

Studies on Duck Organs, Glands and Meat Production

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BODY organs, glands and meat production characters were studied for 5 males and 5 females of Sudani, Rouen and Pekin ducks at 12 months of age. The following results were obtained -Pekin exceeded Rouen and Sudani in absolute digestive organs weights. The females were of heavier relative digestive size than the males. The lungs of Sudani and Rouen were heavier than Pekin, while the trachea of Pekin was heavier. Heart and blood absolute and relative weights were higher in the Sudani than in the Pekin and Rouen. The drakes were of the lower relative blood and heart weight than the females. The Sudani drakes had lower testes size, while the Pekin and Rouen had the heavier. The absolute reproductive weight of females was heavier for the Sudani, followed by the Rouen then the Pekin. The pituitary absolute and relative weights of the Sudani breed were higher than the Pekin and the Rouen. No breed differences were observed in thyroid weight and percentage.

The females exceeded the males in this respect. The adrenal breed differences followed the same breed differences in gonads. The absolute and relative weights of the thymus gland of the Rouen were higher than the others. There were no significant breed differences in the relative carcass weight.

Males had heavier carcasses than the females. Absolute and relative weights of wings were higher in Sudani than in the other two breeds. Sudani had the largest breasts, either meat or bones. Pekin, however, had some what heavier bones. Weight and percentage of legs of Pekin were the heaviest than Rouen and Sudani. The Pekin excelled the other two breeds in back and pelvis size but not significantly. The Sudani gave the heaviest meat and the lowest giblets weight than the other two breeds. No significant breed differences were observed with fat. The females had heavier fats than males. Pekin had heavier total bones than the other two breeds. The Sudani exceeded the Pekin and Rouen in body depth and circumference, while the Pekin exceeded the others in body length. Shanks of the Pekin and Sudani were relatively equal in length, but exceeded Rouen. Body depth and circumference in Pekin, tibia length in the Rouen and body circumference in the Sudani were approximately the most correlated.

Almost few studies were done to compare the organs, glands and meat production of different breeds of ducks. However, species differences are observed in thyroid weight as the thyroid weight of duck is found to be greater in relation to body weight than that of the chickens and turkeys (Bielier and Turner, 1950). There are no breed differences in the adrenals of the ducks up to the twelfth week of age (Oakberg, 1951). The rate of growth in ducks was found to differ from one breed to another. The Pekin was found to be the fastest followed by the Rouen which was faster than the Muscovy (Hurd and Hilbert, 1942 and Kamar, 1962).

Materials and Methods

Five males and five females of each of Pekin, Rouen and Sudani (Native breed) of 12 months of age were available. They were slaughtered and the different organs, glands and meat production characters were studied. Before slaughtering the birds they were treated alike in all the managerial and environmental conditions.

Results and Discussion

Body weight

Although the Pekin, the Rouen and the Sudani ducks are of the meat type, the Sudani exceeded the other two breeds in their weight. Also, the Muscovy ducks, which is similar to the Sudani in shape and characters, are heavier than the Pekin and Rouen. Breed differences were significant (Table 6). Sudani drakes were heavier than the ducks, while both sexes in the other breeds are almost of the same weight.

Digestive organs

The average absolute weight of the digestive organs in Pekin exceeded that of the Rouen and Sudani. However, the crop, esophagus, cecum and large intestine of the Sudani were higher in the average weight than those of the other breeds (Table 1). The relative weight of digestive organs showed also breed differences. The Pekin was higher in duodenum, liver and pancreas relative weight than the other two breeds. The Rouen was higher in proventriculus, gizzard, small intestines, cecum and large intestines relative weights than the other two breeds. Only the Sudani exceeded the foreign breeds in the crop and esophagus relative weights. It seems that the Pekin requires more concentrated feedstuffs, while the Rouen is on the reverse, as its cecum and large intestines are large than the other breeds thus enabling it to utilize feeds of a more fibrous nature. The Sudani seems to consume more food as its crop relative weight exceeded greatly the other breeds especially in drakes. Breed differences were highly significant in digestive organs relative weights (Table 6). Sex differences in the relative weights of the digestive organs were highly significant (Table 6). In general, the females were of heavier relative digestive organs size than males and this was more obvious in the Rouen than in the other two breeds. As the size of digestive system is associated with the efficiency of feed utilization (Kamar and Mostageer, 1963), it seems that the females are more efficient in utilizing food than males as they use their food in producing eggs while the males only used it in the preservation of their life and the production of semen which is not a nutritional material like eggs. Sex differences were more expressed in the organs that play important role in digestion such as the gizzard, duodenum, small intestine, liver and pancreas.

