WEIGHTS OF COMPONENT PARTS OF THE INCUBATING EGG OF THE JAPANESE QUAIL *(COTURNIX COTURNIX JAPONICA)*

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ABSTRACT.—Because of its short period of embryonic development and the early age of attaining sexual maturity, the Japanese quail is well suited for use in genetics and in the analysis of factors involved in morphogenesis. Certain measurements of normal conditions are essential, both to an understanding of experimental results, and to the comparison of the Japanese quail with other species of birds. Various components (shell, embryo, albumen, yolk and allantois) were weighed from eggs taken at intervals from the fifth through the fifteenth day of incubation. Results will be presented in tabular and graphic form.

The use of the Japanese quail as a pilot animal for laboratory research in this country is a development of the last decade, although the bird has been known for centuries. Padgett and Ivey of Auburn University, Alabama (1959) and Wilson, Abbott and Abplanalp of the University of California, Davis (1959, 1961) pioneered in this work. In both of these laboratories the interest has been primarily in poultry research from the agricultural point of view. There have also been studies with the emphasis on Wildlife Management (Edwards, 1957; Stanford, 1957; Wetherbee, 1959).

The fact that the incubation period of this quail is only 16 days makes it a valuable and interesting species for embryological investigation. As is usual when a little-known organism is employed for experimental purposes, normal morphological features should be explored at the same time. Thus, various investigators have contributed to our knowledge of normal development that portion which was particularly applicable to their respective projects. For example, see Padgett and Ivey (1960), Zacchei (1961), and Abbott and Craig (1964) for external features, McFarland and Wilson (1965) for brain, Kannankeril and Domm (1964) for ovary, Haffen (1964) for sexual differentiation, and Yasuda and Ariyuki (1966) for teratology.

In the course of a study of albumen utilization in the avian embryo in our laboratory, the weights of the various components of the incubating egg have been obtained, adding one more parameter to the available information on the quail.

MATERIALS AND METHODS

One hundred sixty five *Coturnix* eggs were incubated. Of these, 62, or 37.58%, were found to be fertile. At intervals from the 6th through the 15th day of incubation the entire egg was weighed. The components were then separated and weighed individually on a Mettler

TABLE 1.—Weights of components of incubating Japanese quail egg.

Days Incubated	Number of Eggs	Total Weight		Albumen Weight		Yolk Weight		Embryo Weight	
		Range	Av.	Range	Av.	Range	Av.	Range	Av.
5	2							0.06–0.11	0.09
6	5	8.45–10.92	9.62	1.13–1.85	1.46	5.48–7.09	6.20	0.11–0.32	0.26
6½	3	8.02– 9.02	8.367	1.42–1.89	1.730	4.98–5.26	4.85	0.38–0.46	0.41
7	5	8.48–10.52	9.678	1.59–1.88	1.740	4.61–6.35	5.58	0.50–1.14	0.73
8	2	10.37–11.50	10.935	2.09–2.62	2.36	6.08–6.33	6.21	0.82–0.89	0.86
9	5	8.70– 9.85	9.292	1.68–2.14	1.860	4.55–5.59	5.03	0.79–1.22	1.05
10	2	7.81–10.20	9.005	1.32–1.97	1.65	3.85–5.39	4.62	1.38–1.40	1.39
11	5	8.17– 9.38	8.844	0.22–1.64	0.910	3.33–5.52	4.77	2.14–2.79	2.38
12	9	7.39–10.52	9.047	0.00–0.95	0.42	3.12–5.78	4.25	2.47–3.88	3.14
12½	5	8.07– 9.39	8.734	0.00–0.14	0.09	3.20–4.41	3.96	3.34–3.81	3.60
13	9	6.66–11.12	8.889	0.00–1.40	0.19	2.33–5.82	3.99	2.63–4.72	3.51
14	6	8.09–10.40	9.293	0.00–0.30	0.05	2.77–4.35	3.69	4.00–4.58	4.36
15	4	8.09–10.21	8.833	00	0	1.76–3.22	2.40	5.04–5.70	5.26

balance. The data included weights for the embryo, for the shell with shell membranes, for the albumen in the albumen sac, and for the remaining material which was largely yolk and yolk sac, but which also contained the allantoic and amniotic membranes. Averages for each age, ranges, and percentage of the whole represented by each component were tabulated and plotted.

