

# Aluminum Foil Is a Major Source of Aluminum Exposure, Studies Show

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Theme: [Science and Medicine](#)

Global Research, November 06, 2024

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*Using aluminum foil in cooking significantly increases aluminum exposure, with studies showing an 8.1% increase in urinary aluminum concentrations during high-exposure periods*

*Cooking with aluminum foil leads to aluminum leaching into food, even exceeding safety limits at times. Factors like acidity, salt content, fat, temperature and cooking time affect leaching rates*

*Aluminum accumulation in your body is linked to neurological issues, including Alzheimer's, autism, multiple sclerosis and Parkinson's disease. It also affects bone health and causes anemia*

*Symptoms of aluminum toxicity include memory loss, confusion, coordination difficulties, bone pain, kidney dysfunction and respiratory issues. Early recognition and reducing your exposure are crucial for health*

*To reduce aluminum exposure, avoid cooking with aluminum foil and cookware, choose alternative cookware materials, limit processed foods, use aluminum-free personal care products, avoid aluminum-containing vaccines and filter your water if aluminum levels are high*

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Aluminum is everywhere in our modern world, from cookware to food packaging. But did you know that your everyday use of aluminum foil could be significantly increasing your exposure to this harmful metal? Research published in Environment International revealed aluminum foil and containers used in food preparation contribute to your body's aluminum burden,<sup>1</sup> with serious risks to your health.

While aluminum is naturally present in the environment, its widespread use in consumer products has led to increased human exposure. Your body doesn't need aluminum for any biological processes, and accumulation over time is dangerous.

Aluminum has been linked to various health issues, including neurological problems and bone disorders. What's more, your body may struggle to eliminate excess aluminum, especially if you have impaired kidney function. Minimizing your exposure to this pervasive metal in your daily life, the new study shows, may start right in your kitchen.

## **Using Aluminum Foil Boosts Your Body's Metal Burden**

The research, a first-of-its-kind human intervention study, explored whether consuming food prepared with aluminum foil and containers leads to increased aluminum levels in the body. The study involved 11 healthy participants who followed a controlled diet for 30 days.

During the middle 10 days, their meals were prepared using aluminum foil and stored in aluminum containers. Urine samples were collected twice daily throughout the study to measure aluminum excretion. This rigorous design allowed researchers to detect even small changes in aluminum levels and determine if any increases were reversible.

The findings were clear: consuming food prepared with aluminum foil and containers led to a measurable increase in aluminum levels in the body.<sup>2</sup> On average, participants experienced an 8.1% increase in their urinary aluminum concentrations during the exposure phase.

This increase was reversible in healthy adults with normal kidney function — once the exposure to aluminum cookware ceased, aluminum levels returned to baseline within days. However, this reversibility might not apply to everyone, especially those with compromised kidney function.

The estimated additional aluminum intake from this high-exposure scenario represented about 4.4% of the tolerable weekly intake set by European food safety authorities. However, aluminum exposure is cumulative and comes from multiple sources in your environment.

Even small increases in aluminum exposure could contribute to a higher body burden over time, and current safety guidelines may not account for the most vulnerable populations or the effects of lifelong exposure.

## **The Hidden Dangers of Cooking with Aluminum Foil**

A study published in the International Journal of Environmental Research and Public Health also found aluminum leaches into your food when you cook with aluminum foil.<sup>3</sup> Researchers examined the aluminum content in meat and fish wrapped in aluminum foil and cooked in an oven.

The use of aluminum foil significantly increased aluminum levels in the food. For instance, chicken and fish cooked with aluminum foil and seasoning showed aluminum concentrations as high as 40 to 42 milligrams per kilogram (mg/kg). When cooked without seasoning, the aluminum levels were still notably elevated compared to food cooked without foil.

These findings are particularly concerning because the European Food Safety Authority (EFSA) has established a tolerable weekly intake (TWI) of 1 mg of aluminum per kg of body weight. The study suggests that regular consumption of foods cooked in aluminum foil could lead to exceeding this recommended limit, especially when combined with other sources of aluminum.

## **Factors Affecting Aluminum Leaching**

Several factors influence the amount of aluminum that leaches into your food when cooking with foil. The study revealed that pH levels, salinity, fat content, temperature and exposure

time all play roles in this process.<sup>4</sup> Acidic foods, those high in salt and fatty foods tend to increase aluminum migration from the foil into your food.