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TABLE 1. Average absolute and relative weights of body weight and digestive organs of different breeds and sexes.

Items	Sex	Pekin		Rouen		Sudani	
		Wt.	Rel. wt.	Wt.	Rel. wt.	Wt.	Rel. wt.
Body wt	Male . .	2001	—	1492	—	2403	—
	Female .	1936	—	1264	—	1624	—
Crop and esophagus	Males . .	11.55	0.58	7.69	0.52	17.82	0.74
	Females .	10.97	0.57	7.17	0.57	10.77	0.66
Proventriculus . . .	Males . .	8.50	0.42	5.75	0.39	8.95	0.37
	Females .	7.55	0.39	6.41	0.51	6.82	0.42
Gizzard	Males . .	60.58	3.03	40.28	2.70	52.87	2.20
	Females .	58.92	3.04	50.72	4.01	42.43	2.61
Deudenum	Males . .	7.13	0.36	4.48	0.23	5.65	0.24
	Females .	7.78	0.40	5.40	0.43	5.32	0.33
Small intestine . . .	Males . .	31.77	1.59	21.39	1.43	29.28	1.22
	Females .	33.27	1.72	28.90	2.29	23.34	1.43
Cecum and large intestine	Males . .	8.20	0.41	7.09	0.48	10.12	0.42
	Females .	5.42	0.28	8.44	0.67	8.91	0.55
Liver	Males . .	49.73	2.49	32.94	2.21	47.69	1.98
	Females .	59.77	3.09	45.49	3.60	42.87	2.63
Pancreas	Males . .	5.40	0.27	3.34	0.22	3.00	0.12
	Females .	5.02	0.23	3.90	0.31	2.77	0.17
Total	Males . .	182.86	9.15	122.96	8.18	175.38	7.29
	Females .	188.70	9.72	174.60	13.51	125.06	7.72

Lungs and trachea

The average absolute and relative weights of the lungs were higher in the Sudani than in the other two breeds (Table 2). Also, as the Sudani and Pekin drakes have heavier body weights, their lungs were also heavier in absolute and relative weights than the females. However, this was not clear in the case of the Rouen as both sexes had almost the same relative lung's weight. It can be concluded that the size and weight of lungs is associated with body weight rather than either breed or sex, since the heavier are the bodies the larger are the absolute and relative lung's weights. The absolute and relative weight of the trachea was higher in pek in and Rouen than in the Sudani. It seems that the syrinx of the Pekin and Rouen being a part of the trachea is well-developed in these breeds as their voices are higher than in the Sudani. Breed differences were significant in trachea's relative weight (Table 6). The trachea of the drakes exceeded greatly that of the females in all the breeds as they include the syrinx which is larger in males than in females. Sex differences were highly significant in the trachea relative weight in this respect. However, breed and sex differences of the total relative weight of lungs and trachea were not significant (Table 6).

TABLE 2. Average absolute and relative weights of heart, blood and respiratory organs for males and females of different breeds.

