

## **Chew on This: Is There Plastic in That Gum?**

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### **STORY AT-A-GLANCE**

- › Chewing gum is a popular item, yet estimates are 75% of people do not know there are fossil-fuel-based plastic chemicals in the product. The chemicals are so damaging to the environment that Singapore banned chewing gum in 1992
- › Gum base includes plastics and waxes. Most chewing gum is also sweetened with artificial sweeteners, including aspartame and sucralose, which raise your risk of obesity, cancer and heart disease
- › Plastic chemicals found in gum contribute to the plummeting sperm count, which one scientist believes will require assisted reproduction within the next 30 years
- › Analysis of urine found 90% of those tested had eight different plasticizers. If you don't think there's enough plastic in the food supply, DARPA granted \$2.7 million to find a process to make food out of plastic and paper waste

Society has a dangerous addiction to plastics and your exposure now includes chewing it.<sup>1</sup> Several of the chemicals found in the production of plastic compounds are known to act as endocrine disruptors. Phthalates are one of those types of chemicals;<sup>2</sup> they are also found in chewing gum.

During the fetal and neonatal periods,<sup>3</sup> babies are particularly susceptible to exposure to endocrine-disrupting chemicals that can affect thyroid hormone, sex hormone and vitamin D levels. This in turn can trigger preterm birth, infant hypospadias, growth restriction and preeclampsia.

The impact on health does not stop in infancy but continues through adulthood. The endocrine-disrupting chemicals affect your endocrine system, which is instrumental in regulating your mood, growth and development, sexual function, reproduction and metabolism.

Yet these chemicals are ubiquitous, and products and components made with plastic have been integrated into nearly everyone's daily life. You can find plastic chemicals in shower curtains, storage bags and takeout containers. But did you know that they can also be found in cigarette butts, tea bags, clothing and chewing gum?<sup>4</sup>

Oceana International<sup>5</sup> likens plastic material to a curious cat, finding places in the environment where it shouldn't fit and being able to sneak in. Plastics can be found in seawater, sea salt, shellfish, whale stomachs and your drinking water. One study<sup>6</sup> in 2014 found 24 brands of beer all tested positive for plastic.

Chewing gum has been enjoyed worldwide for roughly 6,000 years.<sup>7</sup> The U.S. and global markets are growing. In December 2021, Research and Markets estimated the gum market in the U.S. was \$29.9 billion in 2020 and projected it to grow to \$38.6 billion by 2027.<sup>8</sup> This represents a compound annual growth rate (CAGR) of 3.7%, which is far below the estimated CAGR of 6.8% in China over the same period.<sup>9</sup>

## Chewing Gum Ingredients May Surprise You

Although chewing gum is a popular item, according to one estimate,<sup>10</sup> 75% of people do not know there are fossil-fuel-based plastic chemicals in the product. Additionally, 32% thought the primary ingredient in gum was natural, such as animal products or gelatin.

Technically speaking, gum is not consumed and yet it is still edible. One of the ingredients listed in gum is “gum base.” This is the part of the product that gives gum chewiness,<sup>11</sup> and while the exact ingredients are often kept a trade secret, Science Focus reveals many of them contain:<sup>12</sup>

- **Fillers** — These provide texture and bulk to the gum and are usually calcium carbonate or magnesium silicate (talc).

- **Elastomers** – Long synthetic polymer molecules such as polyvinyl acetate.
- **Emulsifiers** – These chemicals help keep flavors and colors mixed.
- **Softeners** – Vegetable oil and lecithin are used to keep the product soft and chewy. Once these have washed away and been swallowed, the gum gets stiff.

The FDA list of additives<sup>13</sup> permitted for direct addition to food for consumption includes Section 172.615 that covers the chemicals allowed in chewing gum. These are the additives they say, “may be safely used in the manufacture of chewing gum”<sup>14</sup> and bear the name “chewing gum base,” which:<sup>15</sup>

*“... means the manufactured or partially manufactured nonnutritive masticatory substance comprised of one or more of the ingredients named and so defined in paragraph (a) of this section.”*

Many of the substances used in the past to make gum base were natural ingredients, such as chicle harvested from a tree.<sup>16</sup> Yet, scientists sought to find a recipe that provided the same characteristics using chemicals that were easier to source. The list of ingredients the FDA allows in gum base includes the following, which are plastics, rubbers and waxes.<sup>17</sup>

- Butadiene-styrene rubber
- Isobutylene-isoprene copolymer (butyl rubber)
- Petroleum wax, Petroleum wax synthetic
- Polyethylene
- Polyvinyl acetate

For clarification, polyvinyl acetate is one of the ingredients found in PVA glue, which you may know as school glue and wood glue.<sup>18</sup> Polyethylene is one of the most widely produced and used plastics, included in plastic wrap, grocery bags, drainage pipes and bulletproof vests.<sup>19</sup>

## Sweeteners Are Also a Problem

These chemical compounds aren't the only problem with chewing gum. Most of the chewing gum on the market today is labeled sugar-free. Yet the gum is sweetened with artificial sweeteners to tempt your palate. Many of the ingredients in gum are potentially dangerous since they enter your body directly into your bloodstream through the wall of your mouth.

