

## PERFORMNCE, INTESTINE MORPHOLOGY AND SERUM BIOCHEMISTRY OF BROILER CHICKENS TO DELAYED POST HATCH FEEDING

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### ABSTRACT

This study was conducted to estimate the effect of delayed post hatch feeding after arrival to the rearing hall on broiler performance, serum biochemistry and jejunum histology. A total of 225 Ross 308 day-old chicks were randomly distributed into three groups T1 chicks access to feed immediately, T2 chicks delayed in feeding for 12 hours and T3 chicks delayed in feeding for 24 hours with three replicates of 25 chicks. Remained yolk sack was lower for chicks that had immediate access to feed compared to other experimental groups. Longer delay feeding time lowered body weight uniformity % at different ages. Immediate access to feed significantly ( $P<0.05$ ) improved broiler performance at different ages compared to that delayed for 12 and 24 hours post hatch. Significantly ( $P<0.05$ ) longer small intestine and higher percent of live body weight were recorded for early feeding groups compared to delayed groups. The level of T3 and T4 hormones in the serum were significantly ( $P<0.01$ ) higher for early feeding groups compared to other groups. Increasing delayed post hatch feeding led to a significant ( $P<0.01$ ) increase in uric acid level in serum. Early feeding significantly ( $P<0.01$ ) improved jejunum histology including villi height, villi width, villi height to crypt depth and surface area.

**KEY WORDS:** broiler, early feeding, performance, intestine histology

### 1. INTRODUCTION

**H**atch window 21 days of incubation is the range in which a broiler chicks need to get hatched in the hatchery machine, having 24 to 48 hours as an approximate to complete the entire process (Jacobs et al., 2016). Incubation conditions and age of the parent are the some of the many other factors that affect the hatching process of a chick (Lourens et al., 2005). During this process, hatching, chicks have no access to water or feed unless they are in the field which is the beginning of their performance and health (Simon et al., 2015). Simultaneous pulling and processing of the chicks for example; vaccination, counting, sexing, and sorting are done at the end of the hatch window. According to the standard guidance, they are sorted for about 1-4 hours before transferring them to the broiler farms. Intestinal improvement (Lilburn and Loeffler, 2015) as well as immunological development (Panda et al., 2014) have been claimed by providing immediate feed and water in the post-hatch stage. However, studies

showed that this process may be useless in later stage of life and lead to unclear benefit of immediate feeding of the chicks (Gonzales et al., 2003; Simon et al., 2014, 2015). In practical, early nutrition is done through providing the nutrition (feed and water) in the hatcher which is called on-farm hatching in which the chick is hatched within broiler house unit. According to some researches, production performance of the chicks may be negatively affected if they transported to the field in 1-day old and this depending on the transport period which may lead to disability of the chick to adapt to the stress and deprivation of feed (Bergoug et al., 2013; Jacobs et al., 2016). Although residual egg yolk is a good source of nutrition, commercial broiler chicks cannot obtain sufficient nutritional requirements from this source. Furthermore, delay provision of feed may reduce villus height, villus width a surface area, crypt depth or percentage of cell proliferation in the chicks which are the main affected morphological changes in chicks (Shinde et al., 2015; Ghanem et al., 2018).

Therefore, the aim of this experiment was to study the influence of delaying post hatch feeding on performance, intestine morphology and serum biochemical of broiler chicks.

## 2. MATERIAL AND METHOD

### 2.1 Subjects and experimental design

Two hundred and twenty five day old chicks (Ross 308) were provided by a local hatchery. After arrival, chicks were weighed. They were equally and randomly distributed to different

delayed feeding time after arrived to rearing hall. T1 0 (feeding immediately) T2 delayed feeding for 12 hours and T3 delayed feeding for 24 hours. Each group was replicated three times (25 chicks each). Birds were reared in (1 m x 1 m) floor pens. The halls were equipped with essential equipment's including heating facilities and adjustable setting of temperature. The starter diet was provided to birds from 1- 14 days of age. Later, from 14-21 days, the birds were fed on the grower diet. Ad libitum feed and water were provided to the birds (Table 1).

