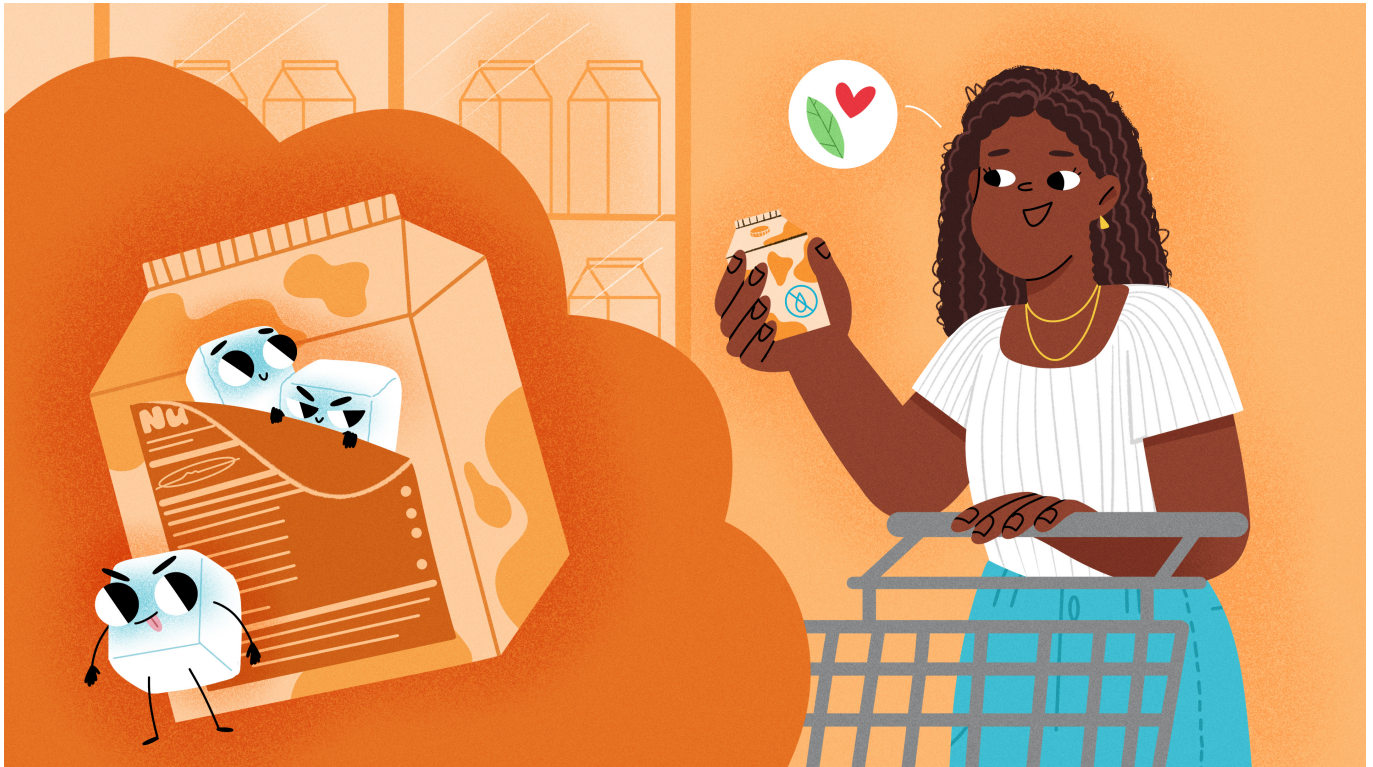




SUGAR: THE MASTER OF DISGUISE

David Guedes* and Marília Prada

Iscte - Instituto Universitário de Lisboa, CIS-Iscte, Lisboa, Portugal

YOUNG REVIEWERS:



EMMA

AGE: 13



SAATVIK

AGE: 15

Sugar is almost everywhere. You can find it in your favorite treats, like candies, cookies, ice cream, or soda. But sugar is also hidden in places you may not expect, like yogurt, breakfast cereals, or even bread. In this article, you will learn more about how sugar sneaks into our daily foods, its effects on our bodies and minds, and how to spot it so you can make smarter choices to keep a healthy diet.

WHAT IS SO SWEET ABOUT SUGAR?

