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## Comparative osteology and morphology of digestive system of misri gold (*Fayoumi* x RIR) and aseel birds

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A total of 40 (20 male and 20 female) birds of both groups i-e. Group A Misri gold male and female (6 week of age) and Group B Aseel male and female (6 week of age) were used in the present study. Live weights of each bird were recorded. After slaughtering carcass weight were recorded. Careful eviscerations of the digestive organs were done. The weight, length and width of digestive organs such as esophagus, proventriculus, crop, gizzard, small intestine and large intestine were measured by means of vernier calipers. After removing the skin the weight, length and width of bones such as Humerus, radius, ulna, femur, tibia and metatarsal were also measured through vernier caliper. Morphometric study of digestive organs were significantly higher ( $p < 0.05$ ) among both groups. The length of esophagus was significantly higher ( $p < 0.05$ ) in group A(m) ( $9.75 \pm 0.334$ ) as compared to group B(m) ( $12.02 \pm 0.420$ ). The width of esophagus was significantly higher ( $p < 0.05$ ) in group B(f) ( $0.55 \pm 0.020$ ) as compared to group A(f) ( $0.98 \pm 0.032$ ). The weight of esophagus was significantly higher ( $p < 0.05$ ) in group B(f) ( $2.50 \pm 0.091$ ) as compared to group A(f) ( $4.50 \pm 0.191$ ). The length of crop esophagus was significantly higher ( $p < 0.05$ ) in group A(m)  $1.65 \pm 0.049$  as compared to group B(m)  $3.80 \pm 0.227$ . The weight of crop was significantly higher ( $p < 0.05$ ) in group A(f)  $2.19 \pm 0.040$  as compared to group B(f)  $2.99 \pm 0.485$ . The width of the proventriculus was significantly higher ( $p < 0.05$ ) in group A(f)  $0.50 \pm 0.016$  as compared to group B(f)  $1.08 \pm 0.035$ . The weight of proventriculus was significantly higher ( $p < 0.05$ ) in group B(m)  $1.18 \pm 0.005$  AS compared to group A(m)  $3.80 \pm 0.476$ . The length of gizzard was significantly higher ( $p < 0.05$ ) in group A(m)  $4.00 \pm 0.158$  as compared to group B(m)  $3.40 \pm 0.190$ . The width of the gizzard was significantly higher ( $p < 0.05$ ) in group A(f)  $2.45 \pm 0.050$  as compared to group B(f)  $2.60 \pm 0.085$ . The length of the small intestine was significantly higher ( $p < 0.05$ ) in group B(m)  $66.00 \pm 1.895$  as compared to group A(m)  $51.75 \pm 2.236$ . The width of distal end of the Humerus was significantly higher ( $p < 0.05$ ) in group A(f)  $1.010 \pm 0.028$  as compared to group B(f)  $0.782 \pm 0.111$ . The width of the distal end of ulna was significantly higher ( $p < 0.05$ ) in group B(m)  $0.652 \pm 0.064$  as compared to group A(m)  $0.498 \pm 0.081$ . The length of ulna was significantly higher ( $p < 0.05$ ) in group B(f)  $4.020 \pm 0.029$  as compared to group A(f)  $3.422 \pm 0.334$ . The weight of femur was significantly higher ( $p < 0.05$ ) in group A(f)  $0.558 \pm 0.047$  as compared to group B(f)  $0.408 \pm 0.068$ . The weight of metatarsal was significantly higher ( $p < 0.05$ ) in group A(m)  $0.418 \pm 0.031$  as compared to group B(m)  $0.558 \pm 0.033$ .

**Keywords:** Esophagus, Crop, Proventriculus, Gizzard, Ulna, Femur

## INTRODUCTION

Past introduction here.

