

# SEED OILS

## FRYING UP CONTROVERSY

By Grant Currin

Critics are using chemistry in an attempt to prove that common ingredients are far more unhealthy than doctors say.

Does the evidence support their claims?

Imagine you're listening to a podcast or scrolling through TikTok and you come across someone who claims to be revealing hidden information. They say that kitchen pantries and store shelves are dripping with toxic ingredients.

Even worse, these are foods that you've heard medical doctors say are healthy.

Supposedly, you can cure everything from diabetes to depression to some cancers just by cutting a few ingredients from your diet—and maybe buying some supplements to help with the detox.

How would you know whether to believe them?

It's not a hypothetical scenario. For several years now, a small group of people has been raising concerns online about the dangers of vegetable oils made from the seeds of plants such as corn, soybeans and sunflowers. They claim you'd be better off eating butter, beef fat or more expensive oils from fruit, such as avocados or olives.

*ChemMatters* turned to experts in nutrition and fats to figure out if this group of anti-seed oil activists is offering evidence-backed advice.



## DIETARY FAT 101

Fat has a bad reputation, but it's vital to human health. According to the Dietary Guidelines for Americans, between one-fifth and one-third of calories in a healthy diet should come from fats. Fats, a type of lipid, have long chains of  $-CH_2$  groups attached to a head group that contains oxygen atoms.

Macronutrients, which include proteins, carbohydrates and fats, are the nutrients required in large amounts to function and remain healthy. For several reasons, fats should account for between 15 and 40% of your daily macronutrient intake. One reason is that the cytoplasm inside every human cell is separated from the outside world by a cell membrane, and phospholipids are the building blocks of the cell membrane. Phospholipids are lipids that contain a hydrophilic polar head built around a phosphorus atom and two nonpolar tails made of carbon chains. There are several important vitamins—A, D, E and K—that need fat to dissolve and be absorbed. Without fat present in the digestive system, the body will just eliminate those vitamins and you will not benefit from them. If that happens for an extended period of time, the body can suffer from nutritional deficiencies.

There are two broad categories of fat: saturated and unsaturated. Saturated fats are solid at room temperature, and they usually come from animals. Butter, lard and the fat you find on a steak are good examples.

Unsaturated fats are typically liquid at room temperature. They typically come from the fruit or seeds of plants. Think olive and corn oil.

## CARBOHYDRATES



## PROTEINS



## FATS



SHUTTERSTOCK

## MACRONUTRIENT RATIOS

- » **Lower-carb for fat loss:** 10-30% carbs / 30-40% fat / 40-50% protein
- » **Moderate-carb for maintenance:** 30-50% carbs / 25-35% fat / 25-35% protein
- » **Higher-carb for bodybuilding:** 40-60% carbs / 15-25% fat / 25-35% protein

The reason that some fats are liquid while others are solid is due to a small difference in the shape of the individual molecules. All fat molecules are long and spindly, but saturated fat molecules are straight, while unsaturated fat molecules have a bend.

Chemically, saturated fats are long chains of carbons that have only single bonds between carbons. While unsaturated fats are also long chains of carbons, they contain one or more double bonds that cause the bend in the molecule. The molecules in butter can pack together tightly enough to form a solid, but the bends in olive oil molecules keep them sliding past each other.

## UNPACKING THE EVIDENCE

"If you had told me five years ago that people would be talking about [the healthfulness of] seed oils, I wouldn't have believed you," said Kristina Petersen, an associate professor of nutrition at The Pennsylvania State University.

Petersen and two colleagues recently searched for all the studies they could find on

the health impact of seed oils. They published an article summarizing their findings in spring 2025.

"We reviewed a whole lot of literature—observational studies and clinical trials—and found consistent evidence that higher intake of unsaturated fats, which are found in these seed oils, is associated with lower risk of cardiovascular disease and type 2 diabetes," she said.

For Eric Decker, a professor emeritus in the Department of Food Science at the University of Massachusetts, Amherst, the seed oil controversy is a case of influencers using ongoing research to attack advice that rests on solid evidence.