**Table (1):** The composition of the starter and grower diets

Ingredients (kg)	Starter (kg/ton) 1- 14 days	Grower (kg/ton) 14 – 21 days
Corn	471.05	493.55
Wheat flour	50	50
Wheat bran	40	50
Soybean meal 46%	370	340
oil	23	24
limestone	10	8
Di calcium phosphate	7	6
DL methionine	0.200	0.200
L- lysine	1	0.5
Anti-toxin	1	1
Salt	1	1
Premix <sup>1</sup>	25	25
Anti coccidial	0.250	0.250
Enzyme	0.5	0.5
Total	1000	1000
Estimated chemical composition		
Moisture (%)	11.57	11.78
Crude protein (%)	22.49	20.65
Energy Kcal/kg	2966	3055
Fat (%)	2.97	3.36
Fiber (%)	2.18	2.64
Ash (%)	4.83	3.34
Starch (%)	44.22	46.29
Sugars (%)	4.02	3.87
Calcium (%)	1.12	0.97
Available phosphorous (%)	0.58	0.53

### 2.2 Performance measurements

Performance parameter (Body Weight, Feed Intake (FI), Feed Conversion ratio) were measured weekly. However, the relative weight of internal organ, the mortality and production index were measured at 21 days of the experiment.

### 2.3 Yolk sac measurement

At day1, 4 and 7 days of age 2 chicks from each replicate were randomly selected and yolk sac was measured as a percent of the live body weight according to equation (yolk sac weight/ live body weight \* 100).

### 2.4 Body weight uniformity percent

At the end of each week all chicks were individually weighted and the body weight uniformity percentage of each replicate was

recorded according to equation (number of chicks weight within  $\pm 10\%$  of mean/ total number of chicks\*100)

### 2.5 Histology of intestine (jejunum)

Jejunum tissue samples were collected, samples were flushed with saline buffered and the 10% neutral buffered formalin has been used to fix the samples. The eosinin and haematoxylin have been used to stain the sectioned samples after coalition into separation and paraffin wax. The tissue sections that have been prepared were image captured by digital camera at 10 $\times$  magnification under (Dino-Eye-Microscope Eye-piece 38 Camira). The morphometric indices were determined by using Dino-eye program. The photos were digitized and the

measurement parameters recorded according to (Iji et al., 2001)./

## 2.6 Serum biochemical parameters

The serum parameters were determined at 21 days of age according to (Mustafa et al., 2021) . Blood samples from two birds per cage were obtained by venipuncture of the jugular vein at 21 days of age. Then, the blood keep cold and transferred to lab where they will centrifuge at 1500 g for 10 min. The serum was harvested and stored at -20 °C until analysis. Triglyceride, glucose, Globulin, Total protein, Albumin, Cholesterol, LDL, HDL, ALT, AST, T3, T4, and uric acid were measured using auto analyzer (Cobas 6000, Roche Diagnostics. Germany).

## 2.7 Statistical analysis

Data collected were subjected to one Way ANOVA using SAS ( 2010), Differences among means were determined using Duncan's multiple ranges test (Duncan, 1955).

