks that fed immediately post-hatching (figure 1). In agreement to this finding, previous studies have shown that feeding broiler checks immediately post-hatch accelerates the morphological development of small intestine (Noy and Sklan, 1998b). While, delay access to first feed for 24 to 48h post-hatch have decreased villi length (Yamauchi et al., 1996). Uni et al., (1998) indicated that villus volume was depressed in the duodenum and jejunum in chick by 36h fasting post-hatch. In the rat following 4 d fasting, atrophy and hyperplasia were reported in the duodenum and jejunum, but not in the ileum (Holt et al. 1986). Although the digestive capacity begins to develop a few days before hatch but most of the development occurs in the post-hatch period when the neonatal chick begins consuming feed (Ferket and Uni, 2006).
In conclusion, the results of this study revealed that up to 24h delayed access to feed has adverse effects on Japanese quail gastro-intestinal development.

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