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The Gut Microbiota and its Influence in Obesity

Introduction

The **Gut Microbiota** (GM) is similar among people, but everyone has a different composition. Generally there is a relationship between the lost of microbial diversity and some diseases; this alteration is known as **dysbiosis**, which has been described for many diseases, such as obesity. **Obesity,** which currently is an enormous public health problem, is a consequence of alterations in eating behaviour and how the body regulates energy intake, expenditure and storage. Recent evidence suggest that the GM may play a role in obesity.

Goals:
- ✓Describe the GM
- ✓Relate the GM with obesity
- ✓Evaluate the probiotic treatment for obesity

Methodology:
- MOOC course "Gut Check: Exploring Your Microbiome" by University of Colorado
- Congress "SCI sobre Microbiota i Sistema Immunitari de la Mucosa 2014"
- Systematic literature search in PubMed database (selected publications in the last five years)

Results

Gut Microbiota and its Composition

Microbiota: microorganisms which live in the body.
Microbioma: collective of microbiota genomes.

About 10^{13}-10^{14} microorganisms inhabit the human gut, which represents 10 fold the number of eukaryotic cells in the body.

It includes Bacteria, Archaea, Fungi and viruses (Fig.1).

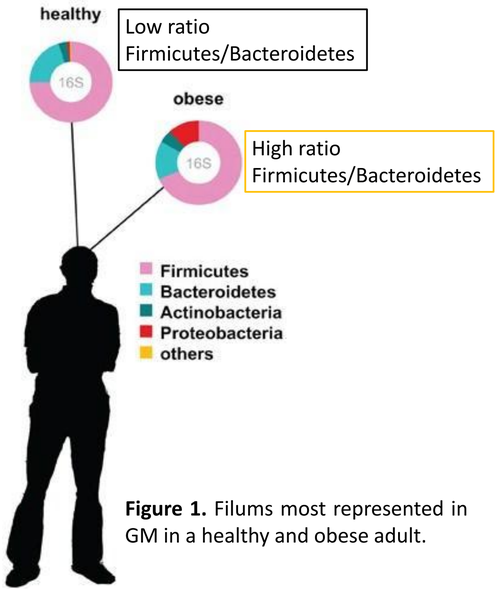
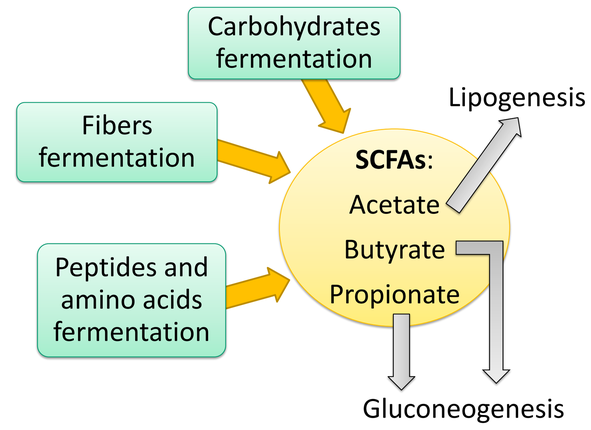


Figure 1. Filums most represented in GM in a healthy and obese adult.