Items	Sex	Pekin		Rouen		Srdani	
		Wt.	Rel. Wt.	Wt.	Rel. Wt.	Wt.	Rel. Wt.
Lungs	Males . .	20.73	1.04	12.98	0.87	28.09	1.17
	Females .	13.54	0.70	11.69	0.92	14.93	0.92
Trachea	Males . .	12.06	0.60	9.69	0.65	11.64	0.48
	Females .	6.82	0.35	4.10	0.32	4.77	0.29
Total	Males . .	32.79	1.64	22.67	1.52	39.73	1.65
	Females .	20.36	1.05	15.79	1.24	19.70	1.21
Heart	Males . .	16.99	0.77	12.69	0.85	20.81	0.87
	Females .	16.80	0.86	9.86	0.78	15.26	0.94
Blood	Males . .	88.00	3.29	69.00	4.62	119.00	4.95
	Females .	93.00	4.80	66.00	5.22	84.00	5.16
Total	Males . .	104.09	4.06	81.69	5.47	139.81	5.82
	Females .	109.80	4.66	75.86	6.00	99.26	6.10

The heart and blood

The heart and blood absolute and relative weights were higher in the Sudani than in the Pekin while the Rouen was the lowest (Table 2). It seems that these differences between breeds in this respect are due to the differences in their body weights. However, the females were of higher relative blood and heart weights than the drakes although the females are generally of lighter bodies. It seems that the blood and heart size are more related to the productivity of the bird when sex differences were taken into consideration. Breed and sex differences in heart and blood relative weights were not significant (Table 6).

*Reproductive organs**Males*

The testes of the Pekin and Rouen were larger in absolute and relative weights than those of the Sudani (Table 3). The testes weight of light breeds, normally, exceed that of the heavy breeds (Kamar and Mostageer, 1960). The Sudani drakes being heavier in weight had lower testes size than that of the Pekin and the Rouen, being lighter in weight. Breed differences in testes relative weights were highly significant (Table 6). The vas difference and the absolute and relative weights of the penis followed the same breed differences observed in the tests. Breed differences in the penis relative weights were significant (Table 6). The previous trend is attributed to the increased secretion rate of testosterone from the testes in the light breeds more than in the heavy breeds which stimulates the secondary sexual organs of these breeds.

TABLE 3. Average absolute and relative weights reproductive organs of different breeds.

Items	Pekin		Rouen		Sudani	
	Wt.	Rel. Wt.	W	Rel. Wt.	Wt.	Rel. W.
Testes	44.30	2.2139	39.32	2.6354	11.36	0.4727
Vas differens . .	1.29	0.0667	0.92	0.0617	0.83	0.0345
Penes	5.57	0.2784	4.09	0.2741	4.42	0.1839
Total	51.16	2.5590	44.33	2.9712	16.61	0.6911
Ovary	8.22	0.4246	26.87	2.1258	35.36	2.1733
Oviduct	13.94	0.7200	20.71	1.6384	32.20	1.9791
otal	22.16	1.1446	47.58	3.7642	67.56	4.1524

Females

The ovary and oviduct absolute and relative weights of the Sudani and Rouen ducks were higher than of the Pekins (Table 3). However, breed differences were not, statistically, significant in both ovary and oviduct relative weights (Table 6).

Endocrines

The pituitary absolute and relative weights of the Sudani breed were higher than the Pekins and Rouens. Breed differences were highly significant, while the sex differences were not significant. The average absolute and relative weights of thyroid gland showed relatively no appreciable breed differences. Breed differences in thyroid relative weight were not significant. The ducks exceeded relatively the drakes in thyroid absolute and relative weights. It seems that ducks being on their full laying capacity had more active thyroids than drakes due to increased metabolic and reproductive activities. Sex differences in thyroid relative weights were highly significant. The adrenal absolute weight of the Pekin was higher than those of the other breeds in this study. However, the relative weights of the adrenals was the highest in the Rouen in comparison with that of the Sudani, and the Pekin had also high adrenals relative weight. The adrenal followed the same trend of the other gonads in this respect. Breed differences in adrenal relative weights were highly significant while sex differences were not significant. The absolute and relative weights of the thymus gland of the Rouen breed were higher than those of the Pekin and Sudani breed, (Table 4). Breed differences of thymus relative weights were significant while sex differences were not significant (Table 6).