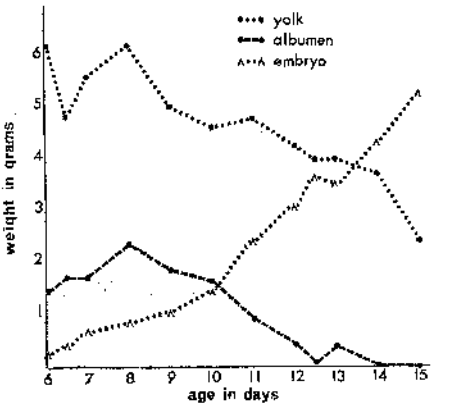
RESULTS

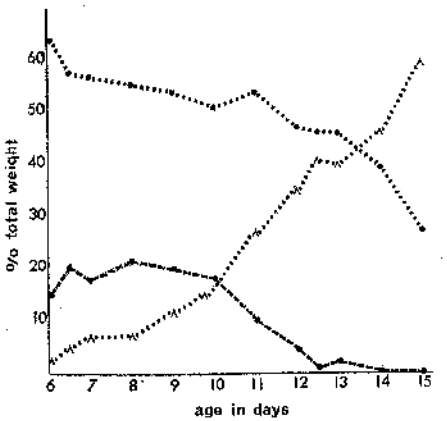
The average weight of the Japanese quail egg from this flock is 9 grams. Of this, the shell and shell membrane comprise one gram. TABLE 1 lists the number of embryos available at ages 6 to 15 days of incubation, the average weights and their ranges of the embryos, the albumen, and of the yolk with attached structures. The average weights are plotted in FIGURE 1 and the percentage of the whole egg which each component represents in FIGURE 2. The two curves closely parallel each other.

The weight of the embryo on the day before it hatches is 5.0 to 5.7 grams, but this is not achieved as a result of a uniform growth rate throughout the incubation period. At about the 10th day a marked increase in the rate of growth begins. This is demonstrated by observation of the changing slope of the curves in both figures, whether plotted as average weights or as percentages. At the same time, there is a pronounced decrease in the weight of the albumen. These weight changes between 10 and 12½ days of incubation appear to be correlated, as is indicated in the discussion of the swallowing of albumen by the embryo. From the 13th to the 15th day little if any albumen remains in the albumen sac, but the embryo continues to increase in weight. There is a nonuniform but continual decrease in the amount of yolk throughout the period under consideration, but it is especially pronounced during the last two days.

DISCUSSION

It has been demonstrated that some species of avian embryos swallow the albumen at a given period during their development (Witschi, 1949; Skrivanek, 1964). This is possible because of the formation of a sero-amniotic duct allowing the passage of albumen into the amniotic cavity (Romanoff, 1952, 1960). In the Japanese quail such a movement of albumen may be taking place during the 10th, 11th, and 12th days of incubation. This then would account for the marked increase in embryonic weight and decrease in





FIGURES 1 AND 2. — 1. Weight in grams of embryo, albumen in albumen sac, and yolk with yolk sac and allantois attached of the incubating quail egg from the 6th through the 15th day. 2. Weight of components of incubating quail egg as a percentage of the total egg weight from the 6th through the 15th day.

weight of albumen that take place at that stage of development. According to Witschi (1949), loss of water from the albumen during incubation, even under optimal conditions of humidity, accounts for part of the loss of both weight and volume of the albumen.

The growth rate of embryos is usually high in early stages, after which the rate declines as birth or hatching approaches. This is the case in the figures presented for the Japanese quail, except for the change between the 10th and 11th days. Again, this weight gain may not represent true growth, but may be further evidence of the swallowing of the albumen at that time.

Shortly before hatching, the yolk sac is withdrawn into the body cavity. The sharp drop in weight of yolk and associated structures between the 14th and 15th days is most likely attributable to this event.

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