

How Mitochondria Help Fight Infections and Calm Autoimmune Storms

Analysis by [Dr. Joseph Mercola](#)

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STORY AT-A-GLANCE

- › Macrophages and mitochondria are immune partners; macrophages clear germs and control inflammation, while mitochondria power cells and signal macrophages to manage inflammation effectively
- › Mitochondria's complex III produces superoxide, signaling macrophages to release IL-10, the "off switch" for inflammation — key for preventing chronic and autoimmune issues
- › Research showed impaired mitochondrial complex III reduces IL-10, causing unchecked inflammation and severe illness, highlighting mitochondria's important immune regulatory role
- › Naturally boost IL-10 through fiber-rich foods for butyrate, sunshine exposure, exercise, and spices like garlic to enhance your body's inflammation control mechanisms
- › Healthy mitochondria, threatened by seed oils in processed foods and toxins, are essential for energy and immunity; lifestyle choices significantly impact mitochondrial function and overall well-being

Your body's a busy place, full of tiny workers keeping you healthy. Some of these workers, like macrophages and mitochondria, do more than you might think. They're not just cleaning up germs or powering your cells — they're also teaming up to control inflammation, that fiery response that protects you from infections in the short term but contributes to diseases when it becomes chronic.

It's important to understand how these cellular heroes work, why they're key for fighting infections and calming autoimmune flare-ups, and, perhaps most importantly, how to support them with simple, everyday habits.

Meet Your Body's Cleanup Crew — What Are Macrophages?

You've got a squad of cells called macrophages patrolling your body. Think of them as your cleanup crew — part janitor, part security guard. They roam around, gobbling up germs like bacteria and viruses, and tidying up after cuts or bruises. But they don't stop there. They also play a big role in managing your immune system's reaction when trouble hits.

- **How do they work?** When something invades — like a cold virus — macrophages swoop in to eat it up. They're your first line of defense, keeping pathogens in check.
- **What's their secret weapon?** Macrophages release a helper called IL-10, which is like an "all clear" signal. It tells your immune system to back off once the danger's gone. This is important because it stops inflammation from going overboard.

Inflammation is like a fire alarm — it's loud and grabs attention when you need to fight off invaders. But if it keeps blaring after the germ's gone, it's trouble. That's where macrophages and IL-10 save the day, especially for conditions like [autoimmune diseases](#) — such as rheumatoid arthritis or lupus, where your body attacks itself — or severe infections like [sepsis](#), a body-wide emergency.

What Are Mitochondria? More Than Just Energy Makers

Inside your cells, you've got tiny mitochondria, often referred to as "power plants." They churn out energy to keep you moving, like batteries powering a city. Macrophages lean on them to fuel their cleanup jobs. But mitochondria do much more than just make energy.

- **A hidden superpower** — Mitochondria are like command centers, sending signals to guide how macrophages handle infections or injuries. Complex III, part of the electron transport chain, is the star here — it's like a switchboard operator telling everyone what to do.
- **Why this matters** — Without these signals, your macrophages can't do their full job. It's not just about power — it's about control. And when that control slips, inflammation runs wild.

So, mitochondria aren't just keeping the lights on — they're helping you fight germs and calm things down when the battle's over.

What Did Scientists Find About Mitochondria and Inflammation?

In a 2025 study published in *Science Advances*, researchers tested mice to see how mitochondria help macrophages.¹ They interfered with the complex III switch in the macrophages of some mice, breaking it on purpose. Then they gave these mice the flu or a serious infection-like state. Those mice got much sicker than normal ones.

- **What went wrong?** In the lab, those broken macrophages barely made IL-10 when they got infection signals. Without IL-10, they couldn't quiet the inflammation alarm — it just kept screaming.
- **Meet superoxide** — Normally, complex III pumps out a molecule called superoxide, a reactive oxygen species (ROS) that's like a flare macrophages shoot off to influence the production of IL-10. But with no complex III, there's no superoxide and no calm-down signal in the form of IL-10. The result? Inflammation takes over. The study reveals how important mitochondria are for your immune system. They're not just energy makers — they tame inflammation, too.

How Does Superoxide Work? The Firefighter Analogy

Let's break this down with a picture you can see in your head. Imagine superoxide as a firefighter spotting a blaze — that blaze is inflammation. The firefighter grabs a radio and calls for backup — IL-10, the water truck that douses the flames.