This means the chemicals bypass your, digestive system that helps get rid of some of these toxins. The Oral Health Foundation<sup>20</sup> recommends chewing sugar-free gum after each meal to help remove the acid buildup in your mouth after a meal. They recommend chewing gum any time you've eaten or had anything to drink when you're not at home to brush your teeth.

That can add up to a lot of artificial sweeteners you consume each day. One of the commonly used artificial sweeteners is aspartame,<sup>21</sup> which is metabolized as poison inside your body. During metabolism, aspartame is broken down into formaldehyde,<sup>22</sup> which is a carcinogen and used as embalming fluid. Formaldehyde cannot be filtered through the liver and kidneys, so it's difficult for your body to remove it.

Aspartame is also broken down into wood alcohol, which is another poison.<sup>23</sup> Yet, the FDA has approved aspartame as a nutritive sweetener. In 1981, the FDA first approved it under certain conditions and expanded those in 1983 to carbonated beverages and in 1986 as a "general-purpose sweetener."<sup>24</sup>

There are decades of science that have demonstrated the danger of consuming aspartame. One study<sup>25,26</sup> followed 474 diet soda drinkers for nearly 10 years and found their waist size grew 70% more than those who drank non-diet soda. If the individuals drank two or more diet sodas a day, they had a 500% greater increase in waist size.

## Your Brain Is Not Satisfied

A similar study<sup>27</sup> in 2015 revealed a striking dose-response relationship between diet soda consumption and increased waist circumference. Although artificial sweeteners provide a taste many times greater than sugar, it doesn't match up with the number of calories the food provides.

One study<sup>28</sup> from Yale University School of Medicine<sup>29</sup> shows this mismatch leads to disruption in your metabolism. When the sweetness of a product matches with the calories, your brain's reward circuit is satisfied. But, when the sweet taste is not followed by the calories, your brain doesn't get the same satisfying message.

This may help explain why diet foods and drinks are linked to an increase in appetite and cravings. The nonprofit consumer education group U.S. Right to Know (US RTK)<sup>30</sup> highlights decades of science that link aspartame to serious health risks. Health risks that have been studied after exposure to aspartame include cancer,<sup>31</sup> heart disease,<sup>32</sup> neurotoxicity,<sup>33</sup> dementia and stroke.<sup>34</sup>

A second artificial sweetener — Splenda (brand name for sucralose) — has also been linked to concerning health effects, such as calorie consumption, an increased risk of cancer in an animal model<sup>35</sup> and disrupted insulin response.<sup>36</sup>

When study<sup>37</sup> participants drank a Splenda-sweetened beverage, their insulin rose 20% higher than when they consumed only water before taking a glucose challenge test. Animal studies<sup>38</sup> have also shown that Splenda can lead to significant alterations in the gut microbiome, including reductions in beneficial bacteria.

## **Gum Contributes to Infertility and Plastic Pollution**

Plastic products and components have been integrated into most people's lives. Unfortunately, while many find them convenient, the convenience comes with a price. Not surprisingly, the plastic in your chewing gum can have a negative impact on your community.

When finished chewing, many just toss the gum on the sidewalk, believing it disintegrates. However, the plastic particles are not biodegradable and when left on the

sidewalk, the microplastics end up in the drains that filter into the ocean. In fact, chewing gum litter was such a problem in Singapore, that they banned chewing gum in 1992.<sup>39</sup>

The added consumption of plastic may also contribute to the dramatically falling sperm counts in human males. In 1992, Shanna Swan, Ph.D., first heard about a potential decline in fertility in humans. She is a reproductive epidemiologist and professor of environmental medicine and public health at the Icahn School of Medicine at Mount Sinai in New York City.

The study,<sup>40</sup> published in the BMJ that year, showed evidence of a decrease in the quality of semen in the past 50 years. In the following decades, Swan's careful research showed that plastics are a smoking gun that is disrupting human development and reproduction to the point she feels we are threatened as a species.

