

GROWTH OF THE DIGESTIVE ORGANS IN LIGHT AND HEAVY TYPES OF CHICKENS

ZORA NIKOLIĆ* and D.VITOROVIĆ**

*Faculty of Veterinary Medicine, 11000 Belgrade, Yugoslavia. **Faculty of Animal Production, 11080 Belgrade, Yugoslavia

(Received, 5. February 1997.)

The absolute and relative digestive organs (proventriculus, gizzard, liver, small intestine, large intestine) in male light (Issa Brown) and heavy (Ross-1) types of chicken was estimated at two week intervals, from hatching to eight weeks of age.

On the first day of age there were no statistically significant differences in organ dimensions between the two strains. The relative growth of digestive organs in both types of chickens showed a rapid increase during the first two weeks and after that decreased. The growth rate in heavy type chicks was faster especially during the first two weeks after hatching. From the second week of age (2, 4, 6 and 8 weeks) the dimensions of the digestive organs were significantly higher ($P < 0.01$) in heavy type chickens. The proportion of the body weight of the gizzard (6,10%), liver (3,20%), and small intestine (4,70%), at hatching, was higher in the light type of chickens than in the heavy type (4,60%, 2,50% and 2,90% respectively). After that the values were similar in both strains.

Key words: growth, digestive organs, chickens, strains

INTRODUCTION

The feed requirements of birds are largely determined by the anatomy and capabilities of its digestive tract. The digestive tract in avian species is relatively shorter than that in mammals. The anterior portion of the alimentary tract is adapted for ingestion, storage and partial digestion of starch and proteins (Turk, 1982). Intensive genetic selection during the last four decades has established two types of poultry. Broiler (heavy) type chickens have been selected for rapid growth and large muscle mass. Layer (light) type chickens have been selected for egg production and slower body growth. Current evidence indicates that light type chickens will eat essentially to meet their energy requirements, whilst broiler chickens will eat to satisfy their appetite (Newcombe et al., 1981), Pinchasov et al., 1985). Lilja (1983) and Lilja et al. (1985) have produced evidence to show that the rate of growth after hatching is at least partly determined by the pattern of organ growth. It appears that a high rate of growth is connected to a pattern where

a large part of the early weight increase is in the digestive organs and liver. There is little information about the growth of digestive organs of chickens after hatching and the methods of measurement are very different. Crompton and Walters (1979) and Vitorović (1989) investigated the growth of the dimensions of broiler chicken intestines. McCance (1974) has studied the relationship between age and the size of the intestines in pigs. The relative growth of internal organs in light and heavy breeds of chickens during first three weeks of age were presented by Dror et al. (1977).

The aim of this study was to estimate the relationships in absolute and relative growth of the digestive organs between the light and heavy type of chickens from hatching to eight weeks of age.

MATERIALS AND METHODS

Male light type (Issa Brown) and heavy type (Ross-1) chickens were reared on the floor with a 10-c-deep litter. All chicks were fed ad libitum the standard broiler mixture: starter (0-4 weeks) and grower (4-8 weeks). Five chicks in each group were sacrificed by cervical dislocation on the first day (0 weeks) and ten chicks per group at 2, 4, 6 and 8 weeks after hatching. Each chick was dissected and the weight of the proventriculus, gizzard, liver, small intestine, large intestine and length of small and large intestine were measured. The weights of each organ during the experimental period were expressed as absolute growth. Statistical analysis of data was performed with the t-test.

To examine the relative growth of organs two parameters were calculated. One was percent of live body weight. The weight of each organ was expressed as a percentage of total body weight. The second parameter was growth rate. The increase of organ size was observed at two week intervals. The mean dimension at each kill (D_{n-1}) was subtracted from that of the subsequent kill (D_n) and this result was divided by the previous (D_{n-1}) dimension. Those values were expressed as a percentage of the initial dimension, for each organ.

$$\text{Growth rate (\%)} = \frac{D_n - D_{n-1}}{D_{n-1}} \times 100$$

RESULTS AND DISCUSSION

The mean values for weight and length of digestive organs in light and heavy types of chickens from the first day (0 weeks) to eight weeks of age, are given in table 1.

The results show that at the first day after hatching there were no significant differences in organ dimensions between the two strains of chickens. After that the size of all digestive organs of broiler increased significantly faster ($P < 0.01$) than in the light chickens.

Table 1. Mean weight and length of digestive organs in light (L) and heavy (H) types of chickens at different ages.

