THE \textit{t} COMPLEX OF THE MOUSE: CHEMICAL CHARACTERIZATION BY URINARY VOLATILE PROFILES\textsuperscript{1}

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Abstract—Urine samples from C3H congenic house mice (\textit{Mus domesticus}) differing only at the \textit{t} complex were examined by capillary gas chromatography to assess variations in the volatile components that may cause olfactory discrimination between animals bearing \textit{t} lethal and + (wild-type) haplotypes. Urine was collected from 192 males and females varying in age from 1 to 9 months. C3H congenic mice that have the same genetic background at all loci but differed in their \textit{t} complex genotypes: $+/+$, $+/t_\lambda$, $T/t_\lambda$, $T+/+$ were used. No urinary volatiles were unique to the \textit{t} complex. However, significant differences among \textit{t} complex genotypes and among ages occurred for concentrations of 12 male volatiles and four female volatiles. Usually young males (1-2 months of age) had significantly higher concentrations of cyclic enol ethers and ketones than older males (4-9 months of age). Moreover, some urinary volatiles (cyclic enol ethers, one ketone, dehydrobrevicommin, and thiazoline) were excreted in the urine of $T+/+$ and/or $T/t_\lambda$ males in significantly higher concentration than in the urine of $+/+$ males. Age and \textit{t} complex genotype influences on the urinary volatiles in females were observed for four ketones. Gas chromatography of urinary components has the potential to be used in field studies of the \textit{t} complex because the two \textit{t} complex genotypes found in wild populations, $+/+$ and $+/t_\lambda$, had significant differences in concentration for two males volatiles and three female volatiles.

Key Words—Urinary volatiles, house mouse, chemosignals, \textit{T} locus, \textit{t} complex, \textit{Mus domesticus}, capillary gas chromatography.

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INTRODUCTION

The house mouse (*Mus domesticus*) t-complex covers the proximal one-third of chromosome 17 of the mouse, and includes the *T* locus (defined by mutations that express both a recessive lethal phenotype and a dominant tail-length phenotype) as well as the major histocompatibility complex (Bennett, 1975; Klein, 1975; Silver, 1985). The *t* complex in the mouse is a set of dominant and recessive mutations, some of which have profound effects on embryonic development, sperm production and function, genetic recombination, and behavior. Approximately 20–25% of wild mice are heterozygous (+/t) for various recessive *t* haplotypes and 75–80% are homozygous (+/+ ) for the wild-type haplotype (Bennett, 1978; Lenington et al., 1988b). Despite strong selection against *t* haplotypes (prenatal deaths of *t* lethal homozygotes), they are maintained with high frequency because of their association with strong segregation distortion in males (Silver, 1985). When a heterozygous (+/t) male reproduces, about 90–95% of his offspring will carry his *t* haplotype. The frequency of *t* haplotypes in wild population of house mouse is considerably lower than predicted by a deterministic model incorporating selection against homozygotes and segregation distortion (Bruck, 1957).

Factors controlling the frequency of *t* haplotypes in wild populations are not known. One possibility explored by Lenington et al. (1988a), is that social behavior associated with this polymorphism may select against mice bearing *t* haplotypes. They found that both male and female mice can discriminate +/+ from +/t individuals of the opposite sex on the basis of their odor alone and prefer +/+ odors. This odor preference for +/+ over +/t individuals could provide a cue for selective mating that might reduce the frequency of *t* haplotypes in wild populations (Lenington, 1983; Lenington et al., 1988a,b; Drickamer and Lenington, 1987).

Mouse urine is a rich source of specific olfactory messengers (Novotny et al., 1991), which include another example of "genetic signaling," also on chromosome 17, the major histocompatibility complex mating preference (Yamazaki et al., 1978, 1979). The purpose of our study was to examine the urinary volatile profiles of male and female mice that differed only in genotype at the *t* complex.

METHODS AND MATERIALS

The mice used in this study were F1, F2, and F3 progeny derived from C3H congenic laboratory animals, heterozygous for a dominant marker allele (*T*) at the *T* locus. Congenic mice have the same genetic background at all loci and differ only at the *t* complex. This allows us to distinguish if differences in urinary volatiles are the result of differences among *t* complex genotypes. The