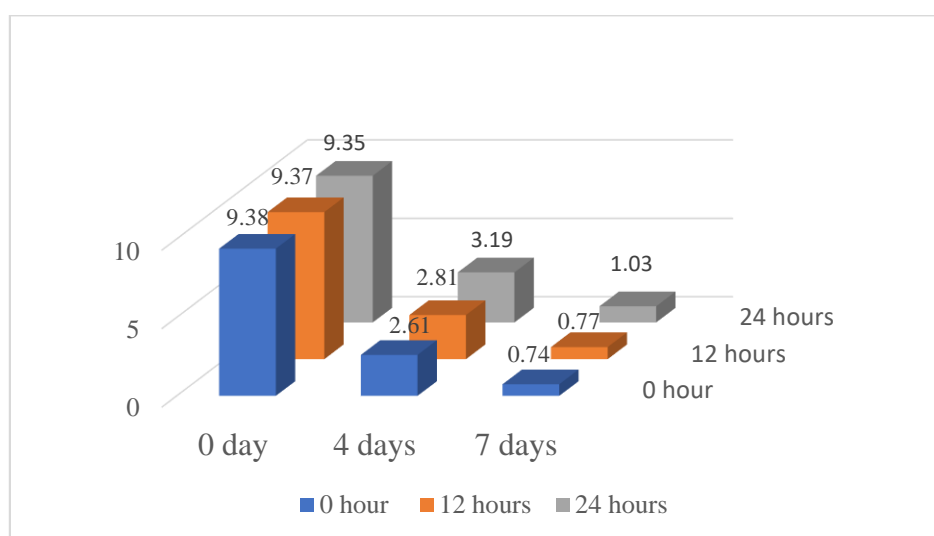
## 3. RESULTS AND DISCUSSION

### 3.1 Yolk sac percent of live body weight

Figure 1 represents the effect of different feeding time after chicks arrived to the rearing hall on the remained yolk sac as a percent of live body weight. Its shows that higher yolk sac remained at 4 and 7 days of age was for chicks that were delayed feeding for 24 hours followed by those that were accessed to feed after 12 hours. Lower yolk sac percentage at both ages was for chicks that were immediately feed after placement in

the rearing hall. Similar results were obtained by (Bhanja et al., 2009; Cardeal et al., 2020) reported that higher yolk sac percent of live body weight was found in birds that were delayed to the access of feed for 24 hours compared to those that were feed immediately. In contrast Ozlu et al., (2020) mentioned that delay chicks feeding time decreased the yolk sac percent of live body weight compared to those feed early. Moreover, Williams et al., (2021) reported that yolk sac percent of live body weight did not significantly affected by the delay feeding time for 24 hours compared to 3 hours. Rapid yolk sac absorption in chicks fed diet immediately is due to presence of feed in the gastrointestinal tract which accelerates secretion of the yolk sac in to the small intestine and raised uptake mechanisms for hydrophilic compounds. Previous trial reported that by this antiperistalsis movements move the digesta proximally toward the gizzard (Esteban et al., 1991). These intestinal movements resulted in increased amounts of yolk content in the proximal small intestine after hatching (Noy and Sklan, 1998a).

High resorption of the yolk sac is generally considered positive for chicken development and has been suggested to stimulate the transport of immunoglobulins from the yolk to the chicken (Moran and Reinhart, 1980) Early feeding after hatching, compared with delayed feeding, appears to stimulate yolk utilization, as reported by (Speake et al. 1998;Bhanja et al. 2009).



**Fig. (1):** Effect of different post-hatch feeding time on the remained yolk at different ages (1g/100g BW)

### 3.2 Body weight uniformity percent.

Figure 2 shows the effect of different delay feeding time after chick placement on the body weight uniformity of chicks at 7, 14 and 21 days of age. It shows that higher body weight uniformity percentage was recorded for chicks that were fed immediately after placement at 7, 14 and 21 days of age being, 79.33%, 75.33 and 72.33, respectively. Followed by those delayed

feeding for 12 and 24 hours. Better body weight uniformity percent for chicks fed diet immediately could prevent the accident of dehydration mainly because of yolk sac utilization (Bergoug et al., 2013; Jacobs et al., 2016; Ozlu et al., 2017). Dehydration of chicks delayed in feeding cause slow growth and make body weight differ (Vieira & Moran 1999a).

