

## Comparative Anatomical Studies on Humerus of Commercial Broiler and Desi Chicken

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### ABSTRACT

*In the proximal extremity interiorly head of humerus of broiler is more thick as compared to desi bird. The large and deep air sac on medial surface is present in commercial broiler but small and shallow observed in desi birds. The crest of humerus is sharp on lateral surface in desi birds but blunt in commercial broiler. Very prominent deep fossa on lateral surface is present in desi but shallow in broiler. Smooth deltoid tuberoses is prominent on medial surface in broiler but absent in desi birds. A large condyle is deep in broiler but shallow in desi birds. On the posterior surface a large trochlea in broiler but small in desi birds. The biometrical studies of humerus of broiler and desi chicken includes, the means length, width and circumference. The mean length, width and circumference of the proximal extremity of humerus showed no difference. The length and width of distal extremity of humerus. The circumference of distal extremity of humerus of broiler and desi bird was significant ( $P < 0.05$ ). Circumference of shaft of humerus of birds was not significantly different. However the width of shaft of humerus of birds shown significant difference ( $P < 0.05$ ), and the length of shaft of humerus of birds were highly significant ( $P < 0.01$ ).*

**Keywords:** Osteometric, morphological difference, humerus, commercial broiler, desi chicken

### INTRODUCTION

Poultry industry has a significant position in Pakistan. It's imperative role in the GDP of Pakistan and contributes in agriculture and livestock sector in 6.1% and 10.8% respectively (Anonymous, 2013). This increasing rate and grave body mass chiefly allied with a little skeletal structure which has been concerned in musculo-skeletal and cardiovascular disease in broilers (Lilburn, 1994).

The birds' skeleton is collectively defined as low weight in response of selection for reducing the energy constraints for flight (Dumont, 2010). The anatomy of the fore limbs (wing) and hind limbs (leg) is very close to those of mammals. The wing anatomy may be divided into the shoulder girdle (scapula, coracoid and clavicle), the free part (the arm - or humerus and the forearm (Wilson, 1980). Birds have many bones that are hollow (pneumatized) with criss-crossing struts or trusses for structural strength. The hollow bones vary specie to specie, although large gliding and soaring birds tend to have the most. Respiratory air sacs often form air pockets within the semi-hollow bones of the bird's skeleton (Gary, 2007).

The wing-skeleton may therefore hold essential signs to the evolutionary radiation of contemporary birds (Purvis and Rambaut, 1995). An inclusive comparative investigation using independent contrasts was used to explore the scaling of avian wing-bone morphology: both lengths scaling with body mass and scaling between individual wing-bones (Nudds, 2007). The bones of the fore limb are very much modified to form the wing. The wing

articulates with the body at the glenoid cavity which is strengthened by the junction of three bones namely, scapula, coracoid and the clavicle. Like the leg, the bones of the wing are recognizably evolved from a basic plan that can be found in all vertebrates, including mankind. The wing consists of a humerus which at one end is attached to the main thorax via the scapula, and at the other end to both ulna and the radius (Hilderbrand and Goslow, 2001). Most long bones of young chickens contain two types of cartilage including the epiphysial cartilage (articular cartilage, the tissue with resilience) and the growth plate (the tissue of growth center) (Nakano et al., 1996). They grow in length by endochondral ossification involving chondrocyte proliferation, maturation, hypertrophy, and calcification, and in diameter by intra-membranous ossification involving appositional growth of osteoblasts that takes place in the periosteum (Ham, 1974). On the basis of above review literature the present research describes the comparative anatomical structure of the humerus of commercial broiler and desi chicken.

