OSTEOPATHIC CENTER

Seed Oils: What are they? Are they concerning? Should they be avoided?

Cooking with seed oils—such as soybean, corn, canola, sunflower, and safflower oils—can pose several health concerns due to their high content of omega-6 polyunsaturated fatty acids (PUFAs), contamination with mycotoxins, and the formation of harmful compounds during repeated heating.

1. **High in Omega-6 Fatty Acids** (Pro-Inflammatory)
    - Seed oils contain high amounts of omega-6 fatty acids, which, when consumed in excess, can contribute to chronic inflammation.
    - An imbalanced omega-6 to omega-3 ratio is linked to increased risk of cardiovascular disease, obesity, and autoimmune conditions.

Seed oils such as *soybean, sunflower*, and *corn oils* are rich in omega-6 PUFAs. Excessive intake of omega-6 PUFAs can lead to an imbalance with omega-3 PUFAs, potentially *promoting inflammation* and contributing to lifestyle diseases such as Alzheimer's disease, type 2 diabetes, and obesity. This is partly due to the formation of lipid peroxidation products like hydroxynonenal, which can impair cellular functions and promote cell death.[46]

2. **Susceptibility to Oxidation**
    - Many seed oils are highly polyunsaturated, meaning their chemical structure is unstable when exposed to heat, light, or oxygen.
    - When heated, they can oxidize and produce harmful free radicals, which contribute to inflammation, aging, and disease.

3. **Mycotoxin Contamination**: Edible oils can be contaminated with mycotoxins, which are toxic compounds produced by fungi. Mycotoxins such as aflatoxins, zearalenone, and ochratoxin A have been detected in various seed oils, with *peanut and sesame oils* being particularly prone to contamination. Chronic exposure to these mycotoxins can pose significant health risks, including carcinogenicity.[47]

4. **Formation of Harmful Compounds During Heating**
    - Trans fats and other toxic byproducts like aldehydes and acrolein can form when seed oils are heated past their smoke points, increasing the risk of metabolic and cardiovascular issues.
    - Cooking at high temperatures (e.g., frying) significantly increases the production of these harmful compounds.

Repeated heating of seed oils, a common practice in cooking, leads to the formation of toxic substances such as polycyclic aromatic hydrocarbons (PAHs) and lipid oxidation products (LOPs). These compounds have been associated with genotoxic and carcinogenic risks, as well as increased risk of cardiovascular diseases due to the promotion of oxidative stress and inflammation.[48-49]

5. **Industrial Processing & Chemical Additives**
    - Most seed oils undergo heavy processing, including chemical extraction using hexane, bleaching, and deodorization.
    - This can strip beneficial nutrients and introduce harmful chemical residues into the oil.

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Deep Dive

Let's take a deeper look at the specific seed oils, what some studies have shown and why they should be avoided. This may get a little complicated but please bear with me.

The relationship between seed oils and inflammation is complex and depends on the specific type of seed oil and its fatty acid composition. Seed oils are rich in polyunsaturated fatty acids (PUFAs), which can have varying effects on inflammation.

n-6 PUFAs, such as linoleic acid found in many seed oils (e.g., sunflower oil), can be converted into arachidonic acid, a precursor for pro-inflammatory eicosanoids like prostaglandin E2 (PGE2) and leukotriene B4 (LTB4). High intake of n-6 PUFAs has been associated with increased production of these pro-inflammatory mediators.[1]

Omega-6 polyunsaturated fatty acids (PUFAs), commonly found in many seed oils such as corn oil and sunflower oil, have been associated with increased cancer risk and progression. For instance, a study demonstrated that a diet high in omega-6 PUFAs enhanced tumor aggressiveness in a murine model of lung cancer, showing increased proliferation, angiogenesis, and pro-inflammatory markers. Similarly, high intake of linoleic acid, an omega-6 PUFA, has been linked to increased risk of prostate cancer.

Soybean Oil

Soybean Oil consists of 51% of linoleic acid (LA). Several studies have shown that high levels of dietary soybean oil can *induce inflammatory responses*. For instance, a study on large yellow croaker fish demonstrated that high dietary soybean oil increased pro-inflammatory cytokines such as tumor necrosis factor α (TNF-α) and interleukin 1β (IL-1β), while decreasing anti-inflammatory cytokines like interleukin 10 (IL-10).[5] Similarly, in rats, excessive consumption of soybean oil led to increased markers of inflammation, including IL-6 and pentraxin-3.[6]

The form of soybean oil also plays a role. *Repeatedly heated soybean oil* has been shown to cause vascular inflammation and hypertension in rats, likely due to the generation of reactive oxygen species.[7]