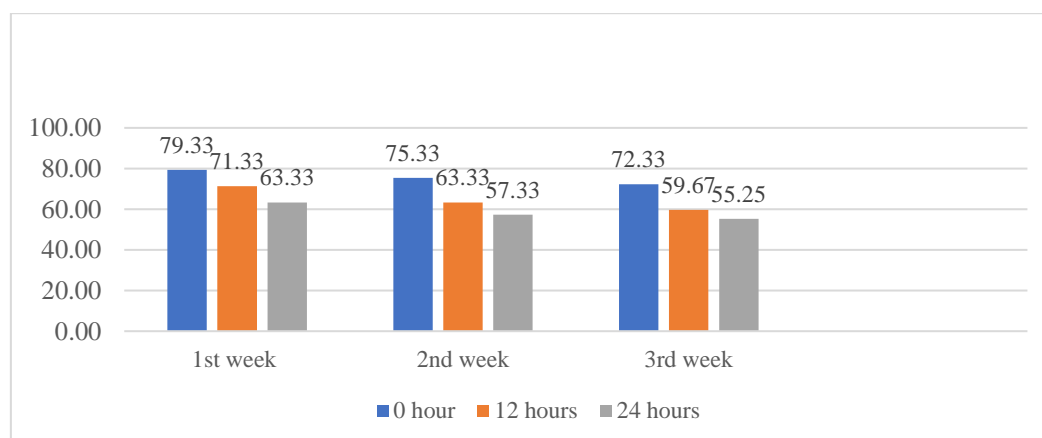


Fig. (2): Body weight uniformity % of broiler chicks at different age exposed to various feeding time

### 3.3 Performance parameters

The influence of different delay feeding after placement on chicks' performance at different ages is presented in (table 2). Significantly ( $p < 0.01$ ) higher body weight, weight gain and feed intake were recorded for chickens that were fed immediately after placement at the farm followed by those that were fed after 12 hours and 24 hours after placement in the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> week and throughout the entire rearing period (21) days. At third week of age chicks that were fed immediately after placement significantly ( $P < 0.05$ ) recorded better feed conversion ratio compared to those that were fed after 24 hours of placement being 1.242 and 1.338, respectively. Throughout the 21 days of experimental period chicks on immediate fed after placement significantly ( $P < 0.01$ ) reported better feed conversion ratio (1.163) compared to those fed diet after 12 hours (1.213) and 24 hours (1.234). Chicks fed diet immediately (0 hours) significantly ( $P < 0.01$ ) recorded higher production index value compared to those that were delayed feeding for 12 and 24 hours being 368.2, 318.59 and 283.55 respectively. Livability percentage did not affect by the delayed feeding period after placement. These results were in agreement with the finding of

(Özlu et al., 2020) who found that delaying chicks feeding at placement for 12 hours significantly ( $P < 0.01$ ) affected the body weight. Moreover Cardeal et al., (2020) found that delaying chicks feeding for 24 hours significantly ( $P < 0.01$ ) decreased the body weight and feed intake compared to those fed diet after 3 hours at 21 days of age. However, in contrast Shafiei et al., (2018) reported that delayed feeding for 12 hours didn't significantly affect the body weight, weight gain and feed conversion ratio of broiler chicks. Moreover Bhanja et al., (2009) found that delayed feeding for 24 hours didn't significantly affect the body weight and feed conversion ratio of 21 days old broiler chicken compared to those that were fed immediately after placement.

Better performance for chicks fed immediately after arrival to the rearing hall may be due to that birds placed earlier had a longer feeding time than the birds placed after 12 and 24 h, and the increased feed intake usually continued throughout life which clearly demonstrated a negative effect of body weight resulting in a reduction in feed intake, lower body weight and high mortality percent for delayed accesses to the fed were may be is associated dehydration and a shortage of

available energy (Vieira and Moran, 1999b). furthermore, high level of the thyroid hormone for chicks fed immediately compared to other groups delayed fed for 12 and 24 hours. Zhan et

al., (2007) summarized that concentration of thyroid hormones were closely correlated with growth performance and shift the energy metabolism of broilers.

