

Your ultimate guide to ultra-processed food – how bad is it really?

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By Graham Lawton

Highly processed foods, from pizza to bread, are said to be seriously bad for your health. Here is a digestible guide to what the evidence says, to help you make sense of the conflicting claims.

I RECENTLY scoured my kitchen looking for trouble, and I found plenty. There was a packet of instant noodles in a cupboard. Tins of baked beans and a box of muesli. In the fridge, a Jamaican patty, ketchup, hummus and probiotic yoghurts. Over in the bread bin, a loaf. I didn't dare peek in the freezer.

These foods are part of my normal diet, which I don't think is especially unhealthy. But by eating them, I may be opening myself up to obesity, heart disease, a fatty liver, cancer and more. That's if you believe the increasing worries over ultra-processed foods (UPFs) and how bad they supposedly are for our health.



But amid the warnings, there are still many open questions. Are UPFs really bad for you? If so, why? In fact, what exactly are ultra-processed foods anyway? Sprinkle in the myriad social and economic issues intimately associated with the purchase of said foods (see “Ultra-processed do’s and don’t’s”, below), and it is no wonder everyone is so confused.

In an attempt to get some clarity on the matter, I have spoken to researchers at the forefront of the debate. And while there are no clear answers on UPFs, it is possible to navigate this nutritional quagmire.

Humans have been processing food for millennia to make it tastier, more digestible, more resistant to decay and more convenient. Salting, drying, fermenting, pickling and smoking were invented to preserve foods; milling produced flour to bake bread. Cooking turned unpromising or toxic raw ingredients into tasty, safe and nutritious meals.

During the industrial revolution, however, mechanisation entered the food system. In 1802, the first sugar beet refinery opened in what is now Poland. Ten years later came the first canning factory, in London (sadly not in Canning Town). In 1864, Louis Pasteur invented his eponymous processing technology in which foods are treated with mild heat to eliminate pathogens and extend shelf life. In 1869, margarine was invented. Processed food was on the shelves, and its share of the market has been growing ever since. Around 1950, purchases of processed foods in the West overtook those of whole foods.

The term “ultra-processed food” appeared in the scientific literature in the late 2000s and subsequent studies have linked it to various health conditions. But there was an obvious problem: what exactly are UPFs?

The science of these foods took hold in 2009 when Carlos Monteiro at the University of São Paulo in Brazil and his colleagues introduced a new classification system called NOVA. This was in response to the growing interest in processed foods and the absence of a clear definition of what they were.

Which foods are ultra-processed?

NOVA (which is Portuguese for “new”) divides foods into four groups: unprocessed and minimally processed; processed culinary ingredients, such as fats, sugars and salt; processed foods, which are created by adding group 2 ingredients to group 1 foods and/or using preservation methods, and, finally, UPFs, making up group 4.

Monteiro defined the last of these as created by the fractioning of whole foods into their constituents, such as sugars, fats and fibres, before these substances are chemically modified and industrially assembled into products, frequently with additives. “It looks a recipe for chronic disease,” he says – and increasingly the science suggests he is right.

Foods in this category include breakfast cereals, instant soups, ready-made pizzas and pasta, biscuits, fish fingers, or fish sticks, reconstituted meat products, ice cream, cakes, packaged breads, carbonated drinks and many more. Basically, a lot of what is in my cupboard.

The system broke new and controversial ground in nutrition science by ignoring the nutrients completely and focusing on the degree of processing. The rationale for this, says Monteiro, was because the extent and purpose of processing of foods is now more useful than the nutrient content in assessing their impact on health.

The UPF industry’s goal, says Monteiro, is to maximise profits by cajoling consumers to abandon freshly prepared food. “They have affordable prices because of low-cost ingredients, they are convenient, they have long durations, they are engineered to have craving-like palatability and they are aggressively marketed,” he says. In the US, Canada and UK, UPFs have long provided around half of all calories consumed, though their rise seems to have plateaued in the past decade. Consumption is still increasing in many other high-income countries as well as middle and low-income ones.

Monteiro says there are easy ways to tell if a product is ultra-processed: it contains at least one food substance rarely used in home cooking – such as high-fructose corn syrup, chemically modified oils or hydrolysed proteins – or additives such as flavourings, colourings, glazing agents or thickeners.

Why are ultra-processed foods bad for you?