The exact class of chemicals are phthalates, which are so ubiquitous that the CDC states "phthalate exposure is widespread in the U.S. population."<sup>41</sup> Swan's book "Count Down: How Our Modern World Is Threatening Sperm Counts, Altering Male and Female Reproductive Development, and Imperiling the Future of the Human Race," is based on a 2017 study she co-wrote, which found sperm counts dropped by 59.3% from 1973 to 2011.<sup>42</sup>

Using mathematical prediction, she believes that most couples may need assisted reproduction by 2045<sup>43</sup> due to exposure to phthalates.

## **Are We Becoming Plastic People?**

A study<sup>44</sup> from the Norwegian Institute of Public Health analyzed the urine of 144 men and women residing in Norway. They found 90% of those who were tested had eight different plasticizers excreted in their urine, including phthalates.

After years of exposure to drinking water and food covered in plastic, you may expect most adults would have plastic chemicals in their bodies. The chemicals are not

strongly bound to the product, so they leach out with use. They then dissipate into the surrounding environment, including your drinking water and food.

Even drinking a soothing cup of hot tea to boost your phytochemicals and other nutrients may include 11.6 billion microplastic pieces and 3.1 billion nanoplastics with every cup.<sup>45</sup> The study analyzed the plastic released from tea bags while steeping hot tea. However, if you're drinking your tea with bottled water, the number of plastics you consume may be even greater.

One study<sup>46</sup> from the State University of New York tested 259 bottles<sup>47</sup> of 11 popular bottled water brands and found on average they contained 325 pieces of microplastics per liter. The highest contaminated brands were Aqua, Bisleri, Nestle Pure Life and Epura, while the least contaminated brands included San Pellegrino, Evian and Dasani.

A 2021 study<sup>48</sup> showed there was more polyethylene terephthalate (PET) in the feces of infants than there was in adults. Disturbingly, researchers found high levels of PET in meconium samples, which is a baby's first stool.

These tiny bits of plastic are everywhere. An analysis of the existing but limited literature available on the average amount of plastic ingested by humans, estimated per week the average person consumes:<sup>49</sup>

- 1,769 plastic particles from drinking water
- 182 plastic particles from shellfish
- 10 plastic particles from beer
- 11 plastic particles from salt

## **Plastic in Food or Food Made From Plastic?**

The primary reason why most people choose to purchase organic products instead of conventionally grown produce is to avoid pesticides and other chemicals. Yet, even organic food has a problem with plastic. It's not the plastic the produce is wrapped in, though, but the plastic mulch many organic farmers use for weed control.<sup>50</sup>

The plastic acts as a barrier to keep weeds in check. Once the growing season ends, most of it ends up in landfills, which represents a large amount of plastic waste since it's not unusual for a large farm to spread plastic over thousands of acres. If you don't think there's enough plastic in your food and beverages, you may be interested to know that scientists are seeking a way to make food from plastic waste.

The project began with an aim on military logistics from the Defense Advanced Research Projects Agency (DARPA).<sup>51</sup> They awarded Iowa State University and partners a \$2.7 million grant to make food from plastic and paper waste products, which they intend to feed to the military.

The idea was to turn waste products into food to help with short-term nourishment and improve military logistics for extended missions. The university is working on a system where plastics are converted and consumed by microorganisms, which could "go a long way toward solving looming problems of plastic disposal and ensuring a viable global food chain."<sup>52</sup>

But there's a lesson to be learned from the fake meat industry – it may look like a hamburger, and it may taste a little bit like a hamburger, but that doesn't mean it carries the same nutritional value as beef raised in a healthy environment. In the short term, DARPA plans plastic food as a solution to a military problem, but do you think it will stop there?

In addition to problems with infertility, plastic is also damaging other cells in your body. One study<sup>53</sup> published in November 2021 suggests that past research data on plastics and human health have not been consistent for an interesting reason. Although there is emerging evidence that microplastics are toxic and increase oxidative stress and inflammation,<sup>54</sup> other studies had not drawn an association between microplastic consumption and disease.<sup>55</sup>

However, lab data published in 2021 in the Journal of Hazardous Material<sup>56</sup> found microplastic damaged human cells at levels relevant to the number of particles that humans ingest, and the study found that microplastics trigger cell death and allergic reactions. The difference was the microplastics used in this lab experiment.



The researchers found that it was irregularly shaped microplastics that cause cell damage and not the spherical microplastics that are normally used in laboratory experiments. This suggests that past lab research using spiracle microplastics may not fully represent the damage microplastics cause in human health.

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