EFFECT OF DEPRIVATION ON PRODUCTIVE TRAITS OF NEWLY HATCHED CHICKS: HISTOPATHOLOGICAL STUDY

Z. Kh. Jalob
Assist. Prof.
Department of Pathology and Poultry Diseases/College of Veterinary Medicine/ University of Fallujah
ziadallheeti@yahoo.com

ABSTRACT

The aim of this study was to investigate the effect of deprivation on productive traits of newly post hatched chicks. A total number of Ross 308 birds (120) were divided into four groups as in the following way: group1 (G1=38 bird), was regarded as positive control and had been supplied directly with the feed, whereas group2 (G2=27 bird), group3 (G3=28 bird) and group4 (G4=27 bird) were supplied with the diet at post hatch period of 24h, 48hr and 72h respectively. Water supplied was *ad libitum* to all groups immediately after placing. Result revealed that G1 showed significant performance (P<0.05) according to the level of yolk sac absorption (Y.S.A), Feed Conversion Ratio (F.C.R). The final body weight gain (B.W.G) showed significant increase in G1 (P<0.05) as compared to other groups. In conclusion the study showed that chicks which have fed immediately after hatching were significantly exceeded (P<.0.05) the deprived chicks concerning the used up of residual yolk for more than 48h as well deprived chicks showed low productive traits.

Keywords: Histopathological, productive traits, newly hatched chicks

مجلة العلوم الزراعية العراقية – 124- 131 :49(1)/ 2018 جلوب

تأثير الحرمان على الصفات الإنتاجية لأفراخ حديثة الفقس: دراسة نسجية مرضية

زياد خلف جلوب
أستاذ مساعد
فرع الأمراض وأمراض الدواجن/ كلية الطب البيطري/ جامعة الفلوجة
ziadallheeti@yahoo.com

المستخلص

تهدف الدراسة إلى التحري من تأثير الحرمان على الصفات الإنتاجية لأفراخ حديثة الفقس. أجريت التجربة على 120 فرخة نوع Ross 308 والتي قسمت إلى أربعة مجاميع وكالاتي: المجموعة الأولى (38) فرخة والتي اعتبرت كمجموعة سيطرة موجبة جهزت بالعلف مباشرة، المجموعة الثانية (27) فرخة، المجموعة الثالثة (28) فرخة والمجموعة الرابعة (27) فرخة حيث جهزت بالعلف بعد 24 ساعة، 48 ساعة و72 ساعة على التوالي، وتجهيز الماء لجميع المجاميع حراً. أظهرت نتائج المجموعة الأولى تفوقاً معنوياً (P<0.05) في الأداء الإنتاجي ممثلاً بسرعة امتصاص كيس المح، معامل التحويل الغذائي، كما كان معدل الزيادة الوزنية لأفراخ هذه المجموعة متفوقاً معنوياً (P<0.05) مقارنة مع المجاميع الأخرى. يستنتج من الدراسة أن الأفراخ ذات التجهيز المباشر للعلف تتفوق معنوياً على الأفراخ التي تتعرض للحرمان في استهلاك كيس المح كما أن الأفراخ التي تتعرض للحرمان لوقت يزيد على (48) ساعة تعاني من قلة أداء الصفات الإنتاجية.

الكلمات المفتاحية: الامراضية النسجيه، صفات إنتاجية، أفراخ حديثة الفقس.

