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Does the Human Microbiome Influence Food Cravings and Dietary Habits?

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It's well established in the scientific literature that diet affects the composition of bacteria in the gut, but my hypothesis is that it also happens the other way around; that the microbiome influences food cravings and dietary habits. It's often suggested that humans are designed to desire sweet, fatty, and salty foods. Naturally, these cravings come and go throughout the day, but there also seems to be a degree of individual variability. While some people

claim to have an intense sweet tooth, others rarely feel the need to consume fruits, cakes, sodas etc. It also seems that someone can "permanently" alter their food preferences and cravings by changing their diet or supplements. While some people attribute these changes to hormonal factors, blood sugar etc., microorganisms also seem to be a vital part of this whole puzzle.

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The second brain

Studies show that there is a strong link between the gut and the brain, and the gut is often considered the [second brain](#). Gut microbiota influences mood and behaviour (Clark et al., 2012; Collins, Surette, & Bercik, 2012; Diaz Heijtz et al., 2011).

Gut microorganisms aren't working for us

Contrary to popular belief, the microorganisms hosted by a human body aren't working for us. Rather, they are interested in their own survival and reproduction. By design, this is a symbiotic relationship with the human host. E.g., certain microorganisms are able to ferment specific polysaccharides that in turn become energy that we can use.

Different microbial species are also able to suppress the growth of other microorganisms (i.e., by altering the gut pH, pH in fermented foods) in order to optimize their own living conditions. E.g., it has been shown in several studies that the growth of bifidobacteria in the intestines is linked to suppressed growth and/or death of other microorganisms.

While more bifidobacteria is usually considered beneficial, other cases of this "microbial war" are detrimental to human health, and this is seen when antibiotics allow pathogenic microbiota a chance to overgrow.

Is it possible that gut microorganisms aren't just able to alter their immediate environment, but also influence the behaviour of the host to benefit themselves? This could potentially happen by some type of biochemical/metabolic response, and [Petro Dobromylskij](#) believes that it happens when microbes alter peptide neurotransmitters in our brain.

Some gut microbes in the upper gastrointestinal tract seem to thrive on glucose (e.g., certain LPS-

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containing bacteria, candida albicans), and the “overgrowth” of these microbes could potentially result in cravings for carbohydrate-rich foods such as bread, fruit, cupcakes etc. These cravings could occur between meals, but can also be “intensified” during or right after meals.

Sugar seems to be addictive in the sense that we continue to eat and crave it both during and between meals. Several explanations have been proposed for this desire to eat sweet food, but the role gut microbiota plays in regulating host appetites has been mostly unrecognized. Is it possible that the growth of some intestinal microorganisms (upper GI tract?) following the consumption of carbohydrate-rich foods leads to a desire to eat more “sugar”?

Anecdotal reports and studies supporting the hypothesis

Individuals with chocolate cravings harbour different gut microbes

A study done by Rezzi et al. (2007) showed that individuals who have an [apparent desire for chocolate have different colonies of bacteria in their intestines](#) compared to people who are “indifferent” towards chocolate.

Blood and urine of 11 men who ate chocolate on a daily basis were compared against 11 men who never ate chocolate. When the researchers looked at the byproducts of their metabolism they found several differences between the two groups, and the specific substances that differed are linked to specific types of microorganisms. Although this is only a small pilot study, it gives us some hints about the relationship between food, bacteria, and host appetites. Regular chocolate consumption results in an altered gut microbiota composition, but this study also suggests that certain bacteria influence the desire for chocolate.

I suggest that “chocolate lovers” don’t actually have an altered gut microbiota prior to introducing chocolate into their diet, but rather that chocolate consumption leads to the growth of microorganisms that are able to utilize some ingredients in chocolate, which in turn promotes regular “cravings” for chocolate.

This explains why so many people have a hard time quitting chocolate all together and why removing chocolate from the diet completely often is necessary to get rid of the cravings. Both sugar and cacao (found in chocolate) have been shown to be highly addictive, and this is probably influenced by gut bacteria. Certain compounds found in sugar and cacao (e.g., alkaloids in cacao) probably also contribute to the regular cravings for these food ingredients.

Gut dysbiosis is associated with intense food cravings

[Gut dysbiosis](#) is often accompanied by abnormal host appetite. A typical western diet perturbs the gut microbiome, and building on the information in the previous paragraph, it seems possible that the subsequent growth of certain microbial species following antibiotics, poor diet etc. results in an increased desire for food that contains substances that feed these microbes.

These cravings depend on the severity of the condition, and individuals with severe gut dysbiosis will usually have the most apparent food preferences and cravings. As mentioned in the previous paragraph, these cravings might be intensified during or directly following meals.

