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ASSESSMENT BY MICROCALORIMETRY OF METABOLIC EFFICIENCY IN ISOLATED HEPATOCYTES FROM LEAN AND OBESE RATS

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Energetic efficiency varies with different metabolic pathways and the extent of these pathways is determined to a major degree by the type and amount of substrates provided by the food eaten and by the plane of nutrition. In the overall process involving the oxidation of metabolic fuel, production of ATP, hydrolysis of ATP and biological syntheses, a proportion of energy is lost to the environment in the form of heat. For systems in which a large proportion of newly-formed ATP is conserved in molecular synthesis, the proportion of heat loss to the environment is less. Thus for a closed system the metabolic efficiency of that system can be assessed from the ratio of oxygen consumed to heat produced, where the more efficient system has the higher ratio. An increased efficiency of utilization may be a factor in obesity, reflected in less energetically-wasteful cycling, less heat loss and more energy conserved in triglyceride formation.

In the present study a modified batch microcalorimeter has been applied in conjunction with polarographic measurements of oxygen consumption to determine the ratio of oxygen consumed to heat produced in isolated hepatocytes prepared from normal rats, from rats rendered obese by overnutrition and from genetically obese Zucker rats.

By measuring the heat output and oxygen consumption of hepatocytes prepared from fasted rats in the presence of 2.5 mM fructose or 10 mM dihydroxyacetone an increase in heat output over control values was observed, indicating that when certain substrates are metabolized by fasted cells an increase in heat output can be measured.

A comparison was made between hepatocytes from normal colony rats, colony rats which developed obesity when fed *ad lib* for 5 months on a high carbohydrate or a high fat diet and between genetically obese Zucker rats and their lean litter mates. In obese animals, particularly with genetically obese, there was a trend towards a lower heat output c.f. lean controls. The values for oxygen consumption showed a similar trend.

	Colony			*Zucker*	
	Control	High CHO	High Fat	Lean	Obese
Mean B.W. (g)	290	367	521	292	414
Joules/g D.W./min	7.4±0.5	7.0±0.4	6.2±0.6	6.1±0.5	5.5±0.8
O_2 µmoles/g D.W./min	13.5±0.7	11.9±0.7	11.4±1.5	11.3±0.2	8.5±0.8
O_2/J	1.8±0.1	1.7±0.1	1.9±0.2	1.9±0.1	1.6±0.1

The ratio oxygen consumed/heat production for the cells from genetically obese rats, although not significantly different, appeared to be lower than for the lean litter mates.

This calorimetric assessment of metabolic efficiency would not support the hypothesis that increased metabolic efficiency in liver cells may be a significant factor in obesity.

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