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GROWTH AND DEVELOPMENT OF MUSCLES, BONES AND FAT OF DOMESTIC FOWL (*GALLUS GALLUS*)

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ORIGINAL ARTICLE

ABSTRACT: *This study was conducted to evaluate the growth pattern of muscles, bones and fat of domestic fowl. Eighteen day old chicks were reared for 22 weeks and serial slaughters were done every four weeks for evaluation. Results showed that the feed conversion ratio was 1:4, highest feed intake at 22 weeks of age and highest weight gain at 15 weeks. Carcass yield was 60%. The great mass of muscle was found in the thorax and hind limb, highest bone percentage was found in the pelvis and wing and the flank had high percentage of muscle and connective tissues and all regions had the same percentage of fat. Thorax and hind limb had high growth rate when compared with pelvis, wing, neck and flank.*

Keywords: *Carcass yield, body regions, serial slaughter*

INTRODUCTION

Growth is often measured as live weight gain per unit time, (Berg and Butterfield, 1976). Live weight could be a useful measure of growth as it is highly predictive of the amount of desirable edible products such as muscles. Carcass weight is more useful than live weight and the components of the carcass when measured, give a true picture of the benefit from the animal. Carcass composition is measured by the proportion of components, muscles, bones, fat and connective tissues.

Factors that affect carcass composition are slaughter weight; breed or genetic differences, sex and plane of nutrition, Nheta et al. (1997) said that sex has no effect on the growth rate of birds. The carcass is the most important unit in meat studies, since it finally settles the value of the meat animal, both for the farmer and the butcher, (Callow, 1948). The muscle is the most important tissue in the animal; because it is most desired by the consumers and superior carcasses have a maximum yield of muscle, minimum of bone and an optimum amount of fat (Berg and Butterfield, 1976). Hammond (1932) stated that during their lives animals have two sets of muscles; early developing and late developing ones. So there must be causes for the changes in the proportion of individual muscles as animals grow. The growth of muscles can be measured by comparison of weights of the individual muscles on serial animal slaughters, and dissected throughout the lifespan of homogenous animals (weight, breed and sex) raised on a similar plane of nutrition. This method compares the percentage values of weight of individual muscles or muscle groups relative to total muscle weight at various stages of development (Berg and Butterfield, 1976). The growth patterns of the tissues show that the bones growing at a steady, but slow rate, the muscle grow relatively fast, so that the ratio of muscle to bone increases. In poultry the first ossification takes place 12–24 hours later in the form of laminae of bone which eventually fuse to form a thin, compact cylinder which is the periosteal bone collar (Hall, 1987). Long bone growth is a complex process which takes place in the growth plates located at the end of these bones; it consists of cartilage cells which form a template over which bone is laid. Fat is the most variable tissue in the carcass and it varies even in its partitioning among various depots and alters markedly throughout growth; therefore it has the greatest influence on both the amount of each of the other tissues in the carcass at any particular weight and the proportionate size of cuts. Fat comprises a relatively small amount of the carcass at birth and then increases so that it approaches and occasionally in very fat animals surpasses muscle tissues in absolute amount, (Berg and Butterfield, 1976).

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The domestic fowl appears to have been known to man from the very early times. It has been generally supposed that the domestic fowl owes its origin to the great jungle of India, (Richardson, 1956). The domestic fowl appears to have been known to man from the very early times. It has been generally supposed that the domestic fowl owes its origin to the great jungle of India, (Richardson, 1956). Noy and Sklan (1997) studied the post-hatch development in poultry and concluded that the earlier access to feed the better the growth through marketing and the body weight. Iheukwumere et al. (2007) evaluated the growth of control broilers fed cassava leaf meal and found that daily feed intake was 0.143 kg, body weight gain 0.040 kg and the feed conversion ratio was 3.53. Jayalakshmi et al. (2006) studied the production performance of broilers fed sunflower acid oil and found that the weight gains during the first, second, third, fourth, fifth and sixth week of breeding were 0.095, 0.285, 0.610, 0.112, 0.146, and 0.186 kg and the feed conversion ratios during these weeks were 1.14, 1.35, 1.49, 1.56, 1.87 and 2.03. Daria and Bochno (2007) compared the slaughter quality of layer-type cockerels and broilers and found that the day-old cockerel chicks were lighter than broilers by 7 g. they concluded that layer-type cockerels as compared to broilers are characterized by lower body weight, lower carcass weight, lower dressing percentage, lower breast muscles and high bone contents. Lubritz (1997) studied the effect of sex on the growth, and found that males yielded a higher ratio of white meat to live weight than females. Calistar and Aydin (2006) studied the effect of animal bone fat on body performance and carcass characteristics in broilers. They found that animal bone and fat were significantly influenced by the live weight gain, feed efficiency, cold carcass weight and abdominal fat level. Iheukwumere et al. (2007) evaluated the carcass yield of broilers under different levels of cassava feeding and found that when the live weight was 1.43 kg under zero level of cassava feeding the dressing percentage was 79% and thigh and shank, neck, wings, back and breast muscle weights were 0.118, 0.032, 0.075, 0.108 and 0.154 kg respectively. Esen et al. (2006) examined the growth and carcass characteristics of Rock Partridges (*A. graeca*) and found that when the average value of the bird weight was 0.481 kg, the dressing percentage was 72.11%, wing weight was 0.033 kg and the leg weight was 0.146 kg. Fasuyi (2007) examined a protein supplement in broiler finisher diets and found that when the live weight was 1.250 kg, the dressed weight percentage was 82% thigh, drumstick, shank, back, wing and neck weights were 0.047, 0.102, 0.030, 0.081, 0.039 and 0.063 kg respectively. Akinfala et al. (2007) found the slaughter weight of cockerels to be 1161.15 gram; the dressed weight was 574.50 gram with percentage 49.48%. They found that at this slaughter weight the weights of the neck and shank were 14.42 and 26.84 gram.

