Ultra-Processed Foods

Decoding a Food Transformation with Major Health Consequences

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PART 1

From kitchen to laboratory: how the food industry has transformed what we eat over the past two centuries

For millennia, transforming food was a matter of survival. Salting meat for the winter, fermenting milk to prevent it from spoiling, cooking to aid digestion. The logic was simple: starting from a raw ingredient and applying a few basic steps. In this way, the final product remained identifiable.

Today, walking through supermarket aisles, the contrast is striking. Artificial colors, standardized shapes, long ingredient lists... The simple gestures of the past have given way to complex industrial processes that are impossible to reproduce at home. As a result, ultra-processed foods now represent between 60% and 70% of the food supply in many countries. Some populations are exposed to them in a particularly concerning way, especially younger people. In the United States and the United Kingdom, ultra-processed foods account for more than 60% of the calories consumed by children and adolescents[1-3]. In France, Canada, or Australia, this figure is around 50%. Even in Italy or Brazil, where exposure is lower, it exceeds 25%[4].

How did we get here? What are the health consequences? How can we learn to identify ultra-processed foods in order to limit their presence in our diet?

The birth of industrial food

In 1810, Napoleon was looking for a way to preserve food to feed his troops. A Frenchman, Nicolas Appert, invented a simple process: heating food in sealed containers. This is how modern canning was born! For the first time, food processing became standardized. Fruits and vegetables, fish, and meat could be transported over long distances and stored for long periods[5-7].

With the second industrial revolution, working days became longer. **Food then had to adapt to these new rhythms**: produce more, faster, and be able to store longer. It was in this context that, at the end of the 19th century, these food processing and preservation techniques gradually spread among the civilian population.

It was during this period that brands still omnipresent today were born. Nestlé was founded in 1866 with a milk and wheat formula intended for infants who could not be breastfed[8].

Maggi was founded in 1885 with the first instant soup designed to quickly and cheaply feed a working-class population with little time and limited means[9]. The following year, Coca-Cola appeared, initially as a syrup sold as a tonic to help endure work[10]. Campbell became famous in 1897 with its ready-made canned soups, ideal for urban life and factory work[11]. **Processing was no longer only about preserving: it made it possible to feed increasingly large urban populations**, with foods that were easy to distribute and cheaper to produce.

Coca-Cola advertisement, 1902.

It was also during this period that the industry began to use synthetic substances. Certain dyes, notably derived from coal and sometimes highly toxic, were used to improve the appearance of products and mask their poor quality. These practices quickly led to widespread misuse, to the point that the United States adopted the Food and Drugs Act in 1906, one of the first laws regulating the use of food additives, in order to control the use of these dyes[12].

Nestlé advertisement, 1940.

The two world wars further accelerated this movement. **Millions of soldiers had to be fed with products that were easy to transport, stable, and ready to consume.** Powdered milk, dehydrated soups, canned goods, and packaged rations became widespread[13,14].

At the end of the conflicts, these innovations did not disappear. The factories and processes were already in place. **So, in order to find new outlets for these products, the industry turned toward the civilian market.** Products designed for the military then entered households and gradually transformed everyday eating habits[15].

The rise of ready-to-eat foods

After the Second World War, a period of rapid economic growth began. Reconstruction stimulated activity, and living standards rose rapidly. Households became widely equipped: refrigerators, freezers, and then microwaves entered kitchens.

At the same time, the organization of work evolved. More and more women entered the labor market. Thus, in the United States, the share of women working outside the home rose from around 20% at the beginning of the 1950s to more than 40% in 1970[16]. **The time spent in the kitchen decreased, and the food industry saw an opportunity**: to offer prepared products, ready to eat or to reheat[17]. Advertising campaigns then massively targeted women, promising them a double benefit: time savings and improved nutritional quality[18]. Kellogg's, for example, promoted cereals said to contain "much more vitamins than whole grains themselves," while Kraft cheddar was presented as providing "11 times more calcium than cream and more protein than meat."

Ralston advertisement,
Published in *Collier's*, July 10, 1943.

Frozen meals and portioned dishes multiplied. They were presented as modern, easy to use, and compatible with an increasingly constrained daily life. At this stage, these products were not yet all ultra-processed, but they established a lasting idea: **it became possible to eat without cooking.**

The boom of ultra-processed foods

From the 1970s onward, a new transformation accelerated. It no longer affected just how meals were prepared, but the very nature of food itself.

Agriculture became highly industrialized. Thanks to the massive use of chemical fertilizers and pesticides, the production of certain crops exploded. Corn, wheat, and soy became the pillars of an intensive agricultural system, capable of producing in very large quantities, at low cost.

This overproduction pushed the industry to change its logic: rather than transforming agricultural products as a whole, it began to "break them down" to extract inexpensive components that are easy to store and combine: sugars, oils, starches, proteins. Thus, wheat is no longer only ground into flour: it is also fractionated into industrial ingredients such as starch or maltodextrin, used to give texture to products. At the same time, corn becomes a central raw material for producing industrial sugars, notably glucose syrup, which gradually replaces sugar in many products from the 1980s onward[19].

A special-edition Kool-Aid Barbie (1992), given to children in exchange for points collected from their purchases of sugary drinks.

At the same time, the two tobacco giants, Philip Morris and R.J. Reynolds, invest heavily in the food industry. They seek to diversify their activities in the face of growing criticism of tobacco and the threats to their core business. They acquire major food companies such as Kraft, General Foods, or Nabisco, and **apply a logic already proven in tobacco: use of flavorings, aggressive marketing, and targeting of children**[20-23]. The example of Kool-Aid is revealing: when Philip Morris acquires General Foods in 1985, and with it the sugary drink brand Kool-Aid, the company decides to rely on the existing Kool-Aid Man character to launch a massive marketing campaign targeting children. It notably creates a loyalty program in which children collect points that can be exchanged for branded gifts. This mechanism is directly inspired by the Marlboro program, which allowed smokers to accumulate points to obtain clothing or accessories featuring the brand. A company executive states the following year: "We decided to focus our marketing on children, where we know our strength is greatest"[24].

Television advertisement for Count Chocula, a character created in March 1971 for General Mills' "Monster Cereals" range (1979)

Source : YouTube — https://www.youtube.com/watch?v=7A7OR9Pgl-g

The objective is no longer simply to feed or save time, but to design products that are highly attractive, low-cost, and frequently consumed. Television becomes a central lever, particularly among children. As more than 95% of American households are now equipped with it, food advertisements flood children's programming. Cereals, sugary drinks, and snacks are staged using endearing mascots and catchy jingles, in order to **capture the attention of younger audiences and anchor consumption habits from a very early age**[26].

Faced with these practices, the Federal Trade Commission (FTC) in the United States attempts in 1978 to restrict television advertising aimed at young children. But under pressure from industry, Congress threatens to reduce the FTC's budget, forcing it to abandon this initiative[27].

Advertising is not their only lever to impose these new products. From this period onward, the industry also seeks to act directly on what triggers desire. Specialists in sensory perception and neuroscience are mobilized to understand what makes a food desirable, and to adjust recipes and textures with unprecedented precision. **Ultra-processed foods are no longer only practical and inexpensive: they become products scientifically optimized to maximize consumption… and therefore sales**[28].

Joe Camel: the mascot that made children like cigarettes

This marketing strategy using mascots aimed at children was also used by the tobacco industry for years, which may initially seem surprising for a product intended for adults. The character Joe Camel, mascot of Camel cigarettes launched at the end of the 1980s, is an emblematic example. This cartoon-style camel was designed to attract the attention of younger audiences.

The objective was clear: to familiarize children with the brand very early on, and to create a lasting attachment, so that, once adults, they would naturally turn to these cigarettes. A study published in 1991 showed that six-year-old children recognized Joe Camel as easily as Mickey Mouse, illustrating the power of this type of marketing strategy.[29]

PART 2

Understanding ultra-processed foods, their design and manufacturing logic

What are we really eating when we consume a bag of chips, a cereal bar, or a ready-made meal? For a long time, scientists answered this question by counting nutrients: sugar, salt, and fat content. But since the 2000s, another approach has emerged, which questions not what a food contains, but what it has undergone before it reaches our plate.

So, what are ultra-processed foods and how are they made? And how can we explain why it is so difficult to stop eating them?

What is an ultra-processed food?

The term “ultra-processed food” was introduced for the first time in 2009 by the Brazilian researcher Carlos Monteiro. This marked a turning point. Until then, foods were mainly evaluated based on their nutritional composition: sugar content, salt, fat, protein[1].

But at the turn of the 2000s, a phenomenon caught researchers’ attention. In Brazil, as in many countries, obesity and chronic diseases are increasing rapidly, including among disadvantaged populations that had until then been mainly affected by undernutrition. By analyzing national dietary surveys, Carlos Monteiro’s team observes a profound shift: raw foods and meals prepared from simple ingredients are declining, while ready-to-consume industrial products are taking up an increasing share of everyday diets.

The evolution of eating habits does not come down to a simple increase in sugar, salt, or fat intake. It reflects a more structural transformation: traditional foods and recipes are progressively replaced by standardized industrial products.

However, traditional nutritional analysis tools only make it possible to measure quantities (calories, sugar, salt, etc.) but are not capable of distinguishing a homemade dish from an industrial one. They do not make it possible to describe this change in the nature of food. This is why **Carlos Monteiro and his team propose a new approach: classifying foods according to their degree of processing.** In 2016, this reflection leads to the NOVA classification, which divides foods into four distinct groups depending on their degree of processing and the objective of the processing[2].

NOVA 1 : Unprocessed or minimally processed foods

This group includes fruits and vegetables, cereals, meats, fish, eggs, or milk. These foods may be washed, cut, dried (dried fruits), pasteurized (pasteurized milk), or frozen (frozen fruits or vegetables). But their structure remains largely unchanged, and nothing else is added.

Objective of processing: preserve or make a food consumable without fundamentally altering it.

