The use of torpor by the Siberian hamster in the thermal gradient system.

Małgorzata Jefimow, Marika Tomaszewska, Michał S. Wojciechowski
N. Copernicus University, Institute of General and Molecular Biology, Department of Animal Physiology, ul. Gagarina 9, 87-100 Toruń, Poland.

Introduction:

Cold and food restriction facilitate torpor use; in cold-acclimated and/or food-restricted Siberian hamsters torpor bouts are longer and deeper than in fed animals kept under short photoperiod but relatively high ambient temperature.

Hypothesis:

Availability of high ambient temperature (T_a) in the environment modifies an effect of food restriction on torpor use.

Results:

• The mean **torpor bout duration** in fed hamsters in the TGS was 152 ± 80 min (vs. ~12 h with T_b = 17 °C in a climate chamber; Fig. 1).

Methods:

Siberian hamsters were acclimated to cold (T_a =10 °C) and short photoperiod (L8:D16) for 7 months. Body temperature (T_b) was recorded continuously with mini loggers (iBBat 22L, Alpha Mach Inc., Canada) implanted intraperitoneally.

After ~3 months of acclimation we started experiments in the thermal gradient system (TGS) where animals could select T_a's freely within the range from 5 to 45 °C. During experiments, T_b and selected T_a were recorded simultaneously and continuously. Each hamster was placed in the TGS for seven days. After four days, food was removed but water was still freely available.

The results are presented as mean ± SD.

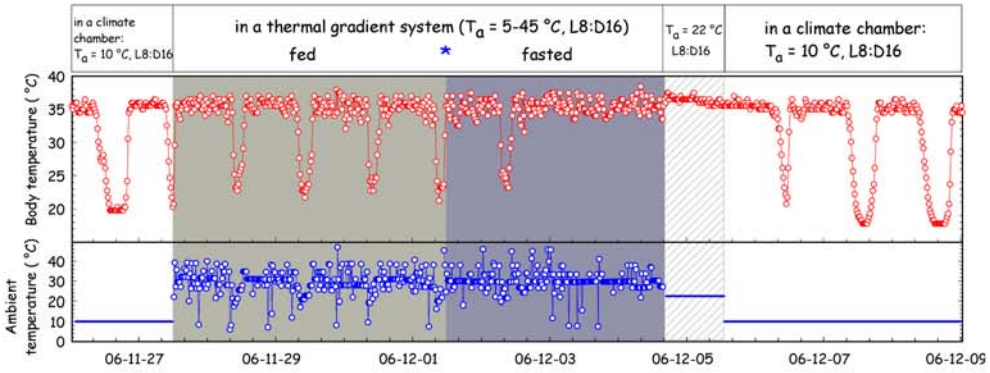

Fig. 1. Time-course of T_b changes in one hamster over 13 days: two days before experiment in the thermal gradient system, one-week experiment in TGS (4-day fed, 3-day fasted), one day under L8:D16 and T_a of 22 °C and next three days in a climate chamber. Lower panel: T_a's during acclimation and T_a's selection in the thermal gradient system.

• Fasted hamsters entered torpor only within the first day after food removal and later were normothermic. However, torpor episodes were shorter than in fed animals (115 ± 69 min).

• After 3-day fasting in the TGS **body mass** decreased by 23.6 %, to 22.3 ± 4.3 g.

• **Minimum** T_b during torpor (24.6 °C) was similar in fed and fasted hamsters but T_a **selected** for torpor was higher in fasted than in fed animals. As a result, the gradient between T_b and T_a in fasted hamsters was reduced (Fig. 2).

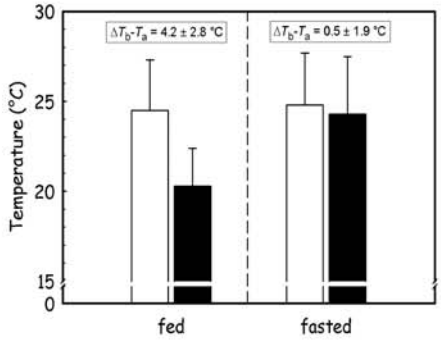

Fig. 2. Minimum body temperature (open bars) and T_a selected for torpor (black bars) in fed and fasted Siberian hamsters in the thermal gradient system.

• Hamsters not only actively selected T_a during rewarming phase (passive warming) but also selected gradually lower T_a's during the entrance phase (Fig. 3).

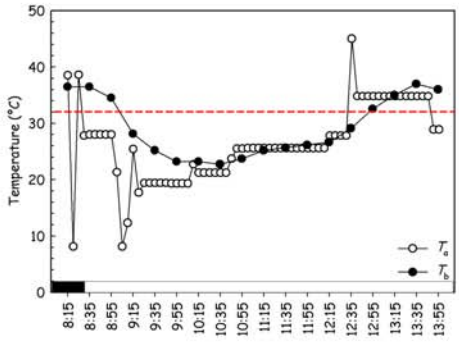

Fig. 3. An example of torpor bout recorded in a fed hamster in the thermal gradient system. Active selection of proper T_a is apparent.

Conclusions:

• Hamsters shorten torpor bouts when high T_a is available in the environment.

• Hamsters actively select T_a's which facilitates entrance and arousal phases of torpor.

• When body energy reserves are low hamsters abandon torpor use because the cost of arousal would surpass the benefits of low T_b.

• Selection of higher T_a by fasted and normothermic hamsters can ensure energy savings.