TABLE 4. Average absolute and relative weight in endocrines of different breeds and sexes.

Items	Sex	Pekin		Rouen		Sudani	
		Wt.	Rel. Wt.	Wt.	Rel. Wt.	Wt.	Rel. Wt.
Pituitary	Males . .	13	0.6	12	0.8	25	1.0
	Females	14	0.7	13	1.0	29	1.8
Thyroid	Males . .	157	7.8	90	6.0	136	5.7
	Females	246	7.5	115	9.1	132	8.1
Adrenal	Males . .	248	12.4	221	14.8	240	10.0
	Females	231	11.9	181	14.3	160	9.8
Thymus	Males . .	462	23.0	830	56.0	570	24.0
	Females	386	20.0	480	38.0	540	33.0

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Miscellaneous organs

The average absolute and relative weights of spleen, shank, feet and feathers showed slight breed differences (Table 5). Breed and sex differences in this respect of the previous organs were not statistically significant (Table 6). Also the average absolute and relative weights of the kidney showed slight breed differences but the differences were not significant. However, females exceeded males in both absolute and relative weights of the kidney. Nevertheless, sex differences in kidneys relative weights were highly significant. The average absolute and relative weights of the head were higher in Sudani than in the Pekin and the Rouen. Also, the heads of the drakes exceeded greatly the of the ducks in this respect. Breed and sex differences in heads relative weights were highly significant. It seems that the Sudani

TABLE 5. Average absolute and relative weights of kidneys, spleen, feather, head duck and feet and cloaca.

Item	Sex	Pekin		Rouen		Sudani	
		Wt.	Rel. Wt.	Wt.	Rel. Wt.	Wt	Rel. Wt
Kidneys	Males	13.00	0.560	8.30	0.556	13.17	0.548
	Females	13.72	0.709	9.79	0.775	13.33	0.821
Spleen	Males	1.85	0.092	3.10	0.208	2.97	0.1234
	Females	2.24	0.116	0.48	0.038	1.45	0.089
Feather	Males	139.0	6.95	101.2	6.78	133.0	5.53
	Females	126.0	6.51	73.0	5.78	114.0	7.01
Head	Males	115.80	5.79	78.40	5.25	129.40	5.38
	Females	104.20	5.38	64.50	5.10	69.30	4.26
Shank and feet	Males	59.00	2.95	33.60	2.25	79.00	3.03
	Females	57.80	2.99	32.40	2.56	46.20	2.03
Cloaca	Males	5.10	0.255	3.75	0.251	6.49	0.270
	Females	6.87	0.355	4.67	0.369	8.83	0.543

breed is characterized with larger head than both the Pekin and Rouen breeds. When sex differences in heads relative weights are concerned normally, males heads are larger in weight and size than females in birds and mammals. There were no breed differences in the relative weight of the cloaca excluding the slight differences in their absolute weights. But the absolute and relative weights of the cloaca were higher in ducks than in drakes. This may be attributed to the deposition of fat in the cloaca of the females than in that of the males, as the cloaca is surrounded by adipose tissue. This increase may be also attributed to the storage and expulsion of the egg from this organ.

TABLE 6. Analysis of variance for the effect of age and sex in the relative weight of body parts and endocrines.

Items	Source of variation	d.f.	Sum of squares	Mean squares	F values
Body	Breed . .	2	2520435.27	1260217.6350	4.80*
	Sex . . .	1	953013.64	953013.6400	3.63*
Digestive system parts	Breed . .	2	22.51	11.2550	6.23**
	Sex . . .	1	34.13	34.1300	18.88**
Respiratory system parts	Breed . .	2	0.15	0.0750	0.03
	Sex . . .	1	1.23	1.2300	0.57
Trachea	Breed . .	2	0.0554	0.0277	3.69*
	Sex . . .	1	0.5230	0.5230	69.73**
Heart	Breed . .	2	0.1166	0.0583	1.98
	Sex . . .	1	0.0108	0.0108	0.37
Blood	Breed . .	2	2.6	1.3000	0.64
	Sex . . .	1	3.9	3.9000	1.92
Testes	Breed . .	2	12.57	6.3750	10.10**
Ponis	Breed . .	2	0.0284	0.0142	3.88*
Ovary	Breed . .	2	9.4100	4.7100	1.91
Oviduct	Breed . .	2	3.8657	1.9329	1.75
Pituitary	Breed . .	2	7678	3739	4.59*
	Sex . . .	1	696	696	0.85

TABLE 6. (Con.)

