Linkage between Panda Plumage and Albumin Loci in Japanese Quail

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The Japanese quail has 39 pairs of chromosomes¹⁾. Therefore, the chance of detecting autosomal linkages is very small. HOMMA and JINNO²⁾ found the first linkage between the two plumage color loci (*al* or *al*^c and *e*) on the Z chromosome in the Japanese quail. Subsequently, Ito *et al.*³⁾ discovered the first autosomal linkage between extended brown (*E*) and phosphoglucose isomerase (*PGI*) loci and revealed a highly significant sex difference in the recombination value. The present paper reports on the second linkage found on a different autosome in the Japanese quail.

Materials and Methods

An autosomal recessive plumage color mutant, panda (*s*)⁴⁾, was obtained from the Nippon Institute for Biological Science, Kobuchizawa. Linkage relationships were investigated between this plumage locus and five autosomal biochemical marker loci controlling albumin (*Alb*)⁵⁾, haemoglobin (*Hb-1*)⁶⁾, phosphoglucose isomerase (*PGI*)⁷⁾, esterase-D (*Es-D*)⁸⁾ and transferrin (*Tf*)⁹⁾. The following 12 combinations were investigated: *s:Alb*, *s:Hb-1*, *s:PGI*, *s:Es-D*, *s:Tf*, *Alb:Hb-1*, *Alb:PGI*, *Alb:Es-D*, *Alb:Tf*, *Hb-1:Es-D*, *PGI:Es-D* and *Es-D:Tf*. Matings were performed by the testcross with birds of various ages. Genotypes of offspring for the above marker loci were determined after hatching.

Results and Discussion

Table 1 shows the segregation data for parental and recombinant types of offspring from the test matings. Of the 12 combinations examined, highly significant deviations from equality were observed in the combination between panda plumage (*s*) and albumin (*Alb*) loci for both sexes (for males, $\chi^2_1 = 63.780$, $P < 0.01$; and for females, $\chi^2_1 = 87.754$, $P < 0.01$). These results showed a loose linkage between the two

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Table 1. Linkage test among the panda plumage and five biochemical marker loci in the Japanese quail

Combination#	Double heterozygous × homozygous cocks					Double homozygous × heterozygous hens				
	<i>M</i>	<i>P</i>	<i>R</i>	<i>T</i>	χ^2_1	<i>M</i>	<i>P</i>	<i>R</i>	<i>T</i>	χ^2_1
<i>s</i> : <i>Alb</i>	46	344	164	508	63,780**	28	365	152	517	87,754**
<i>s</i> : <i>Hb-1</i>	28	63	59	122	0,131	8	15	16	31	0,032
<i>s</i> : <i>PGI</i>	25	59	76	135	2,141	21	112	109	221	0,041
<i>s</i> : <i>Es-D</i>	18	36	30	66	0,545	10	31	34	65	0,138
<i>s</i> : <i>Tf</i>	9	20	31	51	2,373	6	18	19	37	0,027
<i>Alb</i> : <i>Hb-1</i>	52	96	108	204	0,706	17	45	44	89	0,011
<i>Alb</i> : <i>PGI</i>	57	142	122	264	1,515	20	109	113	222	0,072
<i>Alb</i> : <i>Es-D</i>	64	156	135	291	1,515	21	31	43	74	1,946
<i>Alb</i> : <i>Tf</i>	17	53	46	99	0,495	20	56	40	96	2,667
<i>Hb-1</i> : <i>Es-D</i>	67	136	133	269	0,033	29	59	61	120	0,033
<i>PGI</i> : <i>Es-D</i>	55	133	139	272	0,132	30	67	71	138	0,116
<i>Es-D</i> : <i>Tf</i>	21	52	58	110	0,327	20	50	41	91	0,890

: Names of the gene loci are given in Materials and Methods.

M : Number of matings.

P : Number of parental offspring.

R : Number of recombinant offspring.

T : Total number of offspring.

** : $P < 0.01$.

loci. No significant heterogeneity was revealed in the segregation ratio between sexes ($\chi^2_1 = 0.999$, $0.50 > P > 0.30$), and the recombination values were estimated as $32.3 \pm 2.1\%$ for males and $29.4 \pm 2.0\%$ for females, respectively.

With respect to the relationships between each of the two loci (panda *s* and albumin *Alb*) and the phosphoglucose isomerase (*PGI*) locus belonging to Linkage Group I³⁾, no significant deviations from equality were seen in either segregation ratios between *s* and *PGI* or between *Alb* and *PGI* (see Table 1). Accordingly, these two loci were considered to be located at an autosome other than that corresponding to Linkage Group I involving extended brown plumage (*E*) and phosphoglucose isomerase (*PGI*) loci. Therefore, we propose to name this second linkage Linkage Group II.

Ito *et al.*³⁾ reported a significantly lower recombination value in males for the above two loci belonging to Linkage Group I. However, no significant sex difference in recombination value was seen in the present study. Therefore the cytological event giving rise to the sex difference is thought to occur in the whole chromosome or locally in the specific region of the chromosome corresponding to Linkage Group I.

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References

- 1) TALLURI, M.V. and L. VEGNI, *Chromosoma*, **17** : 264-272. 1965.
- 2) HOMMA, K. and M. JINNO, *Jpn. J. Zootech. Sci.*, **41** : News in the Proceedings of the 57th Meeting of Japanese Society of Zootechnical Science, 13-14. 1970.
- 3) ITO, S., M. KIMURA and I. ISOGAI, *Jpn. J. Zootech. Sci.*, **59** : 801-805. 1988.
- 4) MIZUTANI, M., K. CHINO, H. UMEZAWA and S. KURAMASU, *Exp. Anim.*, **23** : 59-61. 1974.
- 5) HALEY, L.E., *Genetics*, **51** : 983-986. 1965.
- 6) MAEDA, Y., T. HASHIGUCHI and M. TAKETOMI, *Jpn. J. Genet.*, **50** : 265-268. 1975.
- 7) JUNEJA, R.K. and M. WILHELMSSON, *Anim. Blood Grps biochem. Genet.*, **6** : 3-7. 1975.
- 8) WATANABE, S., T. SHIBATA and T. KAWAHARA, *Jpn. Poult. Sci.*, **14** : 66-70. 1977.
- 9) ITO, S., H. ASANO, H. HANAI, K. ISHIKAWA, M. KIMURA and I. ISOGAI, *Anim. Blood Grps biochem. Genet.*, **12** : 145-147. 1981.