

Effects of Yerba Mate (*Ilex paraguariensis*) on the Human Body

Yerba mate is a traditional South American beverage brewed from the dried leaves of *Ilex paraguariensis*. It contains a variety of bioactive compounds and has been associated with numerous health effects. Below is an overview of its composition, potential health benefits, and risks based on current scientific research.

Composition of Yerba Mate

Yerba mate's effects stem from its rich chemical composition. The dried leaves are composed largely of carbohydrates (around 80% by weight), with smaller fractions of protein (~4%) and lipids (~1%) ¹. More importantly, yerba mate provides several groups of bioactive compounds:

- **Methylxanthine Alkaloids:** Notably **caffeine** (~1–2% of dry weight) and **theobromine** (~0.3–0.9%), with trace **theophylline** ². These contribute to mate's stimulant effects and bitter taste. A typical 150 mL cup of mate contains ~80 mg of caffeine, comparable to a cup of coffee ³.
- **Polyphenols:** Abundant phenolic compounds, especially **chlorogenic acids** and related caffeoyl derivatives. Chlorogenic acid is dominant, and a cup of mate (~5 g leaves) can provide roughly 0.5–0.9 g of polyphenols ⁴ ⁵. Mate also contains flavonoids like quercetin and rutin. These polyphenols confer strong antioxidant properties.
- **Saponins:** A class of terpenoid compounds (derivatives of ursolic and oleanolic acid) unique to mate, sometimes called **mate saponins**. They total about 0.7–1.2% of the dry leaves ⁶. Saponins contribute to mate's characteristic "dry" bitter flavor and are being studied for anti-inflammatory effects ⁶ ⁷.
- **Vitamins and Minerals:** Mate provides minerals like potassium, magnesium, calcium, and iron in meaningful amounts ⁸. It also contains some vitamins (e.g. ~22 mg vitamin C and B-family vitamins per 100 g dry leaves) ⁹. While not a major source of macronutrients, these micronutrients add to its nutritional profile.

Effects on Cardiovascular Health

Research suggests that yerba mate consumption may benefit cardiovascular health, largely due to its antioxidant and lipid-lowering activities. The polyphenols and saponins in mate have demonstrated **cholesterol-lowering effects**. In a clinical trial, drinking 1 liter of mate daily for 40 days significantly reduced LDL ("bad") cholesterol (by ~8–13%) and modestly increased HDL ("good") cholesterol in participants, even those on lipid-lowering drugs ¹⁰. These improvements are thought to arise from compounds in mate that **block cholesterol absorption and synthesis**, a effect possibly attributable to saponins and caffeine ¹¹.

Yerba mate also appears to protect LDL from oxidation. Antioxidants from the tea are absorbed into the bloodstream and help inhibit lipid peroxidation ¹². This is important because oxidized LDL contributes to atherosclerosis. Studies report that regular mate intake increases serum antioxidant capacity and prevents the loss of HDL's anti-atherogenic function by boosting the activity of paraoxonase-1, an enzyme that protects against plaque formation ¹³ ¹⁴. In both human and animal studies, mate's

polyphenol-rich extracts reduced the progression of atherosclerotic lesions ¹⁵ ¹⁶ . Improved vascular function has been observed as well – the endothelial function and **vasodilatory capacity** may improve due to the high antioxidant load.

Importantly, **blood pressure effects** of yerba mate appear to be mild. While caffeine can acutely raise blood pressure, habitual mate drinkers may develop tolerance. One study noted that consuming cold yerba mate (tereré) did **not increase heart rate or blood pressure**, and even reduced the heart's oxygen demand compared to hot mate in the same individuals ¹⁷ ¹⁸ . This suggests cold preparations might confer cardiovascular benefits without the stimulant stress on the heart. Overall, moderate yerba mate intake – as part of a healthy lifestyle – is associated with better lipid profiles and antioxidant status, which could translate to **lower cardiovascular risk** ¹⁹ ²⁰ .

Metabolic Effects (Weight, Glucose, and Lipid Metabolism)

Yerba mate is often promoted for weight management and metabolic health. Studies support some **anti-obesity** effects. The caffeine and other compounds in mate increase energy expenditure and **fat oxidation**, acting as a thermogenic aid ²¹ . In active individuals, combining mate consumption with exercise led to higher fatty acid utilization and improved satiety and mood compared to exercise alone ²¹ ²² .