***Received:6/4/2017, Accepted:1/8/2017**

INTRODUCTION

The growth rate of broilers selected for fast growth is considerably influenced by intestinal development (26). After hatching, the small intestine of poultry grows faster, it reaches its peak level between 6-10 days of age (15). The previously mentioned points are the basis for new strategy in poultry industry, since antiperistalsis movement, which moves the yolk from the yolk stalk to the duodenum, appears to be stimulated by the presence of feed in the gut (12). Recent studies indicated that residual yolk sac is used up more quickly in chicken which had access to feed immediately after hatch than those fasted for first 48 h. (13). The hatched chicks need quick transit from dependence on the yolk to exogenous nutrients after hatch (24). The transition is necessary for getting high productive traits represented by B.W.G., yolk utilization, gastro-intestinal development and immune system stimulation which result in superior performance at marketing with good profit and extra cost of early feeding can be compensated (12). In commercial hatchery, chicks hatch over a period of 24-48 h, the chicks are removed from the incubator. After the majority of chicks are cleared from the shell some of them may undergo sexing, vaccination, packing and then transport for a long distance, so under these circumstances, chicks may deprived from water and feed for about 48-72 h. after hatching and they depend on residual yolk as a main source of nutrient that is efficient to support birds vitality for 72-96 h, but does not support metabolism and thermal regulation in the neonate chicks which resulted in retardation of body weight and impairment of overall performance .Birds that survive the critical post hatch period will show stunted growth, poor feed utilization and reduced immunity. However, all these limitations can be alleviated by bridging the gap between hatch and first feeding (20). Recently, there is a growing interest among poultry producers to supply newly hatched chicks with specific products that prevent dehydration and nourish the chick with important nutrients prior to full access to feed and water (2). In the other hand it has been demonstrated that delayed access to feed and water after hatch negatively affect subsequent performance in poultry (21). Several studies demonstrated that the intake of exogenous feed can stimulate the growth and development of gastro-intestinal tract (GIT) in newly hatched chicks and is of critical importance in the development of absorptive villi and the uptake of yolk by small intestine (7, 18, 23). For these reasons we planned for this study with the aid of histological investigation in comparison between direct access and deprived newly hatched chicks and their reflects on productive traits .Our study is a dialog between avian immunologists and nutritionist in coordinating and integrating their experts into specific practical solutions that will benefit the industry and improve the well-being of commercial poultry.

MATERIALS AND METHODS

Newly hatched (Ross 308) (n=120) were placed in a convenient place. They were divided into four groups and placed in a separate boxes according to the following distribution:-

Group1 (G1): birds No. =38 bird with direct feed supply.

Group2 (G2): birds No. =27 bird. Feed supply after 24 h.

Group (G3): birds No. =28 bird. Feed supply after 48 h.

Group4 (G4): birds No. =27 bird .Feed supply after 72 h.

Water supply was *ad libitum* to all group. All groups have been supplied with scientific basic diet of broiler chicks. Birds have treated with the classical vaccinal program via drinking water. The average initial B.W. of twenty chicks was 41 g. The yolk sac absorption (YSA) index was estimated according to the following equation as estimated by (7).

$$Yolk\ sac\ absorption\ (YSA) = \frac{a-b}{a} \times 100$$

a= Mean yolk sac weight on the first day.

b=Yolk sac weight on the sampling day.

Average weight yolk sac was estimated by taking the total weight of ten samples divided by ten. During the period of experiment (32 days). All groups were examined weekly concerning the following rearing indices:- Mean body weight (B.W), Feed conversion Ratio (F.C.R), and Body weight gain (B.W.G.).

Histological study

Birds of different groups were sacrificed at 72h. post housing and at 14 days old. Samples were taken from the duodenum and jejunum and kept in 10% formalin to be stained according to (14). Sectioning of slices was 5µ, hematoxylin and eosin stain were used. The length of the villi was estimated by the use of morphometric lens according to (8). The result were analyzed statistically using one way ANOVA. P<0.05 was considered statically significant according to (27).