**Table (2):** Effect of different post hatch feeding time after arrival to hall on the performance of broiler chicks at different age.

Parameters	Delay feeding period			SEM	P value
	T1(0 h)	T2 (12 h)	T3 (24 h)		
<b>First week</b>					
Body weight (g)	175.24 <sup>a</sup>	166.92 <sup>b</sup>	151.01 <sup>c</sup>	3.64	0.0001
Weight gain (g)	136.68 <sup>a</sup>	128.63 <sup>b</sup>	114.51 <sup>c</sup>	3.31	0.0001
Feed intake (g)	144.67 <sup>a</sup>	137.19 <sup>b</sup>	122.80 <sup>c</sup>	3.23	0.0001
FCR (kg/kg)	1.058	1.066	1.072	0.0064	0.725
<b>Second week</b>					
Body weight (g)	451.28 <sup>a</sup>	419.45 <sup>b</sup>	387.94 <sup>c</sup>	9.21	0.0001
Weight gain (g)	276.04 <sup>a</sup>	252.53 <sup>b</sup>	236.93 <sup>c</sup>	5.82	0.0001
Feed intake (g)	297.87 <sup>a</sup>	281.89 <sup>b</sup>	268.44 <sup>c</sup>	4.44	0.0006
FCR (kg/kg)	1.079	1.116	1.133	0.0108	0.1009
<b>Third week</b>					
Body weight (g)	922.98 <sup>a</sup>	845.48 <sup>b</sup>	776.23 <sup>c</sup>	21.41	0.0001
Weight gain (g)	471.69 <sup>a</sup>	426.02 <sup>b</sup>	388.29 <sup>c</sup>	12.37	0.0001
Feed intake (g)	585.84 <sup>a</sup>	560.19 <sup>b</sup>	519.48 <sup>c</sup>	9.80	0.0001
FCR (kg/kg)	1.242 <sup>b</sup>	1.315 <sup>ab</sup>	1.338 <sup>a</sup>	0.0179	0.045
<b>1-21 day</b>					
Body weight (g)	922.98 <sup>a</sup>	845.48 <sup>b</sup>	776.23 <sup>c</sup>	21.41	0.0001
Weight gain (g)	884.42 <sup>a</sup>	807.19 <sup>b</sup>	737.66 <sup>c</sup>	21.41	0.0001
Feed intake (g)	1028.40 <sup>a</sup>	979.27 <sup>b</sup>	910.73 <sup>c</sup>	17.13	0.0001
FCR (kg/kg)	1.163 <sup>b</sup>	1.213 <sup>a</sup>	1.234 <sup>a</sup>	0.0115	0.003
Livability %	97.33 <sup>a</sup>	96.00 <sup>a</sup>	94.66 <sup>a</sup>	0.66	0.296
Production index	368.20 <sup>a</sup>	318.59 <sup>b</sup>	283.55 <sup>c</sup>	13.01	0.0013

<sup>a,b,c</sup> Within the same row different letter mean significantly differ

### 3.4 Internal organs.

The impact of delayed feeding on internal organs of broiler chicks at different ages is shown in (table 2). Significantly ( $<0.01$ ) longer small intestine during first, second and third week was recorded for chicks feed diet directly after arrived to rearing hall compared to those that were delayed feeding for 12 hour and 24 hours. The relative weight of the small intestine and gizzard at first week of age was significantly ( $P<0.01$ ) higher in birds on early access to feed group compared for those delayed in feeding. At second week of age significantly ( $P<0.01$ ) higher percent of liver and proventriculus to live body weight were recorded for delayed feeding group for 24 hours compared to others. Heart percent was significantly ( $P<0.01$ ) higher for chicks delayed feeding for 12 hours compared to other groups. At third week of age significantly ( $P<0.01$ ) higher liver percent was recorded for chicks fed diet at placement compared to delayed group. The relative weight of heart was

significantly ( $P<0.01$ ) higher in chicks that were delay feeding for 12 hours compared to other treatments. On the other hand, significantly ( $P<0.01$ ) higher gizzard relative weight was recorded for chicks delayed feeding for 24 hours compared to other groups. The results were in line with the finding of Sözcü et al., (2020) who mentioned that delaying chicks feeding significantly ( $P<0.05$ ) increased gizzard and heart percent of live body weight compared to early feeding.