Comparing the slaughter quality of layer-type cockerels versus broilers, Daria and Bochno (2007) found that at six weeks of age, the body weights and carcass weights were 0.665 kg versus 2.577 kg and 0.412 kg versus 1.897 kg respectively. Ugwu and Onyimonyi (2008) found the final body weight at 45 weeks of age was 1.723 kg and the carcass weight was 1.163 of spent layer fowl and the thigh, breast, head and neck weights were 0.326, 0.253 and 0.100 kg, respectively.

Koster and Webb (2000) compared the carcass characteristics of South African native chicken lines that include Koekoek, Newhampshire, Naked-neck, Lebowa-Venda, Ovambo and Cobb and found that the highest dressing percentage was in Ovambo line, the percentage of muscle, fat and bone ranges between 55-51%, 6.5-1.2% and 36.2-24.1% respectively for all lines.

MATERIALS AND METHODS

A total of 72 Hisex day-old chicks were brought to the Extension and Rural Development Centre, Faculty of Animal Production–Elmanagil, University of Gezira. The birds were lodged in a pen of dimensions 1.5×2.0×2.0 m. divided equally to three compartments. The birds were divided to three groups each of 14 birds to ease management. The pen sides were guarded by a mesh-wire of fine openings set over a half-meter brick wall up to the roof which was made of corrugated zinc sheets. The ground was concrete with sand bedding. The pen was equipped with chick and then poultry feeders and waterers. The birds were phase-fed. For two weeks as an adaptation period with starter broiler ration (CP 20%, ME 11.65 M j/kg); phase after the grower ration (CP 17.11%, ME 8.58M j/ kg), was fed for 16 weeks of age. A finisher ration (CP 16%, ME 6.01 m j/kg) was fed for four weeks till the experimental feeding was concluded. Feed offer frequency and intake records followed that of the first experiment. Weekly body weights were recorded to the nearest 0.5 g at 7:00 is before feeding, using a small pressure balance. One bird from each of the three groups was selected for slaughter every four weeks for further carcass analysis and muscle groups study. The bird was controlled by tying its legs. The slaughter procedure followed the Muslim practice using a sharp knife to cut the right and left jugular veins and carotid arteries. The blood was collected and weighed after the bleeding was complete. After immersion in tapid water, the feathers were plucked and the skin was removed. The head was removed at its articulation. The abdomen was eviscerated and thorax was opened, (Griffiths and Purcell, 2008). Carcass data was taken. The hot carcass was divided into right and left halves and the left side was divided into six regions (hind limb, pelvis, flank, thorax, neck and wing) and their muscles were separated.

RESULTS AND DISCUSSION

Average performance values of domestic fowl raised to 22 weeks of age are shown in Table (1). Final weight was 1.33±0.11 kg and the feed conversion ratio was approximately 1: 4.