RESULT AND DISCUSSION

Residual yolk sac utilization: The effect of direct access to post-hatch chicks is presented in table 1. The average yolk weight immediately after hatch was 3.18 g which was decreased immediately after hatching to be 0.42g at 72hr post hatch period. No significant difference between G1 and G2. Both of these groups differ significantly (P<0.05) from G3 and G4.G3 showed a residual yolk sac weight equal to 0.64 g at 72 h. post hatch period while G4 showed a residual yolk sac weight equal to 0.77 g at the same period which means that G3 have higher absorption index than G4 and lower than G1 and G2 at (P<0.05). The lowest absorptive index was detected in G4 which have been deprived feed for 72 h. Slow absorption of yolk due to fasting was reported by many workers. (16) mentioned that fasting led to reduce uptake of yolk as compared to fully access birds. (19) observed that yolk utilization was more rapid in fed than in fasted chicks, suggesting that transport of yolk through the intestine could be increased by greater intestinal activity found in fed chicks .Our study agreed with these studies, but do not agreed with several authors (17, 3, 22) who mentioned that the availability of feed and water do not affect BW or YSA during the first 24h.==Table 1. showed that there is no significant difference between G1 and G2 and this agreed with (10) who explained that delayed feeding and watering during the first 24 h. has no effect on yolk sac absorption or body weight gain. Table 2 showed that during the first week G1 possess higher feed consumption, higher B.W.G. and higher F.C.R. than other groups although all groups are significantly differ from each other, while G4 is the lowest feed consumption, B.W.G. and F.C.R. This might be due to the effect of period of deprivation, since direct access to feed initiate rapid developmental changes of small intestine in the immediate post-hatched period when the birds are making the transition from endogenous nutrient supply from yolk for dependence on exogenous feed. This transition usually only begins 48 h or more after hatching as mentioned by (11). Table 3. showed that G1 at the 2nd week of age is still possess significantly high (P<0.05) feed consumption and B.W. as compared with other groups, but there was no significant differences among G1, G2 and G3 in F.C.R., while G4 is significantly differ (P<0.05) from other groups. This can be explained that 48 h of delayed feeding is known to induce changes in feeding behavior in chicks, specifically increased appetite (5). This may explain the increased feed consumption of such deprived chicks is really not due to compensatory growth, but as a result of overloading of the crop with feed and that is why the F.C.R. showed a relative values within the 2nd and 3rd week. Table 4. showed significant differences (P<0.05) between different groups in F.C.R. and B.W.G., while G1 is significantly higher (P<0.05) in F.C.R. from G2, G3 and G4 which they did not differ from each other. Our study is in agreement with other workers (25, 4, 28) who mentioned that lower weight in fasted groups could be attributed to lower feed intake and poor development of digestive tract, since most of energy and nutrient consumed by birds younger than four weeks goes toward growth. Table 5. showed the effect of feed deprivation on the productive traits during the fourth week. It has been shown that there was significant differences (P<0.0.5) between different groups with regard to F.C and B.W.G. but there was no differences between G1, G2, G3 and G4 concerning F.C.R. From these data it has been shown that deprived chicks (G2, G3, and G4) consumed more feed during the period of 2^{nd} and 3^{rd} weeks. This is in order to achieve or to compensate the loss of body weight during the first and second week, but such type of growth depend on the type of impairment in enterocyte. Reduction in cell number (cell production) results in permanent stunting, whereas reduction in cell size results in recovery for normal state after feeding (31).

Table -6 showed that at the age of 32 day (experimental period) the F.C, B.W.G and F.C.R possess a linear effect with the access of feeding in which the birds showed improved growth performance, while G3and G4 showed decreased B.W gain (P<0.05) and need more time to compensate the lost weight due to early deprivation (16, 4, 1). This result is in agreement with other workers who showed that deprived birds have lower B.W at market age as compared with the same age of immediate access to feed and water (21). Other studies disagreed with our results who mentioned that birds possess an amazing ability to recover the negative impact of early moderate feed and water deprivation, but need more time to fully compensate the reduced growth rate in the earlier part of the growth period (9, 30).

Table 1. Absorption index in Ross 308 chicks mean ±SE The different capital letters showed significant differences between different groups at (P<0.05).

Groups	M±SE	
1	0.87±0.06	A
2	0.87±0.05	A
3	0.80±0.01	B
4	0.76±0.04	B

Table 2. Effect of feed deprivation on the production traits during first week in Ross 308 chicks mean ±SE

Groups	Feed consumption		B. W. gain		F.C.R.	
1	6900±57.73	A	5342±11.45	A	1.24±0.006	D
2	4800±65.24	B	3393±6.35	B	1.43±0.02	C
3	4200±28.86	C	2850±4.41	C	1.47±0.05	B
4	3360±34.64	D	1693±4.04	D	1.98±0.06	A

The different capital letters showed significant differences between different groups at (P<0.05)

Table 3. Effect of feed deprivation on the production traits during second week===In Ross 308 mean ±SE

Groups	Feed consumption		B. W. gain		F.C.R.	
1	15350±22.04	A	12908±57.12	A	1.18±0.006	B
2	10000±17.32	D	8107±24.53	C	1.23±0.017	B
3	10850±28.86	C	8648±30.0	B	1.25±0.09	B
4	12800±57.73	B	7207±34.21	D	1.77±0.09	A

The different capital letters showed significant differences between different groups at (P<0.05).

