

Morphometric Study of the Adrenal Gland of the Adult Sudanese Chicken (*Gallus domesticus*) and Duck (*Anas platyrhynchos*)

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Abstract: The aim of study to show the morphometry of the adrenal gland of the adult Sudanese chicken (*Gallus domesticus*) and duck (*Anas platyrhynchos*). The arrangement of nor-adrenaline secreting cells in the medulla was different from that of other animals, they were found in groups with no tendency to predominate in the peripheral layer of chromaffin tissue. The mean volume of the right adrenal gland of chicken was 0.20 cm³, that of duck was 0.14 cm³; they exceeded those of the left glands by 11 and 17% in the chicken and duck respectively. The relative volume of the components remained essentially the same in both glands. The chicken cortex formed 48%, while that of duck mounted to 68% in the volume of the gland.

Key words: Adrenal gland, *Anas platyrhynchos*, chicken, duck, *Gallus domesticus*, morphometric, sudanese

INTRODUCTION

Morphometric data dealing with the cortico medullary ratio have been reported in the Pekin dark (Cronshaw *et al.*, 1974), domestic fowl (Aire, 1980), guinea fowl (Ali, 1987). The adrenal cortico – medullary ratio in the fowl showed that there significant breed, sex and age differences. The interrenal cords of the subcapsular zone were consistently wider than those cords in the inner zone of the adrenal gland of domestic and guinea fowls. The proportion of interrenal tissue was significantly greater in the guinea fowl than in the domestic fowl, but the medullary tissue, blood vessel and connective tissue were not significantly different.

According to Ali (1987), the adrenal cortex of camel occupied 74% of the gland. The proportion of cortex, medulla and vascular space in Pekin dark occupied 68.2, 28.6 and 3.2%, respectively (Cronshaw *et al.*, 1974).

In the light of the limited information available, it was felt important to carry out a further morphometric examination of the adrenal gland of both fowl and duck and to ascertain if there are variation related to season. Search in the literature has shown no morphometric data on the adrenal gland of any of the avian species in Sudan.

MATERIALS AND METHODS

In the Sudan, morphometric analysis was carried out at the light microscopic level on the right and left adrenal of five chicken and ducks were determined during Winter season. The glands were fixed in bouin's solution and embedded in paraffin wax. The entire gland was cut in

serial section at 7 µm. Three of these were selected, one from the middle of the gland and two from the poles. They were stained by haematoxylin and eosin (Hand E) to identify the main cell types.

The histological sections were analysed by the point - counting technique (Weibel, 1963; Aherne and Dunnill, 1982) to determine the volume densities of the various components of the gland. The point-counting was carried out with the same zeiss integrating eye piece used to analysed the testis as discussed above. The mean volume densities (Vv) were then calculated for the components of the gland.

The analysis of the glandular components included the connective tissue, cortex, medulla, blood vessels and nerves. Ganglionic cells were depicted only under X40 objective lens. Since the counting was carried out under X10 objective lens, it was decided not to be considered chromaffin tissue and ganglion as two separate entities, but to consider both of them as adrenal medulla. Each complete section was analysed field by field using an objective X10. Depending on the area of the section, the number of fields ranged from 6 to 15 field per sections.

RESULTS

As given in Table 1 and 2 the mean values of age of five adult Hisex brown chicken was 9 months. measurements of the weight of birds gave mean values of 2210.32 g and 2913.3 g in duck respectively in Winter season and the weight of right and left adrenal gland gave mean values of 0.20 g and 0.18 gm in the chicken and 0.14 and 0.12 g in duck in Winter season.

Table 1: Showing weight of birds in gm, weight in gm and volume in cm³ of right (Rt) and left (L) adrenal gland of five adult Hisex brown chicken. Mean \pm standard deviation are also shown (Winter season)

Bird number	Weight of Birds (g)	Weight of adrenal gland in air (g)		Volume of adrenal gland in (cm ³)	
		Rt	L	Rt	L
1	1935	0.20	0.10	0.20	0.10
2	2200	0.10	0.10	0.10	0.10
3	2669.3	0.20	0.20	0.20	0.20
4	2161.1	0.20	0.20	0.20	0.20
5	2086.2	0.30	0.30	0.30	0.30
Mean \pm SD	2210.32 \pm 275.86	0.20 \pm 0.07	0.18 \pm 0.08	0.20 \pm 0.07	0.18 \pm 0.08