NOVA 2 : Culinary ingredients

This group includes ingredients used to cook and season foods from group 1. These include, for example, oil, butter, vinegar, sugar, or salt. They are obtained from natural resources or raw foods through different processes, such as extracting salt from seawater or pressing seeds to produce oil. They are generally not consumed on their own, but in small quantities to prepare dishes.

Objective of processing: produce ingredients for cooking.

NOVA 3 : Processed foods

This group corresponds to foods from group 1 to which one or more ingredients from group 2 are added. These products can be prepared at home, in an artisanal setting, or industrially. Examples include bread, cheese, canned vegetables, fruit in syrup, or a homemade cake. They are composed of a limited number of ingredients. In principle, they can be prepared at home with ingredients commonly found in one's cupboards.

Objective of processing: preserve a food or improve its taste with a few simple ingredients.

NOVA 4 : Ultra-processed foods

This group includes industrial formulations that incorporate highly processed ingredients used almost exclusively by the food industry (glucose syrup, maltodextrin, protein isolates, etc.), as well as additives intended to modify texture, color, or taste. These products are designed to be convenient, appealing, and to have a long shelf life.

Objective of processing: create an industrial product ready to consume, convenient, stable, and attractive.

Illustration credits: Yuka

The NOVA classification is therefore based on a central principle: classifying foods according to the way they are processed and the objective of this processing. But this approach raises a practical difficulty. In most cases, the industrial processes used to manufacture a product are not accessible to the consumer: this information is not indicated on the product[3].

In 2019, the Food and Agriculture Organization of the United Nations (FAO) therefore proposes a more operational approach to identifying ultra-processed foods[4]. Rather than relying on manufacturing processes - often invisible to the consumer - **the FAO suggests observing an accessible indicator**: **the ingredient list**, which is mandatory on all packaged products. In fact, certain ingredients and additives are characteristic of ultra-processed foods according to the FAO:

- **Industrial ingredients:** these are ingredients that are not found in a typical kitchen. They are intentionally added to products to modify their structure and/or the cost of production. Examples include hydrogenated oils, hydrolyzed proteins, mechanically separated meats, modified starches, sugar syrups, etc.

- **“Cosmetic” food additives:** ultra-processed foods generally contain several additives that serve to improve appearance, intensify taste, or provide a pleasant texture. They are called “cosmetic” additives because they act on perceptions - visual and sensory - like makeup that gives the illusion of a real food. Among the most common are artificial colorants, sweeteners such as aspartame or sucralose, texture agents such as mono- and diglycerides or certain gums, flavor enhancers such as monosodium glutamate, as well as flavorings.

Thus, according to the approach proposed by the FAO, the presence in the ingredient list of at least one industrial ingredient or cosmetic additive constitutes an indication that a product belongs to the category of ultra-processed foods.

This approach does not replace the NOVA classification, but it makes it easier to apply. By relying on the ingredient list - information accessible on packaging and legally mandatory - the FAO proposes a concrete way to identify ultra-processed foods in practice.

Deconstructing then reconstructing: how the food industry manufactures these products

Unlike a homemade dish, where whole ingredients are combined, ultra-processed foods result from a multi-step industrial process that first breaks down the food’s natural structure before artificially reassembling it.

Step 1: Deconstruction

Everything begins with low-cost raw materials, often derived from large monocultures that are heavily subsidized (corn, wheat, soy, peas, etc.) or from by-products of other sectors (lower-quality cuts of meat, whey from the dairy industry, etc.)[5].

These raw materials are not used as they are. They are processed to extract their different components. **The food industry “takes them apart” by separating proteins, sugars, fibers, or fats.** This step makes it possible to obtain standardized ingredients: powders, oils, or syrups, often colorless and sometimes almost tasteless.

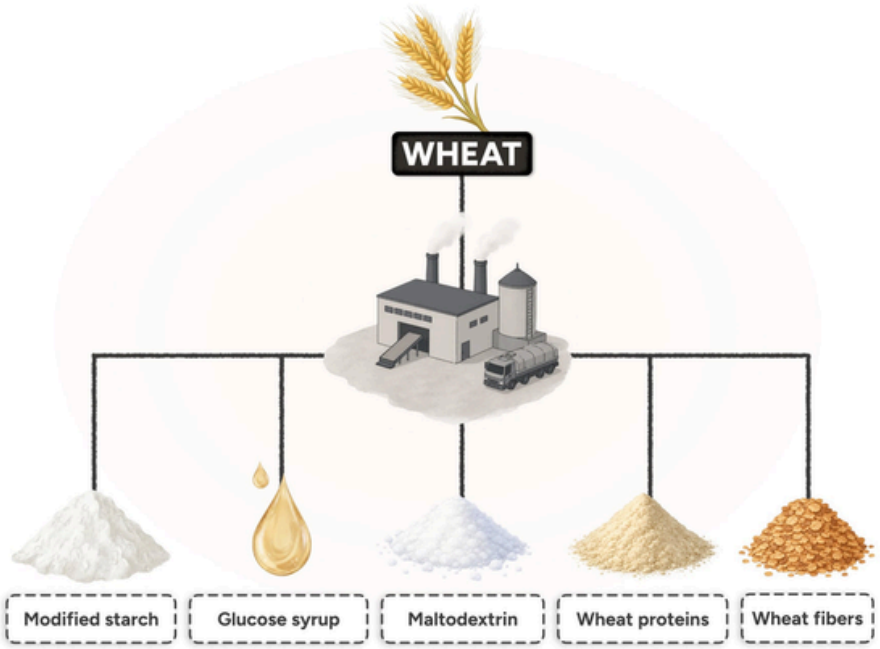


Illustration credits: Yuka

During this process, **the natural structure of the food is profoundly altered.** What researchers call the “matrix” - the complex organization that links nutrients together and notably influences how they are digested - disappears. The food is no longer a coherent whole, but rather a series of isolated components ready to be reassembled[6-8].

Step 2: Reconstruction

Once the components are separated, they must be given form again. These powders, oils, and syrups no longer have the appearance or texture of a food: they must therefore be reassembled to become a consumable product.

Concretely, all these elements are mixed and reworked to form a uniform preparation. The objective is to obtain a stable product: a sauce that does not separate, a cream that always remains smooth, a biscuit identical from one batch to another.

It is at this stage that additives come into play. Texturizing agents are added to provide softness or crispness. Emulsifiers are used to create a creamy texture. Colorants add an attractive shade. Flavorings are used to recreate the taste of a fruit, meat, or another ingredient that may not actually be present in the product[9].

The preparation can then be shaped using industrial processes such as extrusion cooking. This technique consists of subjecting the material to high pressure and high temperature,

then passing it through a mold that gives it its final shape. Under the combined effect of heat and pressure, the texture is deeply modified: the material can become airy and crispy. This is how many breakfast cereals or certain puffed snack products are made.

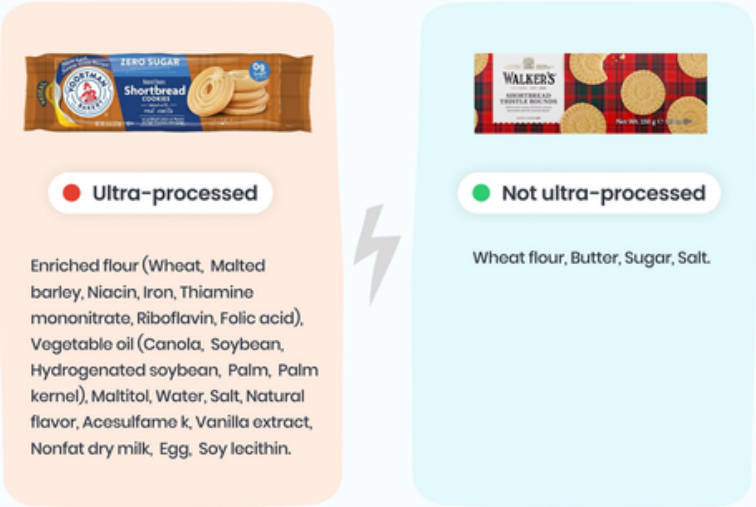
At the end of this stage, it is no longer simply a processed food, but an industrially constructed product.

How to differentiate a processed food from an ultra-processed food?

Transforming a food is an ancient practice and often necessary to facilitate preservation, improve digestibility, or simply make foods more palatable. For example, milk can be fermented to make yogurt, overripe fruit can be cooked to turn it into compote, bread can be made from flour, or a simmered dish made of meat and vegetables can be prepared and kept for several days. Processed foods (NOVA 3) fit within this logic. They can, in principle, be prepared in a home kitchen with common ingredients.[11]

The shift toward ultra-processing occurs when the product is no longer simply "prepared," but "constructed." It is no longer a matter of assembling familiar ingredients, but of combining highly modified ingredients and additives to artificially recreate a texture, taste, or appearance, often very far from the original food. The objective is no longer only to preserve or improve an existing food, but to create a standardized, attractive, and highly profitable product.[12]

Let us take the example of a cake. A homemade cake generally contains flour, eggs, butter, and sugar. Its ingredient list is short and understandable. It costs between 3 and 5 euros to produce and keeps for less than five days in the refrigerator. By contrast, an industrial cake may contain glucose syrup, refined oils, modified starches, flavorings, or emulsifiers: its ingredient list is much longer and contains substances not found in a typical kitchen. It costs around 30 cents to produce and can be stored for several months on a supermarket shelf.[13]



Products designed to be irresistible

The design of ultra-processed foods does not aim only to produce practical and low-cost products. It also pursues a central objective for the food industry: **maximizing the pleasure experienced during consumption.** To achieve this, companies rely on teams specialized in sensory optimization[14].

One of the key notions in this field is the "bliss point". This concept was developed in the 1970s by the American psychologist Howard Moskowitz, trained at Harvard. A researcher specializing in the study of taste, he published several scientific works at the time on the relationship between sugar concentration and perceived pleasure, showing that pleasure increases with the quantity of sugar and then decreases when the concentration becomes too high. **These results are also valid for the quantity of salt or fat: there exists a precise level at which taste is judged "just right"**[15].

