AN ATTEMPT TO PRODUCE QUAIL-CHICKEN HYBRIDS

AN ATTEMPT TO PRODUCE QUAIL-CHICKEN HYBRIDS

By

Takatsugu MITSUMOTO

Department of Animal Husbandry, Faculty of Agriculture,
Tohoku University, Sendai, Japan

(Received February 23, 1959)

Introduction

By use of natural or artificial inseminations the attempts to obtain interspecific and intergeneric hydrids in *Phasianidae* have been caried out by many authors. The insemination overcomes some of the isolating mechanisms between species or genera (1, 2, 5, 8, 9, 11, 13, 15). From these attempts the ability of various combinations of gametes to form zygotes and the factors influencing their formation and viability may be studied. With regard to taxonomy, the systematic relationships between birds have recently been demonstrated by cytogenetical studies on those hydrids (16). However, there is no information on the hydrids produced between the quail (*Coturnix coturnix Japonica*) and chicken (*Gallus gallus* var. *domesticus*). The chicken has some similarity in the karyotype of the chromosomes with that of the quail, but shows a great difference in body size from that of the quail (7).

This paper is a preliminary report on whether hybrids can be produced between the quail and the chicken.

Materials and Methods

The materials used consisted of 3 chickens (1 White Leghorn female, 1 Rhodhorn female and 1 Rhode Island Red male) and 7 Japanese Quails (3 females and 4 males). All animals were confirmed to possess normal reproductivity by autocross before being experimented upon.

Mating: Reciprocal mating was accomplished by artificial insemination. Semen was collected immediately before each insemination by the method of Burrows and Quinn (3) from the chicken and by the method of Taji and Ikeda (12) from the quail.

When the semen collected was insufficient in quantity for insemination, the semen of the chicken was diluted to obtain the sufficient volume to inseminate all quails. Semen was diluted by mixing one volume of semen with one volume of Ringer's solution. The quail was inseminated with about 0.3cc

of diluted or undiluted chicken semen and the chicken was inseminated with about 0.5cc of foamy undiluted quail semen. In above cases semen was inseminated into the lumen of the oviduct which was pressed out through the cloaca using the tuberculin injector with catheter at 30 min. before and after the egg laying. At the insemination, the number and activity of spermatozoa were observed microscopically at 37–39°C.

For 40 days hens of chicken and quail were separated from their males and they were confirmed to lay unfertilized eggs. Eggs laid after insemination were kept one or two days at room temperature before incubation, then they were incubated at a temperature of 103–105°F and at a relative humidity of 50–60 per cent. They were tested by candling after five days incubation. Eggs in which a living embryo could be detected were replaced in the incubator, while those appearing infertile were broken and examined for evidence of development by a magnifier. All living embryos were fixed in various stages of development with Allen-Bouin's solution. In each case serial sections were prepared by the usual method and stained with Heidenhain's iron-hematotxylin for the histological and cytological studies.

Results and Discussion

First, to infer the activity of spermatozoa inseminated in the heterogenous oviduct, that of chicken spermatozoa in the quail serum were observed microscopically with 1:1, 3:1 mixture of the medium against semen in each group at 37–39°C.

From Table 1 it is to be noted that the majority of the chicken spermatozoa agglutinated and inactivated in the quail serum up to 20 min., while chicken spermatozoa in homologous serum and Ringer's solution have continued vigorous movements to 60 min..

Table 1. Degree of survival and agglutination of chicken spermatozoa in various media at 37–39°C.

Ratio of dilution	Quail serum				Chicken serum				Ringer's solution			
	1 : 1		1 : 3		1 : 1		1 : 3		1 : 1		1 : 3	
Minutes after being mixed	d.s.	d.a.	d.s.	d.a.	d.s.	d.a.	d.s.	d.a.	d.s.	d.a.	d.s.	d.a.
5	95	±	95	+	100	−	100	−	100	−	100	−
10	50	++	45	++	100	−	100	±	100	±	100	±
20	10	+++	5	+++	100	±	100	±	100	+	100	+
30	5	+++	5	+++	100	±	100	±	95	+	90	++
60	0	+++	0	+++	90	+	90	+	80	++	80	++

Noted : d.s. : degree of survival, d.a. : degree of agglutination.

On the spermatozoa in the heterogenous lumen of the oviduct, Yamane and Egashira (14) reported that hair spermatozoa are inactivated in the lumen

of the uterus of the rabbit before fertilizing. Ryle (10) suggested that normal heteroantibodies may contribute to the difficulties of species hybridization by damaging the heterogenous spermatozoa and by reducing the hybrid embryonic viability. The process inactivated of spermatozoa in heterogenous serum may suggest that the spermatozoa inseminated are immediately inactivated in the lumen of the oviduct of different genera, and like this environmental factor may be of considerable importance for the fertility in the intergeneric hybrids.

Secondly, during 86 days artificial inseminations were performed at least once almost every day from chicken to quail. From three quails, a total of 149 eggs which were assumed to have a good chance of being fertile were incubated and examined for embryonic development. Eight of the 149 eggs showed embryonic development. These embryos attained to various stages of development, *i.e.* 2~3 days (5 embryos), 5 days (2 embryos), and 9~10 days (one embryo). These are listed in terms of equivalent development of the normal quail embryo.