Table 2: Showing weight of birds in gm, weight in gm and volume in cm³ of right (Rt) and left (L) adrenal gland of five adult ducks. Mean \pm standard deviation are also shown (Winter season)

Bird number	Weight of birds (g)	Weight of adrenal gland in air (g)		Volume of adrenal gland in(cm ³)	
		Rt	L	Rt	L
1	2817	0.20	0.10	0.20	0.10
2	2818.2	0.10	0.10	0.10	0.10
3	2955.1	0.10	0.10	0.10	0.10
4	2999.1	0.10	0.10	0.10	0.10
5	2977.1	0.20	0.20	0.20	0.20
Mean \pm SD	2913.3 \pm 88.74	0.14 \pm 0.05	0.12 \pm 0.04	0.14 \pm 0.05	0.12 \pm 0.04

Table 3: Morphometric analysis of right adrenal gland showing the number of points (P), volume densities (Vv) as percentage volumes and absolute volume (V) of the main components of right adrenal gland of adult Hisex brown chicken. Mean \pm standard deviation are also shown (Winter season)

Bird number	Capsule and supporting framework			Cortex			Medulla			Blood vessels			Nerve		
	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³
1	60	2.50	0.01	1072	0.09	935	935	38.96	0.08	325	13.54	0.03	8	0.33	0.001
2	78	3.00	0.01	1482	0.11	641	641	24.65	0.05	388	14.92	0.03	11	0.42	0.001
3	72	2.77	0.003	1182	0.05	1072	1072	41.23	0.04	268	10.31	0.01	6	0.23	0.0002
4	58	2.15	0.004	1259	0.09	1030	1030	38.15	0.08	348	12.89	0.03	5	0.19	0.0004
5	44	1.83	0.01	1118	0.14	954	954	39.75	0.12	281	11.71	0.043	3	0.13	0.0004
Total number of points	312			6113			4632			1610			33		
Mean \pm SD		2.45 \pm 0.47	0.01 \pm 0.004		48.07 \pm 5.06	0.10 \pm 0.03		36.55 \pm 6.75	0.07 \pm 0.03		12.67 \pm 1.76	0.03 \pm 0.01		0.26 \pm 0.12	0.001 \pm 0.0004

Table 4: Morphometric analysis of the left adrenal gland showing the number of points counted (P), volume densities (Vv), as percentage volumes and absolute volumes (V) of the main components of left adrenal gland of five adult Hisex brown chicken. Mean \pm standard deviation are also shown (Winter season).

Bird number	Capsule and supporting framework			Cortex			Medulla			Blood vessels			Nerve		
	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³
1	86	3.58	0.004	1046	43.58	0.04	819	34.13	0.03	438	18.25	0.02	11	0.56	0.0005
2	78	2.89	0.003	1620	60.00	0.06	675	25.00	0.03	315	11.67	0.01	12	0.44	0.0004
3	74	2.74	0.01	1242	46.00	0.09	118	41.41	0.08	266	9.85	0.02	-	-	-
4	30	1.36	0.003	1011	45.95	0.09	866	39.36	0.08	284	12.91	0.03	9	0.4	10.001
5	49	1.81	0.01	1140	42.22	0.13	1135	42.04	0.13	373	13.81	0.04	3	0.11	0.0003
Total number of points	317			6059			4613			1676			35		
Mean \pm SD		2.48 \pm 0.89	0.01 \pm 0.004		47.55 \pm 7.14	0.08 \pm 0.03		36.39 \pm 7.08	0.07 \pm 0.04		13.30 \pm 3.14	0.02 \pm 0.01		0.28 \pm 0.21	0.0004 \pm 0.0004

The ratio of the mean weight of birds to the mean weight of right and left glands in chicken was 2210.32:1 and 2913.3:1 in duck respectively. The ratio of the mean weight of right adrenal gland to the left one was 1:1 in both chicken and duck.

Measurements of the volume of right and left adrenal gland of five adult chicken gave mean values of 0.20 cm³ for the right and 0.18 cm³ for the left and the duck gave mean values of 0.14 cm³ for the right and 0.12 cm³ for the left.

Table 3, 4, 5 and 6 showed data and results obtained by the analysis of histological sections of the right and left adrenal glands using the point-counting technique.