Have you ever thought about why most people have cake when they celebrate their birthdays? Or why do kids ask for sweets on Halloween, rather than, say, sour or bitter foods? The answer appears to be that most people like sugar. Although every person likes to eat different things, most people find sweet foods to be pleasant—so much so that “sweetness” and “pleasantness” are used as synonyms. You may have heard people say things like, “Matilda is such a sweetie”, or “What a sweet voice John has”. In most cases, these remarks are meant as compliments, meaning that being with Matilda or hearing John’s voice

CARBOHYDRATES

Nutrients in foods like bread, rice, and pasta that give us energy.

feels pleasant, just like tasting sweet food is pleasant [1]. But why is sugar pleasant in the first place?

To answer this question, we need to go back to the beginning—when you were a baby living on a diet consisting of a single ingredient: milk. Maternal milk is made mostly out of water (87%–88%), **carbohydrates** (7%), and fat (3.8%) [2]. The carbohydrate in milk is called lactose, or “milk sugar”, and it gives milk a very sweet taste. Most newborns are instinctively drawn toward sweet tastes, possibly because maternal milk also tastes sweet. For example, research has shown that when newborns are given a sweet liquid to taste, they usually increase sucking and their faces look relaxed. In contrast, when they taste bitter and sour solutions, they usually make a funny face showing displeasure [3].

Another hypothesis is that people may instinctively look for sweetness because sweet foods are a source of glucose [4]. Glucose is the main source of energy for cells in the body, particularly for those cells in the brain called neurons. Without glucose, these cells cannot produce neurotransmitters, the chemical messengers that neurons use to communicate between themselves [5]. Way back when humans lived in the wild, hunting and gathering whatever was available, this instinct to look for sources of glucose may have been an advantage. However, most people today live in environments where food is more abundant and readily available than ever, so craving sweet foods may no longer be necessary.

To understand why we love sweets so much, we also need to look at how our brains regulate food intake. One part of the brain, called the hypothalamus, is responsible for telling you when your body needs nutrients. The hypothalamus can detect when there is not enough glucose in the blood, and it sends a message to the body saying that it is time to start looking for food. Whenever you feel hungry, that is the hypothalamus **doing its job**.

Another part of the brain, called the reward system, also helps to regulate food intake. It is called a “system” because it involves several parts of the brain working together [6]. These brain parts communicate among themselves using “feel-good” chemicals (like one called dopamine), which help create feelings of pleasure. For example, when we eat sugary foods, the reward system becomes very active and releases a lot of dopamine, which makes us feel happy and satisfied.

Over time, if you eat sugary foods too often, your brain starts to expect that sugar boost. It learns to crave sugar, not just for energy, but for the pleasure it brings. That is how eating sweets can become a habit: our brains remember the pleasure and push us to keep going back for another bite.

MONOSACCHARIDES

The smaller type of sugar, consisting of one sugar unit. An example is fructose, the sugar that makes fruits taste sweet.

DISACCHARIDES

Sugars made of two monosaccharides joined together. A good example is sucrose, which is the sugar we use to sweeten tea or to bake a cake.

FREE SUGARS

Sugars added to foods or drinks, like candy or soda, plus the sugar naturally found in honey and fruit juice.

CALORIES

A measure of the energy that food gives to our bodies.

Figure 1

(A) Naturally occurring sugars, like fructose, sucrose, and glucose (in varying proportions) can be found in fruits and vegetables. Dairy products like milk also contain a natural sugar called lactose. **(B)** Free sugars are the sweeteners put into foods. These can include the sugars added to foods during production, for example in a soda factory, at a restaurant, or at home, such as when you use maple syrup to bake cookies.

WHAT IS SUGAR AND WHERE TO FIND IT

Everyone has seen sugar and tasted sugar. But do we know what sugar is? The term “sugar” can refer to different molecules that include **monosaccharides** and **disaccharides**. Monosaccharides are made of a single sugar subunit (mono = one), like fructose (the sugar in fruits), while disaccharides are made of two sugar subunits (di = two), like in sucrose, the molecule that makes up the white table sugar we all know.

The word “sugar” can refer to the sugar naturally present in foods like fruits, vegetables, and dairy (Figure 1A). However, it also refers to the sugar added by people to certain foods. This includes the food industry (e.g., the sugar used in a soda factory) or people at home (e.g., when mom or dad add sugar to a cup of coffee or use honey for baking a cake). These added sugars are known as **free sugars** (Figure 1B). Consuming natural sugars—like when eating a piece of fruit—often comes with nutrients that are good for your health, like fiber, vitamins, and minerals. Free sugars, on the other hand, can provide energy (**calories**) but often without the nutrients our bodies need.