## **MATERIALS AND METHODS**

Immediately after slaughter, the right and left wing bones of birds were dissected with knife, removed muscles, tendons, ligaments and other soft tissues with the help of scalpel. Physically examined the wings in the position where it was detached from the body of bird. Depending on the wing is cut see cartilage and bone marrow. The skin of the wings was carefully cut and removed by using scissors without cutting the muscle attached under the skin. Cut was made until reach the shoulder to elbow joints. Then rinsed the wing bone (humerus) in tap water, and then soaked in hot 10% potassium hydroxide for 5 days. Subsequently, the proximal and distal wing bone (humerus) was air-dried in the sun light for a week. Samples of the right and left humerus of wings from commercial broiler and desi chicken with no gross anatomical lesions were obtained for further studies. Total 40 bones samples from both groups of birds were measured for following comparative gross anatomical structures and biometrical observations. The length, width, circumference of diaphysis, proximal and distal epiphyses of humerus were measured and recorded in millimeter (mm). The length and the width at the level of the proximal and distal epiphysis, mid shaft of bones were measured macroscopically.

### **Data Analysis**

The length, width and circumference expressed as mean  $\pm$  SD (Standard Deviation) were analyzed statistically using Statistical Package for Social Sciences (SPSS) version 17.0. For the paired samples t-test 95 and 99% confidence interval we used to determine the level of significant difference between two species of chicken.

## **RESULTS**

A comparative anatomical study on the humerus of commercial broiler chicken and desi chicken was conducted.

### **Comparison of Humerus of the Commercial Broiler and Desi Chicken.**

Anatomically the humerus of broiler and desi birds possesses shaft, two extremities (proximal and distal) and four surfaces (anterior, posterior, medial and lateral).

In proximal extremity anteriorly the head of broiler is thicker as compared to desi bird (Plate. 1). Very prominent deep fossa is present in front of the head of bone of desi, whereas, it is shallow in case of broiler (Plate.2). The shaft of the bone is twisted cylindrical in both species. On lateral surface of proximal extremity of humerus of desi bird the crest is sharp but blunt in commercial

broiler (Plate.3). Smooth deltoid tuberosity is prominent in broiler but it is absent in desi birds (Plate. 4).

The large and deep air sac is present on the medial surface of the proximal extremity of the bone in commercial broiler but in case of desi birds it is small and shallow (Plate.5). On the lateral surface of distal extremity of humerus present large condyle which is deep in broiler but shallow in desi birds (Plate. 6). Furthermore, trochlea is present on posterior surface of the distal extremity of broiler but found small in desi birds (Plate.7).