The word 'poultry' comes from Poult, pullet. This term is used for any kind of domesticated bird. Fowl can be described as household chickens particularly as turkeys, geese and ducks which are produced for the development of meat or eggs (Houghton, 2009). Aseel bird is famous for gambling purpose traditionally because of its aggressive behavior and meat value. The people involved in birds fighting kept it and are its main conservers, Aseel is divided into four types such as Lakha, Mushki, Mianwali, and Peshawari on the basis of their color, specific breeding and geographical location (Babar *et al.*, 2012). It is the most established Asian game fowl and guideline ancestor of Indian Game. The meat quality and its organization, particularly proximate piece in Aseel was significant in its supplement arrangement and in customer interest. It is noted on working on Aseel bird by (Singh, 2009). It is used both as backyard poultry and as game bird in various rural areas of Pakistan (Haseeb *et al.*, 2014). Appropriate structure and capacity of skeletal framework are among the significant elements in chickens. The chicken digestive tract has the crop, an extension of the throat, situated in the lower neck area, the glandular stomach (proventriculus), the strong stomach (ventriculus), small digestion tracts (duodenum, jejunum and ileum) and internal organ (ceca and colorectum) (Mahmud *et al.*, 2015). The esophagus is usually bigger in female chick. Its ventral partition is comprehensively formed in the passage of the chest, framing the seed, which is bigger in cock. Separate squamous epithelium, including mucous organs and lymphatic tissues, develops throat mucosa. The esophagus and crop histologically are similar (Rossi *et al.*, 2006). The small intestine divided into duodenum, jejunum and ileum, as the duodenum commences at the pyloric junction to the ligament of Treitz, while the jejunum extends from this ligament to the yolk stalk. The ileum extended from the later structure to the ileo-cecal-colonic junction (Geyra *et al.*, 2001). With respect to storing food, ingested food crop can also influence feed digestion by directly softening and the initial activity of feed (internal and external) and microbial activity of enzymes. The author has further established that crop is one the organs representing the premier and main protection against infectious (Classen *et al.*, 2016). The alimentary tract as related with that of chicken's passes on food to the stomach: this framework includes, the crop, a development of the throat, situated in the lower neck territory, the glandular

stomach (proventriculus), the solid stomach (gizzard) and digestion tracts (Hassouna, 2001). The esophagus in the entrance of the thoracic normally expanded to form an organ called crop. The esophagus of the grey-backed shrike did not have crop, this was in according with the finding in other Passeriformes birds (Rajabi and Nabipour, 2009). Liver is the bird's largest body gland with dark brown or red brown color. The right side of the liver has both endocrine and exocrine glands that release many substances into the bloodstream and secrete bile into the duct system (Dyce *et al.*, 2010). The digestion in the crop is associated with a high pH variability which ranges from 4.0 to 7.8 according to various scientific reports of healthy chickens (Greiner and Konietzny, 2011). The skeletons of chicken are all around portrayed as lightweight because of determination for limiting the vitality required for flight and fight. As per density of the three bones such as femur, Humerus and cranium in birds, overall, these bones are densest in avian followed by the bats bones (Dumont 2010). The root of the scapula in poultry is controversial, a significant segment of the shoulder support, with both somatic and horizontal plate roots being proposed. The scapula creates in a rostral-to-caudal heading and clear chondrification is gone before by a gathering of communicating cells (Huang *et al.*, 2000). Anatomically the ulna and radius of the two avian (commercial layer and Desi chicken) are long sort bones, comprises of shaft and two furthest points (proximal and distal). The pole of the two bones of the commercial layer is thicker yet less smooth than Desi birds. The ulna shaft of the market layer is thick yet slender in Desi chicken (Visto *et al.*, 2018).

## MATERIALS AND METHODS

A total of 40 (20 male and 20 female) birds of each groups i.e. Group A Misri gold male and female (6 week of age) and Group B Aseel male and female (6 week of age) were used in the present study. Live weights of each bird were recorded. After slaughtering carcass weight were recorded. Careful eviscerations of the digestive organs were done. The weight, length and width of digestive organs such as esophagus, proventriculus, crop, gizzard, small intestine and large intestine were measured by means of vernier calipers. After removing the skin the weight, length and width of bones such as Humerus, radius, ulna, femur, tibia and metatarsal were also measured through vernier caliper.