- **What happens when it breaks?** In those mice with broken complex III, the firefighter's radio is dead. No call goes out, no water trucks roll in, and the fire (inflammation) rages on. That's why the mice in the study got so sick.
- **Energy isn't the fix** — Scientists tried giving the macrophages a backup power source called alternative oxidase. It kept the lights on, but without superoxide, IL-10 still didn't show up. So, superoxide is a key signaling molecule involved in regulating inflammation in your body.

How Can a Protein Save the Day?

Here's where it gets interesting. When superoxide couldn't call for help, researchers found a backup plan: a protein called protein kinase A (PKA). Think of PKA as a stand-in firefighter.

- **What did the researchers do?** In the lab, they turned on PKA in those broken macrophages. Guess what? It worked. PKA picked up the radio and called for IL-10, calming inflammation even without superoxide.
- **Why this matters** — This finding hints at new ways to help your immune system when mitochondria stumble. It's like having a spare key to cool things down when inflammation's heating up.

Do All Macrophage Jobs Need Superoxide?

Not exactly. Macrophages don't just fight germs; they also make repairs. The researchers gave some macrophages a "repair" signal called IL-4 to heal tissues instead of battle invaders. Interestingly, broken complex III did not interfere with this job.

- **Two modes, one cell** — Picture macrophages like a car with two gears:
 1. **Fighting gear** — Takes on infections — needs superoxide to call IL-10.
 2. **Healing gear** — Fixes tissues — runs fine without superoxide.
- **What this means** — Your mitochondria play different roles depending on what's needed. Fighting germs? They need that superoxide flare. Healing cuts? They're good without it. This shows how smart your body is — it's got backup plans for different tasks.

Why Should You Boost IL-10 Naturally?

More IL-10 means a stronger "off switch" for inflammation. That's beneficial for your health, especially if you've got:

- **Autoimmune disorders** like multiple sclerosis or rheumatoid arthritis, where your immune system mistakenly attacks healthy body tissue.
- **Severe infections**, where inflammation often spirals out of control.
- **The benefits** — Boosting IL-10 helps calm those storms naturally. It's like giving your cleanup crew a megaphone to shout "all clear" louder and faster.
- **How do you do it?** You don't need fancy tools, just simple lifestyle changes to lift your IL-10 levels.

How Does Butyrate Boost IL-10 Naturally?

One superstar for raising IL-10 is [butyrate](#), a short-chain fatty acid your gut bacteria make when you eat fiber-rich foods. It's beneficial for both your gut and immune system. Growing evidence indicates butyrate increases IL-10 production.²

- **What does butyrate do?** It boosts complex III's signaling, so your macrophages shoot off more superoxide flares and call in more IL-10 — like giving your firefighter a megaphone. Butyrate also helps nourish your colon cells, which rely on butyrate as a main energy source.

When these cells get the fuel they need, your gut lining stays strong, lowering the chances of substances such as undigested food, bacteria and metabolic wastes sneaking through into your bloodstream, a condition known as leaky gut. Butyrate's protective effects are linked to multiple health benefits, including more stable digestion and better immune response.

- **How do you get it?** To boost butyrate production, eat fiber-filled carbohydrates like fruits on a regular basis. You also get butyrate from certain foods like grass fed butter and ghee, but a key way to increase your supply is by adding fiber sources such as fruits, vegetables, whole grains, and beans to your meals. When you give your gut bacteria enough fiber to ferment, they create even more butyrate.

It's important to understand, however, that if your [gut health](#) is poor, increasing dietary fiber must be done gradually to avoid the production of endotoxin, a mitochondrial poison. Rice and whole fruits are a good starting point.

What Are Other Ways to Boost IL-10 Naturally?

Butyrate's not the only trick up your sleeve to boost IL-10. Here are more easy ways to increase IL-10 and keep your immune system happy:

- **Sunshine or ultraviolet B (UVB) light therapy** — Exposure to sunlight or UVB light therapy increases levels of IL-10.³ Ideally, expose your bare skin to direct sunlight daily. Be aware, however, that seed oils, rampant in processed and fast food, are packed with [linoleic acid](#) (LA).

In the future we will be referring to these fats as PUFs which is short for polyunsaturated fats as it is far more accurate than calling them PUFAs, since most people know them as fats and not acids.

When LA accumulated in your skin interacts with the sun's UV rays, it triggers inflammation and DNA damage. It's best to avoid direct sunlight during peak hours (10 a.m. to 4 p.m.) until you've cut back on seed oils for six months. This gives your body time to clear some of the accumulated LA.