Items	Source of variation	d.f.	Sum of squares	Mean squares	F values
Thyroidid	Breed . . .	2	5.6	2.8000	1.10
	Sex . . .	1	19.2	19.2000	7.52
Adrenal	Breed . . .	2	111.8	55.9	6.42**
	Sex . . .	1	0.6	0.6	0.07*
Thymas	Breed . . .	2	7478	3739	4.59*
	Sex . . .	1	696	696	0.85
Uropygeal	Breed . . .	2	0.0043	0.0022	1.69
	Sex . . .	1	0.0140	0.0140	1.08
Kidney	Breed . . .	2	0.0020	0.0010	0.05
	Sex . . .	1	0.2448	0.2448	13.38**
Spleen	Breed . . .	2	0.0044	0.0022	0.23
	Sex . . .	1	0.0219	0.0219	2.33
Feathers	Breed . . .	2	1.0000	0.5000	0.11
	Sex . . .	1	0.2000	0.2000	0.05
Head	Breed . . .	2	3.3140	1.6570	0.92**
	Sex . . .	1	3.0080	3.0083	18.01**
Shank and feet . . .	Breed . . .	2	1.3420	0.6710	2.98
	Sex . . .	1	0.0653	0.0653	0.29

Eviscerated carcass

The Sudani had higher eviscerated carcass weight than both breeds (Table 7). However, eviscerated percentage showed no significant breed differences. Sex differences in eviscerated carcass absolute and relative weights were highly significant (Table 8). Males exceeded females in this respect in Rouen and Sudani breeds only, while the Pekin showed no sex differences at this age. At younger ages, the Pekin ducks gave higher eviscerated percentage, than the drakes (Snyder, 1962).

Proportional growth of body parts

The average percentage of breast exceeded that of the other parts in all the breeds followed by the legs percentage, while the wings, back and pelvis were the smaller. The percentage of the breast and wings in the Sudani were higher than that of the Pekin and the Rouen which were similar in this respect

while the legs and back were higher in Pekin and Rouen. The great difference in body conformation between the Sudani and the other breeds in the cause of this difference (Table 7).

TABLE 7. Absolute and relative weights of different meat production characters

Items	Sex	Pekin		Rouen		Sudani	
		Wt.	Rel. Wt.	Wt.	Rel. Wt.	Wt.	Rel. Wt.
Eviscerated	Males . .	1282	64	1018	69	1632	68
	Females	1247	64	776	65	1037	66
Wings meat	Males . .	126	6.3	95	6.4	208	8.7
	Females	114	5.9	68	5.4	120	7.4
Wings bones	Males . .	54	2.7	35	2.3	75	3.1
	Females	49	2.6	36	2.8	44	2.7
Total	Males . .	180	9.0	130	8.7	283	11.8
	Females	163	8.4	103	8.2	164	10.1
Breast meat	Males . .	305	15.2	260	17.4	439	18.3
	Females	289	15.0	175	13.9	306	18.2
Breast bones	Males . .	48	2.4	29	1.9	48	2.0
	Females	44	2.3	25	2.0	29	1.8
Total	Males . .	353	17.6	289	19.4	486	20.3
	Females	334	17.2	200	15.8	335	20.0
Legs meat	Males . .	298	12.4	170	11.4	269	11.2
	Females	260	13.4	140	11.1	162	9.9
Legs bones	Males . .	32	1.6	21	1.4	40	1.7
	Females	31	1.6	20	1.6	22	1.5
Total	Males . .	330	14.0	190	12.8	308	12.8
	Females	290	15.0	160	12.7	184	11.3

TABLE 7 (cont.)