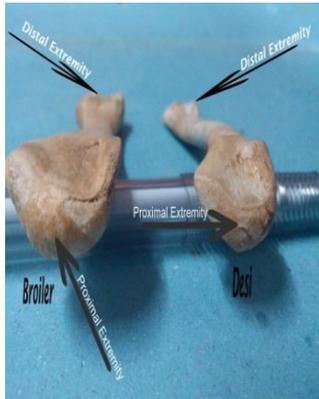


PLATE- 1

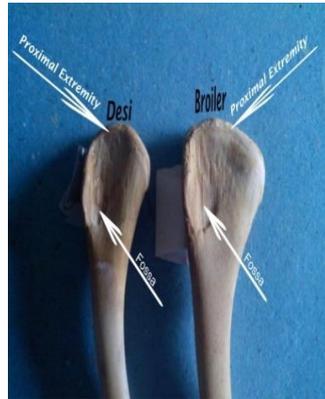


PLATE-2

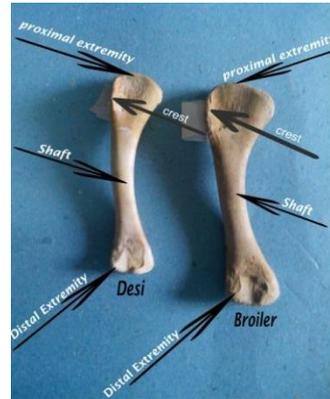


PLATE-3



PLATE-4

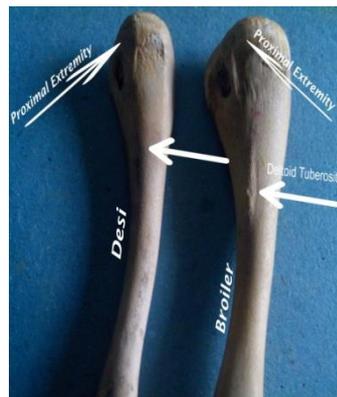


PLATE-5

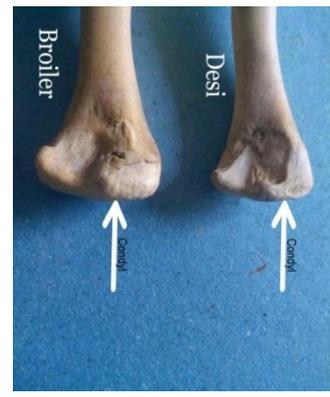


PLATE-6

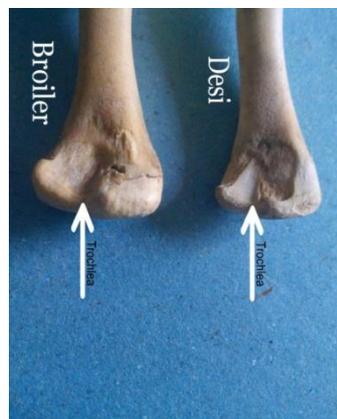


PLATE-7

## Biometrical studies of the Humerus of Birds

### Proximal Extremity of Humerus

The values for mean  $\pm$  SD for length, width and circumference of proximal extremity of humerus of commercial broiler and desi bird are presented in Table 1. The data for comparison proximal extremity of humerus was further statistically analyzed which showed non-significant difference between two variables.

**Table 1. Mean  $\pm$  SD of proximal extremity of humerus of commercial broiler chicken and desi chicken**

Parameter	Broiler		Desi chicken	
	Min-Max	Mean $\pm$ SD	Min-Max	Mean $\pm$ SD
Length	18.0-20.0	19.1 $\pm$ 0.88	14.0-17.0	15.8 $\pm$ 1.03 <sup>NS</sup>
Width	6.0-9.0	8.0 $\pm$ 0.82	5.0-8.0	6.3 $\pm$ 0.82 <sup>NS</sup>
Circumference	45.0-50.0	46.9 $\pm$ 1.91	32.0-39.0	36.5 $\pm$ 2.07 <sup>NS</sup>

### Distal Extremity of the Humerus

The values for mean  $\pm$  SD for length, width and circumference of distal extremity of humerus of commercial broiler and desi bird are presented in Table 2. The data for comparison distal extremity of humerus was further statistically analysed which shows non-significant difference in length and width but very significant differences was observed in circumference between two variables.

**Table 2. Mean  $\pm$  SD of distal extremity of humerus of commercial broiler and desi chicken**

Parameter	Broiler chicken		Desi chicken	
	Min-Max	Mean $\pm$ SD	Min-Max	Mean $\pm$ SD
Length	14.0-17.0	15.7 $\pm$ 0.95	11.0-14.0	12.7 $\pm$ 1.06 <sup>NS</sup>
Width	5.0-7.0	6.4 $\pm$ 0.67	3.0-5.0	4.0 $\pm$ 0.67 <sup>NS</sup>
Circumference	35.0-42.0	37.5 $\pm$ 2.22	27.0-30.0	28.1 $\pm$ 0.88 <sup>**</sup>

### Shaft of the Humerus

The values for mean  $\pm$  SD for length, width and circumference of shaft of humerus of commercial broiler and desi bird are presented in Table 3. The data for comparison shaft of humerus was further statistically analysed, which shows very significant differences in length and significant difference in width but not quite significant difference was observed in circumference between two variables.