- **Exercise** — Getting moving, whether it's walking, dancing, or biking, boosts IL-10. One study found a 27-fold increase in IL-10 immediately after exercise.⁴
- **Spice it up** — Try adding these to your meals regularly:
 1. **Garlic** — Toss it in your meals — it's tasty and helps boost IL-10.⁵
 2. **Licorice** — Consider sipping it as a tea — but be aware licorice is contraindicated for those with high blood pressure, kidney or liver disease and pregnant and breastfeeding women.⁶

Why Does Mitochondrial Health Matter to You?

Mitochondria play a key role in producing adenosine triphosphate (ATP), the energy currency essential for numerous cellular functions. When mitochondrial function is compromised, ATP production decreases, leading to cellular energy deficits.

This reduction in energy impairs the cell's ability to regulate normal processes, fostering an environment ripe for chronic inflammation. If your mitochondria are dysfunctional, you might notice trouble fighting infections, more inflammation, and chronic disease.

- **What harms mitochondria?** LA in most processed foods is a widespread mitochondrial poison that compromises your cellular energy production. **Endocrine-disrupting chemicals** (EDCs), including estrogen-mimicking compounds like

xenoestrogens, and pervasive **electromagnetic fields (EMFs)** also interfere with your mitochondria and your cells' ability to generate energy efficiently.

- **What helps mitochondria?** Along with avoiding LA, EDCs and EMFs, **carbohydrates** play a key role in supporting your mitochondrial function.

Most adults need a daily intake of around 200 to 250 grams of targeted carbohydrates to support cellular energy. If you lead a more active lifestyle, you likely need even more. If you have dysbiosis, avoid fiber until your gut heals.

If your gut health is generally healthy or you have only minor gut issues, start with easily digestible options like white rice and whole fruits. As your gut adjusts, consider adding root vegetables, then non-starchy vegetables, starchy vegetables like sweet potatoes or squash, beans, legumes and, finally, minimally processed whole grains.

FAQs About Mitochondria and Autoimmune Disorders

Q: What foods boost IL-10 naturally?

A: Fiber-rich foods, including apples, berries, broccoli, sweet potatoes, oats and rice, feed your gut bacteria, which then produce butyrate. Butyrate is a short-chain fatty acid that acts as a "power-up" for your immune system, specifically boosting the signaling of mitochondrial complex III in macrophages.

This enhanced signaling leads to increased superoxide production, which in turn triggers a greater release of IL-10, the anti-inflammatory molecule. Therefore, focusing on incorporating diverse fiber sources in your diet is key to naturally elevating IL-10 levels. One caveat — if you have dysbiosis, avoid fiber until your gut health is healed.

Q: How does exercise help your immune system?

A: Exercise serves as a rapid and potent natural method to enhance your immune system's ability to manage inflammation. Even a short burst of physical activity, such as walking or dancing, significantly increases IL-10 levels — up to 27 times in one study.⁷

This surge in IL-10 acts as a powerful "off switch" for inflammation, quickly calming down immune responses. By regularly engaging in physical activity, you're effectively training your immune system to efficiently resolve inflammation, promoting balance and preventing it from becoming chronic.

Q: Why does IL-10 matter for autoimmune disorders?

A: IL-10 is important in autoimmune disorders because it functions as the immune system's "off switch" for inflammation. In autoimmune conditions like lupus, rheumatoid arthritis and multiple sclerosis, the immune system mistakenly attacks the body's own healthy tissues.

IL-10's role is to signal the immune system to stand down and stop this attack. By effectively promoting the resolution of inflammation, IL-10 provides significant relief in autoimmune disorders by preventing the immune system from continuously harming healthy cells and tissues.

Q: What's the best way to support mitochondria?

A: Supporting your mitochondria involves several key strategies: dietary fiber intake to produce butyrate, daily physical activity to boost IL-10, and overall mitochondrial function, and regular sun exposure (or UVB light therapy) to also increase IL-10.

Equally important is avoiding factors that harm mitochondria, such as linoleic acid prevalent in processed foods and seed oils, endocrine-disrupting chemicals and electromagnetic fields.

Further, ensuring adequate targeted carbohydrate intake (200 to 250 grams daily) fuels mitochondrial energy production. Paying attention to gut health and gradually increasing fiber intake is also important for optimal mitochondrial support.

Sources and References

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