

Effects of Delayed Access to Feed and Different Crude Protein Levels in Broiler Chicks After Hatching 3. Morphological Development of Small Intestine Segments

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Abstract

This experiment was conducted to investigate effects of delayed access to feed/water (immediately, after 12 h, 24 h and 48 h) and different dietary crude protein levels (low, normal and high) on morphological development of small intestine segments in broiler chicks after hatching. Delaying 24th h or more time in access to feed after hatching ($P < 0.01$) significantly impaired mucosal development of small intestine. Increasing delayed access to feed after hatching decreased villus size and surface area except for villus width in small intestine segments. A significant interaction between feed accessing time and dietary CP levels for villus size was also observed indicating that high CP diet alleviated retardation of development of villus size and area for 48 h-delayed access to feed.

Introduction

Development of digestive system and small intestine characteristics (villus height, surface area and crypt depth etc.) are impaired when chicks are delayed to access to feed after hatching (Sklan and Noy, 2000). Although the intestinal system in chicks at hatch is anatomically completed, development of the absorptive surface and rate of enterocyte has accelerated during posthatch (Moran 1995). Therefore, nutrition and applications of feeding have increased their importance in early ages because of mucosal development of small intestine. In this study, effects of a delay access to feed and crude protein levels on the morphological development of digestive system in broiler chicks after hatching.

Materials and Methods

Experimental diets were formulated in three CP/amino acid concentrations with 3100 kcal /kg ME and based on corn, soybean meal and fish meal. Normal CP diet was formulated to provide nutrient requirements of National Research Council (1994), and others were 80% and 120% of NRC recommendation. Mixed feeds in 3 different crude protein levels (18.4% low; 23.0% normal; or 27.6% high) were provided to chicks in 4 different accessing times to feed and water (immediately (0-6 h), fed after 12h, 24h or 48h) with a complete 3x4 factorial arrangement for 0-14 d period. Male Ross-308 broiler chicks fed as described above were killed by cervical dislocation and measured the morphological development of small intestine segments (4 chicks per treatments for each period) at 12th h, 24th h, 48th h, 4th d, 7th d and 14th d of ages. Morphometric indices were determined as described by Uni et al. (1998). All data were statistically evaluated by the computer software (Minitab 1989). Differences between means were tested by the Multiple Range Test (Duncan 1954).

Result and Discussion

Values of morphological development of small intestine segments were given in Table 1 except for 12th h, 24th h, 7th d and 14th d of ages. As delaying access to feed after hatching was increased, villus size and surface area of small intestine segments were impaired but not villus width. A significant interaction between feed accessing time and dietary CP levels for villus size was also observed indicating that high CP diet increased villus size and area when chicks

were delayed 48 h access to feed. Experimental results are parallel to results of previous studies (Gonzales et al 2000, Geyra et al 2001).

Table 1. Effects of delayed access to feed and different crude protein levels on morphological developments of small intestine in broiler chicks after hatching