In animal models of obesity, mate supplementation inhibited weight gain and adipose tissue growth. Mice on a high-fat diet had **lower body weight, less visceral fat, and reduced liver fat** when given yerba mate over several weeks ²³ ²⁴ . Mate-treated animals also showed lower serum triglycerides, LDL cholesterol, and blood glucose levels than controls ²⁵ ²⁴ . These effects are linked to mate's ability to **reduce adipocyte formation** (down-regulating genes involved in fat cell differentiation) and to increase baseline metabolism ²⁴ ²⁶ . The polyphenol **chlorogenic acid** in mate may play a key role by modulating adipogenic genes ²⁷ ²⁸ .

Human studies, though limited in number, echo these findings. In one 12-week clinical trial, overweight adults who took a concentrated yerba mate extract (3.15 g/day) saw significant reductions in body fat mass and percentage compared to placebo ²⁷ . Another trial found that 15 days of daily mate (one cup) increased antioxidant defenses and favorably shifted gene expression related to obesity in healthy women ²⁹ ³⁰ . Yerba mate also **delays gastric emptying**, which prolongs the feeling of fullness and helps reduce overall calorie intake ³¹ . In a study of overweight individuals, a yerba mate herbal preparation significantly slowed stomach emptying and led to weight loss over 45 days ³¹ .

Beyond weight loss, yerba mate shows **anti-diabetic potential**. It appears to improve blood glucose control and insulin sensitivity. In diabetic mice, mate intake lowered fasting blood glucose in a dose-dependent manner and improved insulin signaling in the liver by reducing inflammatory pathways (NF-κB) that contribute to insulin resistance ³² ³³ . Notably, mate's polyphenols can inhibit formation of advanced glycation end-products (AGEs) – harmful compounds formed from sugar-protein reactions that contribute to diabetic complications. In fact, mate extracts in vitro inhibited AGE formation as effectively as the drug aminoguanidine (an anti-glycation agent), an effect largely credited to chlorogenic and caffeic acids in the tea ³⁴ ³⁵ .

Early human research is encouraging: One small trial with diabetics and pre-diabetics showed that drinking 1 liter of yerba mate daily for 60 days increased antioxidant glutathione levels and reduced lipid peroxides, suggesting reduced oxidative stress ³⁶ ³⁷ . Another randomized study (in which yerba mate was combined with minor components like white mulberry and chromium picolinate) reported **improved glycemic control** over 3 months – including lower fasting glucose, post-meal glucose spikes,

and HbA1c – as well as reductions in total and LDL cholesterol ³⁸. While more research is needed, these findings indicate yerba mate could be a useful adjunct for metabolic health, by promoting weight loss, improving lipid profiles, and enhancing blood sugar regulation.

Neurological Effects (Stimulating and Cognitive Effects)

Yerba mate is perhaps best known for its **stimulant effect** on the central nervous system. As a caffeine-containing beverage, it enhances alertness and can reduce fatigue. Indigenous consumers and modern users alike note that mate drinking increases mental energy. Caffeine from mate **activates the cerebral cortex**, leading to improved memory, attention, and reaction time in the short term ³⁹. Users often experience better focus and mood after drinking mate, similar to the effects of coffee or tea. In fact, controlled tests have found that mate consumption can improve certain aspects of cognitive function and exercise performance through its stimulant action ⁴⁰ ⁴¹.

Interestingly, many regular mate drinkers report a calmer experience compared to coffee. They describe sustained energy **without the jitteriness** or anxiety that coffee can sometimes provoke ⁴². This subjective difference might be due to the presence of theobromine and polyphenols, which could modulate caffeine's effect, though scientifically it's the same 80 mg or so of caffeine per cup as coffee ³ ⁴². Additionally, mate stimulates the release of dopamine and other neurotransmitters to a degree, which can contribute to improved mood and perhaps mild euphoria in some users, though more research is needed on mood effects.

Beyond wakefulness, emerging research hints at **neuroprotective properties** of yerba mate. Laboratory studies have shown that mate's compounds protect neurons in cell culture. For example, an extract of *Ilex paraguariensis* significantly prevented dopamine-producing neuron death in a model of Parkinson's disease, outperforming caffeine alone in its neuroprotective effect ⁴³. Both chlorogenic acid and theobromine isolated from mate showed protective effects on neurons, but the full spectrum of mate's phytochemicals had the strongest effect ⁴³. These findings suggest a synergy of compounds might contribute to brain health. Antioxidants in mate can cross the blood-brain barrier and reduce oxidative damage in neural tissues ⁴⁴. In animal models of neuroinflammation and arthritis, mate treatment reduced oxidative damage in the brain and normalized levels of antioxidant enzymes (such as catalase and superoxide dismutase) ⁴⁵. While human data are still limited, such studies raise the possibility that long-term mate consumption could help protect against neurodegenerative diseases or cognitive decline by combating oxidative stress and inflammation in the nervous system.

