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Selection for increased alcohol tolerance in Drosophila melanogaster in relation with the Adh locus.

It has repeatedly been shown that the alcohol dehydrogenase (Adh) locus in Drosophila melanogaster is of great importance in the detoxification of ethanol and other alcohols (review in VanDelden 1982). Survival of the Adh genotypes on alcohols is positively correlated with in vitro ADH activity.

Experiments were designed to study the effects of long term exposure of D.melanogaster strains, either homozygous for the Adh^S or the Adh^F allele to particular alcohols. For this purpose Adh^S and Adh^F strains, originally derived from the Groningen population, were kept for many generations on ethanol supplemented food (18 vol.%), on propanol supplemented (3.5%) on hexanol supplemented food (0.525%) and on regular food without alcohol. The procedure for founding and maintaining these strains was described in Van Delden and Kamping (1983).

The aim of the experiment was to determine whether the different strains kept on various alcohols had developed resistance to propanol. At the time of the test the strains had been exposed to their particular alcohols for many generations: 70 generations for the ethanol strains SSE and FFE; 90 generations for the propanol strains SSP and FFP; 90 generations for the hexanol strains SSH and FFH; while the control strains SSC and FFC had been kept for 140 generations. Tolerance to propanol was determined in mortality tests on adult flies (5 to 9 days old; sexes separated). Mortality was measured on control food and on four different propanol concentrations (3.5, 4.5, 5.5 and 6.5 vol.%). There were 10 replicates, each with 10 flies, per sex and per concentration. Mortality was determined after three days of exposure to propanol.

The results are given in Table 1. It appears that both the SSP and FFP strains (previously exposed to propanol) are considerably more resistant to propanol than the controls SSC and FFC. Especially FFP females are highly resistant to propanol: an increase in LD50 exceeding 400% is found. But also in the ethanol and hexanol strains a significant increase in resistance to propanol is observed. It was previously found that these strains had become resistant to their "own" alcohol. Apparently the genetic changes in the ethanol and hexanol strains, both SS and FF, also provide higher tolerance to an alcohol which the strains never experienced. This suggest a general mechanism in the development of tolerance to alcohol stress.

Table 1. Median lethal doses (LD50) of propanol for adult survival of control, ethanol, propanol and hexanol strains (95% confidence limits given in parentheses).

Strains	Females	Males
SSC	6.2 (5.9-6.5)	4.5 (4.2-4.7)
FFC	5.9 (5.7-6.2)	5.5 (5.3-5.8)
SSE	12.0 (10.2-13.7)	8.1 (7.4-9.0)
FFE	6.6 (6.2-7.0)	6.7 (6.3-7.2)
SSP	11.2 (9.7-12.9)	6.3 (6.0-6.6)
FFP	33.3 (26.0-42.6)	8.3 (7.7-8.9)
SSH	15.4 (13.2-17.8)	7.6 (7.1-8.2)
FFH	8.5 (7.7-9.4)	9.8 (8.4-11.5)

Concerning the role of ADH in the adaptation to propanol it is striking that the absolute height of in vitro ADH activity cannot be the main factor responsible for increased tolerance to propanol as both the SSE, SSP and SSH strains are considerably more resistant to propanol than the FFC strain, though the latter has a much higher in vitro ADH activity. These results are in agreement with earlier obtained results (Van Delden & Kamping 1983).

References: VanDelden, W. 1982, Evol.Biol. 15:187-222; VanDelden,W. & A.Kamping 1983, Ent.exp.&appl. 33:97-102.