NOVA was quickly adopted by researchers and numerous papers came out on the correlation between category 4 foods and ill health. But the big breakthrough came in 2019, when Kevin Hall at the US National Institutes of Health (NIH) and his colleagues ran a randomised-controlled trial – the gold standard of evidence gathering – to clarify the link between UPFs and obesity.

They recruited 10 men and 10 women with a body mass index of around 27, just slightly over what is deemed “healthy” – and housed them at the NIH Clinical Center in Bethesda, Maryland, for 28 days. For two weeks, the volunteers were fed a diet high in either UPFs or unprocessed food. In the following two weeks, they received the opposite diet. The regimens were equal in terms of overall calorie content, energy density, protein, carbohydrates, fat, fibre, sugars and sodium, but differed widely in the amount of calories from UPFs. The unprocessed diet delivered 88 per cent of its calories via unprocessed foods, mainly whole fruits and vegetables and some meat, fish, eggs and yoghurt. The UPF diet delivered 81 per cent of its calories in UPF form, such as burgers, fries, canned ravioli and hot dogs.

The volunteers were given three meals a day plus unlimited access to diet-appropriate snacks and – crucially – were told they could eat as much or as little as they wanted.

The results were striking. On the UPF diet, volunteers ate around 500 more calories a day than on the unprocessed diet, and after two weeks had gained 0.9 kilograms on average. On the unprocessed diet, they lost 0.9 kilograms, regardless of whether they were given it in the first two weeks or the

second. The weight changes were exactly in line with the differences in calorie consumption, says Hall. “There’s no magic here, the changes in body weight are directly related to the changes in calorie intake.” The conclusion is obvious: UPFs “lead people to overeat calories”, he says.

When they dug deeper, the researchers discovered that when people were on the UPF diet, they generally ate bigger meals and consumed more fat and carbohydrates.

Since the work, which remains the only published randomised-controlled trial on UPFs, dozens of other studies have found associations between high UPF consumption and ill health – not just obesity, but also cardiovascular disease, asthma, cancer, depression, inflammatory bowel disease, fatty liver disease, kidney disease, type 2 diabetes and all-cause mortality. For the latter, one study found that the highest consumers of UPFs were 1.62 times more likely to die during the study, which followed almost 20,000 people between 1999 and 2014, than the lowest consumers.

According to Monteiro, more than 70 high-quality studies have now been published showing a relationship between consumption of UPFs and 20 illnesses.

That may sound like clinching evidence, but there is plenty of wiggle room. Except for Hall’s randomised-controlled trial, all the data comes from observational studies, where subjects are monitored in their normal life. These produce a lower standard of evidence than a randomised-controlled trial and aren’t considered definitive proof of cause and effect – confounding factors can bias the results.

This uncertainty has led some critics to downplay the link between UPFs and ill health. One recent review concluded that “to date, there is insufficient documentation of a causal role played [in obesity] by processing” and criticised Hall’s randomised-controlled trial as “limited”, in part because the 20 subjects didn’t find the UPF diet more palatable than the unprocessed one. The lead author of the review disclosed that he is a member of the scientific advisory boards of Mars Foods and the Grain Foods Foundation, although no funding was received for the study.



People eat about 500 more calories on an ultra-processed diet compared with an unprocessed one

Monteiro dismisses these critics. But he accepts that the causal mechanisms remain unclear, beyond the obvious one of UPFs delivering poorer nutrition via high calorie and salt loads and reduced fibre, vitamins, plant chemicals and micronutrients. “I suspect there’s more than one mechanism linking UPFs with different diseases,” he says.

Last year, a team led by Bernard Srour at the University of Paris, France, proposed several mechanisms that could contribute to the unhealthiness of a high-UPF diet. One is that extreme processing makes the foods softer and easier to consume, digest and absorb, and hence

promotes overeating. Indeed, Hall found in the randomised-controlled trial that when people were on the UPF diet, they ate faster, at a rate of 50 calories per minute versus 30 on the unprocessed diet.

This is perhaps the most pressing question surrounding UPFs: is the processing itself partly responsible for their health effects? Monteiro thinks so and some others agree. In April, doctor and academic Chris van Tulleken, who is author of *Ultra-Processed People: Why do we all eat stuff that isn’t food... and why can’t we stop?*, told *New Scientist*: “When you separate [whole foods] into their molecular components and chemically modify them, they seem to interact with the body in a very different way.”