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Table 1 - Average performance values of domestic fowl raised to 22 weeks of age	
Item	**Value**
Initial weight (kg)	0.310±0.002
Final weight (kg)	1.327±0.108
Daily weight gain (kg)	0.009±0.005
Daily feed intake (kg)	0.040±0.008
Feed conversion ratio	1: 4.40

It is clearly illustrate in Figure 1 that average values of feed intake and weight gain (kg) of the domestic fowl raised to 22 weeks of age. The highest feed intake was at week 22 (0.34 kg). The highest gain in weight (0.11 kg) was during the 15th week of age and the lowest gain was during the first two weeks of age. Feed intake of the domestic fowl was high during 22 weeks of age (0.343 kg). The lower feed intake occurred during the first week of age which was 0.11 kg. Iheukwumere et al. (2007) evaluated the growth of broilers fed cassava leaf meal and found the feed intake to be 0.143 kg. Noy and Sklan (1997) concluded that the earlier access to feed the better the growth rate. In this study the weight gain of the domestic fowl was high during the 15th week of age (0.112 kg). Iheukwumere et al. (2007) evaluated the growth of broilers fed cassava leaf meal and found that the body weight gain was 0.040 kg, but Jayalakshmi et al. (2006) studied the production performance of broilers fed with sunflower acid oil and found that the weight gain in second, third, fourth, fifth and sixth week of breeding were 0.095, 0.285, 0.610, 0.112, 0.146 and 0.186 kg. In our study the weight gain during the sixth week of age was 0.071 kg. Differences here may be attributed to difference in breeds. Feed conversion ratio was found to be averaged 4.4 during 22 weeks of age. This result was near to that obtained by Iheukwumere et al. (2007) which was 3.53.

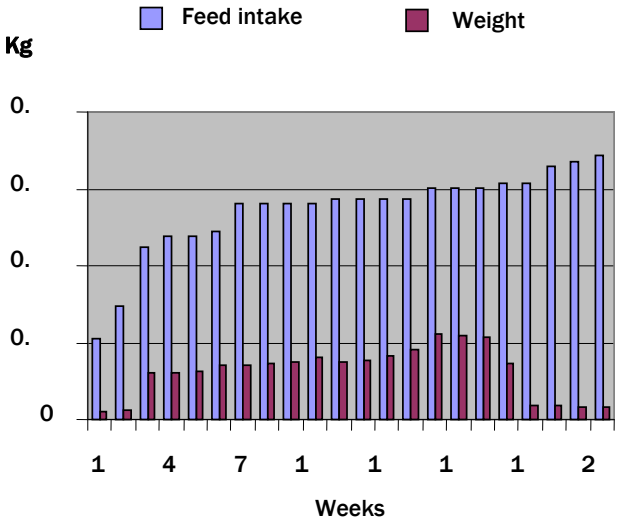

Figure 1 - Average values of feed intake and weight gain (kg) of the domestic fowl raised to 22 weeks of age

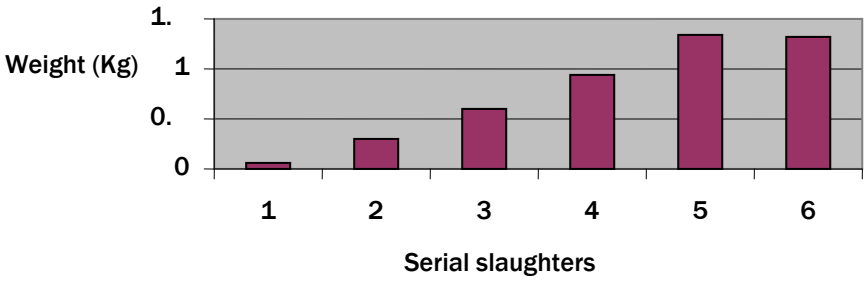

Figure 2 - The slaughter weights (kg) of the six serial slaughters of the domestic fowl

Figure 3 shows the hot carcass weight (kg) of the six serial slaughters of the domestic fowl. The hot carcass weights of the six serial slaughters were 0.017±0.005, 0.140±0.004, 0.281±0.006, 0.488±0.044, 0.624±0.076 and 0.793±0.120 kg. The weight of the carcass of the domestic fowl was 0.793 kg when the live weight was 1.377 kg and the dressing percentage was 60% at 22nd week of age. Iheukwumere et al. (2007) studied the growth and carcass yield of broilers and found that when the live weight was 1.430 kg, the dressing percentage was 79%. Such

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differences are due to breed and management practices specially feeding, beside the environmental conditions prevailing when running the experiment. They found that weight of the shank and thigh that comprise the hind limb was 0.118 kg, the neck 0.032 kg, wings 0.075 Kg, thorax 0.154 kg and the back 0.108 kg. In this study the weights of the hind limb, neck, wings, thorax and pelvis (back) were 0.131, 0.047, 0.084, 0.141 and 0.030 kg respectively. Fasuyi (2007) who examined a protein supplement in broiler finisher diets found that when the live weight was 1.250 kg, the dressing percentage was 82% the weights of thigh, drumstick, shank (hind limb), back, wing and neck were 0.047, 0.102, 0.030, 0.081, 0.039 and 0.063 kg. The difference in weights of the above mentioned regions occurred due to the variations in body weights and breeds used in this study.