In summary, yerba mate acts as a mild central nervous system stimulant, enhancing alertness, cognitive performance, and mood. At the same time, its rich polyphenol content might confer longer-term neurological benefits, although this is an active area of research.

Antioxidant and Potential Anti-Cancer Properties

Yerba mate is **high in antioxidants**, which has spurred research into its anti-cancer potential. Chemically, mate tea exhibits strong antioxidant capacity in lab assays, comparable to green tea extracts ⁴⁶. Both green (unroasted) and roasted yerba mate infusions can scavenge free radicals and prevent oxidative damage, thanks to their high polyphenol content ⁴⁶ ⁴⁷. In one study, 14 healthy volunteers took concentrated yerba mate extract (750 mg, thrice daily) for 60 days, and saw a ~16% increase in serum antioxidant capacity by day 30, with significant rises in endogenous antioxidant enzymes (glutathione, catalase, superoxide dismutase) and corresponding decreases in lipid peroxidation markers ⁴⁸ ⁴⁹. This indicates that mate's polyphenols are bioactive in humans and can bolster the body's antioxidant defenses.

The anti-inflammatory effects of yerba mate's compounds are also well documented. Mate saponins and polyphenols (like ursolic acid and rutin) can modulate the NF-κB pathway, a key driver of inflammation ⁷ ⁵⁰. Animal studies show that administering yerba mate extract reduces production of pro-inflammatory cytokines (such as TNF-α, IL-6) and increases anti-inflammatory cytokines like IL-10 in tissues ⁵¹ ⁵². These systemic anti-inflammatory and antioxidant actions set the stage for investigating mate in cancer prevention.

Anti-Cancer Effects: Preliminary research (mostly in cell cultures and animals) suggests that yerba mate may have anti-cancer properties, particularly against colon cancer. In vitro, yerba mate extracts have been shown to **inhibit the growth of human colorectal cancer cells** by inducing apoptosis (programmed cell death). One study found a polyphenol-rich mate extract could suppress the proliferation of colon adenocarcinoma cells (HT-29 and Caco-2) at levels of effectiveness similar to pure gallic acid, a known anti-cancer antioxidant ⁵³. The mate extract triggered apoptotic pathways and cell cycle arrest in these cancer cells ⁵³ ⁵⁴.

In vivo experiments reinforce this potential. In a mouse model of chemically induced colorectal cancer, oral administration of yerba mate extract (1.6 g/kg/day) significantly **inhibited tumor growth and angiogenesis** (the formation of new blood vessels that feed tumors), without toxic effects on the mice ⁵⁴ ⁵⁵. Treated mice had slower cancer cell proliferation and higher rates of tumor cell apoptosis compared to controls ⁵⁵. Similarly, mate saponins given to rats helped prevent colitis-associated colon cancer by downregulating inflammatory enzymes (iNOS, COX-2) involved in tumor promotion ⁷ ⁵⁰. These findings highlight that multiple constituents in yerba mate – caffeoyl derivatives, saponins, flavonoids – may work together to exert **chemopreventive effects**, especially in the gastrointestinal tract.

It's worth noting that **epidemiological evidence in humans is mixed**. There are not yet clear data showing that mate drinkers have lower cancer rates, and in fact some studies (discussed below) have noted increased cancer risks with certain consumption patterns. Therefore, the anti-cancer potential of yerba mate is still under investigation. Nonetheless, its high antioxidant load and anti-inflammatory activity make it a compelling candidate for further research into cancer prevention. Including yerba mate as part of a balanced diet might help reduce oxidative stress and inflammation, which are common pathways in the development of chronic diseases ⁵⁶ ⁵⁷.

Effects on Digestion and Gastrointestinal Health

Yerba mate has a history of use as a digestive aid, and science is beginning to explore its impact on the gastrointestinal (GI) system. One immediate effect of mate is **slower gastric emptying**. As noted earlier, consuming yerba mate can prolong the time the stomach takes to empty after a meal ³¹. This delay can contribute to longer-lasting satiety (useful for weight control) but may also affect digestion speed. Some individuals find that drinking mate after eating helps them feel comfortably full and can aid in digestion of fatty foods, possibly by stimulating bile flow (anecdotally reported, though direct studies are limited).