T	FAT	CP	Duodenum												Jejunum								
			Villus height (µm)				Villus surface (µm ²)x10 ⁴				Crypt depth (µm)				Villus height (µm)			Villus surface (µm ²)x10 ⁴			Crypt depth (µm)		
			48 ^h h	4 ^h d	14 ^h d	48 ^h h	4 ^h d	14 ^h d	48 ^h h	4 ^h d	14 ^h d	48 ^h h	4 ^h d	14 ^h d	48 ^h h	4 ^h d	14 ^h d	48 ^h h	4 ^h d	14 ^h d			
1	0-6h	L	487.5	429.0c	1035.0efg	6.08	4.13ef	16.69de	137.4	85.64cdef	173.95cdef	252.8b	373.1b	943.50cd	1.98cd	27.80abc	13.28ef	106.3a	95.16a	222.30b			
2	0-6h	N	502.1	582.0b	883.3g	6.10	6.95bc	14.13e	140.5	89.20bcde	189.60abcd	252.0b	280.2cdef	1260.2a	1.61cde	22.24bcd	23.66ab	86.71abc	74.56cd	179.10cd			
3	0-6h	H	520.5	617.5b	1141.7cdef	5.75	6.17bcd	18.93de	161.2	103.98ab	152.30ef	271.0b	263.8defg	817.40d	2.45abc	21.39bcd	12.66ef	95.08abc	61.39de	179.01cd			
4	12h	L	428.9	621.1b	1257.9bcde	4.03	7.31b	28.98bc	107.6	79.50def	147.66f	356.6a	312.4bcde	1071.3bc	3.20a	36.22a	19.45cd	85.85abc	68.24cd	182.75cd			
5	12h	N	453.6	492.5bc	1288.1bcd	4.86	6.78bc	30.89bc	120.3	109.50a	202.37abc	340.2a	321.0bcd	913.90cd	2.90ab	31.46ab	16.23de	100.3ab	73.14cd	169.62cd			
6	12h	H	405.0	775.8a	1558.8a	3.69	9.9406a	32.65b	132.4	95.90abc	210.33abc	263.4b	439.7a	981.63cd	1.76cde	36.15a	21.52abc	78.19bc	89.53ab	177.24cd			
7	24h	L	454.4	481.0bc	1286.1bcd	5.43	4.57def	29.62bc	124.8	92.45bcd	205.43abc	176.8d	350.3bc	1056.6bc	1.00e	35.65a	24.37ab	71.06c	94.40a	270.80a			
8	24h	N	466.3	613.8b	1430.5ab	5.25	6.96bc	31.56b	145.3	86.92cdef	161.00def	234.3bc	204.9gh	596.30e	2.21bc	14.72d	68.27g	83.50abc	67.07cd	150.86d			
9	24h	H	405.6	487.9bc	1156.6cdef	3.84	5.41cde	23.71cd	133.9	89.42bcde	162.20def	188.1cd	246.7efgh	966.00cd	1.12de	19.89cd	22.51abc	97.17ab	93.01a	169.80cd			
10	48h	L	388.3c	1007.0fg		3.26f	3.26f	19.12de	104.6	64.58g	199.6abc	217.6	189.2h	671.00e		14.27d	10.52fg		48.56e	157.15d			
11	48h	N	350.3	397.0c	1108.0defg	3.13	4.61def	24.56a	104.6	73.52fg	184.3bcde	217.6	316.1bcd	959.20cd	1.83	25.27bc	20.99bc	64.46	77.06bc	172.13cd			
12	48h	H	504.9bc	1359.4abc		4.61def	4.61def	33.70b	104.6	76.64efg	222.21a	224.6fgh	1176.7ab		14.28d	25.31a		66.19cd	202.80bc				
SEM			12.3	19.7	32.8	0.23	0.295	1.131	3.28	2.13	4.31	9.89	11.8	29.5	0.13	1.46	0.93	2.84	2.35	5.39			
FAT																							
0-6h			503.4a	542.9b	1020.0c	5.98a	5.75b	16.58c	146.4a	92.94a	171.97b	258.6b	305.7b	1007.1a	2.01ab	2.38b	16.54	96.03a	77.03b	193.47ab			
12 h			429.2b	629.8a	1368.3a	4.19bc	8.01a	30.84a	120.1b	94.96a	186.78ab	320.1a	357.7a	988.90a	2.65a	3.66a	19.06	88.12a	76.97b	176.53b			
24 h			443.8b	527.6b	1291.1a	4.84b	5.65b	28.28ab	134.7ab	89.60a	176.21b	199.7c	267.3c	873.00b	1.44b	2.34b	17.90	83.91a	84.83a	197.10a			
48 h			350.3c	430.1c	1158.1b	3.13c	4.16c	25.79b	104.6c	71.58b	202.10a	217.6c	243.3c	935.60ab	1.83b	1.79c	18.94	64.46b	63.94c	177.35b			
CP																							
Low			458.6	479.9b	1146.6b	5.18	4.82b	23.60	123.3b	80.54b	181.66	262.1ab	306.2	935.60	2.06	2.85a	16.90b	87.74	76.59	208.20a			
Normal			474.0	521.4b	1177.4b	5.41	6.32a	25.29	135.4a	89.78a	184.36	275.5a	280.5	932.40	2.26	2.34b	16.93b	90.17	76.96	167.93b			
High			443.7	596.5a	1304.1a	4.43	6.54a	27.25	142.5a	91.48a	186.77	240.8b	293.7	985.40	1.78	2.29b	20.50a	90.14	77.53	182.20 b			
P values																							
T			0.048	<0.001	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001			
FAT			0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005	<0.001	<0.001	0.012	0.003	<0.001	0.181	0.015	<0.001	0.049			
CP			0.584	0.004	0.013	0.141	<0.001	0.120	0.010	0.005	0.784	0.046	0.269	0.268	0.134	0.038	0.002	0.903	0.328	<0.001			
FATXCP			0.729	0.004	0.004	0.737	0.008	0.005	0.268	0.009	<0.001	0.004	<0.001	<0.001	0.001	0.002	<0.001	0.023	<0.001	<0.001			

a-h; Values within columns with different superscripts are significantly different (P<0.05).