## MORPHOMETRIC STUDY

For morphometric study of digestive organs the weight, length and width of digestive organs such as esophagus, proventriculus, crop, gizzard, small intestine and large intestine were measured by means of vernier calipers. After removing the skin the weight, length and width of bones such as Humerus, radius, ulna, femur, tibia and metatarsal were also measured through vernier caliper for morphometric studies.

### STATISTICAL ANALYSIS

Descriptive statistical analysis was measured using Microsoft Excel computer programs for each parameter examined. Mean of parameters were compared with one-way ANOVA. Means of group was compared with Turkey's honest significance test (THS,  $\alpha = 0.05$ ). Values were presented as mean  $\pm$  SE.

### RESULTS AND DISCUSSION

#### Morphometric study of Digestive Organs

The length of esophagus is  $9.75 \pm 0.334$  and  $12.02 \pm 0.420$  in Misri gold and Aseel male birds respectively Table no 1. The length is significantly higher ( $p < 0.05$ ) in Misri gold. The width of esophagus is  $0.55 \pm 0.020$  and  $0.98 \pm 0.032$  in Aseel and Misri gold female birds respectively Table no 1. The width is significantly higher ( $p < 0.05$ ) in Aseel. The weight of esophagus is  $2.50 \pm 0.091$  and  $4.50 \pm 0.191$  in Aseel and Misri gold female birds respectively Table no 1. The weight is significantly higher ( $p < 0.05$ ) in Misri gold. The length of crop esophagus is  $1.65 \pm 0.049$  and  $3.80 \pm 0.227$  in Misri gold and Aseel male birds respectively Table no 1. The length is significantly higher ( $p < 0.05$ ) in Misri gold.

The weight of crop is  $2.19 \pm 0.040$  and  $2.99 \pm 0.485$  in Misri gold and Aseel female birds respectively Table no 1. The weight is significantly higher ( $p < 0.05$ ) in Misri gold. The width of the proventriculus is  $0.50 \pm 0.016$  and  $1.08 \pm 0.035$  in Misri gold and Aseel female birds respectively Table no 1. The width is significantly higher ( $p < 0.05$ ) in Misri gold. The weight of proventriculus is  $1.18 \pm 0.005$  and  $3.80 \pm 0.476$  in Aseel and Misri gold male birds respectively Table no 1. The weight is significantly higher ( $p < 0.05$ ) in Aseel. The length of gizzard is  $4.00 \pm 0.158$  and  $3.40 \pm 0.190$  in Misri gold and Aseel male birds respectively Table no 1. The length is significantly higher ( $p < 0.05$ ) in Misri gold. The width of the gizzard is  $2.45 \pm 0.050$  and  $2.60 \pm 0.085$  in Misri gold and Aseel female birds respectively Table no 1. The width is significantly higher ( $p < 0.05$ ) in Misri gold. The

length of the small intestine is  $66.00 \pm 1.895$  and  $51.75 \pm 2.236$  in Aseel and Misri gold male birds respectively Table no 1. The length is significantly higher ( $p < 0.05$ ) in Aseel. In the present study the weight of the small intestine of Aseel and Misri gold birds is  $25.98 \pm 0.990$  and  $16.93 \pm 0.105$ , previously reported that the weight of small intestine of Nigerian indigenous birds is  $27.63 \pm 2.51$  (Muhammad *et al.*, 2015). In the present study the length of esophagus is  $2.50 \pm 0.091$  and  $4.50 \pm 0.191$  in Aseel and Misri gold birds, previously reported that the length of the esophagus if Nigerian indigenous chicken is  $15.67 \pm 1.31$ . in the present study the weight of esophagus of Aseel and Misri gold birds is  $4.60 \pm 0.491$  and  $2.10 \pm 0.031$ , previously reported that the weight of esophagus of Nigerian indigenous birds is  $6.98 \pm 0.57$  (Muhammad *et al.*, 2015).