Table 4. Effect of feed deprivation on the production traits during third week in Ross 308 mean ±SE

Groups	Feed consumption		B. W. gain		F.C.R.	
1	7150±28.68	A	22592±11.54	A	1.20±0.09	B
2	17700±57.73	B	13693±23.32	B	1.29±0.01	A
3	16850±63.32	C	13062±42.30	C	1.29±0.08	A
4	15400±58.69	D	11700±30.12	D	1.31±0.01	A

The different capital letters refer to significant differences between different groups at (P<0.05).

Table 5. Effect of feed deprivation on the production traits during fourth week in Ross 308 mean ±SE

Groups	Feed consumption		B. W. gain		F.C.R.	
1	35800±23.33	A	29608±14.85	A	1.20±0.08	B
2	23900±44.09	C	19607±16.62	C	1.21±0.01	B
3	28000±72.64	B	21900±31.22	B	1.27±0.01	A
4	21850±29.05	D	17050±23.86	D	1.28±0.09	A

The different capital letters showed significant differences between different groups at (P<0.05).

Table 6. Effect of feed deprivation on the production traits during 32 day in Ross 308 mean ±SE

Groups	Feed consumption		B. W. gain		F.C.R.	
1	40900±29.06	A	38042±25.41	D	1.07±0.01	C
2	25400±32.14	C	21313±38.94	C	1.19±0.03	B
3	28600±94.51	B	22900±31.79	B	1.24±0.04	AB
4	21000±72.64	D	16800±30.55	D	1.25±0.01	A

The different capital letters showed significant differences between different groups at (P<0.05)

The histopathological : study is the guideline that can be followed to explain all these contrasts explanations. The duodenum and jejunum were used to investigate the effect of early access or delayed impact on absorptive capacity of digestive tract, since absorption

occur mainly in these two parts and are the most organs that are affected by changing the habit of feeding (10, 9). With a special attention for the length of the villi and proliferative state of crypt cells which are regarded as progenitor cells due to the presence of stem cells at the base of the crypt that are continually divide and provide the source of all epithelial cells in the villi. The length of villi was estimated according to (8). Table-7 showed significant differences ($P<0.05$) among all groups in which the villus length is corresponding to the habit of feeding regarding from the highest length in G1 and G2 (851±0.6, 853±0.9) respectively to the lowest length or even sloughing in G4, (249.06 ±0.6) while G3 lie between them (692±0.3) during the first week of treatment (Fig. 1, 2, 3) The crypt cells of G1 and G2 showed hyperplasia and are more active as compared to G3 and G4. The effect of fasting was specific to the duodenum and jejunum and this agreed with (11) At the second week of age a slight improvement in the villus absorptive capacity was found as well as renewing in the crypt cells to be nearly closer to that of G1 and G2. This agreed with other workers (6, 29) who reported that fasting for 3 days decrease villus height of duodenum and alter the apical surface, but re-feeding of fasted birds showed rapid villus recovery. This is also agreed with (30) who mentioned that villus volume was depressed in the duodenum and jejunum by 36h fasting post hatch. The study showed that early feeding has a great effect in triggering the right momentum of growth in broiler hatchling. Early nutrient supply to chicks is essential to increase the intestinal mechanical activity, faster intestinal development, greater assimilation of feed (12). This explanation is in agreement with our histological study that showed hyperplasia of the crypt cells and increased villus length in G1 and G2 that have immediate access to feed, while those of delayed feed supply (G3, G4) showed atrophy in villus length or hypoplasia of crypt cells. These observations were disagreed with (5) who found that reduced productive traits is transitory because of re-feeding will create palatability in chicks making the crop impacted and finally will result in heavy weight. At the end of experimental period (32day), feed consumption rate was observed in G3 and G4 to be higher in order to compensate the losses in traits performance, but G4 still remain retarded as compared with other groups and this might be due to numeral impairment of enterocyte (Fig. 3) while G3 showed compensatory growth and regenerated the lost enterocyte, since these cells were suffering from reduced size (atrophy) rather than numeral depletion (aplasia).(Fig.2). It was concluded from this study that early access to feed is of critical importance for attaining high productive traits. Deprivation can be overcome up to 48h. Post hatched deprivation for more than 48h causes villus atrophy, compensatory growth may occur but not efficient to compensate the lost B.Wt created by early deprivation period

