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Morphometrik Indicators of Wing Girdle Bones in the Postnatal Ontogenesis of Chickens

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Annotation: The dynamics of changes in the linear dimensions and weight of the wing girdle bones of laying hens in postnatal ontogenesis has been studied. It was found that the absolute values of the linear size and mass of the wing belt bones increase intensively from the first day of postnatal ontogenesis to 16 days of age, and this condition continues until the physiological period of chickens, i.e. up to 168 days, and at this age is higher than in chickens of other ages, and the intensity of growth from 280 days to At 570 days of age, it slows down due to the intensification of the egg-laying process. There was an increase in the mass of the growth coefficient of the absolute parameters of the scapula, clavicle and coracoid bones compared with their linear sizes at the physiological stages of postnatal ontogenesis.

Keywords: birds, chickens, wings, bone, shoulder blade, clavicle, coracoid, postnatal ontogeny, absolute index, length, width, weight, growth factor.

Relevance of the Topic: Poultry farming is considered one of the most efficient, highly profitable, and promising sectors of livestock. Unlike other sectors, it is not seasonal and plays a leading role in supplying food products to the population throughout the year. For this reason, a comprehensive study of the functional morphology of poultry is of great importance in improving breeding and selection practices.

Poultry bones show certain differences in their morphological structure based on their location and functional characteristics. The skeletal system performs support and mechanical functions in the organism, and its composition includes calcium and phosphorus compounds. Furthermore, the reserves of calcium, phosphorus, and other macro and microelements, which play an essential role in maintaining continuous metabolic processes in the organism, are primarily stored in the bones.

Poultry bones exhibit notable differences from those of livestock in terms of their morphological, mechanical, and chemical composition. During various physiological stages of postnatal ontogenesis, the formation and development of their musculoskeletal system, like that of other organ systems, occur under the influence of both internal and external environments. As a result of scientific studies, the main differences in the skeletal structure of domestic hens and roosters have been identified. According to the authors, the sternum base in hens is somewhat shorter and wider compared to that in roosters. The femur in domestic hens is less elongated, and there is no distinct S-shaped bend, which is evident in roosters. These differences are related to adaptability to environmental conditions.

Two stages have been proposed for the postnatal development of chickens. The first stage is characterized by a period of rapid growth, lasting up to 10–12 weeks. The second stage extends until the onset of sexual maturity and activity, lasting from 21 to 23 weeks, during which growth occurs at a slower rate [8].

Due to the structural characteristics of the avian skeleton, it is relatively lighter compared to that of mammals. Some bones contain air-filled cavities that connect to air sacs. Pneumatic bones include certain skull bones, vertebrae, pelvic bones, and shoulder girdle bones. During sexual maturity, a coarse, porous tissue rich in calcium forms inside the bones of chickens, which is utilized in the formation of the eggshell [10].

Scientific research on the development of the avian skeleton indicates that chickens experience active growth and development until they are 60 days old. During this period, the skeletal system increases by 65–70% relative to the body weight, while overall body weight increases by 40%. By the age of four months, the active growth of the skeleton is completed, but internal restructuring continues. As chickens age, the weight of the skeleton decreases by half [1].

Scientific studies have determined that during the postnatal period, the skeletal development of the avian thoracic region begins with the formation of ossification centers on the 20th day. The strength of the keel bone reaches 116 g/mm², and between days 20 and 75, bone strength increases ninefold. From days 75 to 140, the transverse growth of thoracic bones is completed, while longitudinal growth slows down, with overall bone growth doubling. At sexual maturity, a reduction in bone mass is observed, which has been linked to eggshell formation [6].

The skeleton of chickens differs from that of farm animals in certain aspects. Their thoracic cage consists of seven thoracic vertebrae and seven pairs of ribs. The external structure is short, tall, and cone-shaped, with the base of the cone directed caudally. The first and second vertebrae are connected by a saddle-shaped joint, while the bodies of the second, third, fourth, and fifth vertebrae are fused. The sixth vertebra is articulated with an adjacent vertebra, allowing movement, whereas the seventh vertebra is fused with the synsacrum. The dorsal spinous processes are arranged in a continuous row [4, 7].

Studies on the linear dimensions and weights of wing and leg bones in different chicken crossbreeds have shown that while the linear measurements of stylopodial and zeugopodial bones are similar in both "Lohmann Brown Classic" and "Lohmann Brown LSL" chickens, their

absolute weights are higher in the "Lohmann Brown LSL" classic crossbreed. Due to the structural and functional characteristics of the skeletal system, the third toe bone has significantly higher linear measurements and weight compared to other toe bones [2].

Scientific research on the dynamic changes in the linear dimensions and weights of the tibia during different physiological stages of postnatal ontogenesis in broiler chickens has shown that the absolute values of tibial length and weight increase rapidly from the first to the 14th day. By the 35th day, the growth coefficient for bone weight surpasses that for bone length. Moreover, the bone parameters in probiotic-supplemented chicks have been found to be superior compared to the control group [3].

Studies on the locomotor system of chickens during post-incubation ontogenesis have highlighted the full structural formation of bones. Research has covered the anatomical structure, physiology, histology, and classification of skeletal bones, along with the growth and linear dimensions of all skeletal sections. Additionally, the influence of environmental factors on skeletal growth indicators has been determined.

Scientific research has established that the ossification of the vertebral column in the chicken embryo begins in the cervical region on days 12–13 of incubation. By the 19th day of embryonic development, the ossification process can also be observed in the sacral vertebrae [5].