The width of distal end of the Humerus is  $1.010 \pm 0.028$  and  $0.782 \pm 0.111$  in Misri gold and Aseel female birds respectively Table no 2. The width is significantly higher ( $p < 0.05$ ) in Misri gold. The width of the distal end of ulna is  $0.652 \pm 0.064$  and  $0.498 \pm 0.081$  in Aseel and Misri gold male birds respectively Table no 2. The width is significantly higher ( $p < 0.05$ ) in Aseel. In present study the width of distal end of ulna of Aseel and Misri gold chicken is  $0.454 \pm 0.105$  and  $0.630 \pm 0.066$ , previously reported that the width of distal end of ulna of Desi bird is  $5.5 \pm 0.85$  (Visto *et al.*, 2108).

The length of ulna is  $4.020 \pm 0.029$  and  $3.422 \pm 0.334$  in Aseel and Misri gold female birds respectively Table no 2. The length is significantly higher ( $p < 0.05$ ) in Aseel. The weight of femur is  $0.558 \pm 0.047$  and  $0.408 \pm 0.068$  in Misri gold and Aseel female birds respectively Table no 2. The weight is significantly higher ( $p < 0.05$ ) in Misri gold. The weight of metatarsal is  $0.418 \pm 0.031$  and  $0.558 \pm 0.033$  in Misri gold and Aseel male birds respectively Table no 2. The weight is significantly higher ( $p < 0.05$ ) in Misri gold. In the present study the distal end of the Humerus of Aseel and Misri gold chicken is  $0.782 \pm 0.111$  and  $1.010 \pm 0.028$ , previously reported that the distal end of Humerus of Desi chicken is  $4.0 \pm 0.67$  (Vistro *et al.*, 2015). In the present study the width of proximal end of Humerus of Aseel and Misri gold birds is  $0.828 \pm 0.103$  and  $0.754 \pm 0.134$ , previously reported that the width of proximal end of the Humerus of Desi birds is  $6.3 \pm 0.82$  (Vistro *et al.*, 2015). The length of tibia was significantly higher in female bird (Table 2)

Table: 1. Micrometric parameters (mean  $\pm$  SE) of Digestive system of Misri gold and Aseel birds.

Organs			Length (cm)	Width (cm)	Weight (g)
Esophagus	Group A	Male	9.75 $\pm$ 0.334*	0.12 $\pm$ 0.009	2.10 $\pm$ 0.031*
		Female	11.02 $\pm$ 0.320*	0.55 $\pm$ 0.020*	4.50 $\pm$ 0.191*
	Group B	Male	12.02 $\pm$ 0.420*	1.09 $\pm$ 0.120	4.60 $\pm$ 0.491*
		Female	9.25 $\pm$ 0.414*	0.98 $\pm$ 0.032*	2.50 $\pm$ 0.091*
Crop	Group A	Male	1.65 $\pm$ 0.049*	1.90 $\pm$ 0.012	2.19 $\pm$ 0.040*
		Female	3.70 $\pm$ 0.127*	2.70 $\pm$ 0.090*	2.00 $\pm$ 0.085*
	Group B	Male	3.80 $\pm$ 0.227*	2.88 $\pm$ 1.099	2.99 $\pm$ 0.485*
		Female	1.95 $\pm$ 0.079*	2.10 $\pm$ 0.104*	2.89 $\pm$ 0.090*
Proventriculus	Group A	Male	2.35 $\pm$ 0.079*	0.12 $\pm$ 0.009	1.18 $\pm$ 0.005*
		Female	1.90 $\pm$ 0.063*	0.50 $\pm$ 0.016*	3.00 $\pm$ 0.076*
	Group B	Male	2.00 $\pm$ 0.163*	1.92 $\pm$ 0.120	3.80 $\pm$ 0.476*
		Female	2.35 $\pm$ 0.079*	1.08 $\pm$ 0.035*	1.48 $\pm$ 0.025*
Gizzard	Group A	Male	4.00 $\pm$ 0.158*	2.03 $\pm$ 0.003	5.71 $\pm$ 0.116*
		Female	3.00 $\pm$ 0.090*	2.45 $\pm$ 0.050*	17.71 $\pm$ 0.146*
	Group B	Male	3.40 $\pm$ 0.190*	2.90 $\pm$ 0.233	17.75 $\pm$ 0.350*
		Female	4.00 $\pm$ 0.158*	2.60 $\pm$ 0.085*	14.75 $\pm$ 0.050*
Small Intestine	Group A	Male	51.75 $\pm$ 2.236*	0.32 $\pm$ 0.009	16.93 $\pm$ 0.105*
		Female	65.90 $\pm$ 1.857*	0.60 $\pm$ 0.022*	23.93 $\pm$ 0.135*
	Group B	Male	66.00 $\pm$ 1.895*	1.02 $\pm$ 0.950	25.98 $\pm$ 0.990*
		Female	102.75 $\pm$ 2.306*	0.99 $\pm$ 0.022*	14.98 $\pm$ 0.790*
Large Intestine	Group A	Male	50.50 $\pm$ 0.066*	0.43 $\pm$ 0.013	15.86 $\pm$ 0.102
		Female	57.50 $\pm$ 0.883	0.50 $\pm$ 0.020	7.86 $\pm$ 0.122*
	Group B	Male	57.90 $\pm$ 0.983*	1.98 $\pm$ 0.122	19.35 $\pm$ 0.317
		Female	51.60 $\pm$ 0.076	1.05 $\pm$ 0.035	1.35 $\pm$ 0.117*

