

Temperature Sensitivity and Sensitization by Ethanol

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Electrophysiological impulse recordings from hypothalamic neurons in rat brain slices elucidated highly nonlinear interactions between different stimuli, including neural sensitization [1]. Particular sensitization phenomena have been observed when alcohol (EtOH) was applied during slow sinusoidal temperature changes [2]. The figure shows a typical example: EtOH application induces a strong initial firing rate with succeeding transient inhibition which is followed by spontaneous recovery with drastically enhanced temperature sensitivity – from about 2Hz to about 10 Hz frequency modulation with the same temperature stimulus of 4° C amplitude. Remarkably, enhanced temperature sensitivity mainly results from stronger inhibition during cooling while the firing rate during warming is slightly enhanced. This indicates that alcohol exerts opposite effects at high and low temperatures.

For a better understanding of such a particular sensitisation phenomenon we have made use of Hodgkin-Huxley type computer modeling studies. Our model includes two opposite mechanisms of nonlinear temperature and alcohol sensitivity: 1) a cold-sensitive current I_{cold} and 2) a warm-sensitive current I_{warm} , which are both sensitized by alcohol by means of changing the slope of their temperature dependent activation curves.

More detailed insights into the corresponding ion channels are expected from a combination of these modeling studies with patch clamp-experiments.

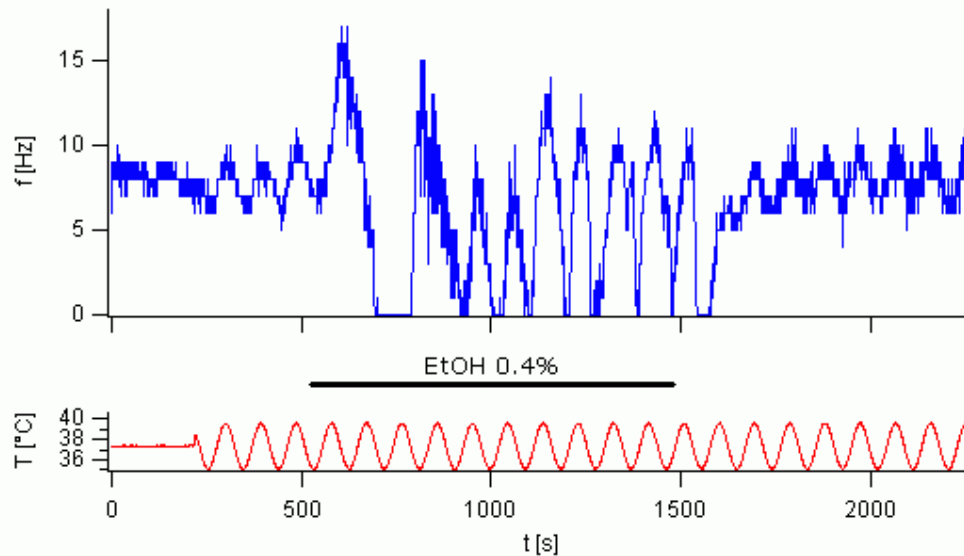


Figure: Firing rate (f , blue curve) of impulse discharges recorded from single hypothalamic neurons during slow sinusoidal temperature changes (T , red curve) with transient application of alcohol (EtOH) as indicated by the black bar. Figure modified from ref. [2].

References:

- [1] Dewald M, Braun HA, Huber MT, Zwingmann D, Roth J, Voigt K (2002) Interactions of temperature and angiotensin II in paraventricular neurons of rats in vitro. *Pflügers Arch* 444: 117-125.
- [2] Wollweber BT, Schneider H, Voigt K, Braun HA (2004) Ethanol effects on temperature-sensitive hypothalamic neurons in rat brain slices. *J Thermal Biol* 29: 345-350.

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