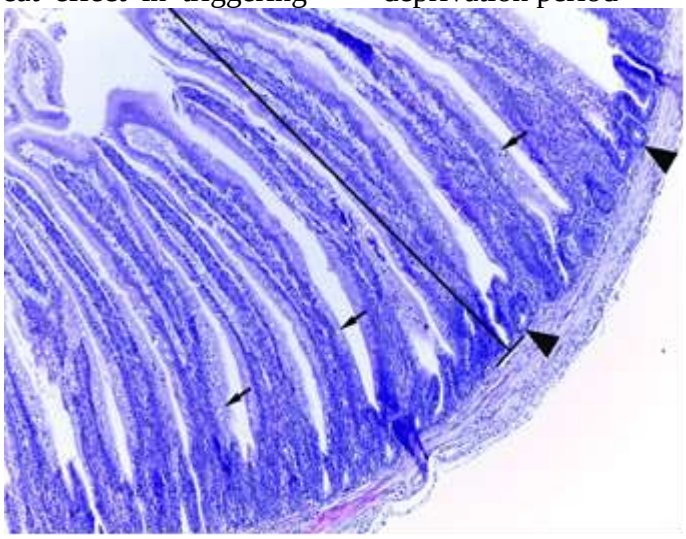

Fig. 1. (G1 and G2). Hyper function of the digestive system as represented by increased villus length (851±0.6 and 853±0.9) µ respectively

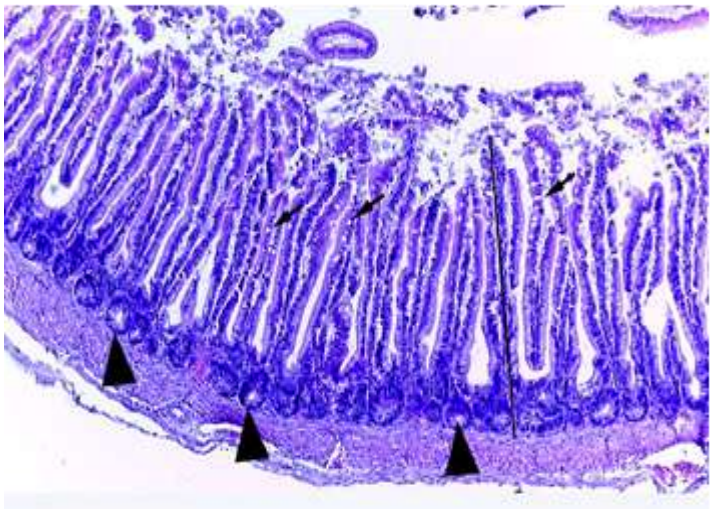

Fig. 2. (G3). Newly formed villi with hyperplasia of crypt cells (arrow head), increase number of goblet cells (narrow arrow).