Strains	Age (weeks)				
	0	2	4	6	8
	Proventriculus (g)				
L	0.3 ± 0.08 ^a	1.1 ± 0.13 ^b	2.0 ± 0.25 ^b	3.1 ± 0.25 ^b	3.9 ± 0.60 ^b
H	0.4 ± 0.04 ^a	1.7 ± 0.17 ^b	3.3 ± 0.58 ^b	5.2 ± 0.37 ^b	8.9 ± 1.25 ^b
	Gizzard (g)				
L	1.8 ± 0.27 ^a	5.4 ± 1.10 ^b	11.0 ± 2.36 ^b	19.8 ± 4.04 ^b	23.1 ± 3.62 ^b
H	2.1 ± 0.20 ^a	7.8 ± 1.77 ^b	17.7 ± 4.15 ^b	27.5 ± 1.45 ^b	41.0 ± 5.69 ^b
	Liver (g)				
L	1.0 ± 0.19 ^a	3.8 ± 0.53 ^b	8.1 ± 0.41 ^b	14.1 ± 1.50 ^b	19.3 ± 2.24 ^b
H	1.1 ± 0.12 ^a	6.7 ± 0.92 ^b	13.4 ± 2.43 ^b	24.4 ± 1.52 ^b	44.8 ± 6.78 ^b
	Small intestine (g)				
L	1.3 ± 0.12 ^a	7.8 ± 0.88 ^b	16.5 ± 0.96 ^b	23.5 ± 2.65 ^b	34.7 ± 7.59 ^b
H	1.4 ± 0.15 ^a	13.9 ± 2.31 ^b	24.4 ± 4.23 ^b	40.9 ± 3.03 ^b	66.0 ± 9.87 ^b
	Large intestine (g)				
L	0.4 ± 0.08 ^a	3.0 ± 0.54 ^b	7.4 ± 1.13 ^b	10.1 ± 1.08 ^b	13.6 ± 1.56 ^b
H	0.7 ± 0.09 ^a	4.6 ± 1.19 ^b	9.0 ± 2.00 ^b	17.4 ± 3.36 ^b	23.1 ± 5.10 ^b
	Small intestine (cm)				
L	37.0 ± 2.12 ^a	70.1 ± 2.24 ^b	88.6 ± 4.45 ^b	105.2 ± 7.88 ^b	119.4 ± 13.8 ^b
H	38.0 ± 1.00 ^a	87.9 ± 8.61 ^b	120.1 ± 7.75 ^b	129.0 ± 6.54 ^b	149.7 ± 14.8 ^b
	Large intestine (cm)				
L	6.7 ± 0.43 ^a	10.1 ± 0.66 ^b	13.2 ± 0.78 ^b	16.0 ± 1.10 ^b	16.5 ± 1.13 ^b
H	6.8 ± 0.21 ^a	12.2 ± 0.71 ^b	16.4 ± 1.92 ^b	18.2 ± 1.20 ^b	21.5 ± 2.32 ^b

^a differences had no statistical significance^b differences were highly significant (P<0.01)

The relative growth of organs (percentage body weight and growth rate) is presented in table 2. The relative weights of the gizzard (6.10%), liver (3.20%) and small intestine (4.70%) at hatching in the light breed were greater than in the heavy breed (4.60%, 2.50%, 2.90%, respectively). After that the relative weights were similar in both breeds. Similar results were obtained by Dror et al. (1977) and Newcombe et al. (1981). The highest relative growth rate in both types of chickens, occurred during the first two weeks of age. This is in agreement with the results of Crompton and Walters (1979), Lilja (1983) and Vitorović (1989). After that the growth rate decreased.

During the period of intensive growth (first two weeks of age), the digestive organ dimensions in the heavy type of chickens increased faster than in light type. The highest growth rates were obtained for intestine weight and liver, especially in broilers. At 4, 6, and 8 weeks of age the growth rate of the digestive organs in light and heavy type chickens was similar.