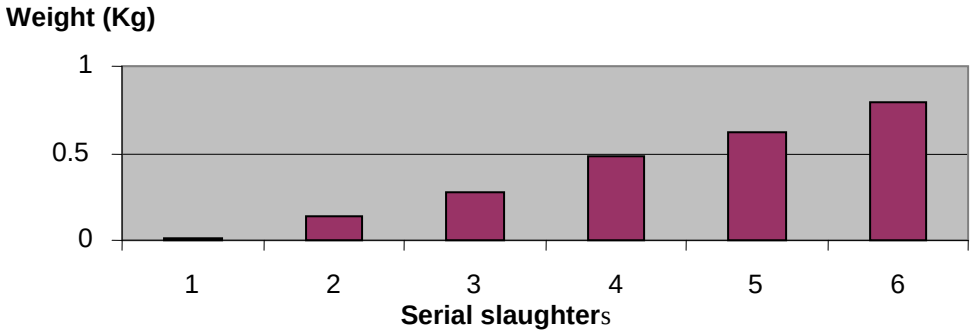

Figure 3 - The hot carcass weight (kg) of the six serial slaughters of the domestic fowl

Table 2 - Average body regions absolute weights (kg) and their percentages from the left side weight and body region tissues percent of the left side region weight at terminal slaughter

Region	Weight	Percentage	Muscle %	Bone %	Connective tissues %	Fat %
Pelvis	0.030±0.005	8	49	41	7	3
Thorax	0.141±0.002	36	79	17	2	2
Flank	0.005±0.001	1	56	0	44	0
Hind limb	0.131±0.020	33	78	19	1	2
Wing	0.042±0.004	10	56	39	4	2
Neck	0.047±0.002	12	47	47	4	2

Average values (kg) of different body region weights of domestic fowls raised to 22 weeks of age are shown in Figure 4.12. The highest regional growth rate occurred in the thorax and hind limb. All other regions are much lower in value

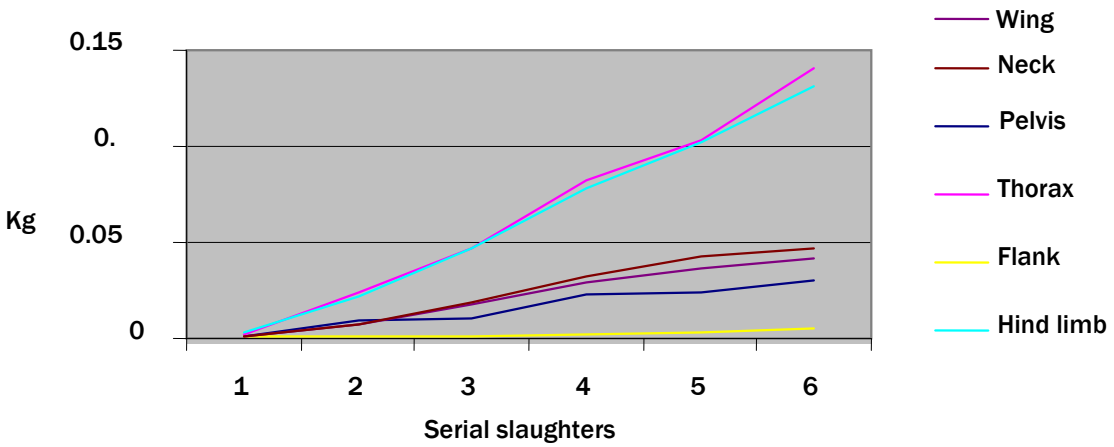

Figure 4 - Average values (kg) of different body region weights of domestic fowls raised to 22 weeks of age

Table 2 shows average body regions absolute weights (kg) and their percentages from the left side weight and body region tissues percent of the left side region weight at terminal slaughter. The thorax comprised the highest percentage from the left side of the carcass (36%) and next to is the hind limb (33%). The flank had the lower percentage (1%). The thorax and hind limb had the greater mass of muscle (79 and 78% respectively). The highest bone percentage obtained was from the pelvis and the wing (41 and 39% respectively). The flank had no

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bones or fat but high percentage of muscle and connective tissues (56 and 44% respectively). All regions had the same percentage of fat (2%) or no fat except for the pelvis (3%).

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