Illustration credits: Yuka

In the 1980s, Moskowitz became a consultant and applied these methods to the food industry. To help brands optimize their recipes, Moskowitz developed a method based on large-scale sensory tests. Hundreds of people tasted different versions of the same product, whose proportions of sugar, salt, or fat varied slightly. By analyzing their preferences, he

identified the precise combination of these elements that maximizes taste pleasure. Neither too much nor too little: it is the perfect balance that makes a product irresistible. **When a product reaches this threshold, it becomes particularly difficult to limit its consumption.**

The method quickly achieved considerable success in the food industry. During the 1980s and 1990s, many major brands including Pepsi, Unilever, Dr Pepper, and Tropicana turned to these sensory optimization techniques to refine their products. A frequently cited example is Campbell's, which asked Howard Moskowitz in 1986 to work on its Prego tomato sauce, which was then losing momentum. Consumer testing made it possible to identify the levels of sugar, salt, and fat that provided the greatest satisfaction. The recipe was then adjusted to reach this optimal level of pleasure - the bliss point - and the product went on to achieve significant commercial success[16-17].

From the 1990s onward, these techniques became even more sophisticated. **Methods from neuroscience were used to directly analyze the brain's reactions to food.** Rather than limiting themselves to what people say they like, they seek to measure brain signals associated with pleasure and reward. Some neuroscientists use brain imaging to observe brain activity during the tasting of different foods[18].

This research shows that certain foods strongly activate brain circuits linked to reward. This is particularly the case for products rich in sugar and fat, which stimulate the release of dopamine, a neurotransmitter associated with the sensation of pleasure. **This knowledge is progressively integrated into the design of food products.** Manufacturers seek to reproduce the sensory characteristics that trigger the strongest pleasure responses[19].

Researchers then begin referring to **"hyper-palatable" foods: products designed to provoke a particularly intense response from the reward system.** These foods are designed to offer a multisensory experience mobilizing all five senses. Thus, their taste, texture, smell, or appearance are carefully engineered in order to make the consumption experience particularly rewarding[20].

The foods that activate these circuits the most often combine high amounts of sugar and fat, a combination rarely found in natural foods. For example, fruits are rich in carbohydrates but low in fat, while salmon or nuts are rich in fat but low in carbohydrates. This combination of sugar and fat can amplify the reward response and encourage repeated consumption[21,22].

Some researchers suggest that these **hyper-palatable foods may mimic certain mechanisms of addiction**: by activating the same brain reward circuits as certain drugs, they could promote compulsive consumption behaviors[23,24]. Two factors would explain this similarity: the high concentration of ingredients that are highly rewarding for the brain, and their particularly rapid absorption by the body. To study this phenomenon, scientists have developed a scale called the Yale Food Addiction Scale, aimed at identifying addictive behaviors related to food. An analysis combining more than 280 studies based on this scale estimates that around **14% of adults and 12% of children show signs of food addiction linked to the consumption of ultra-processed foods**[25,26].

PART 3

Numerous and increasingly well-documented health risks

Over the past decade, a growing number of scientific studies have established a link between high consumption of ultra-processed foods and an increased risk of numerous chronic diseases. Studies also suggest a link with certain mental health disorders, such as depressive symptoms or cognitive impairments.

For a long time, these effects were attributed solely to their poor nutritional composition: too much sugar, salt, or fat. However, recent research suggests a more complex reality. Several studies show that the negative effects of ultra-processed foods persist even when calorie intake and nutritional content are comparable, suggesting that the issue is not limited to nutrients alone, but also relates to the very nature of these products and the processes used to manufacture them.

Strong evidence now exists for several major risk factors

Today, more than a hundred studies converge on the same conclusion: **high consumption of ultra-processed foods is associated with an increased risk of numerous chronic diseases**, including obesity, type 2 diabetes, cardiovascular and cerebrovascular diseases, hypertension, dyslipidemia (an imbalance in cholesterol and/or triglycerides), as well as certain cancers[1-9]. Research also points to associations with depressive symptoms, cognitive disorders, sleep disturbances, and higher overall mortality[10-12].

These findings are now supported by **a body of converging evidence using complementary scientific methodologies**: meta-analyses, umbrella reviews, large cohorts followed over several years, cross-sectional studies, and, more recently, randomized controlled trials. Furthermore, these results have been observed across many countries, at different stages of life, and in large and diverse populations, which strengthens the robustness of the associations identified.

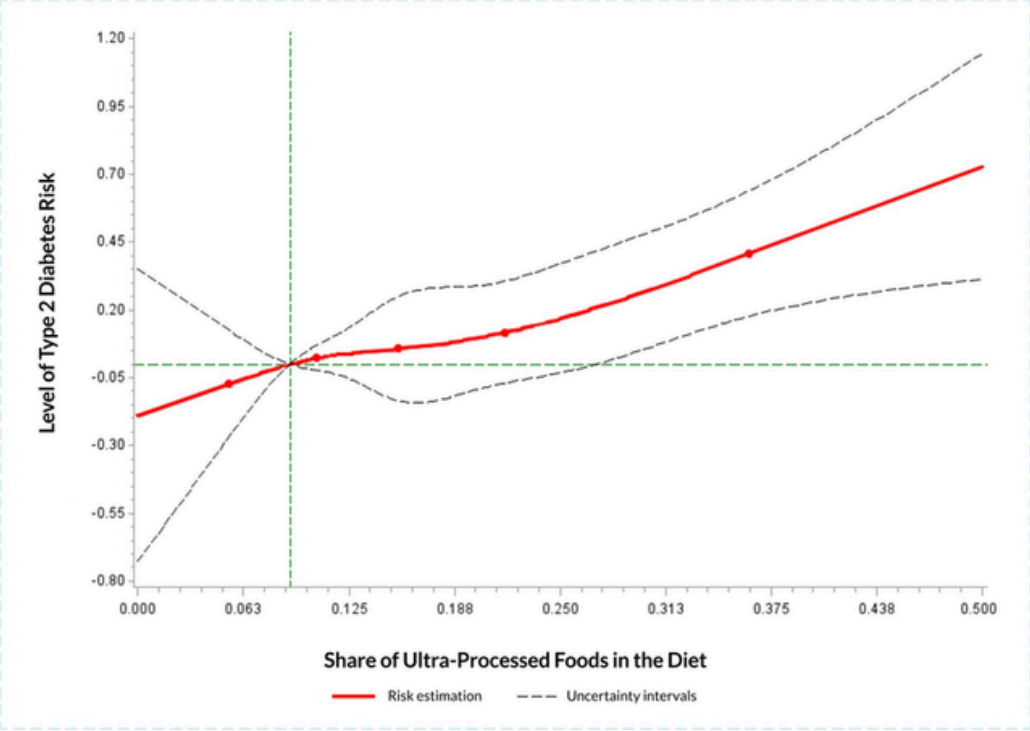
Cardiovascular risk is among the most well-documented effects. An analysis published in 2024 involving more than 200,000 U.S. adults followed over several decades showed that high consumption of ultra-processed foods was associated with a significant increase in the risk of cardiovascular diseases, particularly heart attacks and strokes. In this study,

participants consuming the most ultra-processed foods had an **11% higher risk of cardiovascular disease and a 16% higher risk of coronary disease** compared with those consuming the least, even after adjusting for numerous factors such as smoking, physical activity, and overall diet quality[12].

Robust associations have also been observed for other chronic diseases, particularly type 2 diabetes, obesity, and certain cancers. This is notably the case for findings from the French NutriNet-Santé cohort, one of the largest nutrition cohorts in the world. Its results are striking: **an increase of just 10% in the proportion of ultra-processed foods in the diet is associated with**[13-15]:

- **+12%** risk of **overall cancer**
- **+11%** risk of **breast cancer**
- **+15%** risk of **type 2 diabetes**
- **+11%** risk of **overweight**
- **+9%** risk of **obesity**

These associations follow a dose-response pattern: **the greater the proportion of ultra-processed foods in the diet, the higher the risk tends to be.** In other words, these effects do not concern only individuals who consume them excessively. Even at moderate levels, a gradual increase may already be associated with a progressive rise in risk. Conversely, reducing their share in the diet could help lower this risk.



The higher the consumption of ultra-processed foods, the higher the risk of type 2 diabetes

Source: adapted from Srour et al., JAMA Internal Medicine, 2019., 2019.

Recent syntheses go even further by ranking these associations according to their level of evidence. Umbrella reviews and meta-analyses published in 2024 and 2025 - meaning studies that aggregate and assess the best available evidence according to strict quality criteria - confirm that **the link between high consumption of ultra-processed foods and certain diseases is supported by strong evidence.**

The 2024 umbrella review analyzed data from 9.9 million individuals across 14 independent, high-quality studies. It identified direct associations between the consumption of ultra-processed foods and an **increased risk of 32 health outcomes.** The researchers then identified the associations supported by the highest levels of evidence:

🧠 **Mental disorders**	Class I
😰 **Anxiety**	Class I
🫀 **Cardiovascular mortality**	Class I
🩸 **Type 2 diabetes**	Class II
🌩️ **Depressive symptoms**	Class II
⚖️ **Obesity**	Class II
🛌 **Sleep disorders**	Class II
🪦 **All-cause mortality**	Class II
🎗️ **Cancer (all types)**	Class III
📏 **Abdominal obesity**	Class III
🩺 **Hypertension**	Class III
📊 **Overweight**	Class III

Class I: convincing evidence; Class II: highly suggestive / very likely evidence; Class III: suggestive / probable evidence

Source: umbrella review (Lane et al., 2024)[16]

These findings are supported by a large meta-analysis published in 2025 in The Lancet, one of the most prestigious and widely cited medical journals, conducted with the participation of 20 experts from around the world. Of the 104 studies analyzed, covering large populations across several continents and different life stages, 92 showed a significant increase in risk for more than a dozen health problems.

