A C T A   T H E R I O L O G I C A

VOL. 20, 23: 297—300.   June, 1975

Fragmenta Theriologica

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THERMOREGULATION IN COMMON HAMSTER

TERMOREGULACJA U CHOMIKÓW

In common hamster (*Cricetus cricetus* Linnaeus, 1758) the resting metabolic rate was measured in the ambient temperature ranging from −12 to +35°C. The thermoneutral zone of these animals lies between 27.5 and 30.0°C. Metabolic intensity between 27.5 and 12.0°C amounts to 5.33%/°C, while the dependence of *RMR* on temperature within this range can be expressed by the equation: $M(\text{ccm } O_2/\text{g hr}) = 1.97 - 0.07\,X$

Hamsters belong to animals of hardly explored physiology, as regards the active periods (Malan & Hildwein, 1969; Erdakov, 1972). So far, chiefly the period of hibernation represented the subject of interest of researchers (Kayser, 1935, 1961).

This time, experiments were carried out on hamsters *Cricetus cricetus* (Linnaeus, 1758), captured in the Wisła Valley, some 80 km east of Kraków. Prior to testing, the animals were housed for about three weeks in a laboratory (at 20°C and a 12*L* and 12*D*); they were provided with almost natural food.

Measurements of the resting metabolism rate (*RMR*) were carried out with a modified, Kalabukhov and Skvortzov respirometer, in 10 l chambers, using 10 to 20 animals for each temperature (Table 1). The *RMR* was measured at ambient temperatures (T_A) ranging between −10 and +35°C, a intervals of 5°C; and additionally at −12; 27.5; and 32.5°C. In all, 210 measurements were taken from 30 hamsters. Volume of the oxygen consumption is expressed in ml/g hr and as kcal/kg$^{0.75}$ day, on assuming the respiratory quotient (*RQ*) to be 0.8.

The thermoregulation curve is shown in Fig. 1. The range of the thermoneutral zone is fairly narrow, the lower critical temperature falling in 27.5 and higher critical temperature in 30.0°C. The metabolic level of the common hamster is lower, at both T_A, than the corresponding level in many other species of mammals, yet similar to that in the golden hamster (*Mesocricetus auratus* (Waterhouse) (Tęgowska & Gębczyński, 1975). In both directions away from the thermoneutral zone the metabolic rate clearly goes upwards: by 52% until 35°C and by as much as 217% down to −12°C. Intensity of heat production for thermoregulation within a range covering low values of T_A amounts on the average to 5.33%/°C, though it differs considerably within the individual fragments of the the thermoregulation curve (Table 1). The intensity of thermoregulation at the extreme T_A, is very high; at lowest temperatures it goes beyond 8%/°C, while at physiologically high tempe-

Table 1

Resting metabolic rate of hamster at different ambient temperatures.

Ambient temp., °C	No. of animals	Body wt., g ± S. D.	Oxygen consumption ml/g hr ± S. D.	CV, %	kcal/kg$^{0.75}$ day	Intensity of thermoregulation, %/°C
−12.0	10	324.9 ± 81.0	2.00 ± 0.63	31.5	173.8	8.39
−5.0	10	324.9 ± 81.0	1.63 ± 0.50	30.6	141.6	3.17
−2.0	10	322.6 ± 82.2	1.57 ± 0.30	19.1	136.1	5.60
0.0	20	379.7 ± 110.9	1.50 ± 0.51	34.0	135.6	7.60
5.0	20	374.3 ± 84.8	1.26 ± 0.39	30.9	113.4	3.82
10.0	20	389.9 ± 112.9	1.14 ± 0.33	28.9	103.7	4.12
15.0	20	368.7 ± 88.1	1.01 ± 0.30	29.7	90.5	2.22
20.0	20	334.3 ± 99.4	0.94 ± 0.36	38.2	82.1	6.00
25.0	20	376.8 ± 101.1	0.75 ± 0.22	29.3	67.7	7.68
27.5	10	336.7 ± 103.9	0.63 ± 0.32	50.7	55.1	0.60
30.0	20	373.5 ± 102.3	0.64 ± 0.24	37.5	57.5	8.91
32.5	10	331.1 ± 105.3	0.78 ± 0.32	41.0	67.9	11.41
35.0	20	381.6 ± 47.9	0.98 ± 0.41	42.7	86.8	

