The Testes of Chicken-Quail Hybrids

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Yoshihiro TAKASHIMA and Yutaka MIZUMA

*Department of Animal Science, Faculty of Agriculture,
Tohoku University, Sendai, Japan*

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Summary

The average testis weight in the F_1 hybrid was much less than that of chicken or Japanese quail. By light microscopy, the hybrid testis were observed to contain only basal spermatogonia in the seminiferous tubules. The section of F_1 testis strongly suggested that F_1 hybrid is completely sterile. It may be presumed that the F_1 sterility is produced by the incompatibility between parental karyotypes and a small amount of gonadotrophin.

A large number of interspecific and intergeneric hybridizations in avian species were listed by Gray (1). The crosses between chicken and Japanese quail have been carried out by some investigators (2–7). In taxonomic classification, Japanese quail and domestic fowl belong to the same family Phasianidae, but to different genus. A few papers have reported that the testis of the chicken-quail hybrid was very small and all F_1 hybrids were entirely sterile (6–7).

The purpose of our research was to observe the testicular tubules and to compare the differences of spermatogenesis in the testis between the parental species and their progeny.

Materials and Methods

The chicken-quail hybrids were obtained by crossing chicken ♂ and Japanese quail ♀. The procedure of hybridization was described previously (5). Each bird was housed in a separate metal cage and kept in a room illuminated by artificial light 14 hrs a day. Three chickens (1–1.5 years old), three Japanese quail (20 weeks old), and six F_1 hybrids (9–12 months old) were killed and their testes were removed for weighting and histological evaluation. After weighting, the gonads were fixed in 10% neutral buffered formalin. They were then embedded in paraffin, sectioned at 10 μm, and stained with routine haematoxylin and eosin. The sections were examined under light microscope and photographed.

Results

The testicular weight of F_1 hybrids had an average of 0.05 g (about 3 mm length), which was much less than that of chicken (20 g) or Japanese quail (2.5 g) (Fig. 1). The cross sections of testes of Japanese quail and F_1 hybrid are shown in Fig. 2. Using light microscopy, it was observed that the testicular section of Japanese quail contained of all phases of spermatogenesis including spermatozoa (Fig. 2A). Active spermatogenesis and abundant spermatozoa were obtained within the seminiferous tubules of adult chicken and Japanese quail. Whereas, the F_1 hybrid testis contained only basal spermatogonia and sertoli cells (Fig. 2B). The germinal epithelium of F_1 hybrid consisted of a single peripheral row of inactive spermatogonia and no spermatids or spermatozoa were observed. The interstitium of F_1 testis was rich in connective tissue elements. There were no bivalents at first metaphase in the spermatogenesis of F_1 testis.

FIG. 1. The testes of chicken-quail F_1 (Arrows indicate the testes)

Table 1 shows the comparision of diameter and frequency per unit area of seminiferous tubules in chickens, Japanese quail, and F_1 hybrids. The average diameter of seminiferous tubules in chickens was $590\pm100\,\mu m$ and that of Japanese quail was $660\pm140\,\mu m$. However, the seminiferous tubules in the F_1 hybrid were $130\pm30\,\mu m$ in average diameter which was narrower than those of