In some cases, such as with beef, cooking without seasoning led to higher aluminum levels. This unexpected result was attributed to the high fat content in beef, which may interact with organic acids present in the meat, resulting in increased aluminum uptake from the foil.

The study also noted that the thickness of the aluminum foil used affects the amount of metal released. While the research used one of the thinnest foils available on the market, preliminary tests suggested that thicker foils might lead to even greater aluminum release into food.

To further illustrate the aluminum leaching process, researchers examined used aluminum foil under a scanning electron microscope. The results were striking. Foil that had been in direct contact with food showed significant deterioration, with numerous holes ranging from 100 to 150 micrometers in diameter.<sup>5</sup> Foil used to cook food with seasoning showed even more extensive damage, with larger and more numerous holes.

This visible degradation of the foil's surface provides clear evidence of aluminum migration into the food. Even portions of the foil not in direct contact with the food showed some deterioration, albeit to a lesser extent. These microscopic observations offer a tangible representation of how cooking with aluminum foil leads to the transfer of aluminum into your food.

## **Food Cooked in Foil May Have 40 Times More Aluminum**

In another study exploring how cooking different foods in aluminum foil affects aluminum levels, significant increases in aluminum content across various food types were found, especially those that were marinated.<sup>6</sup>

For example, marinated mackerel wrapped in foil and baked showed aluminum levels up to 49.34 mg/kg — over 40 times higher than the control samples. Even without marinade, foods like salmon and duck breast still saw noticeable increases in aluminum. The study authors concluded that “excessive consumption of food prepared by baking in aluminum foil can carry a health risk.”<sup>7</sup>

Again, the study found the amount of aluminum that migrates into your food depends on several factors. Temperature plays a key role — higher cooking temperatures lead to more leaching. In this study, foods were baked at 220°C (428°F) for 40 minutes, resulting in significant aluminum increases.<sup>8</sup>

The acidity and salt content of food also impact aluminum transfer. Marinated foods consistently showed higher aluminum levels compared to their non-marinated counterparts. For instance, marinated duck breast without skin reached levels of 45.18 mg/kg when cooked in foil, while the non-marinated version only increased to 0.61 mg/kg.<sup>9</sup> Interestingly, the presence of skin seemed to provide some protective effect.

Duck breast with skin showed lower aluminum levels than skinless samples, suggesting the skin may act as a barrier. The specific type of aluminum foil used can also influence

leaching. The study tested five different commercial foils and found variations in their aluminum transfer rates, revealing that not all foils are created equal when it comes to food safety.

## **Aluminum Accumulates in Your Brain, Contributes to Alzheimer's Disease**

Aluminum has been linked to several serious health conditions, including [Alzheimer's disease](#) and autism. It's considered a neurotoxin and accumulates in various tissues, including bones, your parathyroid gland and your brain.

For instance, studies have found higher concentrations of aluminum in the brains of Alzheimer's disease patients compared to people without Alzheimer's, particularly in areas like the hippocampus and temporal lobes.<sup>10</sup>

Drinking water with high aluminum levels (over 0.1 mg/L) was also associated with two to three times higher Alzheimer's prevalence in long-term studies,<sup>11</sup> while reducing aluminum burden through silicon-rich mineral water consumption improved cognitive function in some Alzheimer's patients. Silicon appears to be a natural antagonist to aluminum, helping reduce its absorption and accumulation.

Meanwhile, autism rates have risen dramatically since the late 1990s, with some researchers attributing 75% to 80% of this increase to environmental factors rather than just improved diagnosis. Multiple studies have found higher aluminum concentrations in hair and urine samples of autistic children,<sup>12</sup> and autism may involve impaired ability to metabolize and excrete aluminum.

