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Short Communication

Brown fat and a short circuit make warm and slim

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Abstract

It is not widely known that the body contains a mechanism that protects against cold and at the same time leads to normal body weight. It is brown fat, combined with a special protein called thermogenin/UCP1. Though there are several UnCoupled Proteins, the main one for the brown tissue is UCP1. It switches ATP production towards heat production. Good oils and cool outside temperatures help in this process.

Introduction

Humans have white and brown adipose tissue. White is well known as a fat store, but brown is less well known: it is rich in mitochondria and serves to generate heat. To do this, the respiratory chain in the mitochondria is «short-circuited» and the energy produced is not stored in ATP but released as heat. For this to happen, the body has developed a protein called Thermogenin/UCP1 that can switch between ATP and heat production [1]. Though there are several UnCoupled Proteins, the main one for the brown tissue is UCP1 [2].

Thermogenin/UCP1

Thermogenin (uncoupling protein 1 or UCP1) is a transmembrane protein found in the mitochondrial membrane of brown adipose tissue. Its function allows heat to be generated without muscle activity such as shivering. Thermogenesis induced by UCP1 is the predominant mode of heat generation in newborn mammals including human infants and young children [3].

The molecular mechanism of uncoupling mediated by thermogenin is well understood: the function of this ion channel provides an additional pathway within oxidative phosphorylation for the re-entry of protons into the mitochondrial matrix. When thermogenin is activated, it

short-circuits the proton circuit that couples the respiratory chain to the ATP synthase complex, which supplies adenosine triphosphate (ATP) for the cell's energy balance: Thermogenin impairs this coupling - similar to 2,4-dinitrophenol - and the energy obtained by cellular respiration is immediately converted to heat (dissipation) without the formation of the energy store ATP.

Thermogenin is related to other mitochondrial metabolic transporters such as the adenine nucleotide transporter, a proton channel in the inner mitochondrial membrane that mediates the transport of protons from the intermembrane space into the mitochondrial matrix. Its presence gives this tissue its tremendous ability to generate heat.

UCP1 is activated by fatty acids in the following pathway: Norepinephrine is released in the sympathetic nervous system, which binds to the β_3 -adrenoceptor in the cell membrane of brown adipocytes. This activates an adenylyl cyclase that catalyzes the conversion of ATP to cyclic adenosine monophosphate (cAMP). For its part, cAMP activates protein kinase A, whose active C subunits detach from the regulatory R subunits. For its part, active protein kinase A activates a lipase by phosphorylation. This lipase catalyzes the conversion of triglycerides into free fatty acids, which eventually activate UCP1 by abolishing its inhibition by purine diphosphate nucleotides (GDP, ADP). Thermogenesis is terminated by mitochondria



oxidizing free fatty acid residues. This renders UCP1 inactive and the cell returns to normal cellular respiration in which ATP is synthesized. The thyroid hormone triiodothyronine (L-T₃) or stress hormones can also uncouple the respiratory chain in this way [4].

Brown fat

Newborns have abundant brown fat, otherwise, they would cool down very quickly. The heat that an infant can generate is always amazing. Adults have remnants of brown adipose tissue along the large arteries, in the neck region, and over the collarbones [5]. These regions are important for survival and need their «operating temperature».

The higher the body weight (body mass index), the higher the age, the warmer the environment (heated rooms, etc.), and the lower the brown adipose tissue. Women have more active brown fat than men. The amount of brown fat is highest in inhabitants near the Arctic.

If mitochondrial damage is present, the brown adipose tissue loses its thermal function. Those affected then react very sensitively to drafts, with stiff necks, colds, or bladder infections, and have to keep warm in summer and winter. Blocker drugs also inhibit heat generation in brown fat, such patients then feel colder.

Oils and the outdoor temperature

More brown fat would provide opportunities for weight loss. The energy of the fat would simply be converted to heat and away it would go. Converting white fat to brown fat requires fat-soluble vitamins such as A and D₃, as well as regular, prolonged cold. People in northern latitudes get this naturally. They eat more fatty fish high in fatty acids, and other fatty sea creatures as well (6). Oleic acid (the main fatty acid in good olive oils) can also short-circuit the mitochondria [7].

In fact, one can lose weight with lots of olive oil, for this reason, see the Mediterranean diet [8]. With other oils, this is more difficult. Olive oil has been extracted and consumed for at least 8000 years, starting in the eastern Mediterranean. Olive oil consists mainly of fatty acids (triglycerides) bound to glycerol [6]. In olive oil, 55% - 83% oleic acid, 7% - 20% palmitic acid, 3% - 21% linoleic acid, 0% - 5% stearic acid, and 0% - 4% palmitoleic acid are found. The unsaponifiable fraction ranges from 0.5% to 1.3%; of which phytosterols account for 0.15% - 0.37%, squalene for 0.1% - 0.7%, and chlorophyll for 0-10 ppm. It also contains small amounts of phospholipids, carotenoids, α -tocopherol and about 300 IU of provitamin A. Natural olive oil contains oleocanthal and oleuropein, two antioxidants that are believed to have a number of health benefits.

Body weight

It is not generally known that many chronic diseases, constant fatigue up to burn-out, weight loss blockades, and overweight can result from a fat metabolism that no longer functions properly. In many people, this often gets out of balance due to environmental influences and a wrong lifestyle.

It should pass into the general consciousness that good oils and fats do not make fat, but industrially processed and sugary food.

It is understandable that many people prefer to stay in the heat. However, in terms of a good metabolism and a normal body weight, this is counterproductive. People with Caucasian genes tend to require life in the cool to cold, with distinct seasons [9].

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