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Differential Growth in the Different Organs of Ducks

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FIVE MALES and five females of Pekin ducks at, hatch and of 1, 2, 3, 4, 5, 6, 9 and 12 months of age were used to study the effect of age and sex on the organs of ducks. Body weight increased rapidly until four months of age and no obvious was observed on subsequent ages. Males were heavier than females during all the ages except during the first 3 months age when females were heavier than males. Most of the digestive organs increased rapidly in either absolute or relative weights during the first two to three months of age. Some parts of digestive organs were early maturing whilst others matured later. The females were heavier relative digestive size than the males The lungs and trachea increased in proportional weight until the first four months of age, as their highest proportional weight coincided with the maturity of body weight. The trachea of the male exceeded greatly that of the female mainly on the fifth and sixth months of age as sexual maturity in thought to be reached. The lowest proportional weight of heart and blood was at hatch. At one month of age the highest values were observed for the two items. The drakes were of the lower relative blood and heart weights than the females. There were three phases of testes growth, the first was slight and show increase during the first five months. At the second phase rapid increase occurred, from five to nine months of age, as the sexual maturity is thought to be attained. Constant size was observed in the testes at the third phase onwards. The absolute weight of female reproductive organs showed steady increase until six months of age. At this time sexual maturity seems to be attained at mature ready to rupture follicles were observed in the ovary and rapid increase in the reproductive organs weight at this age and onwards.

The developmental changes that occur in the postnatal life of birds include the increase in size and activity of body organs and tissues according to the acquired activity of such organ or tissue in a certain stage of birds life. Accordingly, the highest developmental period in each organ or tissue occurs at a cettain age of the individual's life. At hatch the central nervous system and the head represents the greater portion of the chicken's body weight than at any later age, also the skeleton and the viscera as a whole account for a higher percentage of the body weight at hatching than in the adult, indicating the early maturity of these parts as compared with the muscular and fatty tissues. Also, at hatch, the legs are better developed than the wings and the depth of the body (Latimr, 1924).

In birds, changes in body proportions occur from hatching to maturity in much the same way as in domestic mammals (Mitchell *et al.*, 1926; Latimer, 1924 and Hammond, 1955).

The relative growth rate of any organ in posthatching life is reversely related to that in the prehatching life. It is possible, to classify the bodyorgans of the bird into three groups according to the stage of development. The early maturing organs, which are physiologically essential during the incubation period develop at a higher rate during the embryonic life than after haching, such as the head, liver, blood and alimentary canal. Organs of locomotion or organs of less vital physiological importance in birds are of intermediate maturing ages such as legs, wings, feathers, lungs, kidneys and pancreas. The late maturing organs are the organs of reproduction and production such as reproductive organs and spleen. It seems that in the early post-hatching life of the bird, the increase in absolute weight is greatly influenced by enviromental factors such as climate and nutrition. In the later stages of life, differential growth is markedly affected by three physiological phenomena: the onset of sexual maturity, the attainment of mature body size and the egg laying capacity of the bird (Hafez, 1955).

Although there are several studies dealing with the developmental changes in body organs and tissues in chickens and turkeys (Jull and Maw, 1923 and Latimer, 1924, Marsden 1940 and Hafez, 1955) yet, no similar studies have been reported on ducks.

Material and Methods

Five individuals from both sexes of Pekin ducks one day old and 1,2 3,4,5,6,9 and 12 months of age were used. Ducks were hatched at one month interval and at the end of the years all the ages were available and the required number summing up 90 individuals were separated from the stock for the study The slaughter test was done for all the individuals from 13th of July to 28th of August. One individual from both sexes from each age was examined each three days. Only the one day old ducklings were all studied at the same time at one day on the 13th of July before the beginning of the test for other ages.

The experimental birds were kept in open pens where half of their area was water pools. Fresh water was supplied to the pools from a water stream. They were housed in wooden houses. Also, the pens were half-qhaded. The ducklings were brooded in portable wooden brooders heated by kerosene lamps when required until 8 weeks of age.