## **Multiple Sclerosis and Parkinson's Disease: More Evidence of Aluminum's Neurotoxicity**

Multiple sclerosis (MS) patients also show higher aluminum levels in brain tissue compared to controls. One study found MS patients had urinary aluminum excretion comparable to those undergoing metal chelation therapy, suggesting their bodies are actively trying to eliminate excess aluminum.<sup>13</sup>

Silicon-rich mineral water consumption increased aluminum excretion in MS patients, potentially reducing its accumulation.<sup>14</sup> For Parkinson's disease (PD), occupational exposure to aluminum appears to double the risk. Miners with respiratory aluminum exposure, for instance, had 30% higher PD incidence.<sup>15</sup>

Aluminum accumulates in the substantia nigra and Lewy bodies, disrupting dopamine production. It may also affect genes related to PD. Combining aluminum exposure with other metals or pesticides seems to have synergistic negative effects. Early PD diagnosis may be possible by analyzing serum aluminum levels along with other element imbalances.

## **Aluminum's Toxic Effects Throughout Your Body**

When you're exposed to aluminum through food, water or other sources, it accumulates in various organs and tissues, leading to a range of health issues. As mentioned, in your brain,

aluminum interferes with gene expression and enzyme function, contributing to neurodegenerative diseases. It disrupts mitochondrial function, [depleting adenosine triphosphate \(ATP\) levels](#) and causing cell death.<sup>16</sup>

In your bones, aluminum replaces calcium, leading to weakened bones and increased fracture risk. It inhibits the enzyme that activates vitamin D, further compromising bone health. Aluminum accumulation in your bone marrow causes anemia by interfering with hemoglobin synthesis. In your liver, aluminum disrupts iron metabolism and mitochondrial function, contributing to fatty liver disease and metabolic disorders.<sup>17</sup>

The symptoms of aluminum toxicity can be subtle at first but become more severe as exposure continues. You may experience memory loss, confusion and difficulty with coordination and speech. In advanced cases, this progresses to seizures and even coma.

Aluminum also impacts your musculoskeletal system, causing bone pain, fractures and muscle weakness. Your kidneys may struggle to filter aluminum, leading to kidney dysfunction and increased risk of kidney stones. Respiratory issues like asthma, chronic bronchitis and pulmonary fibrosis can develop, especially in occupational settings with high aluminum exposure.<sup>18</sup>

You might also experience changes in your blood cells, leading to anemia and increased susceptibility to infections. Liver function is also compromised by excess aluminum, resulting in abnormal enzyme levels and liver disease. These diverse symptoms underscore the importance of recognizing and addressing aluminum toxicity early<sup>19</sup> — and taking steps to reduce your exposure.

## **How to Reduce Your Aluminum Exposure**

To protect yourself from aluminum's harmful effects, start by examining your diet and lifestyle. Avoid cooking with aluminum foil or cookware and storing foods in aluminum containers, as this poses the risk of leaching. Opt for stainless steel, glass or ceramic cookware instead.

While I don't recommend cooking your food in foil, if you do be sure to avoid cooking acidic or salty foods in it, as these increase aluminum leaching. Reducing cooking temperatures and times when using foil may also help limit transfer. If you're preparing food for young children, it's especially important to avoid using aluminum foil. Children under 3 years of age, in particular, are considered a high-risk group.<sup>20</sup>

Avoiding processed foods and beverages is also important, as many contain aluminum additives. Check your personal care products, especially antiperspirants, as well and choose aluminum-free alternatives. Have your water tested for aluminum and consider using a reverse osmosis filter if levels are high.

To further reduce your exposure, avoid aluminum-based antacids and be aware that aluminum is the most commonly used vaccine adjuvant,<sup>21</sup> making vaccines another route of exposure.

By educating yourself and making informed choices about your cookware and food

preparation methods, you can take steps to protect your health and reduce unnecessary aluminum exposure. Remember, even small changes in your cooking habits may have a substantial impact on your long-term health and well-being.

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#### **Notes**

<sup>1, 2</sup> [Environment International July 2023, Volume 177, 108000](#)

<sup>3, 4, 5, 20</sup> [International Journal of Environmental Research and Public Health 2020 Nov; 17\(22\): 8357](#)

<sup>6, 7, 8, 9</sup> [Food Sci Nutr. 2019 Sep 9;7\(10\):3349-3360](#)

<sup>10, 11, 12, 13, 14, 15</sup> [Int J Mol Sci. 2023 Apr; 24\(8\): 7228](#)

<sup>16, 17, 18, 19</sup> [Emerg Med Int. 2022 Jan 11;2022:1480553](#)

<sup>21</sup> [Curr Med Chem. 2011;18\(17\):2630-7](#)

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