However, it is important to note that some studies have suggested that soybean oil may have obesogenic and diabetogenic effects in mice, which could indirectly impact cardiovascular health.[8]

Traditional soybean oil, which is high in linoleic acid (LA), has been linked to increased risks of colonic inflammation and colon cancer in animal models. [4]

Canola Oil

Canola Oil only has 19% linoleic acid, the lowest percentage of the 'seed oils,' which is why it seems to be the *safest* of the seed oils. A systematic review and meta-analysis indicated a slightly higher risk of cancer mortality associated with high intake of alpha-linolenic acid (ALA), a component of canola oil, although the overall risk reduction for all-cause and cardiovascular mortality was noted.[19]

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Corn Oil

Corn oil has the 4th highest % of linoleic acid (LA) out of the 'seed oils' with 54%. This is probably the **most problematic out of all the seed oils**. It has been shown to have a relationship with inflammation, primarily due to its high content of n-6 polyunsaturated fatty acids (PUFAs), particularly linoleic acid. Several studies have investigated the pro-inflammatory effects of corn oil.

1. **Hepatic Inflammation**: Böhm et al. demonstrated that ingestion of peroxidized corn oil in rats led to increased hepatic lipid peroxidation and upregulation of pro-inflammatory markers such as nitric oxide synthetase-2 (NOS-2), cyclooxygenase-2 (COX-2), interleukin-1β (IL-1β), and tumor necrosis factor-α (TNFα). This suggests that peroxidized fatty acids in corn oil can trigger hepatic inflammation.[10]

2. **Gut Inflammation**: Yan et al. found that corn oil induced gut inflammation in grouper fish, damaging gut health and structure, and activating inflammatory pathways such as the IL-17 and TNF signaling pathways.[11]

3. **Kupffer Cell Activation**: Rusyn et al. reported that corn oil rapidly activates nuclear factor-kappaB (NF-κB) in hepatic Kupffer cells through oxidant-dependent mechanisms, leading to increased production of TNFα, which is mitogenic and promotes hepatocyte proliferation.[12]

4. **Systemic Inflammation**: Papageorgiou et al. observed that acute consumption of corn oil did not significantly decrease TNF-α levels in healthy individuals, unlike other oils such as olive oil, soy oil, and cod liver oil, which had significant anti-inflammatory effects.[13]

5. **Pro-inflammatory Effects in Cell Models**: Ion et al. showed that corn oil mimetic treatment in Jurkat T leukemia cells resulted in a pro-inflammatory response, indicating that corn oil may promote inflammation at the cellular level.[14]

The Minnesota Coronary Experiment, a randomized controlled trial, indicated that while replacing saturated fats with linoleic acid-rich vegetable oils like corn oil effectively lowers serum cholesterol, *it does not necessarily translate to a lower risk of death from coronary heart disease* or all causes.[9]

High-corn-oil diets have been shown to potentially **promote cancer**, specifically stimulating mammary carcinogenesis. For instance, a study demonstrated that a high-corn-oil diet significantly increased the incidence and progression of mammary tumors in rats, likely through mechanisms involving increased tumor proliferation and decreased apoptosis, as well as a proinflammatory microenvironment.[15]

Another study found that high-corn-oil diets promoted the development of high histologic grade mammary adenocarcinomas, suggesting a *more aggressive tumor phenotype* compared to diets high in extra-virgin olive oil.[16]

In the context of colon cancer, high-corn-oil diets have also been implicated in **promoting carcinogenesis**. Research has shown that such diets can enhance colon tumor promotion by increasing the activities of colonic mucosal phospholipase A2 (PLA2) and phosphatidylinositol-specific phospholipase C (PI-PLC), which are involved in the release of arachidonic acid and the formation of

eicosanoids, thereby promoting cell proliferation and tumor growth.[17] Additionally, long-term dietary corn oil has been found to inhibit mitochondria-dependent apoptosis in colon cancer models, further contributing to tumor progression.[18]

Sunflower Oil

Sunflower Oil is rich in linoleic acid, 68%, the second-highest after Safflower Oil. Linoleic acid an omega-6 fatty acid, which can be metabolized into arachidonic acid (ARA). ARA is a precursor for pro-inflammatory mediators such as prostaglandins and leukotrienes, which can promote inflammation.[20] This suggests that high consumption of sunflower oil could potentially contribute to inflammatory processes.