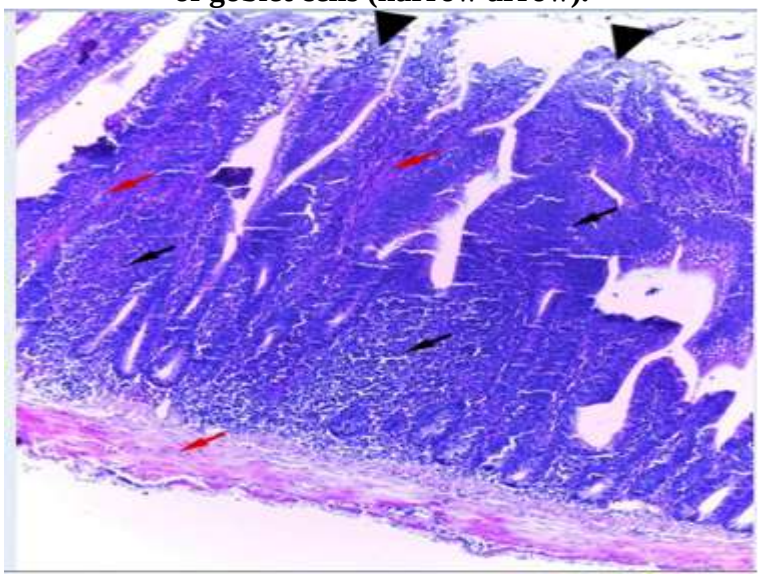

Fig. 3. (G4). Villus atrophy with sloughing in their tips (arrow head), infiltration of inflammatory cells (black arrow). area of congestion (red arrow), considerable amount of goblet cells

Table 7. Villus length of duodenum mean ±SE

Groups	After 72 h(µ)		After 2 weeks	
1	851.5±0.6	A	982±1.99	A
2	853.3±0.9	A	706±3.46	D
3	692±0.3	B	794±6.22	B
4	249.5±0.6	C	767±4.56	C

The different capital letters showed significant differences between different groups at (P<0.05)

REFERENCES

1. Abed, F., A. Karimi, Gh. Sadeghi, M. Shivazad, S. Dashti and A. Sadeghi-Sefidmazgi. 2011. Do broiler chicks posses enough growth potential to compensate long-term feed and water deprivation during the neonatal period?. S. Afr. J. Anim. Sci. 41 (1): 33- 39.

2. Alhotan, R. A. 2011. Effect of Early Feed Restriction During Delayed Placement on the Performance and Gut Health of Broilers a Thesis Presented to the Faculty of the Graduate College at the University of Nebraska.pp: 6-7.

3.Baiao, N. C., S. V. Cancado and C. G. Lucio 1998. Effect of period of feed withdrawal between hatching and housing of the broilers on absorption of the yolk sac. Arquivo Brasilerio de Medicina Veterinaria e Zootecnia. 50 (4): 473-474.

4.Batal, A. B. and C. M. Parsons. 2002. Effect of fasting versus feeding oasis after hatching on nutrient utilization in chicks. Poult. Sci. 81: 835-859.

5.Bigot, K., S. Mignon- Grasteau, M. Picard and S. Tesseraud. 2003. Effect of delayed feed intake on body, intestine, and muscle development in neonates broilers. Poult. Sci. 82(5): 781-788.

6.Booth, C. and J. A. O'shea. 2002. Isolation and Culture of Intestinal Epithelial Cells. In: Culture of Epithelial Cells. 2nd ed. R. Ian Freshney and Mary G. Freshney Eds. Wiley-Liss, Inc. pp: 303-305.

7.Brier, B. W. and T. H. Eleazer. 1965. Effect of feed and water deprivation on yolk utilization in chicks. Poult. Sci. 44 (6):1608-1609.

8.Caruso, M., A. Demonte and V. A. Neves. 2012. Histomorphometric study of role of lactoferrin in atrophy of the intestinal mucosa of rats. Health 4 (12): 1362- 1370.

9.Casteel, E.T., J. L. Wilson, R. J. Buhr and J. E. Sander. 1994. The influence of extended posthatch holding time and placement density on broiler performance. Poult. Sci. 73(11): 1679-1684.

10.Chamblee, T. N., J. D. Brake, C. D. Schultz and J. P. Thaxton 1992. Yolk sac absorption and initiation of growth in broilers. Poult. Sci. 71 (11):1811-1816.

11.Geyra, A., Z. Uni and D. Sklan. 2001. The effect of fasting at different ages and tissue dynamics in the small intestine of young chicks. Br. J. Nutr. 86(1): 53-61.

12.Govinthasamy P., P. Selvaraj, S. Subramaniyan, K. Arumugam and M. Nadan. 2016. Early nutrition and Its importance in poultry: A review. Indian J. Anim. Nutr. 33 (3): 245- 252.

