◀Research Note▶

Scope for Interspecific Hybridization of Chicken and Quail

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Low fertility and hatchability rate is a hindrance in chicken-quail hybridization. An investigation was undertaken to increase fertility and consequently hatchability of quail eggs inseminated with chicken semen through increasing quantity of semen used and modifying the insemination schedule. Pooled fresh and non-diluted semen from two males each pertaining to three breeds (Chandigar Dark Cornish, Red Cornish and White Plymouth Rock) inseminated into Japanese quails twice a week. From 400 eggs set, seven hybrids (1.74 per cent) hatched on the nineteenth days of incubation. The hybrids obtained weighed 5.3–7.6 g with an average of 6.42 at hatch (1.28 g heavier than quail chicks from the same hatch) and 23.5 g at 7 days of age (10 g heavier than quail chicks). Further examination of non hatched eggs showed 25.29 per cent fertility with 17.74, 1.82, 2.20 and 1.25 per cent very early dead (preincubation and 0–2 days), early dead (3–5 days), death at 6–14 days and death at 15–19 days, respectively. The remarkable achievement of the present study was considerably greater fertility per cent of the eggs obtained from quails inseminated with chicken semen. Higher fertility rate could be attributed to insemination method as 150 μ L neat semen inseminated to each quail hen twice a week and insemination postponed by 12 hours for any bird with an advanced egg in oviduct.

Key words : Interspecific hybridization, quail, chicken, artificial insemination

Introduction

Many reports have appeared in the literature describing hybrids between domestic chicken and quail (*Coturnix coturnix japonica*). It seems to be an interesting cross to make, since these two species belong to the same subfamily (Phasianinae) (Peters, 1934) but to different genera. In spite of differences in methodology, in all reports at disposal, hybridization has been carried out by inseminating chicken semen into quail hens. Mitumoto and Nishida (1958) crossed the Japanese quail with chicken and obtained 5.4 per cent fertility but zero hatchability. Wilcox and Clark (1961) inseminated female Japanese quail with semen from three breeds (White Leghorn, Flithless, and Dark Cornish) weekly and from 2282 eggs set they obtained ten hybrids (0.4%) on the nineteenth days of incubation. Down color of the hybrids from leghorn

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and flightless were yellow and those from the Cornish hybrids were brown. Four hybrids could survive upto 4 to 11 months. Plumage was white in the Leghorn hybrid, white with brown flecks in the two Flightless hybrids, and brown with white spots in the Cornish hybrid.

Haley *et al.* (1966) reported 7 per cent fertility and 1 percent hatchability from weekly inseminated female quails with domestic fowl semen. Reciprocal recurrent selection in quail lines on the basis of fertility when inseminated with domestic fowl semen reached the level where selected lines produced eggs from matings using semen to inseminate domestic fowl.

Mathis and McDougald (1981) inseminated pooled semen from 15 white Leghorns cocks into 40 female Japanese quails (*Coturnix japonica*). Insemination was repeated weekly and collected eggs set in an identical incubator daily. Six chicken-quail hybrids were hatched (from a total of 780 eggs set), after 20 days of incubation. The hybrids weighed 6–7 g at hatch, typical to quail chicks, but they grew up to a size intermediate between quail and chicken (about 500 g). Hybrids were not very hardy and all died within a year.

In all relevant reports at hand, quail hens have been inseminated once and in few cases twice a week with little information concerning time of insemination and the magnitude of the semen used. The present study was formulated to further investigate the possibility of enhancing fertility and hatchability of eggs from artificially inseminated female quails with chicken semen through increasing quantity of semen used and modifying the insemination schedule.

Materials and Methods

Chicken semen was obtained from two males pertaining to three breeds namely Red Cornish (RC), Chandigar Dark Cornish (CDC), and White Plymouth Rock (WPR) with large, medium and small body size, respectively. Neat semen (150 μ L) from each chicken breed was used to inseminate 15 to 17 quail hens at 1 to 2 cm depth of oviduct using a micropipette. Insemination was repeated twice a week. However, by adopting external palpation, care was exercised to avoid insemination of the birds having an advanced egg in oviduct. In case, insemination was postponed by 12 hours. Quail hens were separated from males two weeks before insemination. All attempts failed to obtain semen from male quails and therefore the cross was made in only one direction.