Figure 1

The World Health Organization has found that, worldwide, most people—particularly kids and teens—consume more free sugars than necessary for a healthy diet. Their **recommendation** is to limit the consumption of free sugars to less than 5% of the total energy you get from foods and drinks daily. However, this can be quite difficult, as sugar can appear disguised in many foods. You may expect sweet foods and drinks like cookies or soda to contain a lot of free sugars. Sometimes you can even see it sprinkled on your favorite treats. However, other processed foods and drinks can be packed with sugar without you realizing it. These “sneaky” sugars can be disguised in

foods that you do not necessarily consider sweet, such as ketchup, breakfast cereals, yogurt, and even some types of bread.

A TRUE MASTER OF DISGUISE

Imagine you are in a supermarket and you see a low-fat yogurt next to regular yogurt. What would the healthier choice be? The answer is not as simple as it may appear. The first yogurt indeed has less fat, and you may have heard that excessive fat is bad for your health. However, in many cases, manufacturers add more sugar to low-fat yogurt to improve the taste, resulting in a not-so-healthy product overall.

To complicate things even more, sugar molecules have different names that you may not immediately associate with sugar, such as fructose, galactose, lactose, or maltose. Some sweeteners can include a combination of these molecules in varying proportions. When you read a food label, you may come across some of these sweeteners without realizing they are indeed sugars. Currently, there are dozens of these sneaky sugars, including agave nectar, molasses, caramel, corn syrup, honey, rice syrup, fruit juice concentrate, or cane juice crystals—and many more.

Becoming a sugar detective may include knowing how to identify these sneaky sugars but also understanding the claims you often find on food labels—such as “low sugar”, “sugar-free”, or “no added sugars”. Some of these claims may sound similar, but they can mean very different things. Check [Table 1](#), where we break down some of these common claims for you.

Table 1

Food labels often display claims that may appear similar but have very different meanings.

Low sugar	This means the product contains a small amount of sugar according to nutritional guidelines. Typically, this is defined as 5 g or less per serving, but guidelines may vary from country to country
No added sugars	No sugars were added during processing, but the product may contain natural sugars
Sugar-free/No sugar	The product contains less than 0.5 g of sugar per serving, including natural and free sugars
Reduced sugar/contains X% less sugar	Contains less sugar than a similar reference product. For example, for a sugar-reduced yogurt, the reference product may be the regular yogurt of the same brand. Sometimes you may need to read the very small print to find what that reference product is
Contains X grams of sugar	States the exact amount of sugar per serving or per 100 g. While this is usually used to highlight a low sugar content, make sure to check what the recommended serving is, as that may be less than the portion you usually have. Breakfast cereals are a good example since most people pour (much) more than the recommended serving size

Table 1

THE CASE OF THE “FAKE” SUGARS

Have you ever seen a food label that says “no sugar” but the food still tastes sweet? You may have wondered what kind of sorcery that is. Well, it is not exactly magic. Certain ingredients can try to disguise themselves as sugar. Examples include aspartame or saccharine, which are “fake” or artificial sweeteners that can trick your taste buds into thinking you are eating the real thing. While these sweeteners look and taste a lot like sugar, they are actually quite different. Most of them do not give your body energy, and they do not provide important nutrients like the ones you get from fruits and vegetables.

Artificial sweeteners were created to help people enjoy sweet flavors without eating too much sugar. While this can be helpful for people with some health conditions, doctors are still studying how these sweeteners affect our bodies in the long run. So, while they might seem like a clever magic trick, it is still important to focus on eating a variety of natural, nutritious foods.

SUGAR: HERO OR VILLAIN?

Sweet foods and drinks can taste great and make you feel good, but eating too much of these products can be bad for your health. Consuming too much sugar can increase the number of calories you consume. Although our bodies need calories to function, you should try to get those calories from foods that also have beneficial nutrients like fiber, vitamins, and minerals. For example, a soda will get you a high number of calories, but few other nutrients, while fruit and vegetables may contain small amounts of sugar, but also many beneficial nutrients. When people get a lot of calories from nutrient-poor foods and drinks they can be at risk for weight gain and many health issues that come with it, like **cardiovascular disease** and **type 2 diabetes**. In addition, excessive sugar consumption is one of the main causes of **dental caries**. Caries, also known as cavities, are little holes in your teeth. When you eat too much sugar, the bacteria in your mouth make a sticky stuff called plaque that can hurt your teeth and make those tiny holes.