This meta-analysis found, in particular, **an approximately 18% increase in all-cause mortality risk** among individuals consuming the highest amounts of ultra-processed foods. It also identified strong associations with several other conditions, including a 90% increased risk of Crohn's disease, a 33% increased risk of abdominal obesity, and a 26% increased risk of dyslipidemia.

Overall, the observed effects involve nearly all major systems of the body, suggesting that ultra-processed foods may impair health through multiple distinct mechanisms.

Other concerning effects under investigation

For some conditions, the evidence is still being consolidated, but the available findings are sufficiently concerning to warrant attention. This is notably the case for gut health, reproduction, and liver health.

Gut health

Ultra-processed foods are **particularly harmful to the gut microbiota**, the community of billions of microorganisms that play a central role in health. This is due both to their unfavorable nutritional profile and to the presence of numerous additives that can disrupt the composition and balance of this fragile ecosystem[17,18].

This unfavorable nutritional profile, characterized by low levels of fiber and bioactive compounds, and a high content of rapidly absorbable nutrients, **hinders the growth of beneficial gut bacteria while promoting less favorable species**. Gradually, an imbalance in the microbiota develops: this is what is known as dysbiosis[19].

There can be multiple consequences. Metabolically, dysbiosis can disrupt insulin regulation, promote fat storage, increase cravings for sugar and fat, and lead to persistent fatigue. Studies also highlight its role in the development of certain mental health disorders, such as anxiety and depression. An imbalanced microbiota can disrupt the synthesis of certain neurotransmitters, such as serotonin and dopamine, which may negatively affect motivation, mood, and overall mental health[20,21].

In addition, some additives commonly found in ultra-processed foods - particularly emulsifiers and sweeteners - may impair the intestinal barrier and increase its permeability. Pro-inflammatory compounds can then enter the bloodstream and contribute to chronic low-grade inflammation, which is now considered a contributing factor in many chronic diseases, including type 2 diabetes, obesity, inflammatory bowel disease, certain cancers, and non-alcoholic fatty liver disease[22-25].

Reproductive health

A clinical trial published in 2025 showed that in just three weeks, a diet high in ultra-processed foods was sufficient to **alter several markers of male reproductive health**: reduced sperm motility, decreased sperm quality, and disruption of certain hormones involved in fertility, including testosterone. **This finding is particularly striking because it was observed under equal caloric conditions**, suggesting that the issue lies not in the quantity consumed, but rather the nature of the foods consumed[26].

Effects on the liver

Recent literature suggests **an association between high consumption of ultra-processed foods and an increased risk of non-alcoholic fatty liver disease**, commonly referred to as "fatty liver disease." This condition appears to be promoted in particular by the high levels of industrial sugars found in these products, especially high-fructose syrups.

Excess fructose stimulates fat production in the liver. Moreover, when the absorptive capacity of the small intestine is exceeded, some of the unabsorbed fructose becomes an easily accessible food source for certain bacteria that are less favorable to the balance of the gut microbiota, which may further exacerbate dysbiosis[27,28].

The liver plays a central role in overall health, contributing to many metabolic functions, including the regulation of sugars and fats and the elimination of certain substances. According to findings from three large cohort studies conducted in the United States and the United Kingdom, involving more than 250,000 individuals, part of the negative effects associated with ultra-processed foods may be explained by their impact on the liver and on inflammatory mechanisms. Researchers estimate that **these disruptions may account for approximately 20–30% of the observed associations** between ultra-processed food consumption and certain health risks[29].

A problem that goes beyond calories

For a long time, ultra-processed foods were primarily considered problematic because they are too high in fat, sugar, or salt. However, recent research suggests that **their effects cannot be explained solely by their nutritional composition.**

Several studies have therefore sought to determine whether the observed effects could simply be explained by the fact that ultra-processed foods are often higher in calories, sugar, salt, or fat. However, in many cohorts**, associations with obesity and other health outcomes persist even after adjusting for these nutritional factors.** A review published in 2022 concluded that the observed effects do not appear to be fully explained by nutritional composition alone[30].

Clinical trials support this conclusion. The most notable study on this topic was published in 2019 by a team from the U.S. National Institutes of Health (NIH)[31]. In this controlled trial, twenty adults were successively assigned to two diets: one composed mainly of ultra-processed foods, the other of minimally processed foods. The meals were designed to be comparable in terms of calories offered, sugar, salt, fat, protein, carbohydrates, and fiber.

Participants were free to eat as much as they wanted. **The result: when consuming the ultra-processed diet, participants ate about 500 more calories per day and gained an average of 0.9 kg in just two weeks.** Conversely, when following the minimally processed diet, they lost an average of 0.9 kg over the same period. This study marked an important turning point, as it was one of the first to experimentally demonstrate that foods with similar nutritional profiles can produce very different effects depending on their level of processing.

Similar findings were observed in a randomized trial published in 2025 in Nature Medicine[32]. Researchers compared two diets that both met UK nutritional recommendations, but one was composed mainly of ultra-processed foods and the other of minimally processed foods. **Despite broadly comparable nutritional profiles, participants lost about twice as much weight on the minimally processed diet.** Once again, these findings suggest that the effects of ultra-processed foods cannot be explained solely by their content of calories, sugar, salt, or fat.

One explanation proposed by researchers relates to the physical characteristics of ultra-processed foods. **Their textures, often soft or crunchy, require little chewing and promote rapid consumption.** Eating quickly disrupts satiety mechanisms and may lead to increased calorie intake. This hypothesis is supported by a study published in 2025. Researchers observed that foods eaten more slowly spontaneously led to a consumption of about 369 fewer calories per day than foods consumed quickly, despite comparable nutritional profiles. These findings suggest that food texture and eating rate may play an important role in the effects associated with ultra-processed foods.

PART 4

Mechanisms at play: how ultra-processed foods disrupt the body

The risks associated with ultra-processed foods cannot be explained by a single cause: their impact on health relies on a set of interconnected mechanisms. Below is an overview of the main mechanisms involved.

An unbalanced nutritional composition

Ultra-processed foods generally have an unfavorable nutritional profile. They are high in sugars, salt, and fats, while being low in fiber, vitamins, minerals, and bioactive compounds such as polyphenols[1]. **They are often described as "empty calories": high in energy, but low in beneficial nutrients**[2,3].

The data confirm this. A study published in The Lancet in 2024 shows that **two-thirds of ultra-processed foods also have a poor nutritional profile, with too much saturated fat, salt, or sugar**[4]. Similarly, in the United States, nearly 90% of added sugars consumed come from ultra-processed foods[5].

Sugar is also deliberately added, even to savory products, to reach the bliss point, the level of sensory pleasure that drives increased consumption. A U.S. study of more than 200,000 products confirms this: Even in foods we do not typically associate with sugar, added sugars account for a significant share of calories: 2.9% in industrial pizzas, 4.4% in sandwiches and hamburgers, and up to 10% in sauces[5].

However, poor nutritional composition does not explain everything. One of the key findings of recent research is that the negative effects of ultra-processed foods persist even when their nutritional profile appears acceptable[6,7].

The destruction of the food matrix

Imagine a pearl necklace. The pearls represent the natural components of a food: sugars, fats, proteins, fiber, vitamins, etc. The thread represents what holds them together: their natural structure. This is the metaphor used by researcher Anthony Fardet to describe the food matrix[8]. In an apple, a handful of almonds, or an egg, this structure remains intact: everything is naturally connected and organized.

During the production of ultra-processed foods, this thread is broken. **Industrial processes dismantle foods, isolate their components, and then attempt to recreate the structure artificially using additives** such as gums, modified starches, or emulsifiers. The result may resemble food, and even mimic its taste and color through the addition of flavorings and dyes, but its natural structure is gone[9].

Yet this structure is essential. As Anthony Fardet puts it: “the matrix governs, and nutrients obey.” Take the example of a strawberry: it contains vitamin C, which interacts with its fibers, natural sugars, and the hundreds of other compounds present in the fruit. It is this synergy that produces the beneficial effects. When vitamin C is extracted and incorporated into an industrial product, this synergy disappears. The nutrient may still appear on the label, but it has lost much of its beneficial effect. The effect may even reverse: when isolated and consumed at high doses, vitamin C can become pro-oxidant, meaning that instead of protecting cells, it may contribute to damaging them[10].