However, in contrast kang et al., (2018) reported that delaying chicks feeding for 12 and 24 hours had no significant effect on the intestine length, intestine percent and gizzard percent compared to those chicks early accessed to fed at 21 days of age. Moreover, Shafiei et al., (2018) reported that delay feeding for 12 hours had no significant effect on the gizzard percent from live body weight of broiler compared to control.

**Table (2):** Effect of different post hatch feeding time after arrival to hall on the internal organ of broiler chicks at different age.

Parameters	Delay feeding period			SEM	P value
	T1(0 h)	T2 (12 h)	T3 (24 h)		
<b>First week</b>					
Intestine length (cm)	95.33 <sup>a</sup>	89.66 <sup>b</sup>	79.16 <sup>c</sup>	1.744	0.0001
Intestine %	10.86 <sup>a</sup>	9.60 <sup>b</sup>	9.42 <sup>b</sup>	0.189	0.003
Liver %	4.44	4.38	4.51	0.079	0.819
Heart %	0.82	0.86	0.80	0.017	0.302
Gizzard %	3.45 <sup>a</sup>	3.04 <sup>b</sup>	3.40 <sup>a</sup>	0.069	0.019
Proventriculus%	1.01	0.90	0.87	0.026	0.085
<b>Second week</b>					
Intestine length (cm)	134.83 <sup>a</sup>	125.83 <sup>b</sup>	109.66 <sup>c</sup>	2.591	0.0001
Intestine %	9.93	10.25	9.88	0.097	0.252
Liver %	2.37 <sup>b</sup>	2.49 <sup>b</sup>	2.72 <sup>a</sup>	0.048	0.002
Heart %	0.75 <sup>b</sup>	0.84 <sup>a</sup>	0.79 <sup>b</sup>	0.010	0.001
Gizzard %	1.69	1.78	1.75	0.019	0.188
Proventriculus %	0.62 <sup>a</sup>	0.55 <sup>b</sup>	0.60 <sup>a</sup>	0.010	0.010
<b>Third week</b>					
Intestine length (cm)	159.98 <sup>a</sup>	144.68 <sup>b</sup>	132.16 <sup>c</sup>	2.835	0.0001
Intestine %	6.79 <sup>a</sup>	6.38 <sup>b</sup>	6.74 <sup>a</sup>	0.059	0.0021
Liver %	3.50 <sup>a</sup>	2.84 <sup>b</sup>	2.98 <sup>b</sup>	0.074	0.0001
Heart %	0.96 <sup>b</sup>	1.03 <sup>a</sup>	0.80 <sup>c</sup>	0.025	0.0001
Gizzard %	1.55 <sup>c</sup>	1.73 <sup>b</sup>	1.83 <sup>a</sup>	0.031	0.0001
Proventriculus %	0.46	0.43	0.44	0.0068	0.138

<sup>a,b,c</sup> Within the same row means not sharing the same subscript are different letter mean significantly differ