During the brooding period, the ducklings were fed on starting ration (for 4 weeks) and growing (for other 4 weeks) rations similar to those used in chicks rations of 20 and 16% protein respectively. Afterwards, the ducks were fed on a ration containing 23% rice bran, 20% wheat bran, 30% cotton-seed meal, 25% barely, 1 5% calcium carbonate and 0 5% salt. Grain mixture made of equal parts of maize and wheat was given beside the previous ration during the breeding season. Animal protein was supplied in blood or skin milk. Green fodder was supplied as Egyptian clover during winter and chopped maize leaves during summer.

Slaughter test

The birds were weighed early in the morning before feeding. They were sacrificed and weighed to calculated the weight of blood by difference. The birds were plucked and weighed to calculate the weight of feathers by difference. The birds were dissected and the internal organs were sparated and weighed. The different parts of the alimentary canal were emptied and weighed. The liver was weighed with the gall bladder and the pancreas was dissected from the deudenum and weighed. The heart was cut at the base of blood vessels then freed from the adjoining organs and weighed. The male and female reproductive organs, organs such as kidneys, lungs, trachea and spleen were also weighed. The statistical methods for analysis of variance used were those suggested by Snedecor (1957).

Results and Discussion

Body weight

Most of the increase observed in body weight of ducks generally occurred during the first few weeks of age at which this period of rapid growth ends, varies according to breed, locality or season (Horton, 1928 ; Titus, 1928 ; Hamyln *et al.*, 1934 ; Milby and Henderson, 1937; Hund, 1954; Heuser *et al.*, 1951 and Kamar, 1962). In this locality, this period ends at four months of age (Table 1) and (Kamar, 1962). In other localities, this period ceases at nine to eleven weeks of age (Horton, 1928; Titus, 1928; Hamyln *et al.*, 1934; Milby and Henderson, 1937; Hurd, 1954 and Heuser *et al.*, 1961). Age differences in absolute body weight were highly significant (Table 7). Males exceeded females in the absolute body weight allover the ages of the study except the first three months of age. Sex differences were significant in this respect (Table 7).

Digestive organs

Most of the digestive organs increased rapidly in either absolute or relative weight during the first two to three months of age. As far as the relative weight was concerned no obvious increase could be observed after this age (Tables 1 and 2). Meanwhile, the rate of increase in the absolute weight of the digestive organs after four months of age was slightly observed. Some parts of the digestive system tend to mature earlier on the first and second months of age than the others which mature later at the third month of age. The early maturing digestive organs were the crop, eosophagus, proventriculus, deudenum and pancreas, whilst the late maturing ones were the gizzard, small intestine, large intestine, ceacum and liver. It seems that these early maturing organs are more required for the increased digestive activity during the period of rapid growth than the late maturing organs. During the early stages of life when most of food is offered in a fine and nonfiberous form, the ducklings need only the parts which digest the food by the chemical means such as the proventriculus, deudenum and pancreas. Later in life when food contains more grains and fibres, the parts which tend to digest the food by the mechanical means, such as the gizzard, large intestine and ceacum are needed and develop more rapidly. Significant age differences were observed in the total digestive organs, while no sex differences were observed (Table 7).

TABLE 1. Average absolute weights in gramme of the body and digestive organs for males and females at different ages.