"There's a lot of science that can be further explored here, but it's gonna take time," he said. "These fields aren't very well funded."

*ChemMatters* asked the researchers to address a few of the most popular claims about seed oils and share what they're getting right, what they're getting wrong and what scientists are still trying to figure out.

## WHAT ARE...

**Observational Studies:** Researchers collect and observe data without interfering or interacting with the study participants.

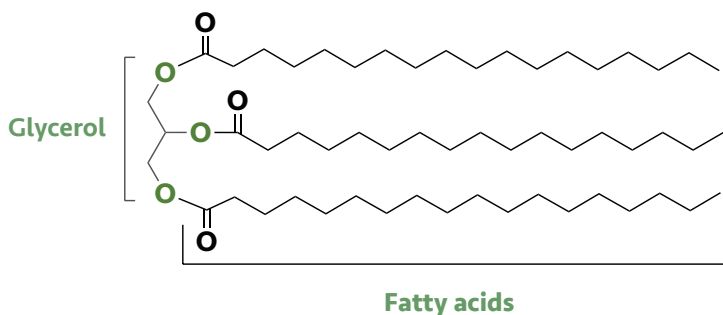
**Clinical Trials:** Participants are given a pharmaceutical or other treatment under close medical supervision.



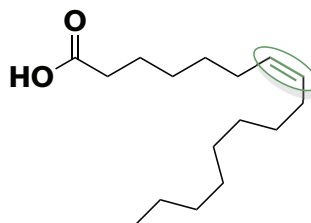
SHUTTERSTOCK

# GLOSSARY OF FATS

**TRIGLYCERIDE:** Three fatty acids connected by a glycerol molecule

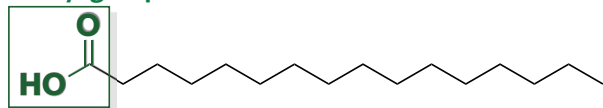


**UNSATURATED FATS:** Fatty acids that contain at least one double bond

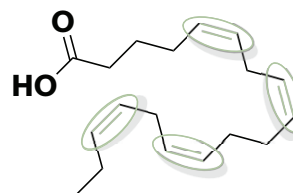


**FATTY ACIDS:** Long chains of  $-CH_2$  groups attached to a carboxylic acid

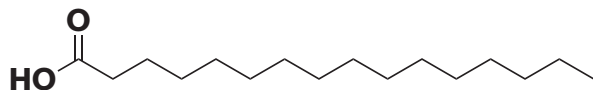
Carboxyl group



**OMEGA-N FATS:** Have multiple double bonds in the carbon chain. The N represents the number of carbons between the first double bond and the  $-CH_3$  group that ends the chain



**SATURATED FATS:** Fatty acids with carbon chains that contain only single bonds



## CLAIM #1

### Chronic Illness Soared as Seed Oils Became Common

Anti-seed oil activists point to observed trends as proof of their ideas. They look at how the incidence of diseases such as heart disease, cancer and diabetes have increased as seed oil consumption has increased and conclude that seed oils are the culprit. "This is the weakest kind of data that we have," Petersen said. "It can be used to formulate hypotheses to design more rigorous research. Arguably, that research has already been done."

Formation of a hypothesis is the first step in the scientific method. Simply claiming that one thing caused something else because it happened earlier, however, is a classic mistake in logical thinking. Ancient philosophers called it *post hoc ergo propter hoc* (after this, therefore because of this), and modern scientists say it's mistaking correlation—two things changing at the same time—with causation—one thing changing the other.

In the papers that Petersen and her colleagues analyzed, research groups from across the world used many different techniques to get to the bottom of this question. Some turned

to statistical tools to track patterns in large datasets. Others described experiments in which scientists gave individual people exact doses of various kinds of oil and tracked how their health changed.

The result?

"We have very consistent evidence that when you replace saturated fat with unsaturated fats, you substantially lower your risk of cardiovascular disease," she said. "All the data is pretty well aligned."

