

## MUSCLE GROWTH 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, 10. July 1998.)

*The absolute and relative growth of leg muscle (*M. gastrocnemius*), breast muscle (*M. pectorialis superficialis*) and wing muscle (*M. biceps brachii*) in male light (Issa Brown) and heavy (Ross-1) types of chickens was estimated at one week intervals, from hatching to eight weeks of age.*

*On the first day after hatching there were no significant differences in muscle weight between the two strains. After that, the weight of all muscles was significantly ( $p < 0.01$ ) greater in heavy type chickens. The relative growth of muscles, in both strains, showed a rapid increase during the first day of age, and after that decreased. Growth rate of muscles was greater in heavy type chickens during the first two-three weeks of age. During this period the breast muscle grew faster than wing and leg muscles.*

*Key words: growth muscle, chicken, strains*

### INTRODUCTION

Growth rate of the body is affected by age. Young animals grow faster than older ones. The highest body growth of chickens occurs during the first two-three weeks after hatching (Ricklefs, 1985). However, there are differences in growth rate between the body parts and tissues. The highest early growth rate was established for pectoralis muscle (Vitorović, 1988). This period of age is of great interest in selection of meat type chickens. Selection for body mass affects the rate of muscle growth. Heavy type chickens have been selected for fast growth and large muscle mass, while light type chickens, selected for egg production, have slow body growth and less muscle mass.

There are numerous studies in which the muscle growth has been compared between slow and fast growing poultry (Halvorson and Jacobson, 1970; Jones et al., 1986; Klasing and Calvert, 1987; Saunderson and Leslie, 1988; Pinchasov et al., 1989; Mitchell and Burke, 1955; Barbour and Lilburn, 1996).

Due to its economic significance most collected information was gathered during the latest stages of growth. The objective of this study was to compare the growth and development of leg, breast and wing muscles in light and heavy types of chickens from hatching to eight weeks of age.

#### MATERIALS AND METHODS

Chickens of a light breed (Issa Brown) and heavy breed (Ross-1) were hatched and sexed. The males were wingbanded at hatching and placed for rearing on the floor with 10 cm deep litter. All chicks were fed ad libitum the standard broiler mixtures. Ten chicks of each breed were weighed and sacrificed by cervical dislocation, beginning from the first day (0 week) and at weekly intervals to eight weeks of age. The skin from the left part of the carcass was cut and removed and one muscle each from the leg (*M. gastrocnemius*), breast (*M. pectoralis superficialis*) and wing (*M. biceps brachii*) was dissected. The mass of each muscle was measured during the experimental period, and expressed as absolute growth. The strain differences were subjected to analysis of variance and t-test. To examine the relative growth of muscles two parameters were calculated. One was the percent of live body mass. The second parameter was growth rate.

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

The increase of muscle mass was observed at one week intervals. The mean mass at each kill ( $M_{n-1}$ ) was subtracted from that of the subsequent kill ( $M_n$ ) and this result was divided by the previous ( $M_{n-1}$ ) mass. Those values were expressed as a percentage of initial mass.

#### RESULTS AND DISCUSSION

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

The results show that, on the first day, there were no significant differences between the strains in muscle weight. At hatch the highest weight was established for *M. gastrocnemius* (0.3 g; 0.4 g) in comparison to *pectoralis* muscle (0.1 g; 0.2 g) and *M. biceps brachii* (0.02 g; 0.03 g). After hatching all muscles increased in size and showed significant differences ( $p < 0.01$ ) between the strains, at all weeks of age. Heavy type chickens had significantly heavier muscles compared to the light type chickens. At eight weeks of age the weights of *M. pectoralis superficialis* were 26 g (light) and 87.9 g (heavy). Weights of *M. gastrocnemius* were 8. g (light) and 23.5 g (heavy) and weights of *M. biceps brachii* were 1. 5 g (light) and 4.4 g (heavy). These differences in muscle mass were the result of different intensity of muscle growth which were expressed by relative parameters of growth, (table 2).



Table 1. Mean weight (g) of muscle in light (L) and heavy (H) types of chicken at different ages

Age weeks	M. gastrocnemius		M. pectoralis superficialis		M. biceps brachii	
	L	H	L	H	L	H
0	0.30±0.01	0.40±0.01	0.10±0.01	0.20±0.02	0.02±0.01	0.03±0.01
1	0.50±0.07	0.80±0.13**	1.40±0.28	2.20±0.61*	0.10±0.02	0.20±0.04
2	1.00±0.21	2.00±0.29**	3.40±0.85	7.10±1.89**	0.20±0.07	0.40±0.10**
3	1.80±0.20	4.20±0.68**	5.90±0.20	15.60±2.03**	0.40±0.05	0.90±0.12**
4	2.50±0.36	6.10±1.34**	8.70±1.11	22.00±4.01**	0.50±0.08	1.30±0.32**
5	3.60±0.57	8.50±1.62**	13.80±0.77	32.90±6.53**	0.80±0.06	1.80±0.30**
6	5.40±0.61	12.50±2.30**	17.40±1.95	48.80±4.85**	1.10±0.14	2.50±0.30**
7	6.60±0.57	18.50±1.75**	22.90±2.33	62.60±3.51**	1.40±0.17	3.80±0.53**
8	8.10±0.80	23.50±1.88**	26.10±2.21	87.90±6.22**	1.50±0.19	4.40±0.25**

Means ± SE (g)

