

Topic: A. Basic Sleep Science - 5. Physiology

Track: Track 4: Sleep mechanisms and functions

Title: Sleep-like behaviour in a sensitive plant (*Mimosa Pudica*)

Author(s): S. Varani, T. Banfi, R. Biancotti, P. Orsini, L. Rocchi, P. d'Ascanio, U. Faraguna

Institute(s): University of Pisa, Pisa, Italy

Text: Background: Sleep is behaviorally acknowledged as a vigilance state characterized by a) a species-specific posture b) behavioral quiescence c) an elevated arousal threshold d) state reversibility with stimulation (Campbell and Tobler, 1984). Although this definition has been confined to animals, all features of sleep could be applied to other organisms lacking a nervous system but still capable of movements, and responsive to external stimuli. In this perspective, we investigated whether *Mimosa Pudica*, also called Sensitive Plant, does fulfill the criteria for sleep. The behavior of *M. Pudica* is characterized by nastic movements in response to light, thermic and mechanical stimuli. Therefore, it seems a valid candidate to formally test the presence of a sleep-like behavior.

Methods and Materials: 23 adult plants (1 year old) were kept indoor in constant temperature and humidity conditions, under a 12h light/12h dark cycle (lights on at 8 a.m.). We constantly recorded the spontaneous movements of *M. Pudica* (n=10) under continuous video-monitoring. Spontaneous movements were quantified by i) a local manual index of single petiole tracking and ii) a global automatic movement index. In another set of experiments, the response threshold to mechanical stimuli was tested via controlled air-puffs. For each plant (n=14) we set 3 different pressure levels (low, medium and high) and visually scored the extent of the induced movement.

Results: There was a significant difference between spontaneous movements during the light (16.181 ± 1.459 a.u.) and the dark phase (13.029 ± 0.741 a.u., $p=0.004$, Mann-Whitney), when the plant took a typical posture (upright state) raising its petioles to the greatest extent. During this phase the spontaneous movements were at their lowest value.

In parallel, the plant motor response to air puffs slowly decreased during the day. From 8 a.m. to 2 p.m. *M. Pudica* showed its peak responsiveness (1.876 ± 0.187 SE), while at night (12 a.m.-8 a.m.) its lowest (0.421 ± 0.104 SE), revealing a significant difference in responsiveness between the night and every other period ($p < 0.05$, Kruskal-Wallis). Moreover, in a subset of experiments (n=7) we observed an increased response threshold at night (12 a.m.-4 a.m.) as compared to the morning (8 a.m.-2 p.m.; 1.5 ± 0.4 versus 1.1 ± 0.14 a.u., $p=0.045$, paired t-test).

Conclusion: In *M. Pudica* two of the criteria necessary to define sleep as a behavioral state are satisfied.