\* = Highly Significant

**Table: 2. Micrometric parameters (mean  $\pm$  SE) of Bones of Misri gold and Aseel birds.**

Bones			Length (cm)	Weight (g)	Width (cm)	
					Proximal End	Distal End
Humerus	Group A	Male	3.926 $\pm$ 0.103	0.364 $\pm$ 0.048	0.656 $\pm$ 0.083	0.814 $\pm$ 0.043
		Female	4.216 $\pm$ 0.212	0.390 $\pm$ 0.031	0.828 $\pm$ 0.103	1.010 $\pm$ 0.028*
	Group B	Male	4.210 $\pm$ 0.163	0.394 $\pm$ 0.034	0.774 $\pm$ 0.067	0.880 $\pm$ 0.083
		Female	3.818 $\pm$ 0.499	0.332 $\pm$ 0.047	0.754 $\pm$ 0.134	0.782 $\pm$ 0.111*
Radius	Group A	Male	3.890 $\pm$ 0.139	0.058 $\pm$ 0.033	0.288 $\pm$ 0.019	0.396 $\pm$ 0.011
		Female	3.932 $\pm$ 0.179	0.090 $\pm$ 0.007	0.296 $\pm$ 0.021	0.382 $\pm$ 0.051
	Group B	Male	4.148 $\pm$ 0.220	0.276 $\pm$ 0.405	0.320 $\pm$ 0.047	0.438 $\pm$ 0.075
		Female	3.790 $\pm$ 0.266	0.048 $\pm$ 0.036	0.290 $\pm$ 0.043	0.366 $\pm$ 0.088
Ulna	Group A	Male	3.910 $\pm$ 0.184	0.268 $\pm$ 0.015	0.544 $\pm$ 0.062	0.498 $\pm$ 0.081*
		Female	4.020 $\pm$ 0.029*	0.278 $\pm$ 0.008	0.574 $\pm$ 0.068*	0.630 $\pm$ 0.066*
	Group B	Male	4.236 $\pm$ 0.151	0.290 $\pm$ 0.063	0.570 $\pm$ 0.055	0.652 $\pm$ 0.064*
		Female	3.422 $\pm$ 0.334*	0.338 $\pm$ 0.366	0.444 $\pm$ 0.065*	0.454 $\pm$ 0.105*
Femur	Group A	Male	3.994 $\pm$ 0.076	0.404 $\pm$ 0.009*	0.980 $\pm$ 0.035	0.798 $\pm$ 0.069
		Female	4.394 $\pm$ 0.195	0.558 $\pm$ 0.047*	0.906 $\pm$ 0.064	0.816 $\pm$ 0.043*
	Group B	Male	4.370 $\pm$ 0.244	0.514 $\pm$ 0.021*	0.912 $\pm$ 0.070	0.852 $\pm$ 0.073
		Female	4.136 $\pm$ 0.375	0.408 $\pm$ 0.068*	0.806 $\pm$ 0.155	0.618 $\pm$ 0.182*
Tibia	Group A	Male	5.684 $\pm$ 0.345	0.670 $\pm$ 0.045	1.022 $\pm$ 0.038	0.916 $\pm$ 0.074
		Female	6.116 $\pm$ 0.243	0.670 $\pm$ 0.062	1.070 $\pm$ 0.057	0.874 $\pm$ 0.084
	Group B	Male	5.972 $\pm$ 0.126	0.826 $\pm$ 0.116	1.166 $\pm$ 0.085	0.938 $\pm$ 0.048
		Female	5.656 $\pm$ 0.664	0.630 $\pm$ 0.110	1.080 $\pm$ 0.131	0.784 $\pm$ 0.138
Metatarsal	Group A	Male	4.038 $\pm$ 0.041	0.418 $\pm$ 0.031*	0.868 $\pm$ 0.089	0.986 $\pm$ 0.043
		Female	4.324 $\pm$ 0.215	0.514 $\pm$ 0.023	0.746 $\pm$ 0.417	1.042 $\pm$ 0.113*
	Group B	Male	4.240 $\pm$ 0.175	0.558 $\pm$ 0.033*	0.962 $\pm$ 0.058	1.018 $\pm$ 0.055
		Female	3.884 $\pm$ 0.501	0.446 $\pm$ 0.055	0.714 $\pm$ 0.167	0.866 $\pm$ 0.091*