Functions of the Gut Microbiota

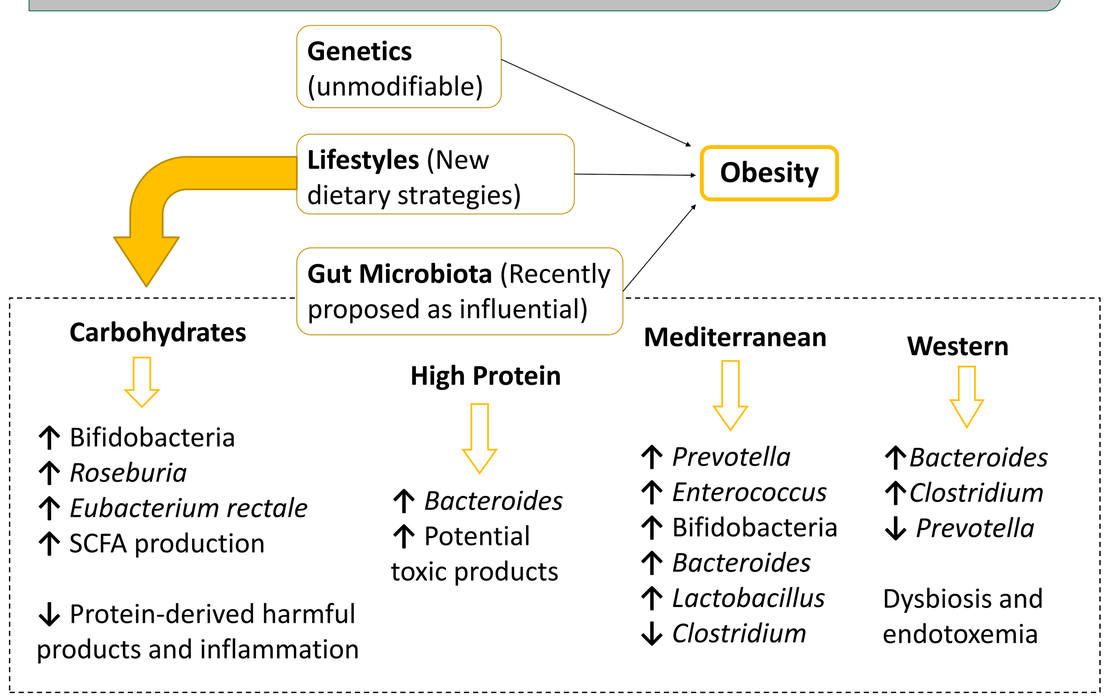
- ○ Protective
- ○ **Metabolic**
- ○ Trophic

The short-chain fatty acids (**SCFAs**) play an important role in host nutrition and energy homeostasis, controlling energy production, and storages as well as appetite.



The Influence of Diet on Gut Microbiota

A diet based on meat has more impact on the structure and functionality of GM than a diet based on vegetables.



Linking the Gut Microbiota to Obesity

A high fat diet is associated with a chronic low-level inflammation and also alters the GM.

There are some changes in the obese GM and in some molecules related to the lean:

- ↑ Archaea (methanogens)
- ↑ Microbial fermentation and extraction of energy from nutrients
- ↓ Functional diversity in microbiome

- ↓ AMPK → ↓ Oxidation of fatty acids → ↑adipogenesis
- ↑ Gut permeability → ↑LPS → ↑Cytokines proinflammatory ↑adipogenesis
- ↑ SCFA → ↑Lipogenesis ↑Fat storage
- ↓Fiaf → ↑LPL ↑Fat storage

AMPK: 5' adenosine monophosphate-activated protein kinase, **LPL:** lipoprotein lipase
Fiaf Fasting Induced Adipocyte Factor, **LPS:** lipopolisacarid

LPL uptakes the fatty fats from lipoproteins and accumulates the triglycerides in adipocytes. **Fiaf** is a LPL inhibitor, whose expression is selectively suppressed by microbiota. This is a reason why wild-type (wt) mice accumulate more fat than Germ free (GF) (Fig. 2).

Probiotics as an Obesity Treatment

Probiotics (WHO): "live microorganisms which when administered in adequate amounts confer a health benefit on the host"

Probiotic	Health Benefit
Lactobacillus gasseri SBT2055	It reduces total mesenteric and subcutaneous adipose tissue masses. There is also a reduction in the total HDL- cholesterol in serum.
Lactobacillus sakei NR28	It reduces significantly total body weight.
Lactobacillus rhamnosus GG	The reduction is only important in epididymial fat.
Bifidobacterium animalis subsp. *lactis* BB-12	It only has health benefit when administered with oligofructose prebiotic.

GF mice are sheltered from diet induced obesity.

Figure 2. Changes in a wt mice when there is a GM transplant.

Conclusions

Studies claim that an increase in the ratio Firmicutes/Bacteroidetes is directly related to obesity, however other authors have failed in demonstrate that. So, it is thought that the differences in the GM composition are probably less important than the aspects based on the methagenomic functionality.

A dysbiosis could be caused by the diet, but there are other factors implicated. It is known that dysbiosis could promote the obesity through different mechanisms.

There are many studies of probiotics that confirm their effectiveness in obesity. Nevertheless, there are some issues at debate, for example the low probability of probiotic to survive the journey until the intestines and the difficulty to colonize the gut surface. However some are able to replicate and persist in the gut temporarily, they disappear after stopping using them.

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