Significantly different: \*p&lt;0.05, \*\* p&lt;0.01

Table 2. Relative growth of muscles in light (L) and heavy types of chickens

Age (weeks)	M. gastrocnemius		M. pectoralis superficialis		M. biceps brachii	
	L	H	L	H	L	H
	% of body mass					
0	0.96	0.92	0.30	0.46	0.06	0.07
1	0.68	0.77	1.91	2.11	0.14	0.19
2	0.75	0.92	2.57	3.28	0.15	0.18
3	0.90	0.96	2.94	3.55	0.20	0.20
4	0.77	0.95	2.68	3.23	0.15	0.20
5	0.82	0.90	3.15	3.29	0.18	0.19
6	0.90	0.99	2.90	3.67	0.18	0.20
7	0.87	1.10	3.02	3.71	0.18	0.22
8	0.99	1.10	3.20	4.11	0.18	0.21
	Growth rate (%)					
0-1	46.8	116.2	860.0	860.1	400.0	433.3
1-2	119.1	152.5	134.7	223.1	130.0	162.5
2-3	73.8	108.4	75.4	118.6	56.5	107.1
3-4	41.9	45.4	47.4	40.9	47.2	47.1
4-5	41.3	39.5	57.7	49.6	52.8	39.1
5-6	50.7	45.9	26.6	48.4	32.1	43.2
6-7	22.7	48.9	30.8	28.2	29.0	49.8
7-8	22.6	26.6	14.8	40.4	8.7	16.0

The relative weight of all muscles (% body mass) was similar in the light and heavy types of chickens. However, there were differences in the intensity of growth between muscles, in relation to total body growth. The breast and wing muscles grew at a faster rate than the chicken body, especially during the first

two-three weeks of age. This finding was confirmed since the relative weight of these muscles increased with age in both strains. The relative weight of the leg muscle was not changed with age and these muscles grew at a similar rate to body mass. The highest growth rate, of all investigated muscles, in both strains, was during the first week of age. This was in agreement with the results of Halvorson and Jacobson (1970), Klasing et al. (1985), Ricklefs (1985), Saunderson and Leslie (1988), Mitchell and Burke (1995), Barbour and Lilburn (1996). Breast muscle grew at the highest rate and then wing muscle. The lowest growth rate was established for leg muscle. During the period of 2-3 weeks of age, muscle growth rate was greater in heavy type chickens than in light type chickens. This finding was in agreement with the results of Jones et al. (1986), Pinchasov et al. (1988) and Vitorović (1988). After the first week of age muscle growth rate decreased and from the third week was similar in light and heavy types of chicken.

#### CONCLUSIONS

On the first day after hatching there were no significant differences in muscle mass between light and heavy types of chicken. After that the weight of muscles in broiler chickens became significantly higher ( $p < 0.01$ ) than in the light type chickens. This is a result of intensive muscle growth during the first two-three weeks after hatching. During that period of age the highest growth rate was shown by the breast muscle and then wing and leg muscles.

#### REFERENCES

1. Barbour, G., Lilburn M. 1996. Comparative growth and development of Nicholas and Hybrid toms from 16 to 82 days and effects of protein restriction from 0 to 59 days on growth of Hybrid toms through 125 days of age. *Poult. Sci.*, 75, 790-796.
2. Halvorson, D., Jacobson M., 1970. Variations of muscles in chickens. *Poult. Sci.*, 49, 132-136.
3. Jones, S., Aberle E., Judge M. 1986. Skeletal muscle protein turnover in broiler and layer chicks. *J. Anim. Sci.*, 62, 1576-1583.
4. Klasing, K., Calvert C. 1987. Growth characteristics, protein degradation in muscles from fast and slow growing chickens. *Poult. Sci.*, 66, 1189-1196.
5. Mitchell, D., Burke H. 1995. Posthatching growth and pectoralis muscle development in broiler strain chickens, bantam chickens and reciprocal crosses between them. *Growth, Development and Aging*, 59(3), 149-161.
6. Pinchasov, Y., Nir I., Nitsan Z. 1989. Muscle growth and composition in heavy and light breed chickens adapted to intermittent feeding. *Br. J. Nutr.*, 61, 245-256.
7. Ricklefs, R. 1985. Modification of growth and development of muscles of poultry. *Poult. Sci.*, 64, 1563-1576.
8. Saunderson, L., Leslie S. 1988. Muscle growth and protein degradation during early development in chicks of fast and slow growing strain. *Poult. Sci.*, 3: 333-337.
9. Vitorović, D. 1988. Uticaj rasta i razvika na promenu međusobnih odnosa mase i dimenzija pojedinih anatomskih delova i tela kao celine pilića hybro linije u toku tova. *Magistarski rad, Fak. vet. med., Beograd.*

## PORAST MIŠIĆA KOD PILIĆA LAKOG I TEŠKOG TIPa

ZORA NIKOLIĆ I D. VITOROVIĆ

### SADRŽAJ

U radu je praćen apsolutni i relativni porast mišića nogu (*M. gastrocnemius*), grudi (*M. pectoralis superficialis*) i krila (*M. biceps brachii*) po jednonedeljnim intervalima, od izleganja do kraja osme nedelje uzrasta, kod pilića lakog i teškog tipa.

Neposredno po izleganju, nema značajnih razlika u masi mišića između pilića lakog i teškog tipa. Posle prve nedelje masa mišića je značajno ( $p < 0.01$ ) veća kod pilića teškog tipa. Brzina porasta mišića, kod oba tipa živine, je najveća u toku prve nedelje, a posle toga opada. Najintenzivniji porast, u ranom uzrastu, ispoljavaju grudni mišići, zatim mišići krila i nogu. U istom periodu, mišići pilića teškog tipa brže povećavaju svoju masu u odnosu na mišiće pilića lakog tipa. Posle treće nedelje života, porast mase mišića se odvija sporije, uz male razlike između pilića lakog i teškog tipa.