Items	Sex	Pekin		Rouen		Sudani	
		Wt.	Rel. wt.	Wt.	Rel. Wt.	Wt.	Rel. Wt.
Back and pelvis meat	Males . .	127	6.3	97	6.5	134	5.6
	Females	118	6.1	54	4.3	76	4.7
Back and pelvis bones	Males . .	57	2.9	38	2.6	26	2.2
	Females	56	2.9	37	2.9	36	2.2
Total	Males . .	184	9.2	135	9.1	160	8.2
	Females	174	9.0	91	7.2	112	6.9
Total meat	Males . .	856	40.3	622	41.7	1050	44.7
	Females	781	40.3	437	34.6	664	40.2
Total bones	Males . .	191	9.5	123	8.2	188	9.4
	Females	181	9.3	118	9.3	131	8.0
Giblets	Males . .	142	7.1	97	6.5	137	5.8
	Females	151	7.9	116	9.1	115	7.0
Abdominal fat . . .	Males . .	11	0.6	15	0.9	1	0.1
	Females	21	1.5	11	0.6	7	0.7
Edible portions . .	Males . .	1112	55.6	844	56.7	1315	54.2
	Females	1012	52.3	663	52.5	915	56.0

Wings

Breed differences in the percentage of wings meat were highly significant. The absolute and relative weights of the meat in wings of the Sudani were greater than the other breeds (Table 7 and 8). The drakes of the three breeds were of heavier wings meat than ducks. Breed and sex differences in relative weights of wings bones were not significant. Sudani, however, had heavier bones than the other breeds. Accordingly, the total weight of wings of Sudani was higher than Rouen and Pekin. The wings of both sexes were almost the same.

Breast

Breast meat absolute and relative weights of the Sudani were higher than that of the other breeds and the differences were highly significant (Table 7 and 8). Pekin absolute and relative bones weights were the highest and the differences were significant, while sex differences in this respect were not significant. Total breast absolute and relative weights followed the same breed trend observed in wings. However, the drakes exceeded the ducks in their total breast weights.

TABLE 8. Analysis of variance for different meat production characters as influenced by sex and breed.

Items	Source of variation	d.f.	Sum of squares	Mean squares	F value
Body wt.	Breed . . .	2	2520435.27	1260217.6350	4.80*
	Sex . . .	1	953013.64	953013.6400	3.63
Carcass %	Breed . . .	2	12	6.0000	0.48
	Sex . . .	1	98	98.0000	7.91*
Wings meat % . . .	Breed . . .	2	28.10	14.1000	35.94**
	Sex . . .	1	6.50	6.5000	16.57**
Wings bones % . . .	Breed . . .	2	0.80	0.4000	2.01
	Sex . . .	1	0.02	0.2000	0.10
Breast meat % . . .	Breed . . .	2	1.11	0.5550	4.59*
	Sex . . .	1	0.15	0.1500	1.24
Legs meat %	Breed . . .	2	9.83	4.9150	4.20*
	Sex . . .	1	4.25	4.2500	3.64
Legs bones %	Breed . . .	2	0.0330	0.0165	0.31
	Sex . . .	1	0.0033	0.0033	0.06
Back and pelvis meat	Breed . . .	2	4.3600	2.18	1.90
	Sex . . .	1	1.5300	1.53	1.33
Back and pelvis bones %	Breed . . .	2	1.2100	0.6050	5.66**
	Sex . . .	1	0.0033	0.0033	0.03
Giblets %	Breed . . .	2	11.20	5.6000	7.10**
	Sex . . .	1	17.20	17.2000	21.31**
Abdominal fat % . . .	Breed . . .	2	2.00	1.0000	3.25
	Sex . . .	1	1.30	1.3000	4.22*
Edible portions % . . .	Breed . . .	2	6.80	3.4000	0.34
	Sex . . .	1	27.20	27.2000	2.72

Legs

Legs meat absolute and relative weights of the Pekin were higher than that of the Rouen and Sudani, and the differences were significant (Table 7 and 8). No breed differences were observed in legs meat items. Total legs absolute and relative weights followed the same breed differences observed in legs meat.