Two groups with moderate-severe gut dysbiosis that have an increased desire for certain foods:

- Candida albicans seems to thrive on glucose, and Candida overgrowth is “always” linked to an increased craving for sugar.
- Mental disorders such as autism and ADHD are linked to gut issues, and Dr. Natasha Campbell-McBride has worked with hundreds of children with a wide range of mental problems. These children suffer from gut dysbiosis, and Campbell-McBride says in her book (Gut and Psychology Syndrome) that all of the children seem to have very unusual food preferences compared to healthy kids.

Have you ever met a child with autism or ADHD that doesn’t have very “unusual” dietary habits?

Obese and lean individuals harbour different gut microbes

It’s well established in the scientific literature that obese and lean individuals harbour different types of gut bacteria. Some studies show reduced numbers of Bacteroidetes in obese subjects, while others point to lower levels of beneficial bacteria like Lactobacillus.

Ian Spreadbury proposed in his excellent paper (Spreadbury, 2012) that a typical western diet – high in refined, acellular carbohydrates – promotes the growth of intestinal microorganisms such

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as LPS-containing bacteria. He further suggests that this altered microbiota drives inflammation and weight gain.

So, it's well established that a poor diet alters the gut microbiota and that it's possible to establish if a person is lean or obese by looking at the gut microbiota. Is it also possible that the composition of gut bacteria in the overweight and obese is part of the reason why they are often drawn towards refined, sweet and/or fatty foods? Will an established inflammatory microbiota further increase the satiety for "unhealthy" food?

Low-carbohydrate diets linked to initial carbohydrate cravings, but no cravings following an "adaptation phase"

Anecdotal reports suggest that most individuals who switch from a high-carbohydrate diet to a low-carbohydrate diet have to go through an initial adaptation period where they experience dizziness, fatigue, carbohydrate cravings, etc. These symptoms seem to correlate with the degree of carbohydrate reduction, and someone who switches from a typical western diet (50-60% energy from carbohydrate) to a ketogenic diet (<20-40 grams of carbohydrate each day) usually experience an initial desire for carbohydrate-rich food. One of the explanations for these carbohydrate cravings is that the body is switching from glucose to fat as the major energy source and that the initial drop in blood glucose somehow results in an increased "glucose craving"; which is the body's attempt to continue using its regular energy source.

However, someone who is properly "fat-adapted" often experience no or only sporadic carbohydrate cravings. Stable blood glucose and insulin levels are often considered the primary reasons why low carb is so effective at silencing those cravings for fruits, cupcakes, bread etc.

While hormones, reduced glucose intake etc. probably influence carbohydrate cravings on a low-carbohydrate diet it seems possible that gut microbes also play a role. The adoption of a low-carbohydrate diet will shut down the "energy supply" for microorganisms involved in carbohydrate digestion.

Microorganisms living in the anaerobic conditions in the colon are able to extract energy from carbohydrates (e.g., fiber), but oxygen is necessary to extract energy from fat (especially saturated fat). So, transitioning to a low-carbohydrate diet is essentially starving some of the bacteria in the colon. These microorganisms who are used to a generous supply of energy get hungry, and they get host metabolism switched to fat burning. So when these "starving" microbes are able to control our weight to their advantage, it also seems quite possible that they can influence our food cravings/desires/preferences.

Individuals eating a low-carbohydrate diet often report that they seldom experience cravings for carbohydrate-rich food. It suggests that the fat-adaptation phase is over and that the number of microorganisms thriving on a high-carbohydrate diet is significantly reduced; thereby not influencing host appetite to any extent.

Conclusions

It has already been shown that the human microbiome impacts mood and behaviour, and microbes are also able to influence host physiology (e.g. fat storage) to their own benefit. Although no well-controlled studies (to my knowledge) have investigated the connection between gut microbiota and food cravings/desires/preferences, there seems to be some anecdotal evidence suggesting a relationship. Whether these dietary cravings result from the actual microorganisms involved in a "dysbiosis" or if the "dysbiosis" leads to some type of physiological change (e.g., hormonal), which in turn promotes an increased desire for specific food, remains to be seen.

It seems to be a vicious cycle where a poor diet promotes an inflammatory microbiota, which in turn increases the satiety for "unhealthy" foods. While gut microbiota adjusts according to diet, it also seems that microorganisms influence you in a way so you desire the food you eat a lot of (e.g., chocolate study). A prolonged consumption of refined, sweet food promotes the growth of certain microbial species, which in turn increases the desire for these exact foods.

A "drastic" dietary change shuts down energy source for some microbes, and this lack of fermentable substrate probably affects the cravings some people experience when they change their diet.

Humans are more like living ecosystems, and only time will show to which extent the microorganisms in and on us influence host appetites.