\* = Highly Significant



Figure 1.1.1 Humerus of Aseel



Figure No: 4.1.5 Metatarsal of Misri Gold



Figure No: 4.1.3 Femur of Misri gold



Figure No: 4.1.4 Tibia of Aseel



Figure No: 4.1.2 Radius of Aseel

## CONCLUSION

It can be concluded that the length of esophagus show highly significant ( $p > 0.05$ ) in both Misri gold and Aseel birds. The width and weight of esophagus show highly significant ( $p > 0.05$ ) in both Misri gold and Aseel birds. The width, length and weight of crop show highly significant ( $p > 0.05$ ) in both Misri gold and Aseel birds. The weight of femur show highly significant ( $p > 0.05$ ) in both Misri gold and Aseel birds. The length, weight and width of proventriculus show highly significant ( $p > 0.05$ ) in both Misri gold and Aseel birds. The length, weight and width of gizzard show highly significant ( $p > 0.05$ ) in both Misri gold and Aseel birds. The length and weight of small intestine show highly significant ( $p > 0.05$ ) in both Misri gold and Aseel birds. The length and weight of large intestine show highly significant ( $p > 0.05$ ) in both Misri gold and Aseel birds. The width of the distal and proximal end of ulna show highly significant ( $p > 0.05$ ) in both

Misri gold and Aseel birds. The length of ulna show highly significant ( $p>0.05$ ) in both Misri gold and Aseel birds. The distal end of the Humerus show highly significant ( $p>0.05$ ) in both Misri gold and Aseel birds.

### CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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### AUTHOR CONTRIBUTIONS

All authors contributed equally in execution of this project.