Items	Sex	Age in months								
		0	1	2	3	4	5	6	9	12
Body wt.	Male	39	193	479	1005	1737	2125	2407	2398	2001
	Female	38	309	465	1130	1571	1807	2091	2150	1936
Crop and essophagus	Male	0.2	1.9	4.1	7.3	8.3	12.9	14.1	13.7	11.6
	Female	0.2	2.8	3.4	7.3	10.8	8.8	10.3	13.2	11.0
Proventriculus	Male	0.3	1.8	3.0	6.1	8.0	7.3	8.6	8.5	8.5
	Female	0.4	2.4	2.8	6.4	7.6	6.5	7.9	8.7	7.8
Gizzard	Male	1.7	10.5	24.2	47.4	77.4	75.7	79.8	58.3	60.6
	Female	1.7	13.7	23.6	41.6	57.5	61.7	67.9	58.3	59.0
Dudenum	Male	0.2	1.1	3.2	6.1	7.1	7.4	7.2	7.0	7.1
	Female	0.1	2.4	3.0	6.3	7.0	6.2	6.5	7.8	7.8
Small intestine	Male	0.9	7.3	18.3	23.9	35.7	33.8	39.3	36.2	31.8
	Female	1.1	9.0	16.1	25.4	35.0	34.7	35.6	36.1	33.3
Cecum and large intestine	Male	0.2	2.2	4.3	8.6	11.7	14.4	12.1	8.2	8.2
	Female	0.3	2.2	4.8	7.4	10.8	9.9	11.8	15.6	5.4
Liver	Male	1.7	7.6	22.1	37.7	49.1	46.8	75.2	50.7	49.7
	Female	1.6	13.4	20.3	34.5	53.9	37.9	51.1	57.4	59.8
Pancreas	Male	0.2	1.3	2.2	5.3	6.1	6.0	6.2	6.5	5.4
	Female	0.1	1.2	1.0	6.2	6.3	4.8	6.9	6.7	5.0
Total weight	Male	5.3	33.6	81.3	142.4	203.4	09.6	224.5	189.1	182.9
	Female	5.4	47.2	76.0	134.9	188.2	70.5	197.9	203.6	188.7

TABLE 2. **Grams of the digestive organs for each 100 g of males and females at different ages.**

Items	Sex	Age in months								
		0	1	2	3	4	5	6	9	12
Crop and esophagus	Male	0.6	1.0	0.9	0.7	0.5	0.6	0.6	0.6	0.6
	Female	0.5	0.9	0.7	0.6	0.7	0.5	0.5	0.6	0.6
Proventriculus	Male	1.0	0.9	0.6	0.6	0.5	0.3	0.4	0.4	0.4
	Female	0.9	0.8	0.6	0.6	0.5	0.4	0.4	0.4	0.4
Gizzard	Male	4.3	5.4	5.1	4.7	4.5	3.6	3.3	2.4	3.0
	Female	4.3	4.4	5.1	3.7	3.7	3.4	3.3	2.7	3.0
Deudenum	Male	0.4	0.6	0.7	0.6	0.4	0.5	0.3	0.3	0.4
	Female	0.3	0.8	0.6	0.6	0.5	0.3	0.3	0.4	0.4
Small intestine	Male	2.2	3.8	3.8	2 4	2.1	1.6	1.6	1.5	1.5
	Female	2.8	2.9	3.5	2.3	2.2	1.9	1.7	1.7	1.7
Cecum and large	Male	0.5	1.1	0.9	0.9	0.7	0.7	0.5	0.3	0.4
	Female	0.3	0.7	1.0	0.7	0.7	0.6	0.7	0.6	0.3
intestine	Male	4.2	3.9	4.6	3.8	2.8	2.2	2.4	2.1	2.5
Liver	Female	4.2	4.3	4.4	3.1	3.4	2.1	2.4	2.7	3.1
Pancreas	Male	0.4	0.7	0.5	0.5	0.4	0.3	0.3	0.3	0.3
	Female	0.3	0.4	0.4	0.6	0.4	0.3	0.3	0.3	0.2
Total weight	Male	13.7	17.5	17.0	14.2	11.7	9.6	9.3	7.9	9.2
	Female	14.1	15.3	16.0	11.9	12.0	9.5	9.5	9.5	9.7

Lungs and trachea

The lungs increased in absolute and proportional weight until the first four months of age, while no remarkable increase is observed afterwards (Table 3). The lungs reached their mature size with the maturity of body weight then remain constant afterwards. The coordination between the growth of lungs and body is due to the fact that larger bodies need greater respiratory capacity. The proportional weight of the trachea increased gradually up to the third month of age, then kept constant with slight differences on subsequent ages. The period of highest growth in trachea coincided with the period of higher growth of the body. Age differences in respiratory organs was highly significant (Table 7).