Research on the formation and development of skeletal bones in chicken embryos has shown that, according to authors' findings, the ossification of skull bones is completed by the 14th day of embryonic development. By this stage, ossification has already begun in the cervical, thoracic, and lumbar vertebrae. The pygostyle vertebra undergoes ossification on the 18th day of incubation.Additionally, studies have examined the anatomical and histological structure of leg bones, including osteoblasts, osteocytes, and osteoclasts. The emergence of ossification centers has been recorded on days 5, 10, 14, 18, and 21 of chicken embryonic development [4].

Research Objective: The aim of the study is to investigate the morphometric characteristics of wing bones at different stages of postnatal ontogenesis in egg-laying chickens.

Materials and Methods: The research was conducted in the laboratory of the Department of Animal Anatomy, Histology, and Pathological Anatomy at SamDVCHBU. The study subjects were egg-laying chickens at the ages of 1, 16, 35, 85, 120, 168, 280, 420, and 570 days. The chickens were slaughtered and bled, and their wing and leg bones were separated from the body and weighed using an analytical balance. The linear dimensions and weights of the bones were measured according to standard morphometric methods.

The macro- and micrometric data obtained from the study were processed using variation statistical methods with the help of Microsoft Excel software.

To determine the dynamic changes in morphometric measurements based on age, the growth coefficient was calculated. This coefficient was obtained by dividing the absolute values of bone measurements in older chickens by the corresponding values in younger chickens. The overall growth coefficient for the entire postnatal ontogenesis period was determined using the formula developed by K.B. Svechin: $K = \frac{V_t}{V_0}$

K – Growth coefficient

Vt – Absolute value of bones in older chickens

V0 – Initial bone measurement value

Research Results. The pectoral girdle bones of poultry differ from those of farm animals, as chickens have well-developed scapula, clavicle, and coracoid bones. The absolute values of the linear dimensions and weights of the pectoral girdle bones in egg-laying chickens exhibited a

distinct growth dynamic across different physiological stages of postnatal ontogenesis.

The absolute indicator of the length of the scapula was equal to 2.01±0.04 cm on the first day of postnatal ontogenesis of chickens, and this indicator increased rapidly until the next 168 days, that is, on the 16th day - to 2.65±0.05 cm (K=1.31; r<0.02), on the 35th day - 4.33±0.06 cm. (K=1.63; r<0.02), at 85 days - up to 6.53±0.15 cm (K=1.5; r<0.03), at 120 days - up to 8.55±0.15 cm (K=1.31), at 168 days - up to 10.65±0.24 cm (K=1.24; r<0.03) increase was observed. It was found that this indicator of the bone does not change significantly from 280 days of development to 168 days, that is, it is 10.6±0.18 cm (K=0.99) at 208 days, 10.58±0.17 cm at 420 days, and 10.52±0.27 cm at 570 days. It was noted that the growth coefficient of the absolute indicator of the length of the scapula increased up to 5.23 times during the period from the first day of postnatal ontogeny of chickens to the 570th day.

The absolute indicator of the width of the scapula of chickens increased slightly until the 35th day of postnatal ontogenesis, from 0.33±0.01 cm to 0.46±0.01 cm (K=1.39; p<0.03) from 1 day to 16 days, and 2.31±0.03 cm (K=5.02) at 35 days. it was noted that it increases and this process continues up to 168 days and reaches 4.51±0.05 cm (K=1.95; r<0.02) at 85 days, 6.6±0.03 cm (K=1.46) at 120 days, and 8.64±0.1 cm (K=1.31; r<0.02) at 168 days. It was found that the rate of growth of this bone index slows down in the later stages of development, i.e. it is 8.34±0.18 cm at 280 days, 8.36±0.16 cm at 420 days, and 8.26±0.13 at 570 days (K=0.98). It was observed that the coefficient of growth of this indicator of the scapula increased by 25.03 times from one day to 570 days of postnatal development of chickens.

The absolute index of the weight of the scapula of chickens increases rapidly up to 168 days of postnatal ontogenesis, i.e. from 0.4±0.01 g from 1 to 16 days of age to 0.52±0.01 g, at 35 days of age – to 4.59±0.11 g (p<0.03), at 85 days of age – to 6.68±0.08 g (K=1.45; p<0.02), at 120 days of age – to 8.52±0.15 g (K=1.27), at 168 days of age – to 10.68±0.14 g (K=1.25; p<0.02), and at subsequent stages it practically does not change in proportion to its linear dimensions, i.e. at 280 days of age – 10.44±0.14 g, and 10.36±0.1 g in 420 and 570 days. It was observed that the coefficient of growth of the absolute indicator of the weight of the scapula increased by 25.9 times until the 570th day of postnatal development of chickens.

Conclusion:

1. The absolute indicators of the linear dimensions and weight of the wing (forelimb) girdle bones of egg-laying chickens significantly increased from the initial days of postnatal ontogenesis until day 16, and this trend continued until the physiological maturity period of the chickens, i.e., up to day 168, where the values were higher compared to those of other age groups.
2. The absolute indicators of the linear dimensions and weight of the wing girdle bones from postnatal ontogenesis day 280 to day 570 showed a slowing of growth rate, which was related to the intensification of the egg-laying process.
3. The growth coefficient of the absolute indicators of the scapula bones in egg-laying chickens was higher for weight than for linear dimensions during the physiological stages of postnatal ontogenesis.

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