Decker agrees. "You could show that correlation for a lot of things, such as obesity," he said. For example, the number of calories that the average American eats per day has skyrocketed in the last 50 years. Dietary fats are part of this story because they are so dense with energy, but that doesn't have much to do with the distinction between seed oils and supposedly healthier alternatives like butter, beef tallow and olive oil. Every gram of fat contains the same nine calories.

## CLAIM #2

### Traces of Industrial Chemicals Left Over from Processing Make Seed Oils Toxic

There is good reason to worry about how our food is made—and to be skeptical about whether companies that make it are always thinking about their impact on public health. For most of human history, people made seed oils by grinding seeds with stones and collecting all the oil they could squeeze out, in a process called “cold pressing.”

It relied on a lot of physical effort from the humans and animals who did the grinding. During the Industrial Revolution, mechanical power replaced muscles. That was a big improvement, but even the most powerful presses left a lot of oil trapped in the plant fibers.

In the early 1900s, chemical engineers figured out how to use solvents to get nearly all of the oil out of seeds and fruits. Those solvents—specifically, hexane (C<sub>6</sub>H<sub>14</sub>)—are the crux of this anti-seed oil concern.

There is an important kernel of scientific truth here. In large enough doses, hexane is bad for humans. But the people who suffer hexane toxicity aren't getting it from their food: They work in factories or laboratories and are in contact with the chemical on a regular basis and at a high concentration.

Hexane in the food supply is a different story. In oils, it's found in incredibly low amounts (less than one milligram per kilogram—in the U.S., 0.8 milligrams of hexane per kilogram of seed oil), and researchers haven't seen evidence of toxicity from dietary hexane.

“When we look at data from clinical trials where scientists have given people seed oils, we don't see any signs of harm. When we look at people who have been consuming seed oils over long periods of time, we're not seeing any negative signals,” Petersen said. “The thinking at the moment is that this isn't an area of concern.”

While there isn't evidence to back up this claim against seed oils, it does cast light on differences between the food systems from one country to another. In the United States, regulation typically stems from evidence that an ingredient is harmful. In Europe, ingredients generally have to be proven safe before they're allowed in the food supply.

“In Europe, they have regulations on the maximum amount of hexane allowed, but we don't have any of those regulations in the U.S.,” Decker said. The European Union limits the amount of hexane in fats and oils to one milligram per kilogram.



## CLAIM #3

### Omega-6 Fatty Acids Cause Inflammation

Inflammation is one of the main ways the body responds to an injury or infection. When the immune system detects damage, it sends signals that cause blood vessels to expand and directs specialized attack cells to mobilize. Inflammation can help heal wounds and fight off invaders, but it can also cause problems. When it happens all the time—a condition called chronic inflammation—these defense mechanisms damage healthy tissues and contribute to diseases like arthritis, heart disease and cancer.

What does that have to do with dietary fats? According to skeptics, seed oils cause chronic inflammation by upsetting the natural balance of two subtypes of unsaturated fat: omega-3 fatty acids and omega-6 fatty acids.

This claim brings us deeper into the biochemistry of unsaturated fats. “Omega” refers to the number of carbon atoms from the methyl end of the fatty acid chain to the first double bond. Different kinds of unsaturated fat contain different ratios of omega-3s and omega-6s. These molecules are called “essential fatty acids” because they are the only two fatty acids required by the body that it can't produce on its own.

It turns out that seed oils are higher in omega-6s than omega-3s, so we're eating a lot more of them than our great-great-grandparents.

According to anti-seed oil advocates, omega-6s cause inflammation, while omega-3s fight it.

While there are some biochemical hints that support that conclusion, the overall evidence doesn't tell the same story.

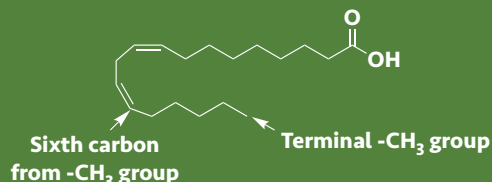
“This concern is rooted in a simplification of metabolism,” Petersen says. “The idea comes from the fact that our main source of omega-6 is a compound called linoleic acid. Linoleic acid can break down into another compound called arachidonic acid, and there's some evidence that arachidonic acid is pro-inflammatory.”