13.Juul-Madsen, H. R., G. Su. and P. Sørensen. 2004. Influence of early or late start of first feeding on growth and immune phenotype of broilers. Br. Poult. Sci. 45:210-222.

14.Luna, L. G. 1968. Manual of Histologic Staining Methods of the Armed Forces Institute of Pathology (US). New York: Blackstone Division, Mc Graw-Hill. 3rd ed. pp: 36- 38.

15.Mateos, G. G., J. M. Gonzales-Alvarado and R. Lazaro. 2004. Facing the Realities of Poultry Health and Performance Without Antibiotic in Europe. Processing of International Feed Industry Symposium; Lexinton. USA. pp: 69-79.

16.Moran, E. T. Jr. and B. S. Reinhart. 1980. Poult yolk sac amount and composition upon placement: effect of breeder age, egg weight, sex, and subsequent change with feeding or fasting. Poult. Sci. 59 (7): 1521- 1528.

17.Murakami, H., Y. Akiba and M. Horiguchi. 1992. Growth and utilization of nutrients in newly- hatched chicks with or without removal of residual yolk. Growth Dev. Aging. 56 (2): 75-84.

18.Novy, Y. and D. Sklan. 2001. Yolk and exogenous feed utilization in the posthatch chick. Poult. Sci. 80 (10): 1490-1495.

19.Noy, Y. Z., Uni and D. Sklan. 1996. Routes of yolk utilization in the newly- hatched chicks. Br. Poult. Sci. 37(5):987-995.

20.Panda, A. K., S. K. Bhanja and S. G. Shaym. 2013. Early post hatch nutrition on growth and development in commercial Broiler Chicken- A review. Anim. Nutr. Feed Technol. 13(2): 323-333.

21.Pinchasov, Y. and Y. Noy. 1993. Comparison of post hatch holding time and subsequent early performance of broiler chicks and turkey poults. Br. Poult. Sci. 34 (1):111-120.

22.Pisarki, R. K., H. Malec and L. Malec. 1998. Effect of initial feeding of broilers on the growth rate, yolk sac absorption and selected blood chemical parameters. Medycyna Weteryjna, 45 (6): 409-412.

23.Potturi, P. V. L., J. A. Patterson and T. J. Applegate. 2005. Effects of delayed placement on intestinal characteristics in turkey poults. Poult. Sci. 84:816-824.

24.Sklan, D. 2001. Development of the digestive tract of poultry. World Poult. Sci. 57:415-428.

25.Sklan, D., Y. Noy, A. Hoyzman and I. Rozenboim. 2000. Decreasing weight loss in the hatchery by feeding chicks and poults in hatching trays. J. Appl. Poult. Res. 9: 142-148.

26.Smith, M. W., M. A. Mitchell and M. A. Peacock. 1990. Effects of genetic selection on growth rate and intestinal structure in the domestic fowl (*Gallus domesticus*). Comp. Biochem. Physiol. A Comp. Physiol. 97(1): 57-63.

27.Snedecor, G. W. and W. G. Cochran. 1986. Statistical Methods. 4th ed. The State University Press American, Iowa. pp: 91- 92.

28.Tabler, G. T. 2008. Early feed intake and

bird performance. Applied Broiler Research Unit Manager, Center of Excellence for Poultry Science– AVIAN Advice. University of Arkansas Cooperative Extension Service, Division of Agriculture. 5 (1): 33- 36.
29.Tarachai, P. and K. Yamauchi. 2000. Effects of luminal nutrient absorption, intraluminal physical stimulation, and intravenous parenteral alimentation on the recovery responses of duodenal villus morphology following feed withdrawal in chickens. Poult. Sci. 79(11): 1578-1585.
30.Uni, Z., S. Ganot and D. Sklan. 1998. Posthatch development of mucosal function in broiler small intestine. Poult. Sci. 77 (1): 75-82.
31.Winick, M. and A. Noble. 1966. Cellular response in rats during malnutrition at various ages. J. Nutr. 89 (3):300-306.