The method of sunflower oil consumption also plays a role. *Heated* sunflower oil has been associated with increased postprandial inflammation, as evidenced by elevated levels of inflammatory markers in peripheral blood mononuclear cells.[21] Conversely, the presence of phenolic compounds in the oil can mitigate this inflammatory response.

Sunflower oil is rich in polyunsaturated fatty acids (PUFAs), particularly linoleic acid, which has been shown to lower LDL cholesterol levels, a known risk factor for cardiovascular disease (CVD).[22] However, PUFAs are also more susceptible to oxidation, which can lead to the formation of oxidized LDL, a contributor to atherosclerosis.[23-24]

Studies have shown mixed results regarding the impact of sunflower oil on heart disease. For instance, a study in hypercholesterolemic hamsters indicated that diets high in linoleic acid-rich sunflower oil led to increased early aortic atherosclerosis compared to diets rich in monounsaturated fatty acids (MUFAs).[23]

Repeatedly boiled sunflower oil has been shown to pose genotoxic and carcinogenic risks. The repeated heating of sunflower oil leads to the formation of polycyclic aromatic hydrocarbons (PAHs), which are known for their mutagenic and carcinogenic potential. Studies have demonstrated that the consumption of repeatedly boiled sunflower oil can induce oxidative stress, DNA damage, and the formation of aberrant cells in animal models, which are indicative of increased cancer risk.[24]

Dietary fat composition also plays a role in cancer development. High intake of linoleic acid, a major component of sunflower oil, has been associated with increased oxidative stress and DNA damage in animal studies, potentially contributing to cancer risk.

Safflower Oil

Safflower Oil actually has the highest percentage of linoleic acid of all the oils, 70%. A high-fat/high-sucrose diet based on safflower oil has been linked to early glucose intolerance in mice, which suggests potential metabolic disturbances.[26] Additionally, thermally-stressed safflower oil has been found to **exert teratogenic** (cancer) **effects** in rats, indicating that the consumption of oxidized safflower oil could pose reproductive risks.[27]

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Moreover, a study indicated that safflower oil supplementation did not mitigate the adverse effects of overnutrition on metabolic parameters in rats, and it altered oxidative measures in the heart and liver.[28] Another study highlighted the toxic effects of safflower extract on mouse **spermatogenesis**, suggesting caution in its use, especially in individuals with reproductive concerns.[29]

Another study demonstrated that safflower oil reduced atherosclerosis development in LDL-receptor-deficient mice, although it increased the susceptibility of LDL to oxidation in vitro.[30]

Grape Seed Oil

Grape Seed Oil has 58-78% linoleic acid, one of the highest amounts commercially available. Grape seed oil, while often promoted for its health benefits, has several potential issues that should be considered.

Liver Toxicity (Hepatotoxicity): There have been reports of hepatotoxicity associated with the use of grape seed oil, particularly when combined with certain extracts. A case series in New Zealand identified 29 reports of hepatic adverse reactions in patients using a supercritical carbon dioxide extract of grape seed oil, with symptoms ranging from jaundice to pruritus and dark urine. The onset of hepatotoxicity varied from 7 days to 12 months, with most cases occurring within 12 weeks.[31]

Contamination: Grape seed oil can be contaminated with mineral oil paraffins, which are potentially harmful. A study found that commercial grape seed oils contained paraffins ranging from 43 to 247 mg/kg, primarily from the peels of the grapes. This contamination can be reduced through mechanical purification and washing with hexane, but it remains a concern.[32]

Cytotoxicity: High doses of grape seed proanthocyanidins, a component of grape seed oil, have been shown to induce cytotoxicity. This is associated with increased nitric oxide production and apoptotic cell death, particularly in studies involving chick cardiomyocytes.[33]

Oxidative Stability: Grape seed oil is rich in polyunsaturated fatty acids, making it *prone to oxidation*. Oxidized lipids from grape seed oil can affect phospholipid metabolism in gastrointestinal cells, potentially influencing lipid absorption and contributing to oxidative stress.[34]

Potential for Increased Atherogenic Risk: Consumption of grape seed procyanidins *during gestation and lactation* has been shown to impair reverse cholesterol transport and increase atherogenic risk indexes in adult offspring, suggesting potential long-term cardiovascular risks.[35]

In summary, while grape seed oil has beneficial properties, it is important to be aware of its potential hepatotoxicity, contamination with mineral oil paraffins, cytotoxic effects at high doses, susceptibility to oxidation, and potential long-term cardiovascular risks.

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Cotton Seed Oil

Cotton Seed Oil has 52% linoleic acid, and has been associated with reproductive issues, mold/mycotoxins, heavy metals, pesticides, and even tumors/cancer.

