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The Food Energy usage in the Human Body and its Recommended Daily Intake

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Commentary

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ABOUT THE STUDY

Food energy is the chemical energy derived from food by animals (including humans) to sustain their metabolism, including muscular activity. Most animals have the majority of their energy from aerobic respiration, which involves combining carbohydrates, fats, and proteins with oxygen from the air or water. Other minor dietary components, such as organic acids, polyols, and ethanol (drinking alcohol), may contribute to energy input. Water, minerals, vitamins, cholesterol, and fiber, which provide less or no food energy, may still be necessary for health and survival for other reasons. Some organisms, on the other hand, have anaerobic respiration, which extracts energy from food through non-oxygen reactions.

The energy content of a given mass of food is usually expressed in the metric (SI) unit of energy, the joule (J), which is multiple of the kilojoule (kJ), or in the traditional heat energy unit, the calorie (cal). The latter is always the "large" variant of the unit in nutritional contexts, also written "Calorie" (with symbol Cal, both with capital "C") or "kilocalorie" (kcal), and equivalent to 4184 J or 4.184 kJ. Fats and ethanol, for example, have the most food energy per unit mass, with 37 and 29 kJ/g (9 and 7 kcal/g), respectively. Proteins and most carbohydrates have about 17 kJ/g (4 kcal/g), though this varies depending on the type.

For example, glucose, sucrose, and starch have values of 15.57, 16.48, and 17.48 kilojoules per gramme (3.72, 3.94, and 4.18 kcal/g), respectively. The difference in energy density between foods (fat, alcohols, carbohydrates, and proteins) is primarily due to the different proportions of carbon, hydrogen, and oxygen atoms. Carbohydrates that is difficult to absorb, such as fiber or lactose contribute less food energy. Polyols (including sugar alcohols) and

organic acids contribute 10 and 13 kJ/g (2.4 and 3.1 kcal/g, respectively). By adding the energy contents of its components, the energy contents of a complex dish or meal can be approximated.

Energy usage in the human body

The human body uses the food energy obtained through respiration for a variety of purposes, including basal metabolism of various organs and tissues, maintaining internal body temperature, and exerting muscular force to maintain posture and produce motion. Approximately 20% is used for brain metabolism.

The efficiency with which energy from respiration is converted into muscular (physical) power is determined by the type of food consumed and the type of physical energy used (e.g., which muscles are used, whether the muscle is used aerobically or anaerobically). Muscles, on average, have a low efficiency: only 18 to 26% of the energy available from respiration is converted into mechanical energy.

This low efficiency is due to approximately 40% efficiency in generating ATP from food respiration, losses in converting energy from ATP into mechanical work inside the muscle, and mechanical losses within the body. The latter two losses are affected by the type of exercise and muscle fibers used (fast-twitch or slow-twitch). One watt of mechanical power is equivalent to 18 kJ/h (4.3 kcal/h) for an overall efficiency of 20%. A manufacturer of rowing equipment, for example, claims that calories released from "burning" food are four times the actual mechanical work, plus 1,300 kJ (300 kcal) per hour, equating to about 20% efficiency at 250 watts of mechanical output.

It can take up to 20 hours of low-intensity physical activity (such as walking) to "burn off" 17,000 kJ (4,000 kcal) more than the body would normally consume. For reference, one kilogram of body fat equals approximately 32,300 kilojoules of food energy (i.e., 3,500 kilocalories per pound or 7,700 kilocalories per kilogram).

Recommended daily intake

Many countries and health organizations have issued recommendations for healthy daily food energy intake levels. For example, the US government estimates that 8,400 and 10,900 kJ (2,000 and 2,600 kcal) are required for women and men between the ages of 26 and 45, whose total physical activity is equivalent to walking 2.5 to 5 km (112 to 3 mi) per day in addition to sedentary living activities. These figures are based on for e.g.: a "reference woman" standing 1.63 m (5 ft 4 in) and weighing 57 kg (126 lb) and a "reference man" standing 1.78 m (5 ft 10 in) and weighing 70 kg (154 lb).

Because caloric requirements differ depending on height, activity, age, pregnancy status, and other factors, the USDA established the DRI Calculator for Healthcare Professionals to help healthcare professionals determine individual caloric needs. The Food and Agriculture Organization of the United Nations estimates that the average minimum energy requirement per person per day is around 7,500 kJ, (1,800 kcal). Children and healthy and active people require more energy than older people and those who lead sedentary lifestyles. Recognizing these factors, the National Health and Medical Research Council of Australia provided alternative daily energy intakes for every age and gender group. Regardless, nutrition labels on Australian food products typically suggest an average daily energy intake of 8,800 kJ. (2,100 kcal).

In cold environments, the minimum food energy intake is also higher. Increased mental activity has been linked to slightly higher brain energy consumption.