It's an interesting hypothesis, so researchers used other methods to look more closely. According to Petersen, they haven't found good reason to be concerned. For one thing, the body doesn't tend to produce very much arachidonic acid. People who ate a lot of linoleic acid in experiments ended up producing very little arachidonic acid, she said.

“We also have some clinical trial data showing that when you feed people linoleic acids, you don't see increases in any biological evidence of inflammation,” Petersen said. “That suggests that it's not an inflammatory product.”

It makes sense in the bigger picture, too. “When you think about the broader evidence base, if linoleic acid was pro-inflammatory, we wouldn't see the cardiovascular benefits that we do see with higher intakes of linoleic acid.”

LINOLEIC ACID



## CLAIM #4

### Fatty Acids in Seed Oils Degrade into Harmful Molecules During Cooking or Storage

Opponents of seed oils claim that fatty acids in seed oils are prone to breaking down into smaller molecules. They point to moments when the oils are being refined, stored and used in high-heat cooking. The worry is that the fatty acids react with oxygen to create dangerous compounds.

Decker, whose research career has focused on the oxidation of fat molecules, says there's some truth to this concern—and questions that researchers still need to tackle.

"Frying puts oil under more stress than anything else. It's at a high temperature all day long, and dunking food in the fryer introduces a lot of oxygen," he said.

Petersen agrees, adding "oils that are high in polyunsaturated fatty acids—having multiple double bonds—can become unstable over time, especially due to improper storage or being heated up and cooled down many times," Petersen says. The molecules generated by the oxidation of the double bonds in the fatty acids may be harmful.

Most restaurants do their best to avoid these problems by frying their food in more stable oils, like peanut oil—but not all restaurants can be counted on to mitigate risks. Manufacturers have started producing oils that contain high levels of oleic acid, which has been found to degrade more slowly than other oils.

### WHAT'S THE VERDICT?

There's no doubt where Petersen, Decker and most other scientists come down on the question: there's nowhere near enough evidence of harm to justify leaving seed oils behind.

"We have several lines of evidence that pretty consistently show the benefit of these oils and really no evidence that's showing harm," Petersen said.

While there is a grain of truth in almost every concern that anti-seed oil activists raise, none of their arguments outweigh the evidence, at least for the time being.

Contrast that with the body of evidence that clearly indicates that beef tallow, lard and other saturated fats have significant negative health impacts, including an increased risk of heart disease.

Above all, thinking scientifically means practicing healthy skepticism, especially if the answer seems too easy.

"When you try to make really simple solutions in nutrition, they're not going to be right," Decker said.

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People are constantly changing what they eat. For proof (and laughs), open up a cookbook from the 1960s. Chances are good you'll come across dishes like Jello-Tuna Salad or Bananas Wrapped in Ham and Smothered in Hollandaise Sauce. Sometimes, dietary change has to do with taste, fashion and preferences. More often, there are structural forces at play.

For example, sometimes a technological breakthrough makes it cheaper to produce a certain food, or an agricultural pest makes it more expensive. Sometimes a government pays farmers extra to grow certain crops or raise specific kinds of livestock. And occasionally, new research in nutrition changes how people feel about the health of a certain food.

The story of fat is no different. In the 1800s and early 1900s, people mostly

ate saturated fats from animals. With the rise of industrial food production, unsaturated fats—mostly from seed oils like soybean and corn—became more popular. This trend was supercharged in the 1950s, when health guidelines started warning that saturated fats are bad for the heart. Low-fat diets were all the rage in the 1980s and '90s, and products that minimized fat content—even at the expense of higher amounts of sugar—became popular. In the 2010s, the U.S. government made it illegal to sell foods that contained trans fat, a once-popular component of partially hydrogenated vegetable oils that researchers discovered was causing serious health problems. Trans fats are unsaturated fats, but the double bond doesn't create a kink or bend in the chain.

Will rumors about seed oils cause the next big shift?

