Heat Production of the Albino Mouse During Growth

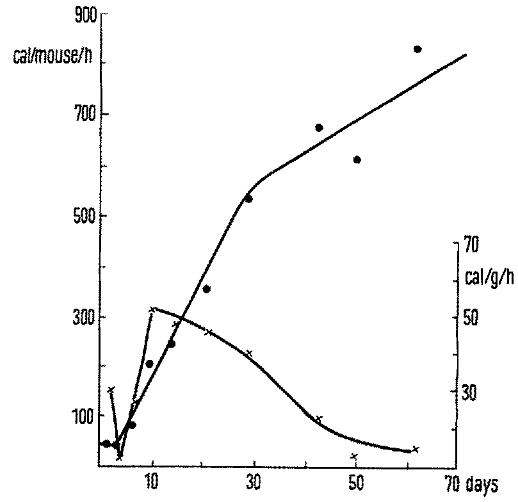
Heat production is usually measured indirectly from the respiratory exchange (BLAXTER[1], BRODY[2], MAYNARD and LOOSLI[3]). In the present investigation direct estimates were obtained during an investigation into the overall energy balance of the albino mouse during growth using a gradient calorimeter similar to that designed by PROUTY et al.[4]. An electric pump pushed air through 2 bottles of concentrated H_2SO_4 and 2 bottles of soda lime which removed the water vapour and CO_2 respectively before entering the calorimeter. The calorimeter was composed of 2 copper boxes with air-tight lids, one inside the other, separated by a 1 cm air gap using rubber spacers. The outer box measured 12 · 12 · 10 cm. The inside box contained a cage mounted on a copper tray which was smeared with mineral oil to collect faeces and urine. The calorimeter was then connected through a bottle of concentrated H_2SO_4 to a Parkinson and Cowan wetmeter which measured the air flow through the system. The radient heat produced by the mouse in the cage is proportional to the difference in temperature between the 2 copper boxes. This difference was registered by 12 copper-constantan thermocouples in series placed alternatively on each of the facing surfaces of the 2 boxes. The temperature of the in-going and out-going air was recorded by thermocouples whose standard junctions were maintained at 25°C in a constant temperature water bath. Room temperature was kept constant at 19°C during every experiment and a fan was directed at the calorimeter in order to maintain a constant air flow over it. The calorimeter was calibrated by introducing a known rate of heat production using an electric coil. Further details of the apparatus and the method of calculation are given by WALKER[5].

In the course of a typical experiment a mouse was weighed and then placed in the calorimeter cage, the 2 lids were sealed with stop-cork grease and the air-flow started. Preliminary calibration tests showed that the apparatus reached equilibrium after 35 min. The galvanometer deflection was then recorded at 5 min intervals for at least a further 30 min. The weight of water evaporated was estimated by weighing the sulphuric acid before and after the experiment. The volume of air that had circulated was recorded from the wet-meter. This averaged 23.5 l/h. The temperature of the in-flowing and out-flowing air and also room temperature were measured at intervals during the experiment. The breakdown of the heat lost by the mouse is shown in the Table. Under the experimental conditions employed, it is apparent that the greatest proportion of the heat produced is lost by radiation. This was registered by an increase in the thermal gradient between the 2 copper boxes. In contrast the heat lost through evaporation was small. Most of the heat lost by conduction and convection was detected by an increase in the difference in temperature of the circulating air as shown by thermocouples placed in the in-flowing and out-flowing airstreams of the calorimeter. However, a proportion of the heat lost in this manner would contribute to the thermal gradient. It is concluded that the heat lost by conduction and convection is negligible.

The relation between heat production and growth is shown in the Figure. 3 phases are discernible. During the early phase lasting about 5 days heat production is relatively low at 25 calories/g/h, but thereafter rises sharply to 41 calories/g/h at 10 days of age. This coincides with the development of hair, and is followed by the third and more stable phase which is prolonged into maturity and which reaches 22 calories/g/h at 55 days. Also shown in the Figure are the same results expressed in calories/mouse/h[6].

Analysis of heat lost by radiation, conduction, convection and evaporation from the albino mouse during growth

Age (days)	Weight (g)	Heat lost (cal/mouse/h) by		
		Radiation	Conduction and convection	Evaporation
2	1.5	45.0	0.0020	0
4	2.1	43.7	0.0002	0
7	2.9	83.3	0.0040	0
10	5.1	200.0	0.0030	9.33
14	6.3	238.3	0.0030	9.63
21	9.3	280.0	0.0175	72.30
29	15.3	450.0	0.0550	86.60
43	25.6	650.0	0.0080	28.90
50	28.3	525.0	0.0130	86.72
62	36.9	800.0	0.0230	28.90



Heat production of the albino mouse expressed both as calories/g/h and also as calories/mouse/h. Each point is the mean of 2 measurements on different mice. ● cals/mouse/h, × cals/g/h.

Zusammenfassung. Mit Hilfe eines Gradientenkalorimeters wurde die Wärmeproduktion der weissen Laboratoriumsmaus während des Wachstums verfolgt und 3 Stadien unterschieden: 1. anfänglich niedrige Wärmeproduktion, 2. nach 5 Tagen starker Anstieg, 3. bei Sexualreife Absinken auf ein Plateau. Wärmeabgabe durch Strahlung, Verdunsten, Leitung und Konvektion wurde separat registriert.

M. G. WALKER

Department of Zoology, Trinity College, Dublin (Ireland), 5th January 1967.

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[6] I thank Professor GRAINGER for his advice and encouragement. The work was carried out under a U.S. Army Contract.