Back and pelvis

Breed and sex differences in the relative weights of back and pelvis meat were not significant (Table 7 and 8). However, the absolute and relative weights of back and pelvis of the Pekin were higher than those of the Rouen and Sudani which was the lowest. Breed differences in back and pelvis bones relative weights were significant, meanwhile sex differences were not significant. The total weight was heavier in Pekin than the other breeds. However, the percentage of the Rouen was higher than the Sudani but lower than the Pekin. No sex differences were observed in almost the different breeds except for the Sudani.

Total meat

Total meat absolute and relative weights of the Sudani were higher than that of the Pekin and Rouen. The Sudani being heavier and of lower egg production seems to be a meat producing breed more than the other two breeds. Drakes produce significantly more meats than the ducks (Table 7 and 8).

Total bones

Absolute and relative weights of total bones of Pekin relatively exceeded the other two breeds. The ducks of the three breeds were of lighter bones than the drakes (Table 7 and 8).

Giblets

Giblets weights were heavier in Pekin than Rouen and Sudani (Table 7 and 8). Breed differences in giblets relative weights were highly significant. The females were significantly of heavier giblets than males.

Abdominal fat

Although there were appreciable breed differences in abdominal fat and relative weight, yet, breed differences were not significant (Table 7 and 8). Ducks exceeded drakes in both abdominal fat absolute and relative weights. This is due to the female sex hormones.

Edible portion

There were slight and insignificant breed and sex differences in edible portion absolute and relative weights (Table 7 and 8).

Body length, depth and circumference

Breed differences in body length, depth and circumference were highly significant (Table 9 and 10). In general, the Sudani exceeded both the Pekin and the Rouen in body depth and circumference, while the Pekin exceeded the others in body length. The Sudani males had the larger body measurements than both Pekin and Rouen males and the Pekin females had the larger body measurements among the other breeds females. The larger body measurements of Sudani drakes and Pekin ducks indicate

TABLE 9. Breed differences in body measurement (cm)

Items	Breeds		
	Pekin	Rouen	Cadani
<i>Body Length</i>			
Male	28.9	24.4	29.3
Female	30.3	22.3	23.2
<i>Body Depth</i>			
Male	10.6	8.2	11.5
Female	9.6	8.0	9.6
<i>Body circumference</i>			
Male	30.6	22.9	34.5
Female	30.3	24.9	28.9
<i>Shank length</i>			
Male	5.8	5.6	6.1
Female	5.6	4.9	4.9
<i>Tibia length</i>			
Male	10.7	9.5	11.1
Female	10.2	9.0	9.2
<i>Femur length</i>			
Male	6.5	5.7	7.3
Female	6.3	5.8	5.7

the cause of increase of fleshing in the Sudani drakes than in the other breeds drakes and in the Pekin females than in the other breeds ducks. The Rouen was the lowest breed in all these measurements either for males or for females. Sex differences were highly significant (Table (10).

TABLE 10. Analysis of variance for different body measurements

Items	Source of variation	d.f.	Sum of squares	Mean square	f value
Body length	Breed	2	197.68	98.84	22.63**
	Sex	1	38.99	38.99	8.93**
Body depth	Breed	2	34.04	17.02	30.97**
	Sex	1	7.91	7.91	14.39**
Body circumference	Breed	2	185.41	92.71	28.94**
	Sex	1	51.22	51.22	15.99**
Shank length	Breed	2	4.65	2.33	8.59**
	Sex	1	1.01	1.01	3.72
Tibia length	Breed	2	7.42	3.71	1.13
	Sex	1	6.92	6.92	2.10
Femur length	Breed	2	3.33	1.67	5.41*
	Sex	1	2.64	2.64	8.56**

** Highly Significant.

* Significant.