Therefore, in the supplementary examination by means of the same method, during 15 days 11 eggs were obtained from three quails. Four of 11 eggs showed embryonic development and the stages of these embryos were 2~3 days (2 embryos) and 5 days (2 embryos). The fertility in the second series may be higher than that in the primary. The reason for this is not clear. In these experiments, 12 of 159 eggs showed embryonic development. If the eggs incubated were examined microscopically the fertility might be higher.

Next, during 50 days artificial inseminations were performed at least once every day from quail to chicken. The total 86 eggs obtained from two chickens did not show embryonic development. The reason for this failure is not clear, though it may correlate with that of Warren and Scott (13), Owen (8), Ryle and Simonsen (9), Asmunden and Lorenz (1, 2) who observed reciprocal differences in fertility and embryonic viability between intergeneric hybrids. The hybrid embryos that lived for five days were observed from the histological and cytological points of view. There were found no histological differences between hybrid embryos and normal embryos of the quail. In the cytological observation, the chromosome in somatogenesis of the hybrid embryos as compared with that of quail showed anomalous condensation and swelling on account of the reducing activity of the embryo or the incompatibility of nucleus and plasma. The maltipolar division and polysomaty observed in the turkey-chicken hydrids by Kondo (5) were also observed in a few cases of the present investigation. As Figs. 1 and 2 show the homologous chromosomes which may be originated to chicken were observed in the hydrid embryo (6, 7). From these facts it was assumed that its development may not be parthenogenetic. The sex of this embryo was female, and that of the other embryos were not identified.

Plate 1. Explanation of Figures

Eig. 1. Metaphase to somatogenesis of hybrid between quail (♀) ×chicken (♂). ×2000. Heidenhain's iron hematoxylin's stain.

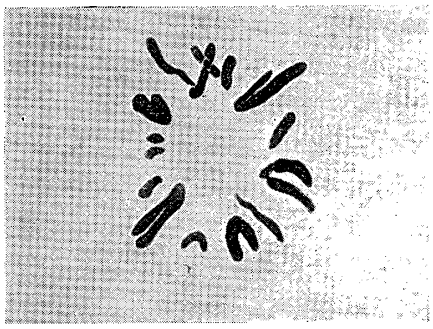

Fig. 2. Chromosomes corresponding to those of Fig. 1. *x* is sex-chromosome.

Fig. 3. Metaphase to somatogenesis of quail. ×2000. Heidenhain's iron-hematoxylin's stain.

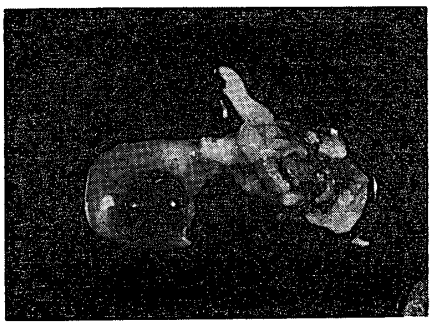

Fig. 4. This hybrid embryo attained to 9-10 days of development. ×2.5.

Summary

Attempts were made to produce quail-chicken hybrids by means of artificial insemination.

In 12 of 159 eggs, embryos were obtained from the quail (♀) ×chicken (♂), but all failed to hatch any of the embryos. Further study is required to determine whether embryo is able to hatch.

In order to infer the environment for the spermatozoa within the oviducts of different genera, serum was employed. The loss of vigour and early death of the spermatozoa within heterogenous serum were compared with that within the homologous serum.

Acknowledgments: I wish to express my thanks to Prof. S. Nishida for his valuable suggestions and constant guidance during the course of the present work.

References

1) Asmundson, V.S. and F.W. Lorenz (1955). Science, **121**, 307.
2) Asmundson, V.S. and F.W. Lorenz (1957). Poult. Sci., **36**, 1323.
3) Burrows, W.H. and J.P. Quinn (1935). Poult Scie., **14**, 253.
4) Fraps, R.M. (1955). Progress in the Physiology of Farm Animals edited by J. Hammond, **2**, p. 734. Butterworths Scientific Pubulications, London.
5) Kondo, K. (1947). Seibutsu, **2**, 110. (in Japanese with English summary).
6) Makino, S. (1954). Cytogenetical Researches of Farm Animal. (in Japanese). p. 74. Maruzen, Tokyo.
7) Oguma, K. (1938). Ann. Zool. Jap., **17**, 612.
8) Owen, R.D. (1941). J. Exp. Zool., **88**, 189.
9) Ryle, M. and M. Simmonsen (1956). Nature, **177**, 437.
10) Ryle, M. (1957). J. Exp. Biol., **34**, 365.
11) Shaklee, W.E. and C.W. Knox (1954). J. Hered., **45**, 183.
12) Taji, K. and K. Ikeda (1956). Mem. Ehime. Univ., VI, **1**, 2.
13) Warren, D.C. and H.M. Scott (1935). J. Hered. **26**, 105.
14) Yamane, J. and T. Egashira (1924). Zool. Mag., **36**, 299. (in Japanese with German summary).
15) Yamashina, Y. (1942). Jap. J. Genet. **18**, 231. (in Japanese with English summary).
16) Yamashina, Y. (1948). New Systematics based on Cytology in Animals. (in Japanese). Hoppô Shuppan, Sapporo.