Eggs were collected daily and set once a week and incubated at 99–98°F. No candling was done and all eggs except those which hatched, were broken out and observed macroscopically for embryonic development.

Results

The results of the three consecutive hatches concerned are presented in Table 1. In this study, the number of eggs set for each breed of chicken in each hatch varied from 20 to 58 with total number of 400 eggs. Fertility was highly diverged hatch to hatch and for various chicken breeds ranging from 10.41 to 43.18 per cent with an average of

25.29 per cent.

Further examination of the non-hatched eggs revealed that 17.31, 25.77 and 10.13 per cent (with an average of 17.74 percent pooled over 3 hatches) of the eggs from the first, second and third hatches, respectively, were fertile but the embryos failed to develop beyond 48 hours. These eggs were examined to observe any obvious changes in germinal disk compared to a non-fertile egg. Embryos with obvious growth and distinct eyes were separated as early dead (3–5 days) accented for 1.82 per cent of all the fertile eggs (Figure 1, A). Embryonic death during 6 to 14 days of incubation period was detected for 2.02 per cent of fertile eggs. Three embryos at this stage were downless and showed clear abnormalities such as very big head and eyes with deformed body (Figure 1, B). Approximately one per cent of fertile eggs contained advanced embryos of 14 to 18 weeks of age (Figure 1, C & D). Three of these embryos showed the down color of white or white and red from their parental breed. Five embryos showed the brown down color more resembling to quails. There was no possibility to precisely detect the embryonic death in 1.21 per cent of fertile eggs due to microbial contamination.

Seven chicken-quail hybrids were hatched in all hatches concerned. Two hybrids from the first and second hatch died within an hour. Both hybrids were not being able to stand up. The hybrids from the second hatch weighed 5.3–7.6 g with an average of 6.42 at hatch, 1.28 g heavier than quail chicks with an average of 5.14 g ($n=41$, from the same hatch). Two hybrid chicks survived up to the end of the first week and weighed 23.5 g while the quail chicks from the same hatch weighed 14.17 g. They also died during the second week. All hatched and dead embryos lacked comb.

Fig. 1. Chicken-quail hybrid embryos.

Discussion

The total number of eggs set in this experiment is quite lower than those set in the previous experiments by Wilcox and Clark (1961) and Mathis and McDougald (1981) with 2282 and 782 eggs, respectively. Less number of eggs could affect the likelihood of observing fertile eggs and achieving hatched hybrid chicks.

Seven chicken-quail hybrids were hatched (Table 1) without assistance and on the nineteenth day of incubation. The average hatching time of 19 days was quite uniform, and is intermediate to that of the quail and chicken, which hatch on the seventeenth (Abbott *et al.*, 1960) and twenty-first day of incubation, respectively. The low hatchability of eggs from quail hens inseminated with chicken semen in this study, in agreement with the relevant literature, suggests the two parent species are not more closely related than is the other species of poultry such as guinea and turkey. Mainardi (1959), mainly based on immunological studies gave a similar suggestion.

Low survivability of the hybrids obtained was expected as pioneer researchers verified that the chicken-quail hybrids are not very hardy (Mathis and McDougald, 1981). Wilcox and Clark (1961) attributed the early death of 6 of the 10 hybrids achieved in their study to failure to learn to eat and drink due to rearing of hybrids in isolation. In this study, the hybrids were reared along with quail chicks in battery cages. While there is no reason to prove the Wilcox and Clark (1961) interpretation, on the contrary base, failing in competition with quail chicks crowd ($n=41$) in the same cage as regards feed and water intake could also be a cause of death. It is quite rational to

Table 1. Fertility and hatchability results of eggs from quail hens inseminated with chicken semen