Table 2. Relative growth of digestive organs in light (L) and heavy (H) types of chickens

Parameter	Strain	Age (Weeks)				
		0	2	4	6	8
Proventriculus						
% Body	L	1.00	0.80	0.66	0.53	0.48
Weight	H	0.86	0.78	0.56	0.42	0.41
Growth	L	—	267	85	53	26
rate (%)	H	—	328	95	60	70
Gizzard						
% Body	L	6.10	3.95	3.59	3.36	2.85
Weight	H	4.60	3.66	3.00	2.22	1.88
Growth	L	—	195	104	79	17
rate (%)	H	—	276	127	56	49
Liner						
% Body	L	3.20	2.79	2.64	2.40	2.38
Weight	H	2.48	3.12	2.29	2.05	1.96
Growth	L	—	297	113	74	37
rate (%)	H	—	495	101	82	82
Small intestine weight						
% Body	L	4.70	5.70	5.40	4.30	4.00
Weight	H	2.90	6.50	4.20	3.30	3.00
Growth	L	—	455	112	48	42
rate (%)	H	—	951	76	67	62
Large intestine weight						
% Body	L	1.50	2.20	2.40	1.70	1.70
Weight	H	1.70	2.20	1.50	1.40	1.00
Growth	L	—	197	149	37	35
rate (%)	H	—	513	95	94	33
Small intestine length						
Growth	L	—	89	26	18	13
rate (%)	H	—	131	36	16	7
Large intestine length						
Growth	L	—	50	30	21	3
rate (%)	H	—	82	33	18	11

CONCLUSIONS

The first day after hatching there were no significant differences in organ dimensions between light and heavy types of chickens. After that the dimensions of digestive organs in broiler chickens become significantly higher ($P < 0.01$) than in the light chickens.

The relative growth of digestive organs in chickens show a rapid increase during the first two weeks of age and after that decrease. The relative weight of

the gizzard, liver and small intestine at hatching is greater in light type chickens. After that the percentages of the body weight become similar. The growth rate of digestive organs in heavy type chickens is extremely fast during the first two weeks after hatching.

REFERENCES

1. Crompton, D., Walters D. 1979. A study of the growth of the alimentary tract of the young cockerel. *Br. Poult. Sci.*, 20, 149-158.
2. Dror, Y., Nir I., Nitsan Z. 1977. The relative growth of internal organs in light and heavy breeds. *Br. Poult. Sci.*, 18, 493-496.
3. Lilja, C. 1983. A comparative study of postnatal growth and organ development in some species of bird. *Growth*, 47, 317-339.
4. Lilja, C., Sperber, I., Marks, H. 1985. Postnatal growth and organ development in Japanese quail selected for high growth rate. *Growth*, 49, 51-62.
5. McCance, R. 1974. The effect of age on the weights and lengths of pigs intestines. *J. Anatomy*, 117, 475-479.
6. Newcombe, M., Dummers, D., Leeson, S. 1981. Comparison of the capacity of the digestive tract of broiler and Leghorn-type chicks. *Poult. Sci. (abstr.)*, 60, 7.
7. Pinchasov, Y., Nir, I., Nitsan, Z. 1985. Metabolic and anatomical adaptations of heavy-bodied chicks to intermittent feeding. I. Food intake, growth rate, organ weight and body composition. *Poult. Sci.*, 64, 2098-2109.
8. Turk, D. 1982. The anatomy of the avian digestive tract as related to feed utilization. *Poult. Sci.*, 61, 1225-1224.
9. Vitorović, D. 1989. Uticaj uzrasta na dužinu creva tovnih pilića. *Arhiv za poljoprivredne nauke*, 3, 245-250.

PORAST ORGANA ZA VARENJE KOD PILIĆA LAKOG I TEŠKOG TIPRA

ZORA NIKOLIĆ I D. VITOROVIĆ

SADRŽAJ

U radu je praćen apsolutni i relativni porast veličine organa za varenje (žlezdani želudac, bubac, jetra, tanko i debelo crevo) po dvonedeljnim intervalima, od izleganja do osme nedelje uzrasta, kod pilića lakog i teškog tipa.

Ustanovljeno je da pri izleganju, nema značajnih razlika u veličini organa za varenje između pilića lakog i teškog tipa. Posle toga brzina porasta organa za varenje se naglo povećava do kraja druge nedelje, pri čemu je znatno veća kod pilića teškog tipa. Od druge nedelje pa do kraja oglednog perioda dolazi do smanjivanja intenziteta porasta organa. Statistički značajno veća ($P < 0.01$) veličina organa za varenje je ustanovljena kod pilića teškog tipa u uzrastu od 2, 4, 6 i 8 nedelja. Pri izleganju, procentni udeo mase organa u masi tela je veći kod pilića lakog tipa. To se posebno odnosi na bubac, jetru i tanko crevo. Dalje sa uzrastom ovaj pokazatelj ispoljava ujednačene vrednosti prilikom poređenja pilića ispitivanih tipova živine.