TABLE 3. **Average absolute and relative weights in grams of lungs and trachea for males and females at different ages.**

Items	Age in months	Males		Females	
		Wt.	Rel. Wt.	Wt.	Rel.Wt
Lungs	0	0.4	0.9	0.3	0.9
	1	1.9	1.0	2.9	0.9
	2	4.7	1.0	4.8	1.0
	3	10.7	1.1	10.8	0.9
	4	20.1	1.2	17.1	1.1
	5	21.3	1.0	22.9	1.3
	6	24.4	1.0	18.5	0.9
	9	20.8	0.9	19.9	0.9
	12	20.7	1.0	13.5	0.7
Trachea	0	0.1	0.3	0.1	0.2
	1	0.5	0.3	0.8	0.3
	2	2.2	0.5	1.5	0.3
	3	6.7	0.7	4.5	0.4
	4	9.5	0.5	5.0	0.3
	5	14.1	0.7	5.8	0.3
	6	15.1	0.6	5.8	0.3
	9	13.9	0.6	6.2	0.3
	12	12.1	0.6	6.8	0.4
Total	0	0.5	1.2	0.4	1.1
	1	5.5	1.3	5.6	1.7
	2	7.0	1.5	6.2	1.3
	3	17.4	1.7	15.3	1.4
	4	29.5	1.7	22.1	1.4
	5	35.4	1.7	28.6	1.6
	6	39.5	1.6	24.2	1.2
	9	34.7	1.5	26.2	1.2
	12	32.8	1.6	20.4	1.1

Heart and blood

Heart and blood increased gradually in absolute weight until maturity was reached, at four months old, then they kept constant with slight fluctuations (Table 4).

The lowest proportional weights of heart and blood were these at hatch. At one month of age the highest values were observed for the two items then followed by a slight decrease at three months of age and the values were almost the same until the end of the year. Age differences in this respect were highly significant (Table 7). This trend indicates that both heart and blood reach their maximum s ze and volume as early as one month of age and before the attainment of mature body size.

TABLE 4. Average absolute and relative weights in grammes of heart and blood for males and females at differnt ages.

Items	Age in months	Males		Females	
		Wt.	Rel.Wt	Wt.	Rel.Wt
Heart	0	0.3	0.8	0.3	0.9
	1	2.6	1.4	3.4	1.1
	2	4.5	0.9	2.3	0.9
	3	8.0	0.8	9.4	0.8
	4	13.1	0.8	10.3	0.7
	5	16.9	0.8	14.0	0.8
	6	18.4	0.8	16.4	0.8
	9	18.5	0.8	17.4	0.8
	12	17.0	0.9	16.8	0.9
Blood	0	1.3	3.3	1.0	2.6
	1	13.1	6.8	192.2	6.2
	2	14.0	2.9	29.0	6.2
	3	53.0	5.3	65.0	5.8
	4	98.2	5.9	67.4	4.3
	5	113.0	5.3	88.0	4.9
	6	155.0	6.4	109.0	5.2
	9	140.0	5.8	105.0	4.9
	12	88.0	4.4	93.0	4.8
Total	0	1.6	4.1	1.3	3.5
	1	15.7	8.1	22.6	7.3
	2	18.5	3.9	31.3	7.2
	3	61.0	6.1	74.4	6.6
	4	111.3	6.4	77.7	5.0
	5	129.9	6.1	102.0	5.6
	6	143.4	7.2	125.4	6.0
	9	158.5	6.6	122.4	5.7
	12	105.0	5.3	109.8	5.7

Other organs

Kidney

The kidney increased gradually in absolute weight until the ninth month of age, then a slight decline was observed on the twelfth month as the body also decreased in weight (Table 5). The relative weight of the kidney was high at the first four ages, then it was almost constant afterwards. The developmental changes in kidneys relative weight followed the same trend of the live body weight in this respect. Age differences were highly significant in the relative weight of kidney, while the sex differences were not significant (Table 7).