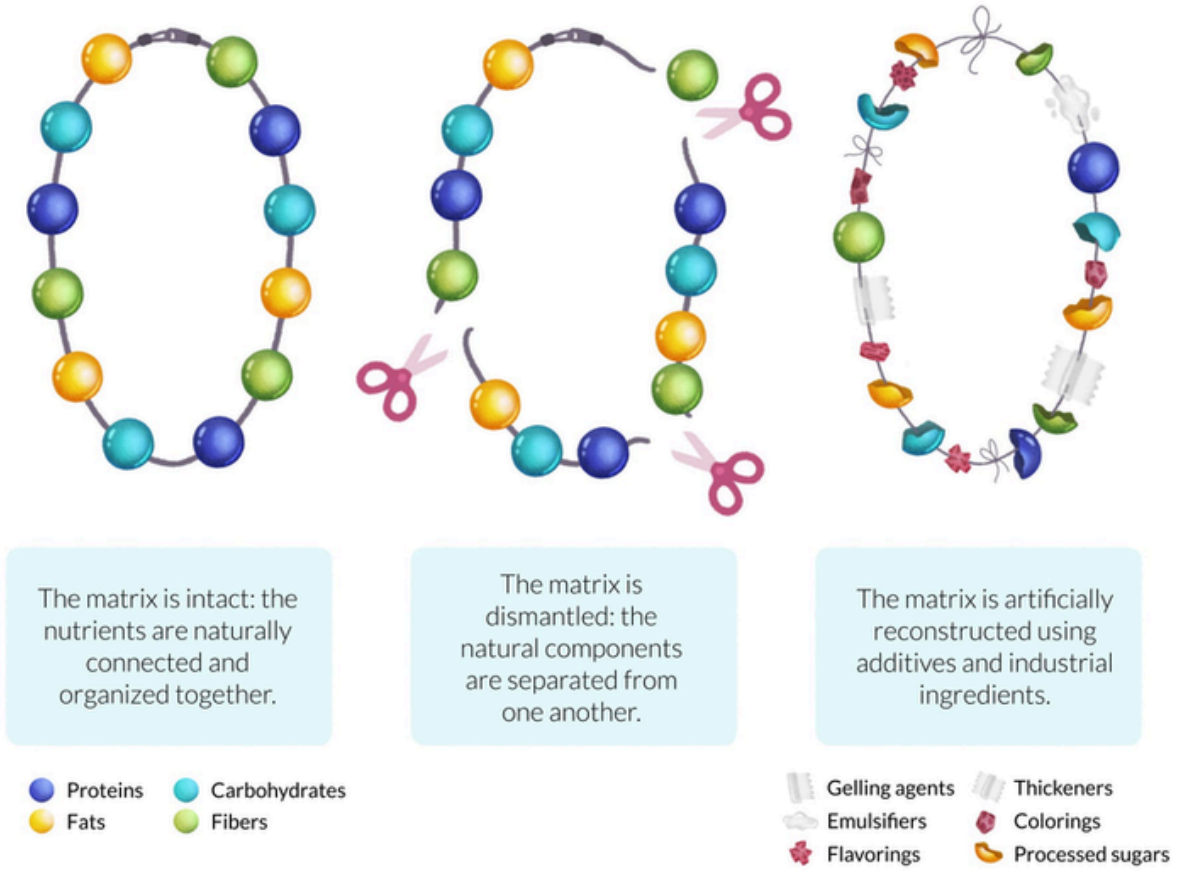


Illustration inspired by researcher Anthony Fardet’s “pearl necklace” analogy

Illustration credits: Yuka

To understand why the food matrix is so important, we need to look at our digestive enzymes. They can be imagined as little Pac-Men, the video game characters that gobble up everything in their path. Their role is to break down the food we eat in order to extract nutrients and release energy. But before they can access those nutrients, they first have to pass through the food's structure. **When the matrix is intact, the nutrients are well protected within dense, fibrous cell structures**[11].

However, our little Pac-Men (the enzymes) have a biological limitation: they are unable to digest the fibers present in the matrix. These fibers act like indestructible walls in a maze - the enzymes cannot pass through them and must work their way around them. As a result, they move slowly, search for a path, and work hard before reaching the nutrients. **Energy is therefore released gradually throughout digestion**[12].

But when the matrix is destroyed, the nutrients are already exposed. Enzymes can access them much more quickly and with little effort, leading to a very high influx of energy into the body, particularly from sugars and fats. In the case of sugars, this results in a blood sugar spike, a sudden rise in blood glucose levels[13]. In other words, ultra-processing pre-digests food for us before we even begin eating.

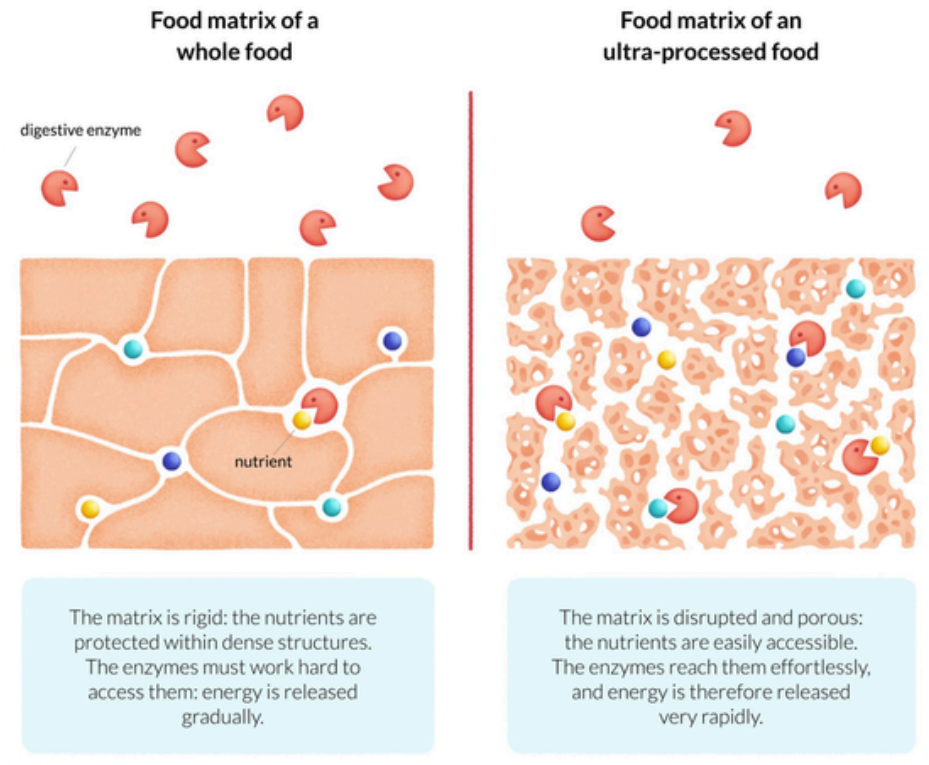


Illustration credits: Yuka

The example of rice cakes illustrates this very well. When cooked rice is consumed, the structure of the grain remains largely intact, particularly in the case of brown rice: our enzymes must work to extract the carbohydrates. **In contrast, in a rice cake, this structure has been completely destroyed through processing:** the carbohydrates then become much more rapidly accessible, resulting in a faster and higher blood sugar spike[14,15].

The destruction of the matrix also has another, less visible effect: it significantly reduces the need to chew. A complex matrix naturally requires mastication. But because their structure has been broken down, ultra-processed foods are often soft, liquid, or highly aerated. They require little effort to eat and can be consumed very quickly[16].

Chewing, however, plays a key role in satiety. The more we chew, the more the brain understands that a meal is being consumed and begins sending satiety signals. This signal takes around twenty minutes to kick in[17]. With ultra-processed foods, which can be consumed in just a few minutes, a massive amount of calories is absorbed before any feeling of fullness is even perceived[18].

This helps explain why eating three apples in a few minutes feels almost impossible, whereas drinking a large glass of apple juice poses no difficulty at all. **The apple still retains its matrix: it requires chewing and promotes satiety. The juice, by contrast, has an almost nonexistent matrix: it goes down effortlessly**[19]. These mechanisms could help explain why diets composed of ultra-processed foods lead to higher calorie intake[20].

A 2018 study provides further insight: the human brain is unable to accurately estimate the caloric density of foods that combine high amounts of both fat and carbohydrates, a combination that is very common in ultra-processed foods, but rarely found in nature. **When faced with an ultra-processed food, the brain simply cannot properly assess how much energy has been consumed**, which completely disrupts satiety regulation[21].

Additives with concerning effects

Ultra-processed foods typically contain numerous so-called “cosmetic” additives, used to enhance appearance, taste, and texture. These substances are far from trivial and fall into several categories with potentially concerning effects.

🧪 Food colorings that manipulate our perception

We are naturally drawn to colorful foods, and manufacturers make use of this. Artificial dyes are widely used, especially in products aimed at children, to increase appeal and encourage consumption. Colors directly influence emotions, and **bright colors can promote an emotional attachment to certain products from an early age**, shaping long-term food preferences[22].

Color even influences our perception of taste. In one study, different colorings were used in a cherry-flavored drink. When the drink was orange, nearly 20% of participants said it tasted like orange. When it was green, 26% of participants said it tasted like lime[23].

In addition, several studies suggest an association between artificial dye consumption and increased hyperactivity or attention deficit disorders (ADHD) in children[24-26].

🍓 Flavor enhancers that disrupt satiety mechanisms

Flavor enhancers are used to intensify taste and increase palatability. The most well-known is monosodium glutamate (MSG), responsible for the umami taste, sometimes referred to as the “fifth taste.” Umami exists naturally, and it comes from glutamate, an amino acid found in foods such as parmesan or seaweed. Biologically, this taste sends a signal: it tells our body that proteins are about to reach the stomach.

The issue is that the artificial glutamate added to products such as chips or ready-made meals sends the same signal without the corresponding protein. The brain anticipates something that never arrives. **As a result, the satiety signal is not properly activated, hormones are disrupted, and we continue eating without really understanding why**[27].

🍮 Texture agents that weaken the microbiota

Thickeners, emulsifiers, gelling agents... These additives modify the texture of foods to make them softer, smoother, and more pleasant in the mouth. In doing so, they reduce the need for chewing and, as we have seen, disrupt satiety signals.

But their effects do not stop there. **Studies suggest that these additives may disrupt the gut microbiota, an essential pillar of human health that remains widely underestimated**, and make the intestine more permeable, allowing toxins and microorganisms that do not belong there to pass into the bloodstream[28,29].

This imbalance can impair insulin regulation, increase cravings for sugary and fatty foods, and cause persistent fatigue. Even more concerning, an altered gut microbiota can trigger a silent but chronic inflammatory state, often without visible symptoms, which serves as the starting point for many diseases such as type 2 diabetes, obesity, certain cancers, and autoimmune diseases[30-32].

🥣 Sweeteners that disrupt glycemic regulation

Intense sweeteners such as aspartame, sucralose, and acesulfame-K emerged a few decades ago as a miracle solution for providing a sweet taste without the calories. However, a growing number of studies are now highlighting their concerning effects on health.

These substances activate the sweet taste receptors on the tongue, just like sugar does. And this is where the problem lies: they deceive the body. By perceiving the sweet taste, the body prepares to receive sugar and releases insulin… even though no sugar actually arrives. **Over time, this mechanism could promote insulin resistance, a common precursor to type 2 diabetes**[33,34]. Some researchers suggest these substances may even contribute to the global obesity epidemic, a paradox given their positioning as weight-control tools[35-37].

Studies have also reported an association between regular sweetener consumption and an increased risk of certain cancers. Regarding aspartame, research from 2022 suggests an elevated risk from consumption levels as low as half a can of soda per day[38]. In 2023, it was classified as “possibly carcinogenic” (Group 2B) by the International Agency for Research on Cancer (IARC)[39].