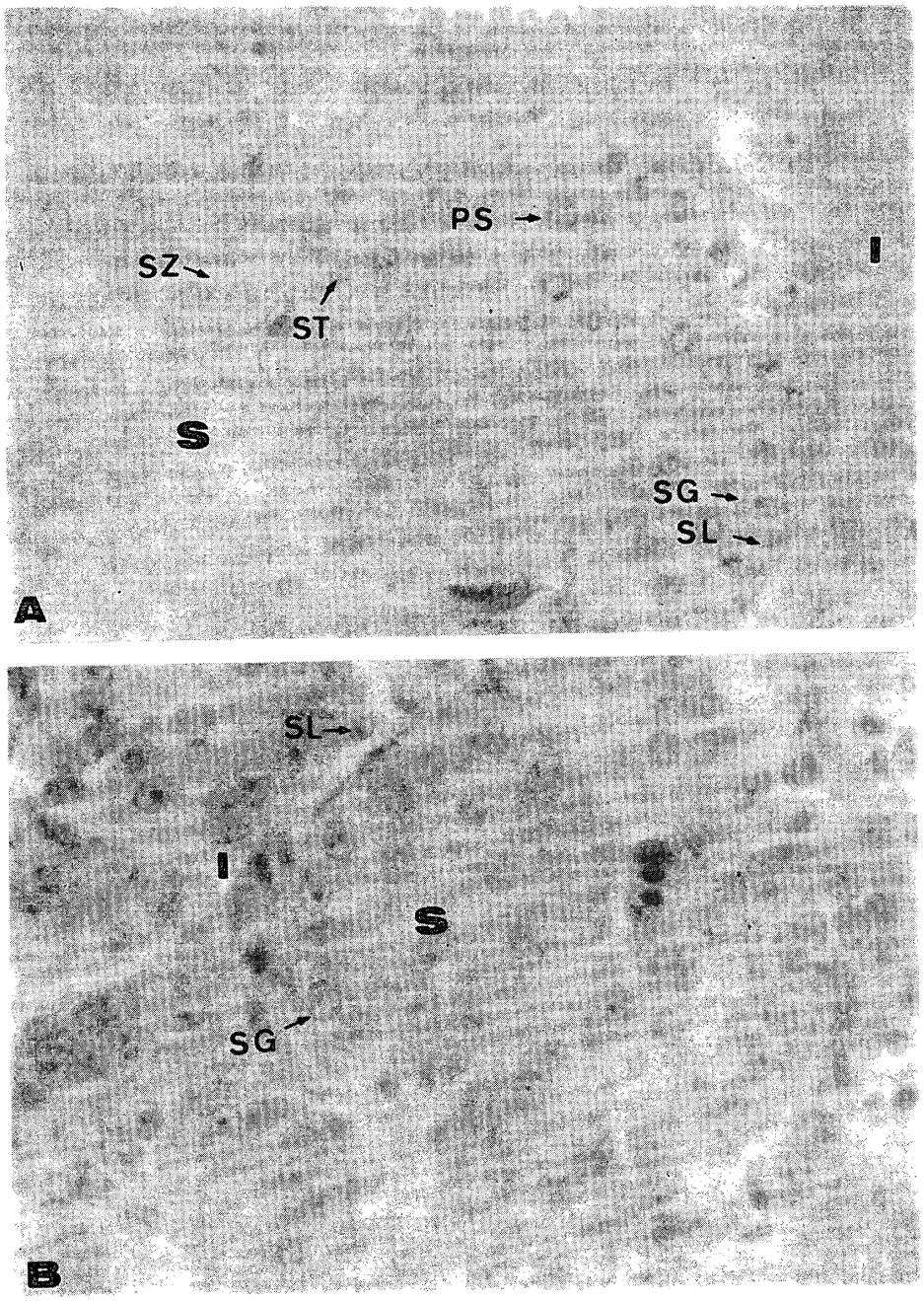

FIG. 2. Testicular section of birds. A: Japanese quail; B: Chicken-quail F_1 (I: Interstitial tissue; S: Seminiferous tubules; SL: Sertoli cells; SG: Spermtogonia; PS: Primary Spermatocytes; ST: Spermatids; SZ: Spermatozoa) ×400.

chicken or Japanese quail. An average of 136.6 seminiferous tubules per unit area was found in F_1 testes, whereas chicken and Japanese quail contained 12.1 and 11.2 respectively. The average diameter and seminiferous tubules per unit area of F_1 hybrid showed significant differences of $P<0.001$ when compared with the chicken and Japanese quail.

TABLE 1. *Average diameter and frequency per unit area (1 mm²) of seminiferous tubules in chickens, Japanese quail, and their hybrids*

Birds	No.	Average diameter	Average frequency
		Means±SE (μm)	Means±SE
Chicken	3	590±100	12.1± 1.7
Japanese quail	3	660±140	11.2± 1.4
Hybrid	6	130± 30***	136.6±15.6***

*** (P<.001)

Discussion

In many cases of interspecific or intergeneric hybridizations, the viable F_1 hybrids tend to exhibit sterility. The reproductive isolating barrier may play an important role in preventing the gene flow between species in animal evolution. However, the subject of the causes of hybrid sterility seems to be very complex, involving cytogenetic and endocrinological aspects.

The chromosome number of chicken and Japanese quail is estimated at 2n= 78 (8–9). Recently, a chromosomal rearrangement between chicken and Japanese quail was found by Ryttman and Tegelström (10). The sterility of F_1 hybrids is based up on the chromosomal incompatibility between parental karyotypes and a failure of synapsis leads to arrest of spermatogenesis at the stage of primary spermatocytes.

On the other hand, the sterility of F_1 hybrid may be regarded as a result of some specific endocrine disturbance. The male steroid hormone, testosterone, plays the principal role in the secondary or extragonadal sex development. Purohit *et al.* reported a low level of sex steroid hormones in the males of chicken-pheasant hybrids (11). Although Yamashina injected two chicken-pheasant male hybrids with male hormones, no significant effect was shown in the activity of their germ cells (12). Loft *et al.* reported that the testicular weight and spermatogenetic condition of House sparrows during the non-breeding season were most advanced in subjects given FSH plus LH injections (13). These data suggested that an early stage in the production of primary spermatocytes in birds may be dependent up on gonadotrophin. It is possible that a higher production level of gonadtrophin is required for the proliferation of spermatogonia and for the advancement of spermatogenesis in the chicken-quail hybrids.

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