This does not mean you have to stop eating sugar altogether. Experts recommend that people consume sugar in moderation. That can mean limiting the number of calories from free sugars to less than 19 g (or 5 sugar cubes) for kids 4–6 years old, 24 g (or 6 sugar cubes) to kids 7–10, or 30 g (or 7 sugar cubes) for older kids. Sticking to this rule may be tricky because of how sugar hides in many of the foods and drinks we eat every day. So, here are some tips to keep a balanced diet:

- Sugar can be disguised in many foods, even those that are not sweet. Look for the different names of sugar on labels and be aware of how much is in each serving.

CARDIOVASCULAR DISEASE

A group of medical problems that affect the heart and blood vessels, like heart attacks or strokes.

TYPE 2 DIABETES

A health condition in which the body has trouble using sugar properly, leading to high sugar levels in the blood.

DENTAL CARIES

Another word for cavities, that is, the holes that form in teeth because of decay.

- Many foods and drinks try to appear healthy by claiming to be low in sugar or fat. Remember that many of these claims look similar but they can mean different things.
- Choose whole foods (like fruits and veggies) over processed foods (like cookies or ice cream). Fruits, vegetables, and whole grains are naturally lower in sugar and provide more nutrients.
- Watch what you drink. Soda, energy drinks, and even fruit juice can be packed with sugar. Water or unsweetened tea are much better choices.
- Do not throw away those cookies! Remember that you can still eat free sugars in moderation. One trick is to leave those sweeter foods and drinks for the weekends or special occasions.
- Encourage grown-ups to cook more. Cooking at home allows you to control how much sugar goes into your food, and it is a fun family activity!

In conclusion, sugar is a master of disguise. It can have different names and sneak into many of the foods we eat every day without us even realizing it. But with a little knowledge and effort, we can become sugar detectives. By understanding the different types of sugar, learning how to read labels, and making mindful choices, we can enjoy the sweetness of life without letting sugar take control of our health.

ACKNOWLEDGMENTS

This work was funded by la Caixa Foundation (LessSugar4Kids Project, LCF/PR/SR23/57000015).

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The author(s) declare that Gen AI was used in the creation of this manuscript. Generative AI (ChatGPT, GPT-4, OpenAI) was used exclusively for text revision and language refinement during the preparation of this manuscript. No content, ideas, or interpretations were generated by the tool. The authors take full responsibility for the manuscript's content.

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SUBMITTED: 04 October 2024; **ACCEPTED:** 16 September 2025;

PUBLISHED ONLINE: 17 October 2025.

EDITOR: Cristina Manuela Dragoi, Carol Davila University of Medicine and Pharmacy, Romania

SCIENCE MENTORS: Nupur Sharma and Evan Propst

CITATION: Guedes D and Prada M (2025) Sugar: The Master of Disguise. *Front. Young Minds* 13:1506233. doi: 10.3389/frym.2025.1506233

CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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YOUNG REVIEWERS

EMMA, AGE: 13

My name is Emma, and I am 13 years old. I am an actor, singer and dancer, and I like sports such as tennis and snow skiing. I am in grade 7, and my favorite subjects



(other than gym) are science and math. I find science really interesting, and I hope to one day become a surgeon like both of my parents.

**SAATVIK, AGE: 15**

Akash is a curious and enthusiastic 9th-grade student with a deep love for science, especially biology and chemistry. He is eager to explore how different exposures impact human health and enjoys reading science articles, asking thoughtful questions, and thinking like a scientist. Akash aspires to become a healthcare professional and researcher who solves real-world problems and inspires other young minds like himself.

AUTHORS**DAVID GUEDES**

David is a psychology professor and researcher at Iscte—University Institute of Lisbon. His research has been dedicated to understanding how people perceive foods and drinks, as well as the factors that influence their preferences and choices. His areas of interest include promoting sustainable eating practices in public canteens and investigating sugar consumption in school-aged children. In addition to his research, David has worked with ANEIS, an association supporting talented children and adolescents, and he is the author of a children's book on emotions.*dhfgs@iscte-iul.pt

**MARÍLIA PRADA**

Marília is a psychology professor and researcher at Iscte—University Institute of Lisbon. She is trained in experimental psychology and is the director of the Psychology Department of Iscte. Teaching and mentoring young researchers are two of her main passions, and she has authored numerous scientific and educational papers and book chapters. Her research interests include exploring how certain cues (e.g., "organic", "gluten-free", "plant-based", "reduced sugar") influence how people perceive food. She was the main researcher of two research projects focusing on what determines sugar intake in children and adults.