The cocktail effect: when risks accumulate

Ultra-processed foods rarely contain a single additive. In reality, they are often made up of a true “cocktail” of substances. However, the safety of additives is mainly assessed individually, without taking into account possible interactions between them.

This is what researchers set out to investigate in a study published in 2025[40]. They recreated several mixtures of additives similar to those found in everyday products, and then observed their effects on human cells. The result: some additives that show no toxic effects when studied alone become problematic when combined with others[41].

This is the core issue: in real-life conditions, we are exposed to these combinations every day, sometimes at every meal. Yet the effects of these mixtures remain poorly understood.

The presence of contaminants

Ultra-processed foods may also expose us to undesirable substances known as contaminants. These can form during industrial processing or through contact with packaging.

Contaminants formed during industrial processes

Certain processes, particularly high-temperature cooking methods (smoking, frying, grilling, etc.), promote the formation of so-called "process contaminants"[42]. These processes give foods their characteristic taste or color, such as the toasted flavor of crispbreads or the appealing browning of nuggets. But they can also generate substances associated with harmful effects. Among them are:

- **Acrylamide**, a substance classified as "probably carcinogenic," which can be found in fried or baked products (chips, biscuits, coffee, etc.)[43,44];
- **PAHs (polycyclic aromatic hydrocarbons)**, produced during intense cooking and smoking, some of which are carcinogenic[45,46];
- **Nitrosamines**, a group of compounds, some of which are classified as "probably carcinogenic," that can form in certain processed meats containing nitrites[47,48];
- **Glycidol** (classified as "probably carcinogenic") and **3-MCPD** (classified as "possibly carcinogenic"), which can form during the high-temperature deodorization of vegetable oils widely used in ultra-processed foods[49];
- **4-MEI**, a substance classified as "possibly carcinogenic," formed during the production of certain caramel dyes[50].

These contaminants are not exclusive to industrial processes. Some, such as PAHs and acrylamide, can also form at home during high-temperature cooking, for example, when bread or meat is heavily charred, or when barbecuing. Others, however, are more specifically linked to industrial processes, such as vegetable oil refining (3-MCPD, glycidol), processed meat production (nitrosamines), or the manufacture of certain additives, such as caramel dyes (4-MEI).

Contaminants from packaging

Ultra-processed foods are often designed to have a long shelf life. They are therefore **packaged in complex materials (plastics, inks, adhesives), which may themselves contain undesirable substances.** Some of these substances can migrate from the packaging into the food: a phenomenon known as migration.

Several factors promote this phenomenon, including storage time, heating the product in its packaging, and the presence of fat in the product, all of which facilitate the transfer of certain compounds[51,52].

Among the main contaminants involved are:

- **Phthalates and bisphenols**, used in certain plastics, several of which are suspected or proven endocrine disruptors[53,54];
- **Mineral oils (MOSH and MOAH)**, originating in particular from packaging inks and adhesives, some of which are recognized as genotoxic, carcinogenic, and harmful to fetal development[55,56];
- **Micro- and nanoplastics**, tiny particles that can detach from packaging and migrate into food[57].

Several studies suggest that individuals who consume more ultra-processed foods have higher levels of some of these contaminants in their bodies.

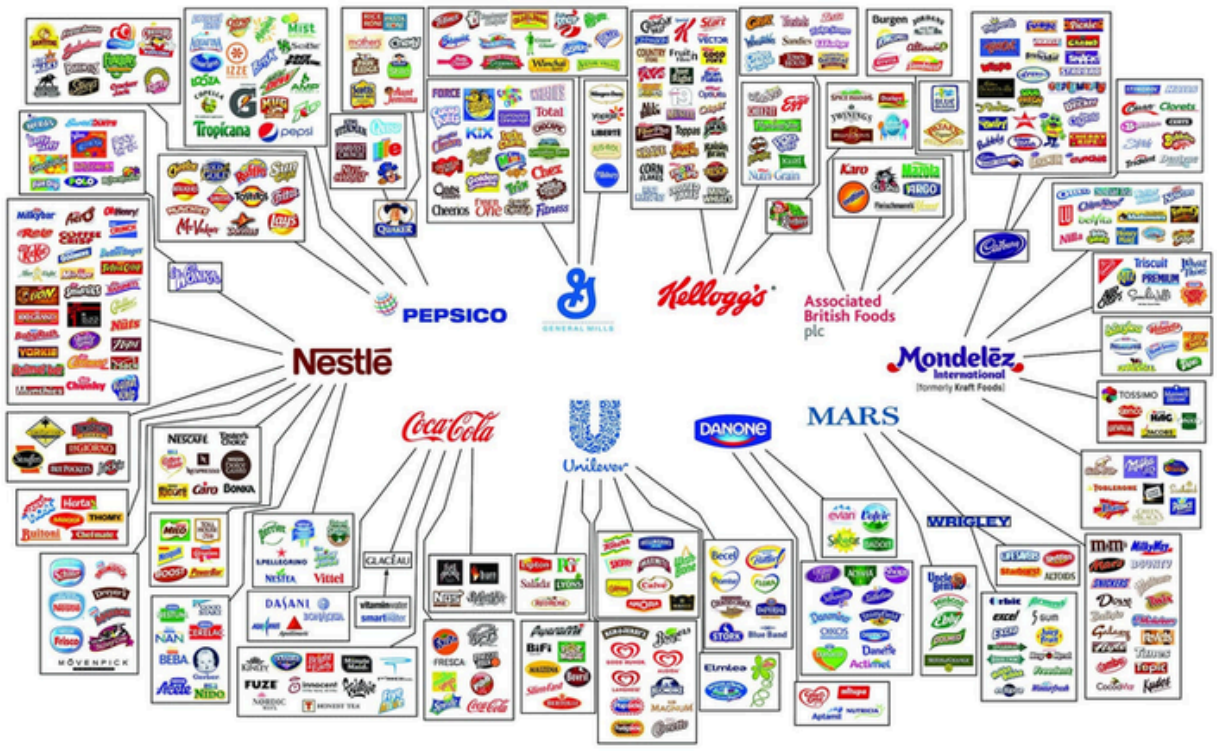
PART 5

A system that makes change difficult

Why, despite the growing body of evidence, do ultra-processed foods still occupy such a dominant place in our societies? Far from being simply the result of poor individual choices, this situation is in fact the product of a system - economic, marketing, and political - structurally designed so that nothing changes.

A system dominated by a few giants that set the rules

Behind ultra-processed foods lies a small number of multinational corporations that largely dominate the global market. Eight companies - Nestlé, PepsiCo, Unilever, Coca-Cola, Danone, FEMSA, Mondelez, and Kraft Heinz - alone accounted for around 42% of a market estimated at $1.5 trillion in 2021. In other words, **nearly half of the global market is controlled by just a few groups**[1].



The Illusion of Choice — Oxfam International (via Visual Capitalist, 2016)
Behind hundreds of brands, a handful of multinationals concentrate most of the market, creating the illusion of wide consumer choice.

Such concentration gives them considerable economic power. When so few players carry such weight, they do not merely sell products: they can also influence the rules of the game[2,3]. **This power is reflected in lobbying activities, ties with decision-making bodies, and the ability to slow down regulations perceived as unfavorable.**

In the United Kingdom, for example, a 2024 investigation showed that some members of the scientific committee advising the government on nutrition had financial ties to major food companies[4]. **Even the World Health Organization has faced pressure:** the Sugar Association, the main lobby of sugar producers in the United States, threatened to involve the U.S. government to reduce its funding after the WHO highlighted the link between sugar consumption and chronic diseases[5].

This power serves a clear objective: profitability. Most of these companies, such as Nestlé, PepsiCo, Coca-Cola, Unilever, Mondelez, and Danone, are publicly traded. They must therefore constantly meet shareholder expectations, with **a central requirement: continuous profit growth**[6].

Ultra-processed foods emerge as an ideal model. They rely on low-cost ingredients, often derived from intensively farmed crops that are heavily subsidized, such as corn, soy, or sugar cane. Between 2022 and 2024, $126 billion in agricultural subsidies were allocated to sugar, corn, and rice, key components of these products[7]. **A small number of inexpensive raw materials can then be transformed into products sold at much higher prices**, thanks to industrial processes, flavorings, and additives. These products also offer decisive logistical advantages: long shelf life, ease of transport, and minimal waste. The result is controlled costs, very high volumes, and substantial margins[8,9].

At a global level, ultra-processed foods hold a dominant position. They account for around half of the stock market value of the food industry: nearly $1.5 trillion in market capitalization is based on these products. This dominance is also reflected in shareholder returns: **ultra-processed food companies distribute around 10% of their revenues to shareholders**, compared with just 1.4% for companies selling unprocessed or minimally processed foods. This dynamic is long-standing: between 1982 and 2021, the amounts paid annually to shareholders by Coca-Cola and PepsiCo increased by more than 9- and 16-fold respectively[6].

In this context, any shift toward healthier diets directly conflicts with financial market expectations. Reducing the share of ultra-processed foods would mean, for these companies, calling into question the most profitable products in their portfolios.

This tension is also visible in corporate governance. **The dismissal of Emmanuel Faber**, former CEO of Danone, in 2021 is a striking example. Faber had committed the group to a strategy placing greater emphasis on health, product quality, and sustainability. However, **under pressure from certain investment funds, this direction was deemed incompatible with financial performance expectations**. He was ultimately forced to step down[10].

Emmanuel Faber in 2019, While still CEO of Danone

© Abaca Press / Alamy

Ultra-processed foods are thus at the heart of an economic system that makes them particularly difficult to challenge.

Omnipresent marketing that shapes our behavior

To drive sales, **ultra-processed food manufacturers do not simply respond to existing demand: they create it**. Their marketing is omnipresent, massive, and increasingly sophisticated. It primarily targets the most vulnerable populations, especially children.