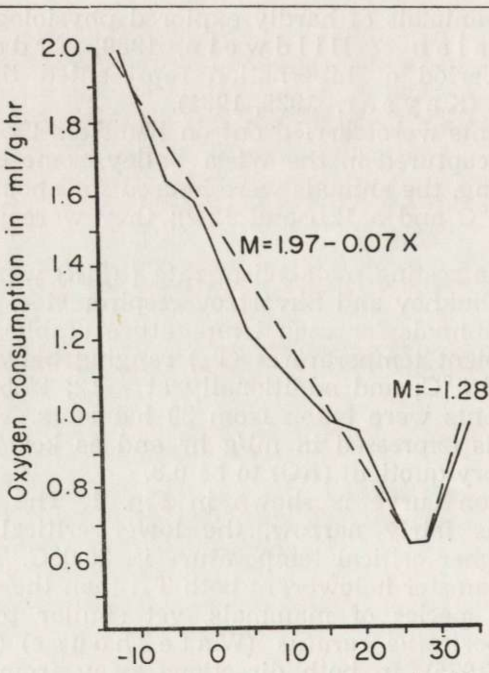

Fig. 1. Oxygen consumption (*RMR*) in common hamster at different ambient temperatures.
Solid line — empirical data, broken line — data calculated from regression equation.

ratures it surpasses even 11%/°C (Table 1). The coefficients of variability of oxygen consumption are rather high (average 34.3%).

Regression equations which express the dependence of metabolism on temperature, both above and below the thermoneutral zone, are given in Fig. 1. Lines plotted from the above equations deviate only slightly from the curve obtained empirically (Fig. 1).

In view of the considerable difference in body weight of animals belonging to groups tested at the different temperatures T_A (from about 220 to 600 g) — the oxygen consumed was expressed per metabolic units of body weight (Table 1).

Differences in body weights made in possible to calculate the regression equations expressing the dependence of the *RMR* on the body weight in hamsters. Calculations of this type were carried out for T_A: −12; 0; 27.5; 30; and 35°C (Table 2). Exclusively at temperature of −12 and 27.5°C has there been noticed a more considerable dependence of the metabolism on body weight.

Studies on thermoregulation in hamsters have been conducted by Kayser (1955, 1961) within a similar range of T_A. In his experiments, the thermoneutral zone lay at a T_A of about 22.5°C, hence much lower

Table 2

Relationship between body weight (in g) and metabolic rate (in ml O_2/hr) of hamsters at different temperatures.

Ambient temp., °C	No. of hamsters	Regression equations
−12.0	10	$M=36.5\ W^{-0.51}$
0.0	20	$M=16.2\ W^{-0.01}$
27.5	10	$M=44.7\ W^{-0.18}$
30.0	20	$M=16.0\ W^{-0.02}$
35.0	20	$M=61.2\ W^{-0.03}$

than was found in the present work. Intensity of thermoregulation running from this zone to zero °C works out, after Kayser, at about 6.2%/°C; while in this paper, within the same T_A range, it is somewhat lower, *viz.* 5.0%/°C. On the other hand, a great divergence occurs in the data on intensity of thermoregulation within the range from 0 to −10°C. Kayser (1955) obtained a very low rate of 1.4%/°C, whereas in our experiments it was 5%/°C.

The summer and autumn means of thermoregulation intensity of *Arvicola terrestris* L. (body wt. 100 g), both within the range of low and of high temperatures (Drożdż *et al.*, 1971), works out in hamster all through the experimental period at a higher level than in *Arvicola terrestris*. Of considerable interest seems to be the comparison of intensity of thermoregulation in hamsters and in small rodents (body wt. about 20 g), in *Clethrionomys glareolus* Schreb. and *Apodemus agrarius* Melch. (Górecki, 1968, 1969). It might seem that being much larger, hamsters should display a lower intensity of thermoregulation. And yet, data in the present paper and also data referring to golden hamster (Tęgowska & Gębczyński, 1975), make it clear that hamsters come near or even surpass the values of the two mentioned rodents, remaining somewhat lower in some only, very short sections of the thermoregulation curve. For the whole studied range (0 to 30°C), the increase in the metabolic rate in bank voles is 162%, or 5.4%/°C; while in field mouse it attains a value of about 7%/°C.

As is evident from the above data the significance of thermoregulation in the daily energy budget of hamsters is very great owing to the comparatively high intensity of heat production for thermoregulation, higher than in other rodents.

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PAŃSTWOWE WYDAWNICTWO NAUKOWE * WARSZAWA 1975

Nakład 810+90. Obj. wyd. 11,0. Maszynopis otrzymano 28.I.1975 r.
Podpisano do druku 30.V.1975 r. Druk ukończono w czerwcu 1975 r.
Papier druk. sat. kl. III 80 g. Format B5.

Białostockie Zakłady Graficzne. Zam. 463/75 r. Cena zł 38.—