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Location on chromosome 6 of the locus for a major liver protein (*Lvp-1*) of the house mouse

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SUMMARY

The linkage of the locus of the major liver protein, *Lvp-1*, has been established on chromosome 6. Testcross data show the following gene order and recombination percentages:

centromere – *Hd* – 7·4 ± 2·4 % – *Lvp-1* – 13·2 ± 3·1 % – *mi*

Data from 39 recombinant inbred strains show complete concordance of the *Lvp-1* locus and the *Lyt-2* locus on chromosome 6.

1. INTRODUCTION

Genetic variation has previously been described in a major liver protein of unknown function with either fast or slow electrophoretic migration in homozygotes and a broad band sometimes seen as two separate bands in heterozygotes (Wilcox, 1972). We now report linkage of the gene for this protein on chromosome 6, using *Lvp-1* to designate the locus, and *Lvp-1*^{a} and *Lvp-1*^{b} for alleles for the fast and slow migrating forms, respectively.

2. METHODS

Electrophoretic migration of the major liver protein on acrylamide gel was measured as previously described (Wilcox, 1972), but with the following modifications. Extracts were prepared from 450 μl liver supernatant by adding 100 μl 8·4 % acetic acid, holding for 30 min at 0 °C, then adding 150 μl 2·5 M-Tris with sufficient acetic acid (7·24 ml glacial acetic acid, 75 ml 3 M-Tris, 7·76 ml H_2O) so that the pH of the final solution was 7·1. The preparation was immediately centrifuged for 10 min at 850 ***g*** at room temperature, and the resulting extract stored frozen until the day of electrophoresis, when an equal volume of citric acid, monohydrate: 15 % sucrose, 1:5 (w/v), plus 6 M-urea was added. Concentration of buffers used for electrode chambers and in preparation of gel was 20 % of that previously employed in order to reduce heating of the gel. Electrophoresis was for 4 hours at 380 volts with a gel containing 7 % Cyanogum-41. Water at 10 °C was circulated through cooling coils of the apparatus.

Mice were from the Jackson Laboratory, Bar Harbor, Maine. Linkage of the *Lvp-1* locus was tested by means of a backcross in which genes coding for 10 isozymes and one inversion on 9 different chromosomes were segregating, and also backcrosses segregating for loci on 8 other autosomes. Once linkage with the *mi* locus on chromosome 6 was apparant, additional linkage data were procured by a backcross segregating for the *Lvp-1* locus and two other loci on chromosome 6 (*Hd* and *mi*). This consisted of crossing males

heterozygous for the three loci to C3HeB/FeJ females. Additional linkage data were obtained from recombinant inbred (RI) strains, derived from progenitor strains that differ at the *Lvp-1* locus. The BXD, BXH, and BXJ RI strains were derived from crosses of the C57BL/6J with DBA/2J, C57BL/6J with C3H/HeJ, and C57BL/6J with SJL/J strains, respectively (Taylor, Bedigian & Meier, 1977). Two mice from each strain were typed in respect to the *Lvp-1* locus. Most of these strains had experienced twenty or more generations of inbreeding.

Table 1. *Alleles transmitted by heterozygous males crossed to C3HeB/FeJ females*

Region of recombination*	Genetic locus			Number
	Hd	*Lvp-1*	*mi*	
None	+	*b*	+	48
	Hd	*a*	*mi*	48
Hd-Lvp-1	+	*a*	*mi*	3
	Hd	*b*	+	6
Lvp-1 – mi	+	*b*	*mi*	11
	Hd	*a*	+	5
				121

* There were no double recombinants.

Table 2. *Classification of RI Strains for* Lvp-1

Type of RI strain	Allele*	Strain no.
BXD	*a*	2, 9, 12, 14, 15, 16, 18, 20, 23, 28, 29, 30, 31, 32
	b	1, 5, 6, 8, 11, 13, 19, 21, 22, 24, 25, 27
BXH	*a*	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 19, 21
	b	None
BXJ	*a*	1
	b	2

* In the progenitor strains, C57BL/6J has the *Lvp-1*^{a} allele, and the others (C3H/HeJ, DBA/2J and SJL/J) the *Lvp-1*^{b} allele.

3. RESULTS AND DISCUSSION

Testcross data are in Table 1, and give the following gene order and recombination percentages:

$$\text{centromere} - Hd - 7{\cdot}4 \pm 2{\cdot}4\,\% - \text{Lvp-}1 - 13{\cdot}2 \pm 3{\cdot}1\,\% - mi$$

Data on classification of RI strains for the *Lvp-1* locus are given in Table 2. Strains from which the BXD and BXH strains were derived also differ at the *Lyt-2* locus on chromosome 6, and classification at this locus has been reported by Tulchin & Taylor (1981) for all these RI strains except BXH 21. The data show complete concordance between the *Lyt-2* and *Lvp-1* loci, and are in essential agreement with the testcross data that place the *Lvp-1* locus approximately 3 cM from *Lyt-2*. Since *Lvp-1* distinguishes between commonly used inbred strains, it should be useful in linkage studies. It is also a valuable marker in the RI strains.

Data have also been procured on classification of strains not previously tested using two mice per strain. They show strains BDP/J, C57BL/10J, C57L/J, SF/CamRk,

SK/CamRk, RIIIS/J, SEA/GnJ, and SEC/1ReJ as well as *M.m. castaneus* as having the *Lvp-1*[a] allele, and CBA/CaJ, DBA/1J, and IS/CamRK the *Lvp-1*[b] allele.

The *Lvp-1* locus is apparently distinct from 8 loci described by Elliott (1979) as responsible for differences between the BALB/cBY and C57BL/6By strains in liver cytosol proteins. Only one of these loci, *Ltn-1*, codes for a polypeptide with molecular weight within the range (10000–20000) reported for the major liver protein (Wilcox, 1972), and this locus is on a different chromosome (number 4) than the *Lvp-1* locus. In addition, there is no difference between the BALB/cJ and C57BL/6J strains at the *Lvp-1* locus, making a difference unlikely between the closely related substrains used by Elliott. The genetic variation at the *Lvp-1* locus, may, however, be responsible for the differences reported by both Lee *et al.* (1979) and Klose & Feller (1981) between the C57BL/6J and DBA/2J strains with two dimensional electrophoresis of liver cytosol, since these strains also differ at the *Lvp-1* locus.

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