Hatch	Chicken breed ¹	Egg set (No.)	Fertility (%)	Embryonic mortality (% of all eggs)				Hatched chicks
				0-2 d	3-5 d	6-14 d	15-18 d	
1	CRC	31	19.35	16.13	0.00	0.00	3.22	0.00
	RC	48	10.41	6.25	0.00	2.08	0.00	2.08
	WPR	44	34.10	29.54	2.27	0.00	2.27	0.00
	Total	123	22.28	17.31	0.76	0.69	1.83	0.69
2	CRC	53	32.07	20.75	1.89	5.66	1.86	0.00
	RC	44	43.18	27.27	2.27	0.00	0.00	13.60
	WPR	58	29.30	29.30	0.00	0.00	0.00	0.00
	Total	155	34.85	25.77	1.39	1.89	0.62	4.53
3	CRC	49	22.40	12.20	6.12	2.04	2.04	0.00
	RC	20	15.00	5.00	0.00	10.00	0.00	0.00
	WPR	53	18.87	13.20	3.77	0.00	1.88	0.00
	Total	122	18.76	10.13	3.30	4.01	1.31	0.00
Total over 3 hatches		400	25.29	17.74	1.82	2.20	1.25	1.74

¹ CDC=Chandigar Dark Cornish, RC=Red Cornish, WPR=White Plymouth Rock

attribute the mortality to physiological obstacles and abnormalities enforced by hormonal or enzymatic disorders. However, experimental evidence on this is lacking.

The down color of 2 hybrids from White Plymouth Rock was entirely white and the hybrid from Red Cornish was white with red flecks. These observations are in fair concord with those from Wilcox and Clark (1961). They reported that down color of the leghorn and flightless hybrids were yellow and that of the Cornish hybrids was brown resembling their male parents.

The hatchwise (18.76–34.85%) as well as overall fertility (25.29%) is considerably higher than those from all previous reports (Mitsumoto and Nishida, 1958 ; Wilcox and Clark, 1961 ; Haley *et al.*, 1966 and Mathis and McDougald, 1981). The obvious differences in hatchability achieved in three hatches could not be attributed to incubation management as all attempts were made to minimize the probable fluctuations in managerial aspects of incubation. All eggs were set in the same setter and hatcher under identical circumstances. The differences between fertile eggs from insemination of quails with different chicken breeds could be rationally attributed to quality of semen, as the chicken breeds chosen are of distinct genetic makeup, especially for body size. The employment of three different breeds of chicken with comparative large, medium and small body size was intended to overcome the probable fertility failures in a sole breed. There is no explanation for differences in per cent of fertile eggs between hatches from the present study. Nevertheless, obvious declinment in fertility for eggs in the third hatch could raise the doubt of immunological reaction against chicken semen in quail's oviduct. Hybridization between other avian species revealed that there are complicate immunological changes in oviduct of females in response to presence of semen from males belong to other species. Olsen (1972) found that there is a clear trend of reduction in fertility of turkey eggs from consecutive inseminations. He concluded that, turkey hens develop an increasing level of antibody against chicken sperm. Harada and Buss (1981) revealed that turkey semen has some enhancing influence on parthenogenic cell division in chicken eggs. Setting of eggs in more consecutive hatches may clarify such an uncertainty.

The most notable feature of the present study is considerably greater fertility per cent (25.29) of the eggs obtained from quails inseminated with chicken semen despite of low number of eggs set compared to the pervious studies. In the reports of Mitsumoto and Nishida (1958), Wilcox and Clark (1961), Haley *et al.* (1966) the fertility per cent is mentioned as 5.4, 7.8 and 7 per cent, respectively. This success could be due to quantity of semen and insemination method as more fresh and non-diluted semen was quickly used twice a week for each quail hen with care of the time of insemination. By external palpation of the abdominal area, hens with advanced egg (shelled egg) could be recognized and their insemination might be postponed by at least 12 hours when egg is laid. In majority of the relevant reports at hand (Mitsumoto and Nishida, 1958 ; Wilcox and Clark, 1961 ; Haley *et al.*, 1966 and Mathis and McDougald, 1981) insemination of female quails has been carried out weekly where the magnitude of the semen used is not mentioned except the 0.03 ml in Wilcox and Clark (1961) report. The results of the current study show that by increasing the quantity of

the semen used and altering the insemination schedule it is possible to increase the chance of reaching more viable sperms to infundibulum where it directly would influence the fertility rate. More experiments with different doses of semen in a series of consecutive hatches is suggested to clarify the optimum volume of semen required to attain highest rate of fertility and to bear out any possible immunological counteraction between semen and oviduct epithelium.

It was concluded that, there is a substantial scope to increase the fertility of the eggs from quail hens inseminated with chicken semen through implementing more semen and carrying out insemination when advanced egg is not preceded in oviduct.

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