TABLE 5. Average absolute and relative weight in gramme of kidneys, feather, head, hands and feet and cloaca for males and females at different ages.

Items	Sex	Age in months								
		0	1	2	3	4	5	6	9	12
Kidney	Male wt.	0.4	2.2	4.5	8.1	11.2	11.6	14.2	15.9	13.0
	Rel.Wt.	1.0	1.1	0.9	0.8	0.6	0.5	0.6	0.7	0.7
	Female	0.4	3.3	4.4	8.9	10.8	10.4	13.2	15.5	13.7
	Rel.Wt.	1.0	1.1	1.0	0.8	0.7	0.6	0.6	0.7	0.7
Spleen	Male Wt.	0.02	0.40	0.81	2.21	1.13	0.93	0.90	4.10	1.90
	Rel.Wt.	0.05	0.18	0.17	0.22	0.07	0.04	0.04	0.17	0.09
	Female	0.02	0.91	0.97	0.58	0.88	0.84	0.95	1.94	2.24
	Rel.Wt.	0.04	0.29	0.21	0.14	0.06	0.05	0.05	0.09	0.12
Feather	Male Wt.	1.6	7.2	21.0	51.0	51.0	127.0	161.0	185.0	139.0
	Rel.Wt.	4.1	3.6	4.4	5.1	7.3	7.6	8.4	7.7	7.0
	Female	1.8	7.6	17.0	53.0	105.8	143.8	161.0	162.0	126.0
	Rel. Wt.	4.6	2.5	3.7	4.7	6.7	8.0	7.7	7.5	6.5
Head	Male Wt.	6.8	23.6	44.6	69.3	98.8	110.0	128.0	119.4	115.8
	Rel. Wt.	17.3	12.2	9.3	6.9	5.7	5.2	5.3	5.0	5.8
	Female	6.6	32.6	39.2	74.2	73.4	83.2	100.8	104.0	104.2
	Rel. Wt.	16.8	10.5	8.4	6.6	4.7	4.6	4.8	4.8	5.4
Shank and feet	Male Wt.	2.4	13.2	26.6	40.6	41.2	47.8	58.8	70.8	59.0
	Rel. Wt.	6.0	6.8	5.6	4.0	2.4	2.3	2.4	3.0	3.0
	Female	2.2	18.6	24.4	36.6	36.2	36.2	45.3	66.7	57.8
	Rel. Wt.	5.6	6.0	5.3	3.2	2.3	2.0	2.2	3.1	3.0
Cloaca	Male Wt.	0.02	0.7	1.0	2.3	4.3	3.9	3.3	5.7	5.1
	Rel. Wt.	0.1	0.4	0.2	0.2	0.2	0.2	0.1	0.2	0.3
	Female	0.01	0.5	0.9	1.9	4.0	4.0	3.7	5.2	6.9
	Rel. Wt.	0.03	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.4

TABLE 6. Average absolute and relative weights in grammes of male and female reproductive organs.

Items		Age in months								
		0	1	2	3	4	5	6	9	12
Testes	Wt.	0.003	0.01	0.300	0.13	0.26	9.07	45.13	118.58	44.3
	Rel. Wt.	0.008	0.005	0.007	0.01	0.02	0.93	1.87	4.95	42.21
Vas differences	Wt.	0.01	0.02	0.04	0.12	0.13	0.23	0.80	1.00	1.29
	Rel. Wt.	0.03	0.01	0.01	1.01	0.01	0.01	0.03	0.004	0.07
Penis	Wt.	0.02	0.03	0.04	0.05	0.06	0.96	4.25	4.93	5.57
	Rel. Wt.	0.05	0.02	0.01	0.01	0.003	0.05	0.18	0.21	0.28
Total	Wt.	0.03	0.06	0.11	0.30	0.45	10.26	50.18	124.51	51.16
	Rel. Wt.	0.08	0.03	0.02	0.03	0.03	0.38	2.08	5.56	2.56
Ovary	Wt.	0.003	0.07	0.07	0.16	0.23	0.27	1.70	16.64	8.22
	Rel. Wt.	0.007	0.02	0.02	0.01	0.01	0.01	0.08	0.77	0.42
Oviduct	Wt.	0.02	0.08	0.11	0.19	0.22	0.33	7.37	21.47	13.94
	Rel. Wt.	0.03	0.03	0.02	0·02	0.01	0.02	0.55	1.00	0.72
Total	Wt.	0.02	0.15	0.18	0.35	0.45	0.60	9.07	38.11	22.16
	Rel. Wt.	0.06	0.05	0.04	0.03	0.03	0.03	0.43	1.77	1.14