### 3.5 Serum bio-chemicals

Table 3 shows the effect of different delaying access to feed of day-old chicks on some serum biochemical parameters of broiler chicks at 21 days of age. Serum content of thyroid hormones T3 and T4 was significantly ( $P<0.01$ ) higher for broiler chicks that were accessed earlier to the diet compared to those delayed feeding for 12 and 24 hours. The level of serum uric acid was significantly ( $P<0.01$ ) higher in chicks delayed in feeding for 12 and 24 hours compared to control being 5.25, 5.40 and 4.45 respectively. The level of AST enzyme chicks that delayed in feeding for 12 hours was significantly ( $P<0.05$ ) higher compared to control. All other serum biochemical parameters didn't significantly affected by delay feeding period. The results were in line with the finding of Kang et al., (2018) who reported that delay chicks feeding for 12 and 24 hours had no significant effect on serum cholesterol, triglycerides and AST enzyme at 21 days of age. Moreover Sözcü et al., (2020) reported that delaying chicks feeding cause significant decrease in the concentration of T3 hormone in the serum compared to control. Furthermore, Shafiei et al., (2018) observed that delay feeding of day old chicks for 12 hours had no significant effect on the serum cholesterol, high density lipoprotein, low density lipoprotein

and triglyceride. While, significantly ( $P<0.01$ ) increase serum uric acid concentration compared to control. On the other hand results were in contrast with findings of Shafiei et al., (2018) who recorded significantly ( $P<0.05$ ) lower serum albumin for chicks delayed feeding for 12 hours compared to control.

The changes in plasma thyroid hormones concentration in feed deprived broilers likely resulted from a shift in the balance between deiodination of T4 by hepatic D1 and T3 degradation by hepatic D3 deiodinases (Darras et al., 2000; Ryens et al., 2002). Györfy et al. (2009) found that during feed restriction, T3 concentration is lowered due to a decreased T4 activation and increased T3 inactivation. Furthermore, they show that hepatic type-I deiodinase (D1) is not affected by energy restriction, however, hepatic D2 is decreased on both transcriptional and enzyme activity levels. The thyroid hormones, including T3 and T4, are recognized as the key metabolic hormones of the body, with T3 being the most functionally active form. High serum uric acid concentration were recorded for chicks delayed feeding and this may be due to protein wastage, uric acid is a function of quality of protein in the ration whereby high levels indicated low protein efficiency utilization (Fafiolu, 2007)

**Table (3):** Effect of different post hatch feeding time after arrival to hall on the serum biochemicals of broiler chicks at 21 days of age.

Parameters	Delay feeding time			SEM	P value
	T1(0 h)	T2 (12 h)	T3 (24 h)		
Cholesterol (mg/dl)	166.50	168.50	167.83	0.626	0.440
HDL (mg/dl)	57.33	57.50	56.50	0.641	0.812
LDL (mg/dl)	47.33	47.16	45.83	0.673	0.494
Triglyceride (mg/dl)	39.83	38.83	37.66	0.800	0.666
T3 (nmol/ml)	2.58 <sup>a</sup>	2.25 <sup>b</sup>	1.88 <sup>c</sup>	0.076	0.0001
T4 (nmol/ml)	22.50 <sup>a</sup>	17.16 <sup>b</sup>	14.16 <sup>c</sup>	0.898	0.0001
Total protein	2.6	2.66	2.63	0.042	0.940
Albumin (mg/dl)	1.25	1.28	1.15	0.033	0.243
Globulin (mg/dl)	1.38	1.38	1.48	0.029	0.293
Glucose (mg/dl)	218.66	217.33	218.16	1.235	0.915
Uric acid (mg/dl)	4.45 <sup>b</sup>	5.26 <sup>a</sup>	5.40 <sup>a</sup>	0.113	0.0001
ALT (U/L)	7.63	7.78	7.78	0.117	0.850
AST (U/L)	238.33 <sup>b</sup>	271.16 <sup>a</sup>	248.00 <sup>ab</sup>	5.656	0.040

<sup>a,b,c</sup> Within the same row means not sharing the same subscript are different letter mean significantly differ AST, aspartate aminotransferase, T3, (triiodothyronine), T4 Thyroxine, AST, Aspartate Aminotransferase ALT, alanine Aminotransferase, HDL, high density lipoprotein, LDL, Low density lipoprotein.