**Table 3. Mean  $\pm$  SD of humerus shaft of commercial broiler and desi chicken**

Parameter	Broiler		Desi chicken	
	Min-Max	Mean $\pm$ SD	Min-Max	Mean $\pm$ SD
Length	57.0-69.0	62.3 $\pm$ 4.11	55.0-60.0	58.0 $\pm$ 1.41 <sup>**</sup>
Width	6.0-10.0	7.9 $\pm$ 1.66	5.0-8.0	6.1 $\pm$ 0.74 <sup>*</sup>
Circumference	21.0-28.0	23.4 $\pm$ 2.50	18.0-22.0	19.5 $\pm$ 1.51 <sup>NQS</sup>

## DISCUSSIONS

Comparative anatomical study of humerus of commercial broiler and desi chicken was conducted. Charuta et al., (2005) conducted morphology and morphometry of the antebrachial skeleton and bones of hand of the domestic Pektin duck. However, Naldo et al., (2000) described normal anatomy of the long bones in bustards. Breugelmanns *et al.*, (2007) reported macroscopically and radiographically the age-related long leg bones of chickens determined both macroscopically in ten broilers. Tiwari et al., (2011) studied the fore limb or pectoral limb of Pariah kite (*Milvus migrans*) was studied for gross morphometry.

In the present study gross anatomical structures of right and left humerus of broiler and desi bird were investigated and found that the humerus consists of two extremities and four surfaces. Similarly, Tiwari et al., (2011) reported similar findings of humerus of Parah kite that the humerus of chicken wing are all homologous to those of a human's.

In the present study the shaft of humerus of both birds is twisted and cylindrical. Mayr and Mourer, (2000) is also reported the shaft of humerus of chicken is slightly curved. While, Tiwari et al., (2011) reported that the shaft of the humerus of Parah kite was long and semicylindrical in shape.

Present study showed that the shaft of humerus is concave on the lateral surface whereas it convex on the medial surface. Dorsally it is straight and curved ventrally. On the other hand, Getty, (1975) stated that the proximal extremity of humerus was larger and more flattened craniocaudally than distal extremity, while in fowl it was convex. Tiwari et al., (2011) reported that the humerus of Parah kite was largest, stout and slightly curved wing bones.

In the present study cranial extremity of humerus consists of centrally head, dorsal and ventral tubercles. Bradley and Grahame, (1960) observed that the tubercle of proximal extremity of humerus was larger and overhangs the pneumatic foramen in domestic fowl. Furthermore, Mayr and Mourer (2000) reported that the proximal end of humerus of chicken is proportionally larger. While, Tiwari et al., (2011) reported tubercle of proximal extremity of the humerus of Parah kite is smaller.

In the present study dorsally crest, centrally fossa, and rounded ventral tubercle is present on the lateral surface of cranial extremity of humerus of broiler. The large and deep air sac is present on the medial surface of the proximal extremity of the bone in commercial broiler but in case of desi birds it is small and shallow. Bradley and Grahame, (1960) investigated the pneumatic foramen was placed medially just below the head of fowl.

Getty, (1975) reported on ventral surface of humerus of fowl thin elongated deltoid crest was thicker, curved laterally and present only at the proximal extremity. Mayr and Mourer, (2000) reported that the tuberculum dorsal of humerus of chicken is small.

In the present study proximal extremity the head of humerus of broiler is thicker as compared to desi. Very prominent deep fossa is present in front of the head of bone of desi, whereas, it is shallow in case of broiler. On the lateral surface of distal extremity of humerus a large medial condyle is present, which is deep in broiler but shallow in desi birds. Further, on lateral surface of the distal extremity present trochlea in broiler but found small in desi birds. Whereas, Tiwari et al., (2011) reported that the proximal extremity humerus of Parah kite is articulated with coracoid by a ligament. It had transversely elongated, convex head and a tubercle. Distal extremity of the humerus had concave olecranon fossa and articulated with ulna and radius by two condyles.

## CONCLUSIONS

In view of above findings, it is concluded that anatomically proximal and distal extremity of humerus of commercial broiler and desi chicken showed major difference in structure of bones. Biometrically, commercial broiler possesses longer bones as compared with desi birds.

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