Spleen

Spleen absolute weight increased gradually throughout the period of study. Low relative values of spleen were observed at hatch. During the subsequent three ages, however, the highest values were observed. Almost, the same values were observed afterwards, except the somewhat high relative weights at the ninth and the twelfth months. As the period of rapid growth of the body during the first three months is the most critical and most of mortalities occur during this period, the spleen as the producer of antibodies is at its utmost activity during this period to give the body the required antibodies to maintain the normal viability to pass this period. Age differences in spleen relative weight were highly significant while sex differences were not significant (Table 7).

Feathers

Feathers increase gradually in absolute weight during the whole period of study except for a slight decrease in the last two age stages when the body decreased maturing in weight Table 5). As the feathers are of the intermediate organs (Hafez 1955), their weight followed nearly the same trend of body weight. However, the relative weight of the feathers was nearly constant until the age of three months then increased reaching their maximum relative weight at the subsequent ages. The feathers followed two trends of variation, the first was when the down feathers represented almost 4% of the body weight and the second after the formation of the feathers after three months of age when the feathers represented almost 7.5% of body weight. Age differences of the feathers relative weight were highly significant while sex differences were not significant (Table 7).

Head

The head increased steadily in absolute weight with the advancement of age (Table 5). As the head is physiologically essential during the incubation period, its relative weight was its maximum on the early ages then decreased gradually until it kept almost constant on the maturity of the body weight at four months and onwards. Age and sex differnces in the head relative weights were highly significant (Table 7). In birds, heads of the males exceed that of the females (Standard of perfection, 1953).

The shank and feet

The shank and feet absolute weights followed the same trend of body weight with the advancement of age (Table 5). The relative weight of shank and feet was slightly high at the first two months of age, then kept constant with slight fluctuations onwards. As they are parts of locomotion, they reached their mature weigh and constant relative weight on the early growing period of life. Age differtences were highly significant in this respect, while sex differences were not significant (Table 7).

TABLE 7. **Analysis of variance for the effect of age and sex on the relative weights of boody organs.**

Items	Source of variation	d.f.	Sum of squares	Mean squares	F. value
Body wt.	Age.	8	62878196	7859775	170.71**
	Sex	1	222507	222507	4.883*
	Interaction	8	58.1751	72719	1.58
Digestive organs	Age	8	911	113.0000	41.83**
	Sex	1	4	4.0000	1.47
	Interaction	8	34	4.2500	1.56
Lungs and trachea	Age	8	1.9229	0.2404	3.77**
	Sex	1	1.2259	1.2259	19.12**
	Interaction	8	0.5474	0.0684	1.07
Trachea	Age	8	0.7774	0.0972	16.47**
	Sex	1	1.0824	1.0824	183.46**
	Interaction	8	0.2566	0.0321	5.44
Heart	Age	8	1.5210	0.1901	26.04**
	Sex	1	0.0058	0.0058	0.79
	Interaction	8	0.0808	0.0101	1.38
Blood	Age	8	100	12.5000	3.73**
	Sex	1	3	3.0000	0.90
	Interaction	8	39	4.8750	1.46
Kidney	Age	8	3.0980	0.3873	44.52**
	Sex	1	0.0094	0.0094	1.80
	Interactkion	8	0.0323	0.0040	0.46
Spleen	Age	8	1.5210	0.1901	26.04**
	Sex	1	0.0058	0.0058	0.79**
	Interaction	8	0.0808	0.0101	1.38
Feathers	Age	8	240	30.0	6.67**
	Sex	1	2	2.0	0.44
	Interaction	8	12	1.5	0.33
Head	Age	8	1488	186.000	1395.03**
	Sex	1	8	8.000	6.00**
	Interaction	8	11	1.3750	1.03
Shank and feet	Age	8	233.4	29.1750	85.38**
	Sex	1	1.2	1.2000	3.51
	Interaction	8	2.8	0.3500	1.02
Testes	Age	8	123	15.3750	69.15**
Penis	Penis	8	0.6110	0.0764	42.44**
Ovray	Age	8	2.8633	0.3579	2.63
Oviduct	Age	8	3.0251	0.3781	2.07*