A UNICEF survey conducted in 171 countries shows that 3 out of 4 children were exposed to advertisements for soft drinks, snacks, and fast food in the previous week. This exposure is not neutral: 3 out of 5 young people say these advertisements make them want to consume the products they have just seen[11].

Children are exposed to strategies designed to capture their attention and influence their preferences from a very early age. As their brains are still developing, they struggle to distinguish between entertainment and advertising[12]. As a result, they are particularly receptive to brand messaging. These strategies rely on two powerful levers:

1. First, **sensory stimulation.** Ultra-processed foods are often very sweet, very fatty, or very salty. They train the brain to expect highly intense flavors, which gradually become the norm and shape long-term preferences. By comparison, simpler foods may then seem bland, to the point that some children begin to reject them[13].

2. Second, **emotional attachment.** Brands do not just sell a product, but an entire world. Mascots, bright colors, cartoon characters, collectible toys: everything is designed to create an emotional connection from an early age. This attachment is far from trivial: it aims to establish a lasting relationship with the brand. The earlier this connection with a brand is formed, the more likely it is to persist into adulthood, making it a powerful tool for long-term customer loyalty[14,15].

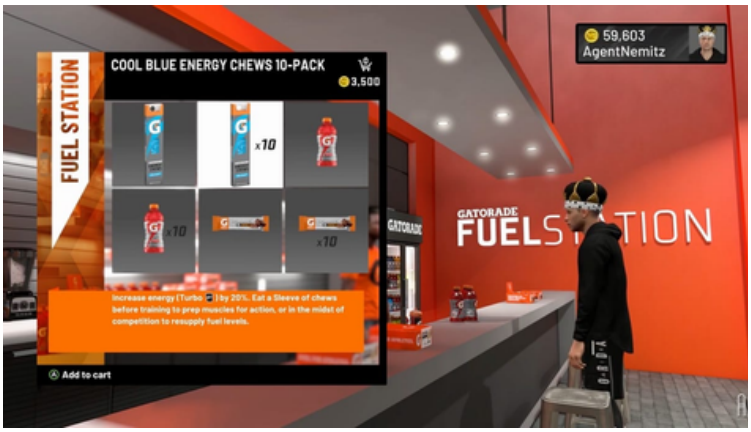
This type of marketing fuels what experts call *pester power*: the ability of children to repeatedly request a product until their parents give in. Accustomed to these highly intense colors and flavors, and conditioned by these brand worlds, children develop an attraction that is difficult to control and begin demanding these products, sometimes with great insistence[13].

Today, these marketing strategies go far beyond traditional formats. They no longer rely solely on television or outdoor advertising, but extend across a wide range of platforms, particularly digital ones[16].

Mascots, characters, and bright colors: packaging designed to appeal to children.

On social media, brands use algorithms that analyze online behavior - videos watched, content liked, accounts followed - to target children and teenagers with highly personalized ads tailored perfectly to their preferences. **Social media is now the leading source of exposure to food advertising among young people**: 52% report having been exposed to it there, followed by websites (46%), television (43%), and out-of-home advertising (43%)[12].

Advertising is also making its way directly into video games, becoming integrated into the experience in increasingly seamless ways. In the basketball game NBA 2K, for example, the Gatorade brand is integrated into the game itself: it appears on the bottles used by players during matches and in training facilities, where players can consume a Gatorade drink to recover energy.



Integration of the Gatorade brand into the NBA 2K video game: players can purchase and consume Gatorade products in a dedicated area ("Fuel Station") to improve their performance.

Source : Capture d'écran YouTube (youtube.com/watch?v=rh_jAs4oJ0c)

Some brands even go far beyond this type of highly sophisticated product placement, seeking to create a truly immersive experience around their product.

This is exactly what Monster Munch did in April 2023 with its "Crazy Galaxy Quest" campaign and its stated goal of "conquering teenagers." The brand created an entire adventure dedicated to its new product, Monster Munch Crazy Tiles, directly integrated into Roblox

Integration of the Monster Munch brand into the Roblox game with "Crazy Land": a fairground in the brand's colors, designed to promote its products to teenagers.

Source: Screenshot from the Castor & Pollux website (castoretpollux.com/projets/monster-munch)

On Roblox, the brand created “Crazy Land,” a fairground-themed world in which every attraction featured the brand’s mascots and visual identity. The campaign was simultaneously promoted on TikTok, Discord, and YouTube, amplified by gaming influencers followed by millions of young subscribers. The result: “the best snack innovation of the past three years,” according to Intersnack, the group that owns the Monster Munch brand. **A commercial success built by deliberately targeting young people within their own gaming spaces, using an advertising message cleverly disguised as an adventure** and blurring the line between advertising and entertainment.

Some researchers believe **that these new forms of digital marketing are even more effective than traditional media**, precisely because they are more difficult to identify as advertising[18,19]. One study, for example, showed that after playing advergames - online games like the Monster Munch game designed to promote a brand - children consume more snacks and fewer fruits and vegetable[20-22].

To anchor their products in youth culture, **brands also leverage another powerful tool: the sense of belonging, by associating themselves with celebrities admired by young audiences.** In 2025, Coca-Cola signed a partnership with the K-pop group BTS, a global phenomenon followed by hundreds of millions of fans. In France, the Oasis brand collaborated in 2023 with rapper JuL to create a full-fledged promotional music project: a complete song, with a music video, set within the rapper’s universe. The video generated more than 10 million views on YouTube in one month, becoming the first “gold single” resulting from a brand partnership.

“Tropical,” the music video by JuL in collaboration with Oasis

© JuL / Oasis – excerpt from the official music video, YouTube

To target adults, the industry relies on other levers, such as reassuring claims displayed on packaging: “made with real fruit,” “no artificial flavors,” “high protein,” … **These mentions create what is known as a “halo effect”: a single positive claim can alter the overall perception of a product**, making it appear healthy as a whole, even if it is ultra-processed and of low nutritional quality. Consumers focus on the positive and are less likely to look further[23-25].

These ultra-processed products display reassuring claims on the front of the packaging.

Behind all these marketing strategies lie enormous budgets that far exceed the resources available to public health agencies. In 2024, Coca-Cola, PepsiCo, and Mondelez spent a combined $13.2 billion on advertising, four times the annual budget of the WHO[1]. When the promotion of ultra-processed foods has four times more resources than the global institution responsible for protecting public health, the scale of the imbalance becomes clear.

The manufacturing of doubt that fuels scientific confusion

As seen in the history of ultra-processed foods, **some of these industries were acquired by tobacco giants in the 1980s and 1990s**. They inherited not only financial resources, but also some of their methods.

The tobacco industry was in fact a pioneer in the art of manufacturing doubt, meaning **deliberately creating scientific uncertainty around the harmful effects of tobacco.** Faced with the first studies establishing a link between smoking and cancer in the 1950s, tobacco companies developed a particularly effective strategy: not to openly deny the facts, but to drown them in controversy. In 1954, they created the Tobacco Industry Research Committee (TIRC), a research organization presented to the public as independent, but in reality operated from the offices of the public relations firm Hill & Knowlton. Its mission was to fund carefully selected research designed to avoid establishing a link between tobacco and cancer. The TIRC thus financed studies on other possible causes of lung cancer - air pollution, stress, genetics - in order to dilute the responsibility of tobacco and maintain the idea that no definitive conclusion could be reached[26-30].

Similarly, ultra-processed food manufacturers fund scientific studies that are favorable to their interests. A large meta-analysis of more than 200 studies found that **research fully funded by the food industry is 4 to 8 times more likely to produce favorable conclusions than independent studies**[31]. Researcher Marion Nestle observed a similar trend: among 76 industry-funded studies, 92% reported results favorable to the products studied[32].

One emblematic example comes from the sugar industry. In the 1960s, a lobbying group representing sugar producers secretly funded Harvard researchers, who published studies in a leading medical journal downplaying the role of sugar in cardiovascular disease[33,34]. Instead, this research emphasized the dangers of saturated fats and cholesterol, helping to fuel for decades the major anti-fat narrative that dominated global nutritional recommendations, to the direct benefit of the sugar industry[35]. Internal documents proving this funding were not uncovered until 2016, more than fifty years later[36].

At the same time, these companies seek to shift responsibility onto individuals: if people are unhealthy, it is because they lack willpower, make poor choices, or do not exercise enough. Coca-Cola, for instance, paid $1.5 million to scientists to promote the idea that childhood obesity was primarily linked to lack of physical activity rather than sugary drink consumption, a claim not supported by independent scientific literature. These payments were revealed in 2015 by The New York Times, triggering a major scandal[37].

In the same way, Kraft Foods - one of the world's largest manufacturers of ultra-processed foods, behind brands such as Kraft Mac & Cheese, Oreo, Lunchables, and Ritz - sought to shift responsibility onto consumers as early as the 2000s, when obesity was becoming a major public health issue. In its official communications, **the company consistently attributed obesity to individual behaviors**, pledging to "provide consumers with more

information on healthy diet and lifestyle choices" without ever examining the role its own products might play in the problem[38-40]. The company even reversed its portion-reduction policy, claiming it was responding to consumer demand from people who wanted "more choice." As a Kraft spokesperson explained, "Different people have different body sizes and activity levels, and it made more sense to provide different portion choices"[41]. This strategy also took the form of promoting "mindful snacking," a concept encouraging consumers to eat these snack products in moderation and with mindfulness, thereby extending a narrative focused on individual behaviors rather than on the quality of the products themselves[42,43].

In the mid-2000s, Kraft launched "100 Calorie Packs" for several of its brands, illustrating a strategy that emphasized portion control by consumers as the solution to the problem.

This narrative proved effective: studies show that the public spontaneously attributes responsibility for the obesity epidemic to individuals themselves rather than to the food environment, making it much more difficult to build public support for stricter regulation of the industry[44,45].

A global expansion targeting the most vulnerable markets

In high-income countries, the share of ultra-processed foods tends to be stabilizing, driven by a combination of market saturation, the gradual tightening of regulations, and growing attention to public health issues[9].