### 3.6 Jejunum histology

The influence of various feeding period for day-old chicks after arrived to the rearing hall on the jejunum morphology is shown in (Table 4). Significantly ( $P < 0.01$ ) higher villus height, villi apical width, villi base width, villi height to crypt depth and surface area were recorded for chicks that were early accessed to feed compared to those delayed for 12 and 24 hours. Crypt depth and muscle thickness were significantly ( $P < 0.05$ ) higher in chicks delayed feeding for 12 and 24 hours after chicks arrived to rearing hall compared to those accesses early to feed. The results were in line with the findings of Sözcü et al., (2020) who found that delay feeding of day-old chick significantly ( $P < 0.05$ ) reduced villi height compared to early feed group. The results were in contrast with the findings of Liu et al., (2020) who reported that delaying chicks feeding for 24 hours had no significant effect on the jejunum crypt depth and villi height to crypt depth compared to early feeding group. Furthermore, villi height was significantly ( $P < 0.05$ ) higher in birds that were immediately accessed to feed than those delayed feeding.

Early nutrition is a stimulus to the early development of GIT, early absorption of the

yolk sac, improved performance and the health status of the birds later in life. In the post-hatch period, there is the rapid development of intestinal length, weight, and its enzymatical activities, where delay in feeding causes a reduction in development and expression of nutrient transporters affecting absorption of nutrients (Yegani & Korver, 2008). Furthermore there is appositive correlation between intestine microflora and intestine developments (Dai et al., 2020) because early feeding significantly improves intestinal microflora compared to delay feeding (Binek et al., 2000; Lan et al., 2005). It is well-accepted that a lower crypt depth is indicative of faster tissue turnover and, perhaps, higher demand for new tissue (Tiwari et al., 2018; Jeurissen et al., 2002). Furthermore, it has been reported that a high intestinal villus is associated with a well-differentiated intestinal mucosa with high digestive and absorptive capabilities (Jeurissen et al., 2002). A meta-analysis study done for the effect of post-hatch delay feeding shows significant sub normality in the small intestine segment with reduced length and relative weight of duodenum, jejunum, and ileum, and shorter villus height and crypt depth of broiler chicks (De Jong et al., 2017)

**Table (4):** Influence of different delay feeding time on jejunum morphology of chicks at 21 days of age

Parameters	Delay feeding time			SEM	P value
	T1 (0 h)	T2 (12 h)	T3 (24 h)		
Villi height ( $\mu\text{m}$ )	702.76 <sup>a</sup>	577.88 <sup>b</sup>	557.59 <sup>b</sup>	5.31	0.0001
Villi apical width ( $\mu\text{m}$ )	87.40 <sup>a</sup>	73.75 <sup>b</sup>	39.95 <sup>c</sup>	1.53	0.0001
Villi base width ( $\mu\text{m}$ )	88.64 <sup>a</sup>	74.31 <sup>b</sup>	48.45 <sup>c</sup>	1.29	0.0001
Crypt depth ( $\mu\text{m}$ )	125.07 <sup>c</sup>	139.07 <sup>b</sup>	172.98 <sup>a</sup>	2.34	0.0001

Muscle thickness ( $\mu\text{m}$ )	103.42 <sup>b</sup>	115.70 <sup>a</sup>	115.17 <sup>a</sup>	2.26	0.043
Villi height/ crypt depth	5.68 <sup>a</sup>	4.61 <sup>b</sup>	3.36 <sup>c</sup>	0.11	0.0001
Surface area ( $\mu\text{m}^2$ )	1415.52 <sup>a</sup>	1160.28 <sup>c</sup>	1274.31 <sup>b</sup>	9.79	0.0001

<sup>a,b,c</sup> Within the same row means not sharing the same subscript are different letter mean significantly differ

#### 4. CONCLUSION

From the results of the current study it could be concluded that feeding day-old chicks directly after arrival to the rearing hall could improve broiler performance, thyroid hormone and intestine morphology at 21 days of age.

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