Mate's rich polyphenols could also influence the **gut microbiome** – the community of microbes in the digestive tract. Although research is ongoing, polyphenols like chlorogenic acid are known to reach the colon where gut bacteria metabolize them, potentially shifting the microbial composition. A 2022 review suggested that many of mate's phenolic compounds, which are poorly absorbed in the small intestine, likely exert effects in the colon by interacting with gut microbes ⁵⁸ ⁵⁹. This interaction could produce metabolites that benefit the host's metabolism and immune system, though specific data on yerba mate and human gut microbiota are still emerging. In general, diets high in polyphenols are associated

with a healthier gut flora and reduced gut inflammation, so this is a promising area for future mate research.

Yerba mate's **anti-inflammatory properties** extend to the GI tract. In animal studies of colitis (inflammatory bowel disease), mate has shown protective effects. For instance, in a rodent model of chemically induced colitis, treatment with yerba mate tea or isolated mate saponins significantly reduced colon inflammation and tissue damage ⁷ ⁵⁰. Markers of inflammation in the colon (like iNOS and COX-2) were downregulated in mate-treated animals, and healing of the colonic mucosa was improved relative to untreated controls ⁶⁰ ⁵⁰. Another study found that mate administration in rats exposed to a high-fat, pro-inflammatory diet reversed many inflammatory changes in the gut and abdominal fat tissue, increasing anti-inflammatory cytokines and lowering pro-inflammatory signals ⁶¹ ⁶². These results hint that mate could be beneficial for people with inflammatory digestive disorders, by calming gut inflammation and protecting the mucosal lining.

At the same time, **some gastrointestinal side effects** of yerba mate are recognized. Because it contains caffeine, mate can stimulate gastric acid secretion. Sensitive individuals or those prone to acid reflux might experience heartburn or stomach discomfort if they drink strong mate on an empty stomach. Excessive intake may lead to diarrhea in some people, as caffeine can speed intestinal motility and draw water into the bowels ⁶³ ⁶⁴. Cases of exacerbated IBS (irritable bowel syndrome) symptoms have been reported in people consuming high amounts of caffeine, including mate ⁶⁴. Thus, while yerba mate can support digestion for many, those with acid reflux or GI sensitivity should consume it in moderation and avoid extremely hot preparations that might irritate the digestive tract.

In summary, moderate yerba mate consumption appears to have a generally positive or neutral effect on digestive health: it may aid fullness and metabolism, has demonstrated anti-inflammatory actions in the gut, and could support a healthy microbiome. Users should be mindful of temperature and quantity to avoid any GI irritation.

Adverse Effects and Risks

Despite its potential benefits, yerba mate is not free of risks. Key concerns include certain cancers associated with the traditional consumption method, side effects from caffeine, and interactions with medications. A balanced understanding of these risks is important for safe use:

- **Cancer Risk (High-Temperature and Heavy Consumption):** Epidemiological studies in South America have found that drinking very large quantities of **extremely hot** yerba mate over many years is linked to higher rates of certain cancers, especially of the esophagus, throat (pharynx, larynx), oral cavity, as well as some other organs ⁶⁵ ⁶⁶. The primary culprit is thought to be chronic thermal injury to tissues from scalding-hot beverages, compounded by exposure to **polycyclic aromatic hydrocarbons (PAHs)**. PAHs are carcinogenic compounds that can form during the smoke-drying of mate leaves. Heavy mate drinkers who repeatedly use the same leaves with very hot water ingest more PAHs, which may increase cancer risk ⁶⁷ ⁶⁸. For example, one large case-control study in Paraguay showed that the temperature of mate (hot vs. cold) was a more significant risk factor for esophageal cancer than the volume consumed ⁶⁹. Similarly, a pooled analysis from Argentina, Brazil, and Uruguay found esophageal cancer incidence rose with both higher mate temperature and greater lifetime intake ⁷⁰. It's important to emphasize that **moderate mate consumption at warm (not boiling) temperatures has not been associated with these cancers** ⁶⁷. Occasional drinkers likely face no elevated risk above baseline. To minimize harm, experts advise letting boiling water cool a bit before pouring, and

avoiding very prolonged or excessive daily intake of mate, especially in combination with other risk factors like smoking or alcohol use ⁷¹ ⁷² .