But others aren't swallowing it. "We think it's unclear, due to limitations in the available evidence, whether the associations are due to the nutritional characteristics of the food or whether there's any independent effect of the processing," says Ian Young at Queen's University Belfast, UK, speaking in his capacity as chair of the UK's Scientific Advisory Committee on Nutrition. "We believe it's mostly due to the nutritive and sensory properties of those foods, not a specific characteristic of their degree of processing," says Ciarán Forde at Wageningen University in the Netherlands, who was involved in Hall's randomised-controlled trial and is working with him on another to probe further.

Another of Srour's proposed mechanisms is that UPFs could be contaminated with toxins leached from packaging or created during processing and heating, such as acrolein, acrylamide, trans fats and advanced glycation end products. These are currently a major focus of dietary epidemiology, according to Edith Feskens, also at Wageningen University.

Additives could be a culprit, too: there are more than 300 in use in the European Union and most aren't under suspicion, but there is some evidence linking emulsifiers – which enable oily and watery liquids to mix – to inflammatory bowel disease and cardiovascular disease. But Feskens is sceptical. "It's difficult to imagine how a small amount of emulsifier can have such an impact," she says.

Ultra-processed foods and your microbiome

UPFs may also disrupt the microbiome. Human guts contain trillions of microbes that play a crucial role in digestion, metabolism and immunity. Studies in mice and humans have shown that compounds present in UPFs can alter the microbiome in ways that promote inflammation.

One stinging criticism of the whole debate over UPFs is that this is just old science with a new label – that NOVA is simply a new way to categorise foods that are high in salt, sugar, fat and refined carbohydrates, which are already known to be unhealthy in large quantities. "Is this really anything new?" asks Hall.



UPFs may also disrupt the microbiome

Another criticism of NOVA category 4 is that it captures foods that are actually pretty healthy. A supermarket wholemeal loaf is classed as ultra-processed because it contains additives, according to Feskens. An equivalent loaf from an artisan baker would feature in category 3 despite being nutritionally almost indistinguishable, she says. In fact, it may be nutritionally inferior because supermarket bread is often fortified with nutrients. Around 55 per cent of Dutch fibre consumption comes from UPFs, largely bread, she says, so in that respect the NOVA category 4 is unhelpful. "Not all UPFs are equally unhealthy," says Feskens.

According to Srour, of more than 220,000 group 4 products available in France, 21 per cent had a good nutritional score according to the country's guidelines. Some researchers, including Feskens, think that NOVA's category 4 could be split in two to differentiate between "good" and "bad" UPFs.

NOVA is also subjective, with experts sometimes disagreeing wildly on the category foods should be in. A recent study asked more than 300 nutrition professionals to categorise 231 different foods; there was unanimous agreement on only four. This calls into question NOVA's usefulness as a tool to make dietary recommendations or policy, says Forde.

Nonetheless, Monteiro stands by his classification and says there is now enough evidence to take

public health action. His strategy is based on efforts in tobacco control: provide reliable information in dietary guidelines, restrict or prohibit advertising, put warnings on packaging, ban sales in schools and tax the products heavily while subsidising unprocessed and minimally-processed foods. Indeed, his native Brazil has been advising people to avoid UPFs since 2014.

That, however, may be counterproductive. Demonising category 4 foods or restricting access to them will deprive a lot of people of nutritious, cheap and convenient foods. It may also make the industry less inclined to develop better processing techniques to enhance the nutritional quality of foods, says Pete Wilde at the Quadram Institute in Norwich, UK. “There is a real risk of demonising foods that are otherwise nutritionally adequate or even beneficial,” says Forde.

How much ultra-processed food should you eat?

So where does that leave us? “Most people would benefit from a reduction in their intake of UPFs, purely based on their nutritional content,” says Young. But how much is too much? “That’s a big question,” says Monteiro. “We’ve been looking for this threshold. The data says that the mechanisms are dose dependent. Five to 10 per cent of calories [from UPFs] won’t have a big effect on health, but at 20 to 30, the problems start to appear.”

Ultimately, for most consumers with busy lives and finite food budgets, UPFs are hard to avoid altogether and rather handy to have. My store cupboards tell a story: I try to cook from scratch, but often don’t or can’t. I confronted the freezer and found a ready-made pizza. I will definitely eat it. With a salad.