** Highly significant
* Significant

Cloaca

Cloaca followed the same trend of development as body weight except that it increased on the adult ages (Table 5). This later increase is attributed to the deposition of fat more than growth, as it was of higher absolute and relative weight in ducks than drakes, besides it is of more importance to the ducks in the role of laying. The relative weight of the cloaca was too small hatch, as it is of less vital importance in the embryomic life. Then it reached its high and constant relative weight as early as one month of age.

Reproductive organs

Males

Testes increased, gradually, in absolute and relative weight with the advancement of age up to the ninth month, yet a remarkable decline was observed afterwards (Table 6). Age difference in testes relative weights were highly significant (Table 7). It is suggested that there are three phases of testes growth. The first phase is during the first five months when a slight increase in testse size is observed. The second phase extends from the fifth to the ninth month when a rapid increase occurs. In this phase sexual maturity of drakes seems to be reached as a result to the rapid enlargement in testes size as there is a definite association between testes size and sexual maturity (Bennett, 1947 and Kamar, 1959). The third phase occurred afterwards when almost constant size was observed. Also, three phases in testes growth were observed in chickens (Kamar, 1960).

Likewise, the vas difference and the penis almost followed the same trend of increase in absolute weight like that observed in testes except that they continued the ncrease until twelfth months of age. The penis relative weight decreased gradually until the age of four months then it showed a rapid increase on the subsequent ages. Age differences were highly significant in the penis relative weight (Table 7). The relative weight of as differences showed irregular growth until the 12*th* month of age without any trend of changes.

Females

The absolute weight of female reproductive organs showed a steady increase until six monts of age (Table 6). At this time sexual maturity seems to b eattained as mature ready to rupture follicles were observed at this age. Developmental changes in the female reproductive organs were more marked prior to sexual maturity than after its attainment. Although the reproductive organs reached the maximum size on the ninth month of age, however, they were depressed again on the subsequent ages as well as the body weight. The change in reproductive organs after sexual maturity may be attributed to the reproductive phase of the birds due to the breeding season in ducks from laying to rest condition. The relative weight of the reproductive organs showed irregular increase before six moths of age till sexual maturity. However, they showed the same trend of increase like that observed in the absolute weight at the onset of sexual maturity and on the subsequent ages. Age differences in ovary and oviduct weights were highly significant (Table 7).

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دراسة النمو النسبى للأعضاء المختلفة فى البط

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زاد وزن الجسم باستمرار الى عمر ١٢ شهر وكانت الذكور أكبر من الاناث وذلك فى البط البكين • بالنسبة للجهـاز الهضمى كان النمو النسبى فيـه سريعا خلال ٢ ـ ٣ شهر من الأعمار الأولى • بالنسبة للجهاز التنفسى كان النمو النسبى سريعـا خلال الأربعة شهور الأولى من العمر • ونضج الجهـاز الدورى سريعا فى الشهر الأول من العمر وكان النمو النسبى للجهاز التناسلى فى الأنثى سريعـا حتى عمر سـتة شـهور من العمر حيث نضجت جنسـيا ووضعت البيض •