- **Caffeine-Related Side Effects:** As a caffeinated beverage, yerba mate can produce the usual array of caffeine side effects if consumed in large amounts. These include **insomnia, nervousness, jitteriness, increased heart rate, and elevated blood pressure** ⁷³ ⁷⁴ . Some people also report headaches or palpitations with high doses. The caffeine in mate stimulates the heart and can cause arrhythmias in sensitive individuals ⁷⁵ . It is also a diuretic, so very high intake may contribute to dehydration or electrolyte imbalances (and potentially bone calcium loss if calcium intake is low) ⁷⁶ . Most of these effects occur with excessive consumption – for example, drinking over 1–1.5 liters of strong mate (equivalent to 300–400+ mg caffeine) daily. Average use (one to a few cups per day) is usually well tolerated, but those with anxiety disorders, hypertension, or heart conditions should use caution, as even moderate caffeine could aggravate **anxiety symptoms or blood pressure** in susceptible individuals ⁷⁷ ⁷⁸ . It's recommended to limit mate (like any caffeine source) during **pregnancy**, since high caffeine intake has been linked to miscarriage and low birth weight; pregnant women are advised to stay under about 300 mg caffeine per day (roughly 6 cups of mate) ⁷⁹ ⁸⁰ .
- **Drug Interactions:** Yerba mate can interact with medications, primarily due to its caffeine content. Caffeine is a stimulant and also influences how drugs are metabolized in the liver. **Concurrent use of mate with other stimulants** (e.g. ephedrine or amphetamines) is hazardous as it may lead to excessive stimulation of the nervous system, raising heart rate and blood pressure to dangerous levels ⁸¹ ⁸² . Mate should likewise be used cautiously (or avoided) with certain **psychiatric medications**. For instance, caffeine can counteract sedatives or tranquilizers – it may reduce the efficacy of benzodiazepines (anti-anxiety drugs) by accelerating their breakdown ⁸³ , and it can antagonize the effect of adenosine agonists used in cardiac stress tests ⁸⁴ ⁸⁵ . There is also a known interaction with MAO inhibitor antidepressants, where caffeine can precipitate a spike in blood pressure ⁸⁶ ⁸⁷ . Additionally, caffeine (and polyphenols) can alter the activity of liver enzymes (like CYP1A2 and CYP3A4) that metabolize many drugs ⁸⁸ ⁸⁹ . As a result, **mate may slow the clearance of certain medications**, leading to higher blood levels. Notable examples include clozapine (an antipsychotic) ⁹⁰ , theophylline (an asthma drug) ⁹¹ , and some seizure medications (e.g. it may reduce the effectiveness of anticonvulsants like carbamazepine or phenytoin) ⁹² ⁹³ . It may also enhance drugs that have a blood-thinning effect (due to caffeine's mild anti-platelet activity) ⁹⁴ . Patients on prescription medications are advised to consult healthcare providers about possible interactions. In practice, moderate consumption is unlikely to cause serious issues for most people, but high intakes or use alongside multiple medications could pose risks.

In conclusion, **responsible consumption** is key. Enjoying yerba mate in moderation (a few cups a day) at safe temperatures can maximize its benefits while minimizing risks. The beverage offers a range of bioactive compounds that contribute to stimulating, antioxidant, and metabolic effects ⁵⁶ ⁵⁷ , but like any herbal supplement or source of caffeine, it should be used with awareness of potential adverse effects. Ongoing research continues to clarify the long-term health impacts of yerba mate, helping drinkers make informed decisions about this unique and culturally significant tea.

References: Scientific findings were drawn from peer-reviewed sources, including *Nutrients* (Gawron-Gzella et al., 2021) for a comprehensive review of yerba mate's chemistry and health effects ¹ ⁷³ , and studies indexed in PubMed exploring cardiovascular ¹² , metabolic ²³ , neurological ⁴³ , and cancer-related effects ⁵³ of yerba mate, as well as safety evaluations from health agencies ⁶⁹ ⁸¹ . These references illustrate both the promising benefits and the precautions associated with yerba mate consumption.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 60

61 62 65 66 67 68 69 70 73 74 **Yerba Mate—A Long but Current History**

<https://www.mdpi.com/2072-6643/13/11/3706>

58 59 **Phenolic Compounds Present in Yerba Mate Potentially Increase Human Health: A Critical Review - PMC**

<https://pmc.ncbi.nlm.nih.gov/articles/PMC9516501/>

63 64 71 72 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 **Yerba Mate: MedlinePlus Supplements**

<https://medlineplus.gov/druginfo/natural/828.html>