T; Treatments, FAT; Feed Accessing Time, CP; Crude protein level, L; Low, N; Normal, H; High, 0-6h; immediately; FAT X CP; interaction

Table 1. (Continued) Effects of delayed access to feed and different crude protein levels on morphological developments of small intestine in broiler chicks after hatching

T	FAT	CP	Ileum								
			Villus height (μm)			Villus surface (μm^2) $\times 10^4$			Crypt depth (μm)		
			48 th h	4 th d	14 th d	48 th h	4 th d	14 th d	48 th h	4 th d	14 th d
1	0-6h	L	173.8c	217.3bc	479.3def	13.97cde	12.87de	56.92c	74.52	50.30b	150.30c
2	0-6h	N	204.8bc	156.2d	509.5cdef	12.88cde	8.76defg	70.57bc	90.88	67.74a	164.38bc
3	0-6h	H	201.1bc	287.6a	700.1b	17.99abc	39.28a	96.31bc	82.043	64.67a	170.76abc
4	12h	L	177.2c	174.7cd	595.5bcde	12.78cde	10.27def	76.34bc	66.27	67.14a	152.68c
5	12h	N	258.2a	294.1a	461.9ef	22.54a	25.61b	59.57c	65.75	70.54a	149.11c
6	12h	H	182.8bc	132.2de	841.7a	10.54de	5.64fg	19.44a	77.06	61.02a	181.50ab
7	24h	L	194.7bc	165.0d	553.8bcdef	14.83bcd	9.20defg	85.39bc	68.92	63.40a	182.40ab
8	24h	N	219.0b	239.4b	600.6bcde	19.49ab	18.93c	70.72bc	73.78	66.79a	145.55c
9	24h	H	166.5c	167.2cd	631.8bcd	9.22e	10.46def	107.91b	75.37	60.98a	172.00abc
10	48h	L		99.8e	616.6bcde		4.11g	90.70bc		38.79c	121.49d
11	48h	N	184.3	175cd	418.7f	11.92	13.43d	55.37c	78.32	49.85b	148.70c
12	48h	H		134.8de	658.4bc		7.08efg	92.90bc		49.40b	192.80a
SEM			5.22	9.45	20	0.771	1.47	6.04	1.77	1.51	3.46
FAT											
0-6h			193.2	220.4a	556.5	14.95	20.30a	73.24b	82.48a	63.90a	160.93
12 h			206.1	200.3ab	633.0	15.27	13.84b	110.10a	69.69b	66.23a	161.09
24 h			193.4	190.5b	595.4	14.50	12.86b	88.01b	72.69b	63.72a	166.64
48 h			184.3	136.5c	565.6	11.92	8.21c	79.66b	78.32ab	46.01b	154.30
CP											
Low			181.9b	164.2b	556.5b	13.85b	9.11b	76.14b	69.90	57.16b	151.63b
Normal			227.3a	216.2a	497.7b	18.30a	16.68a	64.06b	76.80	63.73a	151.93b
High			183.5b	180.5b	708.0a	12.59b	15.62a	122.87a	78.15	59.02b	179.26a
P values											
T			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.033	0.009	<0.001
FAT			0.636	<0.001	0.242	0.695	<0.001	0.006	0.024	<0.001	0.364
CP			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.109	0.010	<0.001
FATXCP			0.022	<0.001	0.009	<0.001	<0.001	<0.001	0.318	0.165	<0.001

a-g; Values within columns with different superscripts are significantly different ($P < 0.05$).

T; Treatments, FAT; Feed Accessing Time, CP; Crude protein level, L; Low, N; Normal, H; High, 0-6h; immediately; FAT X CP; interaction

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