ULTRA-PROCESSED DO'S AND DON'T'S

DO cut down

Keep your calories from ultra-processed foods under 20 to 30 per cent of your total calorie consumption. This is the point at which studies see a link between UPFs and ill health (see main story).

DO diversify

Alongside any UPFs, eat 30 whole foods, such as pulses, grains and vegetables, per week. This is linked to reduced inflammation associated with better physical and mental health.

DO be discerning

Not all ultra-processed foods are as unhealthy as each other. Seeded, wholegrain bread from a supermarket may be fortified with essential nutrients and be nutritionally more beneficial than a home-made white loaf.

DON'T panic

Studies linking additives such as acrylamide or emulsifiers to cancer and other conditions haven't been substantiated in human trials.

DON'T judge

Ultra-processed foods are safe, convenient and cheap, and can often supply much-needed nutrition to families. Replacing UPFs with home-cooked meals where you can is a more sustainable and healthy change for most people.

The weird truth about calories and why food labels get them so wrong

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By Catherine de Lange

A new understanding of nutrition and how our bodies use calories from food explains why balancing diet and exercise is much more complicated than you might think

WHEN you are navigating the complex world of nutrition, the calorie feels mercifully simple. A straightforward measure of the energy in our food, calories sit at the heart of conventional weight control advice. Consume too many, or fail to burn enough, and you will put on weight. Want to slim down? Eat less and move more. As the saying goes, “a calorie is a calorie is a calorie”. Dig a little deeper, however, and you find it isn’t that simple.



This idea of the body as a furnace and food as its fuel was popularised by Wilbur Atwater in the 19th century. He deduced that there are three main components, or macronutrients, with which we can calculate the calorie content of any food: protein and carbohydrates contain 4 calories per gram, while fats contain 9. Combine these and the result informs the calorie content on food labels everywhere.

But think about how food is consumed and you hit your first problem. Take an orange, says Giles Yeo, a geneticist at the University of Cambridge and author of *Why Calories Don’t Count*. An orange is mainly carbohydrate, or sugar. “When you drink orange juice, your body will absorb the sugar [quickly] because there is no digestion required,” says Yeo. Eat orange segments, however, and it takes energy for the digestive system to work on the fibre and extract the sugar. “Physiologically, your body does completely different things with it, with exactly the same calorie hit,” says Yeo.

Orange juice causes a more rapid spike in blood sugar levels than the orange segments, for example, and regular surges in blood sugar levels can increase the risk of many conditions, from diabetes to dementia. The orange segments also take longer to reach the gut, stimulating hormones that help us feel full.

Next, throw in the effects of cooking. The body uses energy to digest food. Cooking is essentially an extension of digestion: it breaks down ingredients, making it easier for the body to extract the energy. For processed and cooked foods, the calorie count you see on labels is most likely to be an underestimate. A stick of raw celery has about 6 calories in it, for example. “If you cook that stick of celery, that 6 calories becomes 30,” says Yeo.

Atwater’s calculations also fail to account for the cost of digestion. Protein may contain 4 calories per gram, but because of the work needed to digest it, we will only ever extract 70 per cent of those, says Yeo. This is why labels on foods containing protein overestimate calories.

The other thing to consider is that people can respond very differently to the same food, resulting in huge variations in weight gain and fat distribution. And finally, calories vary in their nutritional content. A lollipop contains roughly the same number of calories as a small apple, for instance, but consuming lots of nutritionally “empty” calories will soon take a toll on health.

Why exercise won't make you thin

So much for the “calories in” side of the equation. But “calories out” is equally bamboozling. We think of exercise as a “big lever” to get rid of excess calories, says Herman Pontzer at Duke University in North Carolina. But work by Pontzer and others looking at various populations, from hunter-gatherers to ultra-runners and sedentary desk workers, has found that pretty much everyone burns around the same number of calories each day no matter how much exercise they do.

Pontzer's suspicion is that the body adapts to increased exercise in ways that we don't fully understand. Exercise is great for overall health – but it doesn't help much with weight loss, which suggests the solution to obesity isn't quite as simple as eating less and moving more.

The upshot is that the body isn't just a furnace. It has a sensitive thermostat, constantly adjusting to the environment. So while calories are temptingly simple at first glance, we have to reckon with the complexity of the human body.