The volume densities and absolute volumes of the connective tissue, cortex, medulla, blood vessels and nerve were shown in Table 3, 4, 5 and 6. Although the mean volume of right adrenal gland in five adult chicken and duck studied exceeded that of the left one by 11 and 17%, respectively and the relative volumes of the components remained essentially the same in both glands (Table 3, 4, 5 and 6).

Table 5: Morphometric analysis of right adrenal gland showing the number of points (P), volume densities (Vv) as percentage volumes and absolute volume (V) of the main components of right adrenal gland of adult duck. mean \pm standard deviation are also shown (Winter season)

Bird number	Capsule and supporting framework			Cortex			Medulla			Blood vessels			Nerve		
	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³
1	44	1.57	0.003	1907	68.11	0.14	759	27.11	0.05	87	3.11	0.01	3	0.11	0.0002
2	58	2.42	0.002	1632	68.00	0.07	638	26.58	0.03	72	3.00	0.003	-	-	-
3	53	2.21	0.002	1608	67.00	0.07	666	27.75	0.03	69	2.88	0.003	4	0.17	0.0002
4	76	2.92	0.003	1804	69.38	0.07	650	25.00	0.03	70	2.69	0.003	-	-	-
5	77	3.35	0.01	1524	66.26	0.13	581	25.26	0.05	111	4.83	0.01	7	0.30	0.001
Total number of points	308			8475			3294			409			14		
Mean \pm SD		2.49 ± 0.68	0.004 ± 0.00		67.75 ± 1.19	0.10 ± 0.0		426.34 ± 1.18	0.04 ± 0.01		3.30 ± 0.87	0.01 ± 0.004		0.12 ± 0.13	0.0003 ± 0.0004

Table 6: Morphometric analysis of the left adrenal gland showing the number of points counted (P), volume densities (Vv), as percentage volumes and absolute volumes (V) of the main components of left adrenal gland of five adult duck. mean \pm standard deviation are also shown (Winter season)

Bird number	Capsule and supporting framework			Cortex			Medulla			Blood vessels			Nerve		
	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³	P	Vv%	Vcm ³
1	70	2.92	0.003	1680	70.00	0.07	609	25.38	0.03	36	1.50	0.002	5	0.21	0.0002
2	81	3.38	0.003	1600	66.67	0.07	643	26.79	0.02	67	2.79	0.003	9	0.38	0.0004
3	68	2.43	0.002	1876	67.00	0.07	764	27.29	0.03	74	2.64	0.003	18	0.64	0.001
4	46	2.00	0.002	1585	68.91	0.07	600	26.09	0.03	69	3.00	0.003	-	-	-
5	46	1.77	0.004	1744	67.07	0.13	727	27.96	0.06	79	3.04	0.01	4	0.15	0.0003
Total number of points	311			8485			3343			325			36		
Mean \pm SD		2.50 ± 0.66	0.003 ± 1.48		67.93 ± 1.4	0.08 ± 0.03		26.70 ± 1.01	0.03 ± 0.02		2.59 ± 0.63	0.004 ± 0.003		0.28 ± 0.24	0.0004 ± 0.0004

The greater volume of the gland in the parenchyma of the adrenal gland of chicken was occupied by cortex in both right and left gland being 48.07 and 47.55% and duck 67.75 and 67.93%, respectively. It was evident from Table 3, 4, 5 and 6 that the ratio of the volume of the cortex to that of the medulla in the right and left adrenal gland in both chicken and duck was about 1:1 and 3:1 respectively.

The volume densities of the right adrenal gland were closely similar to those of the left adrenal gland (Table 3, 4, 5 and 6).

DISCUSSION

Morphometric data on the adrenal gland of different species are scarce. In the camel the cortex occupied about 74% of the gland (Ali, 1987). According to Cronshaw *et al.* (1974), the duck cortex constitutes 68.2%, the medulla 28.6% and vascular space 3.2% of the total area. This is confirmed by the present study in which it was shown that duck cortex occupies 68% of the gland, that of the chicken occupied a smaller volume amounting to 48% only in the Winter. The proportion of the interregional tissue or cortex, was significantly greater in the guinea fowl than in the domestic fowl, but the medullary tissue, blood vessels and connective tissue were not significantly different (Aire, 1980).

Search in the literature has shown no morphometric data on the adrenal gland of any of the avian species in Sudan.

The finding and interpretation reported in this study provide basic information and indicate that further investigation involving ultrastructure and immunohistochemistry would contribute to a better understanding of these organs and correlates structure and function of the adrenal gland.

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