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### REFERENCES

- Babar ME, Nadeem A, Hussain T, Wajid A, Shah SA, Iqbal A, Sarfraz Z and Akram M, 2012. Microsatellite marker based genetic diversity among four varieties of Pakistani Aseel Chicken. *Pak. Vet. J.* 32:237-241.
- Classen H, Apajalahti J, Svihus B and Choct M, 2016. The role of the crop in poultry production. *World's poult. Sci J.* 72:459-472.
- Comparative Anatomical Studies on Humerus of Commercial Broiler and Desi Chicken.
- Dumont ER, 2010. Bone density and the lightweight skeletons of birds. *P Roy Soc B-Biol Sci* 277:2193-2198.
- Dyce K, Sack W and Wensing C, 2010. Text book of veterinary anatomy fourth edition. *Sunders Elsevier.* 135-138.
- Geyra A, Uni Z and Sklan D, 2001. Enterocyte dynamics and mucosal development in the posthatch chick. *Poultry Sci.*, 80: 776-782.
- Greiner R and Konietzny U, 2011. Phytases: Biochemistry, enzymology and characteristics relevant to animal feed use. In: *Enzymes in farm animal nutrition*, Bedford M.R., Partridge G.G. (eds). CAB Intl. Publishing, Oxfordshire, UK., 96–128.
- Haseeb A, Shah MG, Gandahi JA, Lochi GM, Khan MS, Faisal M, Kiani MA, Ali R and Oad SK, 2014. Histo-morphological Study on Thymus of Aseel chicken. *J Agric Food Tech.* 4:1-5.
- Hassouna E, 2001. Some anatomical and morphometrical studies on the intestinal tract of chicken, duck, goose, turkey, pigeon, dove, quail, sparrow, heron, jackdaw, hoopoe, kestrel and owl. *Assiut J Vet Med Sci* 44:47-78 of wild bird. *Avian Biol. Res.*, 2:161-4. *ARInt Vol.* 6(6) November 2015.
- Houghton M, 2009. "Poultry". *The American Heritage: Dictionary of the English Language.* 4th edition.
- Huang R, Zhi Q, Patel K, Wilting J and Christ B, 2000. Dual origin and segmental organisation of the avian scapula. *Devt.* 127:3789-3794.
- Kausar R, Qureshi AS, Ali MZ, Ateeq MK and Usman M, 2016. Age induced changes in the microscopic anatomy of the digestive system of Japanese quails (*Coturnix japonica*) *Biosci. Res.* 13:26-31.
- Mabelebele M, Norris D, Siwendu N, Ng'ambi J, Alabi O and Mbajorgu C, 2017. Bone morphometric parameters of the tibia and femur of indigenous and broiler chickens reared intensively. *Appl Ecol Environ Res.* 15:1387-1398.
- Mahmud MA, Shaba P, Shehu SA, Danmaigoro A, Gana J and Abdussalam W, 2015. Gross morphological and morphometric studies on digestive tracts of three Nigerian indigenous genotypes of chicken with special reference to sexual dimorphism. *J World's Poult Res.* 5:32-41.
- Mukhtar N, Khan S and Khan R, 2012. Structural profile and emerging constraints of developing poultry meat industry in Pakistan. *World's Poult Sci J.* 68:749-757.
- Rajabi E and Nabipour, 2009. Histological study on the oesophagus and crop in various species
- Rossi JR., Baraldi-Artioni SB, Oliveira D, Da Cruz C, Sagula S, Pacheco MR and De Araújo ML, 2006. Morphology of esophagus and crop of the partridge *Rhynchotus rufescens* (Tiramideae). *Acta Sci. Biol. Sci.* 28:165-168.
- Sarkarati, F. and Doustar, Y., 2012. The frequency of liver lesions of broilers slaughtered in Tabriz abattoir. *Annals of Biological Research,* 3(7), pp.3439-3443.
- Singh D. 2009. Proceedings of national workshop

on synthesizing experiences in promotion of backyard poultry, Hyderabad, India.

Visto WA, Kalhoro IB, Shah MG, Laghari MF, Tarique I, Ahmed N and Liu Y, 2018. Comparative osteometric difference in ulna and radius of commercial layer and desi chicken. 11:28-33.

Vistro WA, Kalhoro IB, Shah MG, Rajput N, Ali SK, Memon KH and Fared SK, 2015. . Comparative Anatomical Studies on Humerus of Commercial Broiler and Desi Chicken. Acad. res. Int. 6:153-158.