Shank, tibia and femur lengths

Breed differences in shank length were highly significant (Table 9 and 10). Shanks of the Pekin and Sudani were relatively equal in length but they exceeded the Rouen in this respect. Although the Sudani males exceeded the females in shank length, yet sex differences in all the breeds were not significant in this respect. Breed and sex differences in tibia length were not significant. However, breed and sex differences in femur length were highly significant. Also, the trend of variation in femur length between breeds, followed the same like that observed in meat percentage. The drakes exceeded the ducks in femur length and also this was found in meat percentage which ascertains the association between the femur length and fleshing percentage.

Correlation of some body measurements with body and eviscerated carcass weights for various breeds

Body length was correlated significantly with body and eviscerated carcass weights in the Sudani and only with eviscerated carcass weight in the Rouen (Table 11). Accordingly, body growth in the Sudani can be approximately evaluated by measuring body length. Also, the eviscerated carcass weight can be evaluated by this criterion in both Sudani and the Rouen. Body depth was correlated significantly with body and eviscerated carcass weight only in the Pekin. Body circumference was correlated significantly with body and eviscerated carcass weights in both the Pekin and the Sudani. Femur length was correlated significantly with eviscerated carcass weight only in the Sudani. Tibia length was correlated significantly with eviscerated carcass weights in the Rouen and Sudani, while it was correlated significantly with body weight in the Rouen. However, there were no significant correlation between shank length and the two previous characters. When all the breeds were considered, there were significant correlations between all the measurements in this study and the two examined characters except the measurement of shank length. It can be concluded that body depth and circumference in the Pekin, tibia length in the Rouen and body circumference in the Sudani were accurate criteria for evaluating body and eviscerated carcass. In general, body length, body circumference and tibia length were the most superior criteria for evaluating these two characters than the other measurements in the three studied breeds at this age.

TABLE 11. Correlation coefficients between body weight and body carcass weight and some body measurements.

Items	Pekin	Rouen	Sudani	Total
<i>Body length</i>				
× Body weight	0.30	0.021	0.62*	0.77**
× Carcass	0.24	0.770**	0.71	0.75**
<i>Body depth</i>				
× Body weight	0.72*	0.38	0.45	0.76**
× Carcass	0.71*	0.43	0.52	0.72*
<i>Body circumference</i>				
× Body weight	0.68*	0.54	0.81*	0.93**
× Carcass	0.63*	0.37	0.96*	0.89**
<i>Femur length</i>				
× Body weight	0.02	0.11	0.56	0.66*
× Carcass	-0.013	0.23	0.67*	0.66**
<i>Tibia length</i>				
× Body weight	-0.37	0.74*	0.57	0.74**
× Carcass	-0.47	0.76**	0.66*	0.71*
<i>Shank length</i>				
× Body weight	0.32	-0.44	0.55	0.34
× Carcass	0.21	-0.57	0.63*	0.60

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دراسات على الغدد والأعضاء وانتاج اللحم في البطل

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درست جميع غدد وأعضاء الجسم واللحم في البطل البكين والروان والسودانى . وتمت الدراسة على الجهاز الهضمى بأجزاء المختلفة والتنفسى والدورة الدموية والقلب والتناسلى فى الذكر والانثى والغدد الصماء ممثلة فى الغدة النخامية والدرقية والتهيموسية وفوق الكلوية ووجدت أن هناك فروق معنوية بين الثلاث أنواع بالنسبة لوزن هذه الأجزاء المطلق والنسبى .

لم توجد اختلافات معنوية بالنسبة لنسبة التصافى ووزن ونسبة الدهن بين الأنواع بينما وجدت اختلافات معنوية بين نسب وزن الأجنحة والمدر والأرجل والحوض الى وزن الجسم الكلى . اختلفت الأنواع أيضاً بالنسبة لوزن العظم النسبى والمطلق ومقاييس الجسم المختلفة .