Brown fat in the fight against obesity

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Introduction and objective

The recent discovery of the presence of brown adipose tissue in adult humans gives way to a new metabolic world that could provide the key to ending obesity, which is one of the most important diseases in modern society. Thus, the aim of writing an informative article about this issue is twofold. On the one hand, it aims to make the reader aware of the implications of obesity in modern society, and on the other hand, to provide up to date information about research into the treatment of obesity.

Material and methods

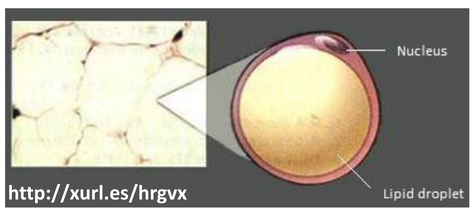
To develop this article I have used as main sources histology books, to define the most technical aspects of the tissue, and scientific articles and reviews, to illustrate the state of the art about brown fat research. In addition, I have consulted videos and other outreach articles with the aim of assimilating the language necessary to transmit the most technical information in a clear and understandable way.

Key concepts

1. Adipose tissue

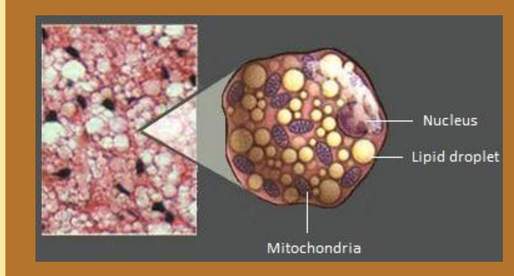
This tissue is composed of 3 different cell types, specialized in the storage of triacylglycerols in lipid droplets:

White fat cells



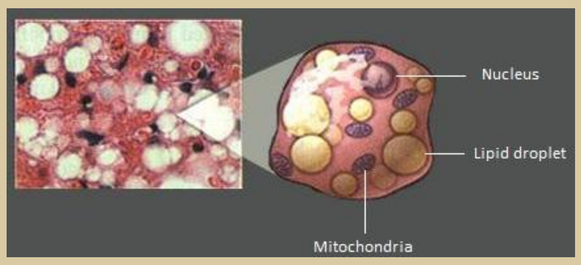
•Contain a lipid droplet that occupies the major part of cytosol.
•Nucleus and mitochondria (with few presence) are displaced to a peripheral zone by the lipid droplet.
•Low quantity of cytosol.

Brown fat cells



•Contain numerous lipid droplets, distributed through the cytosol.
• High quantity of mitochondria homogeneously distributed.
•Abundant cytosol.
•Characterized by the presence of the mitochondrial protein UCP-1.

Beige fat cells

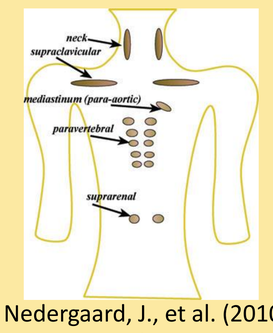


•Present in white adipose tissue.
•Low expression of UCP-1.
•Mixed cell type, as it normally acts as white fat cells do, but with the appropriated stimulation they increase the amount of UCP-1 to the typical levels of brown fat cells.

2. Brown adipose tissue in adult human

Brown adipose tissue is not limited to wintering mammals and babies → Between 30-100% of human adults present brown adipose tissue[1]

•This tissue is characterized by its ability to burn fat, releasing it as heat.
• It thus provides us with a new avenue of research in the fight against obesity.