It is precisely this saturation in North America and Europe, from the 1980s onward, that **pushed major multinationals to expand into low- and middle-income countries.** Sales of ultra-processed foods in these regions increased by 40 to 60% between 2007 and 2022. This is now where the industry's growth is concentrated.

Their strategy relies on three main levers: large-scale marketing campaigns, innovative distribution models to reach remote populations, and the acquisition of local companies. This accelerates what researchers call the "nutrition transition" meaning **the gradual shift toward diets rich in ultra-processed foods at the expense of traditional diets.**

The example of Brazil is particularly striking. In 2010, Nestlé launched the "Nestlé Até Você a Bordo" program, which can be translated as "Nestlé comes to you by boat", a floating supermarket that delivered tens of thousands of cartons of powdered milk, chocolate puddings, and confectionery products to isolated communities deep in the Amazon basin. These populations traditionally relied on diets based on fish, fruits, and local vegetables. The boat operated once a week, offering its products at prices lower than those of the local market. Ivan Zurita, CEO of Nestlé Brazil, openly acknowledged the objective of the initiative: **"We are going to pick up the customer where he is"**[46].

Nestlé's floating supermarket boat at the port of Belém, Brazil, in 2010
Source : Bloomberg / Contributor via Getty Images

The consequences were rapid. Graciliano Silva Ramo, who managed the boat, later admitted to the BBC that it had been a mistake: **“Children’s diets deteriorated significantly, and their health suffered.** They no longer ate properly, which led to various illnesses such as stomach problems and tooth decay.” A school principal in the region also reported “an increase in childhood diabetes, obesity, and high cholesterol in children as young as seven.” Nestlé ultimately withdrew the boat from service in 2017, but other private boat operators have since taken over to meet the demand the program had created[47,48].

Mexico offers another telling example. **Coca-Cola developed a strategy there to establish itself in thousands of small neighborhood grocery stores - the “tiendas”**, which are the main retail channel in rural and low-income areas. The company provided store owners with free refrigerators, an otherwise unaffordable investment, in exchange for exclusivity agreements. As a result, in some rural communities, Coca-Cola became more accessible than drinking water and was sold at a similar price. In the state of Chiapas, consumption reached 683 liters per person per year in 2019, nearly 2 liters per day, and diabetes became the second leading cause of death[51-54].

At the entrance to San Juan Cancuc, Coca-Cola is displayed as a symbol of everyday life.
Source : Thomas Aleto / Flickr

These examples illustrate a broader phenomenon that the World Health Organization describes as the **“double burden of malnutrition.”** Concretely, this means that the same country - and sometimes even the same household - can be simultaneously affected by two seemingly opposite forms of malnutrition: some people suffer from undernutrition and deficiencies, while others are overweight or obese. **The massive arrival of ultra-processed foods does not solve the nutritional problem; it shifts it:** where undernutrition once existed due to insufficient access to food, overweight and obesity are now taking hold[55]. According to the WHO, more than one third of low- and middle-income countries are facing these two extremes at the same time, with particularly alarming prevalence in sub-Saharan Africa, South Asia, as well as East Asia and the Pacific[56,57].

PART 6

How to identify and avoid ultra-processed foods in daily life?

Recognizing an ultra-processed food on a supermarket shelf is far from straightforward: reassuring packaging, health claims, and familiar brands can all blur the lines. However, a few simple habits can help make sense of it and support more informed choices on a daily basis.

Identifying ultra-processed foods

There are a few simple indicators that can help identify ultra-processed foods. The first step is to look at the ingredient list. This is what allows you to better understand the nature of the product. A simple question can help: **does this product contain only ingredients that I could have in my own kitchen?** If the answer is yes, there is a strong chance that it is not an ultra-processed food. On the other hand, if the list includes ingredients that resemble industrial terminology more than a recipe (glucose syrup, maltodextrin, artificial flavoring, etc.), caution is needed. Indeed, ultra-processed foods often contain industrial ingredients derived from complex processing methods (hydrolyzed proteins, hydrogenated oils, flavorings, etc.), as well as additives added to modify texture, taste, or appearance (dyes, sweeteners, emulsifiers, flavor enhancers). These substances, which are absent from homemade recipes, are typical markers of ultra-processing.

To help identify these products, certain types of ingredients should be considered as warning signs. Among these industrial ingredients are, for example:

Ingredient group	Examples of terms on the label
🛢️ **Oils**	Hydrogenated oil, partially hydrogenated oil, fully hydrogenated oil
🍰 **Proteins**	Hydrolyzed proteins, isolated proteins, textured proteins, soy protein concentrate, casein, whey proteins
🍬 **Industrial sugars**	Glucose syrup, glucose-fructose syrup, invert sugar, maltodextrin, dextrose, fructose
🌽 **Modified starches**	Modified wheat starch, modified corn starch, modified potato starch, modified rice starch
🌾 **Added fibers**	Wheat fiber, corn fiber, inulin
⚙️ **Mechanically separated meat (MSM)**	Mechanically separated turkey, mechanically separated pork
🌸 **Flavorings**	Smoke flavoring, artificial flavoring, natural flavoring

In the United States, food additives are listed directly in the ingredient list by their name (for example, “monosodium glutamate,” “sucralose,” or “carrageenan”), sometimes alongside their function.

Identifying them therefore relies on recognizing ingredient names, which can be challenging for consumers, especially when they appear under technical or unfamiliar terms. Spotting several technical or unfamiliar ingredients in a product should raise a red flag. The presence of several such ingredients is generally a strong indication that a product is ultra-processed.

Preservatives and antioxidants are an exception when their role is not cosmetic, but rather to extend shelf life or prevent the growth of microorganisms. On their own, they are therefore not considered markers of ultra-processing.

Becoming familiar with the most common additive names is therefore key to identifying ultra-processed foods. The table below lists the ingredients most frequently found in the ingredient lists of ultra-processed foods:

Additive group	Examples of terms on the label
🎨 **Dyes**	Tartrazine (Yellow 5), Sunset Yellow (Yellow 6), Allura Red (Red 40), erythrosine (Red 3), Brilliant Blue (Blue 1), indigotine (Blue 2), Patent Blue, titanium dioxide, caramel color, paprika extract, curcumin, carmine
🧪 **Sweeteners**	Acesulfame K, sucralose, aspartame, saccharin, neotame, sorbitol, maltitol, stevia
🧱 **Texturizing agents**	Mono- and diglycerides of fatty acids, polysorbates, xanthan gum, guar gum, carrageenans, sodium phosphates, potassium phosphates, diphosphates, glycerol, lecithins, lactylates
👅 **Flavor enhancers**	Monosodium glutamate (MSG), disodium guanylate, disodium inosinate
🧂 **Anti-caking agents**	Silicium dioxide, Aluminium sulfate

The length of the ingredient list is another useful indicator: the longer it is, the more likely the product is to be processed. Conversely, **a short list with simple, recognizable ingredients is often a good sign.**

These guidelines do not apply only to packaged products. When you buy food from a bakery, a cafeteria, or a restaurant, it may also be ultra-processed, even without a label. In such cases, it is more difficult to verify the composition. However, a few simple cues can help: prioritize places that offer a small menu and prepare foods on-site. Do not hesitate to inquire directly as well: ask whether the products are made on-site and whether it is possible to view the full ingredient list.

Making better choices in daily life

Identifying ultra-processed foods is a first step. On a daily basis, a few simple habits can also help limit their presence in your diet.

The simplest approach is to prioritize whole or minimally processed foods. The closer a food is to its original form, the better: fruits, vegetables, legumes, eggs, grains, meat, fish...

Frozen, canned, or pre-prepared fruits and vegetables (peeled, grated, or cut) can be valuable everyday allies when time is limited. **Contrary to some common beliefs, frozen fruits and vegetables are a very good option:** they are generally frozen shortly after harvest, which helps preserve most of their vitamins. Canned products can also be a good choice: they keep for a long time and retain a large part of their nutritional value. Whatever the format, the key is to **choose simple products that remain as close as possible to their original form, without added sauces, seasonings, or other preparations.** For example, choosing plain grated carrots rather than carrots already seasoned with a sauce.

Keeping simple, easy-to-assemble staples at home (rice, legumes, canned foods, eggs, pasta, etc.) can make everyday life much easier. It allows you to quickly prepare a meal, even when time or energy is limited, without relying on ready-made products.

Cooking as much as possible is an important lever to reduce ultra-processed food consumption. This does not mean spending hours in the kitchen or preparing complex recipes: **in most cases, simply combining basic ingredients is enough to make a meal.** Cooking with children can also help: it keeps them engaged while preparing the meal, rather than having to manage cooking alongside other activities.

Cooking larger quantities can also make things easier. Part can be eaten immediately, and the rest frozen for later. It can then simply be reheated, saving time on busy days without resorting to industrial products.

Finally, how we eat matters almost as much as what we eat. **Taking the time to eat and chew, without a television or phone**, helps better perceive flavors, enjoy food more, and be more attentive to hunger and satiety cues. By contrast, **eating in front of a screen can lead to consuming around 10 to 20% more food**, simply because attention is diverted away from the meal[1,2].

Conclusion

Ultra-processed foods are the product of a system designed and built over several decades: an industry concentrated in the hands of a few powerful players with considerable financial resources, marketing strategies designed to shape preferences from childhood, and advertising budgets that far exceed those of public health. Understanding this system is essential, as it reframes the issue where it belongs: at a collective and political level.

The scientific evidence is now strong enough that the issue is no longer about convincing. The history of tobacco shows that, in the face of powerful industrial interests using similar strategies of disinformation, the combined pressure of research, civil society, and public authorities eventually led to regulations that would have seemed unthinkable just a few decades earlier.

In the field of food, this dynamic is beginning to take hold. Research on ultra-processed foods is accelerating at an unprecedented pace, the topic is gaining ground in public debate, and a collective awareness is emerging - among citizens, healthcare professionals, and some policymakers. The road ahead will likely still be long, but the first steps have been taken!

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Part 5

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Part 6

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