1. **Gossypol Toxicity**: Gossypol is a phenolic compound found in cottonseed oil that can cause significant toxicity. It is known to impair reproductive function in both males and females, *interfere with immune function*, and cause acute toxicity symptoms such as respiratory distress, anorexia, and weakness. Gossypol can also accumulate in the body and has been hypothesized to contribute to neurodegenerative diseases like Alzheimer's disease.[36-38]

2. **Cyclopropenoid Fatty Acids (CPFAs)**: CPFAs present in cottonseed oil can have detrimental health effects. These fatty acids have been shown to cause histopathological changes in animal studies, and their *accumulation in body fat* can be problematic.[39-40]

3. **Aflatoxin Contamination**: Cottonseed oil can support the growth of Aspergillus flavus, which produces aflatoxin B1, which is a form of mold (mycotoxin) that has been linked to cancer. This contamination can occur during storage and processing.[41]

4. **Heavy Metals and Pesticides**: Cottonseed oil can be contaminated with heavy metals and pesticides, which pose additional health risks. These contaminants can be introduced during the cultivation and processing of cotton plants.[42-43]

5. **Tetramethoxy Gossypol (TMG)**: TMG, a degradation product of gossypol, can cause significant metabolic changes in various tissues, particularly the *liver*, which may lead to chronic health issues.[44]

Conversely, there are concerns about certain toxic components in cottonseed oil, such as cyclopropenoid fatty acids (CPFAs), which have been associated with an increased incidence of spontaneous mammary tumors in animal studies.[45]

Healthier Alternatives for Cooking

Instead of seed oils, consider heat-stable, nutrient-dense alternatives:

- Extra Virgin Olive Oil – Great for low to medium heat cooking, packed with antioxidants.
- Avocado Oil – High smoke point (~520°F) and rich in monounsaturated fats.
- Coconut Oil – High in saturated fats, making it stable at high heat.
- Beef Tallow
- Grass-Fed Butter or Ghee – Contains beneficial fatty acids and vitamins A, D, and K.

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Research Studies and Supportive Links:

1. https://pubmed.ncbi.nlm.nih.gov/10617994
2. https://pubmed.ncbi.nlm.nih.gov/35682855
3. https://pubmed.ncbi.nlm.nih.gov/8922296
4. https://pubmed.ncbi.nlm.nih.gov/35804751
5. https://pubmed.ncbi.nlm.nih.gov/29631026
6. https://pubmed.ncbi.nlm.nih.gov/34243613
7. https://pubmed.ncbi.nlm.nih.gov/22246209
8. https://pubmed.ncbi.nlm.nih.gov/26200659
9. https://pubmed.ncbi.nlm.nih.gov/27071971
10. https://pubmed.ncbi.nlm.nih.gov/23665282
11. https://pubmed.ncbi.nlm.nih.gov/37865354
12. https://pubmed.ncbi.nlm.nih.gov/10545411
13. https://pubmed.ncbi.nlm.nih.gov/21326271
14. https://pubmed.ncbi.nlm.nih.gov/21631947
15. https://pubmed.ncbi.nlm.nih.gov/30572269
16. https://pubmed.ncbi.nlm.nih.gov/15567939
17. https://pubmed.ncbi.nlm.nih.gov/8564967
18. https://pubmed.ncbi.nlm.nih.gov/15522837
19. https://pubmed.ncbi.nlm.nih.gov/34645650
20. https://pubmed.ncbi.nlm.nih.gov/32460429
21. https://pubmed.ncbi.nlm.nih.gov/22162245
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23. https://pubmed.ncbi.nlm.nih.gov/12121826
24. https://pubmed.ncbi.nlm.nih.gov/12010587
25. https://pubmed.ncbi.nlm.nih.gov/20886885
26. https://pubmed.ncbi.nlm.nih.gov/28012235
27. https://pubmed.ncbi.nlm.nih.gov/12516875
28. https://pubmed.ncbi.nlm.nih.gov/27863203
29. https://pubmed.ncbi.nlm.nih.gov/22395857
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31. https://pubmed.ncbi.nlm.nih.gov/31920644
32. https://pubmed.ncbi.nlm.nih.gov/18989969
33. https://pubmed.ncbi.nlm.nih.gov/16555001
34. https://pubmed.ncbi.nlm.nih.gov/32370178
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37. https://pubmed.ncbi.nlm.nih.gov/1526930
38. https://pubmed.ncbi.nlm.nih.gov/22136946
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41. https://pubmed.ncbi.nlm.nih.gov/10956158
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49. https://pubmed.ncbi.nlm.nih.gov/37877148