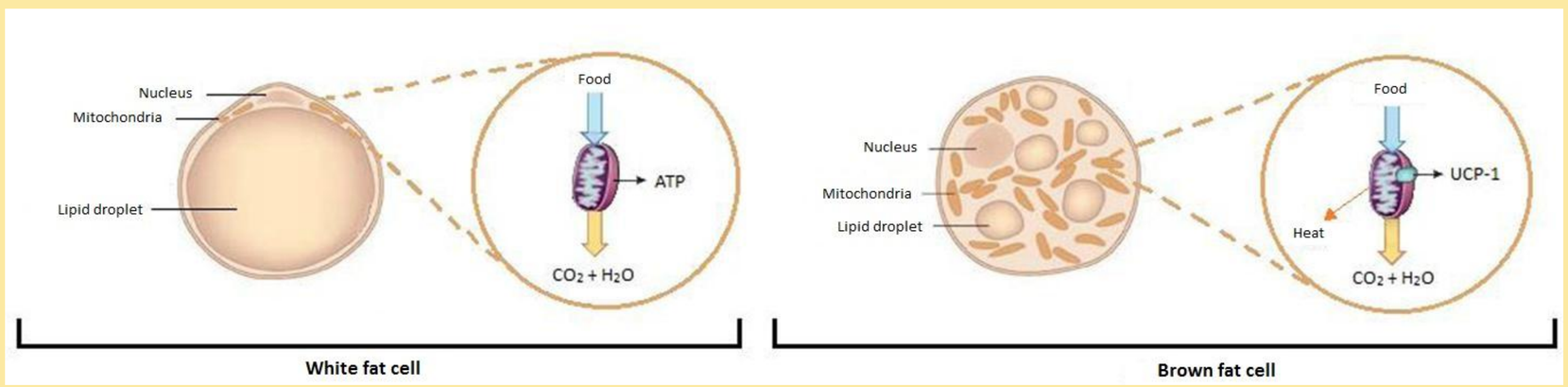


Nedergaard, J., et al. (2010). *Ann N Y Acad Sci.E20-E36.*

3. Mechanism of UCP-1 in brown adipose tissue

• UCP-1 (**un**coupling **p**rotein) present in the mitochondria disrupts the communication between ETC (electron transport chain) and ATP synthase.

•Thus a release of this energy is produced as heat, so UCP-1 is known as a thermogenic protein.



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4. Obesity, a growing epidemic

•Obesity is a disease that can be generated by different genetic or environmental factors.
• 1.400 million adults are affected nowadays (according to data from WHO).
•The seriousness of this pathology lies in the increased probability of suffering:

Pathologies associated to obesity	
Diabetes	Cholesterol
Hypertension	Joint diseases
Gallbladder	Cancer
Coronary complications	Respiratory complications

References

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2. Hondares, E., et al. (2010). Hepatic FGF21 Expression Is Induced at Birth via PPARα in Response to Milk Intake and Contributes to Thermogenic Activation of Neonatal Brown Fat. *Cell Metabolism 11 (3). 206 – 212. 00*
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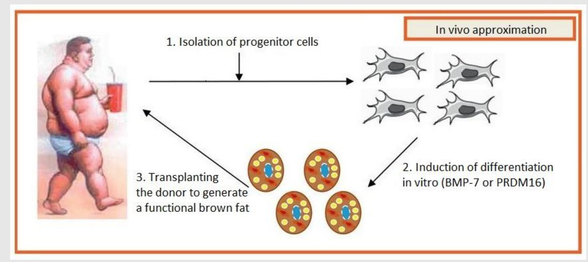
4. Grujic, D., et al.(1997). β3-Adrenergic Receptors on White and Brown Adipocytes Mediate β3-Selective Agonist-induced Effects on Energy Expenditure, Insulin Secretion, and Food Intake. The Journal of Biological Chemistry Vol.272 (28). 17686 – 17693.

Conclusions

The aim of the research into brown adipose tissue is to find a therapy able to create brown fat cells or stimulate them to help obese patients to lose weight easily. Right now we have some approximations:

FGF21 (Fibroblast Growth Factor 21)	**Stimulation of β-adrenergic receptors**	**Approximation in vivo**
•Metabolic regulator involved in glucose homeostasis. •Promotes the expression of thermogenic genes. •It can be injected directly or produced by white adipose tissue (in response to the stimulation of SNS)[2].	• Thiazolidinedione: ligand of β-AR that promote the stimulation and division of brown fat cells but with insufficient results to generate thermogenic activity.[3, 4]	

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