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HEALTH PROPERTIES AND THERAPEUTIC POTENTIAL OF YERBA MATE (ILEX PARAGUARIENSIS) IN HEALTHCARE: A COMPREHENSIVE REVIEW

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ABSTRACT

Yerba mate (Ilex paraguariensis) has emerged as a promising nutraceutical with pleiotropic metabolic and immunomodulatory effects relevant to cardiovascular risk modification, obesity care, glycemic control, oxidative stress, gut immune homeostasis, and inflammatory bowel disease. Randomized clinical data demonstrate reductions in body fat mass, percent body fat, and waist–hip ratio without safety concerns after 12 weeks of standardized supplementation, aligning with mechanistic rodent work showing tissuespecific bioenergetic reprogramming, antiinflammatory signaling, improved mitochondrial coupling in muscle, adipose thermogenic uncoupling, and enhanced hepatic redox tone. Metaanalytic evidence on lipids remains inconclusive overall, though individual trials report favorable LDLC signals in dyslipidemia, including addon effects to statins. Preclinical and translational studies indicate attenuation of hypothalamic and adipose inflammation, improved insulin signaling via PI3K–AKT pathways, modulation of macrophage polarization toward M2 phenotypes, and microbiota shifts that may augment metabolic and intestinal antiinflammatory activity. Safety signals are generally favorable when consumed in moderate amounts, with attention to preparation practices to minimize polycyclic aromatic hydrocarbons and to manganese intake with very high volume use. This narrative synthesizes clinically salient evidence and proposes patient-oriented use of yerba mate in cardiometabolic risk reduction, weight management, and adjunctive care in colitis, while outlining dosing, formulation, and monitoring considerations and research priorities.

KEYWORDS
Yerba Mate, Ilex Paraguariensis, Polyphenols, Antioxidant, Anti-Inflammatory, Metabolic Health, Functional Food

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Introduction

Yerba mate is a South American infusion rich in methylxanthines (primarily caffeine), chlorogenic acids, saponins, and flavonoids that collectively confer antioxidant, thermogenic, and anti-inflammatory properties, which can be successfully implemented in the treatment of many diseases. (Meinhart et al. 2018, Mateos et al., 2018). Obesity, insulin resistance, and low-grade inflammation share an interwoven pathophysiology characterized by adipose macrophage activation, cytokine-driven impairment of insulin signaling, and oxidative stress. The constituents of yerba mate, chlorogenic acids and saponins, interact with redox systems, lipid and glucose pathways, and the gut microbiome (Gambero & Ribeiro, 2015; Santos et al., 2022; Heck & de Mejia, 2007). The clinical utility of such actions is beginning to be clarified by controlled trials in humans and mechanistic studies in animals, together with integrative evidence on safety and chemical composition across preparations (Kim et al., 2015; Walton et al., 2023; RząsaDuran et al., 2022).

Methodology

The review is an analysis of literature from available sources, including databases such as PubMed, Google Scholar, ScienceDirect. The search was performed between July and August 2025. During the research, we took into consideration only articles in English using Medical Subject Headings and keywords. Literature review included studies published between 2007 and 2024, with a particular emphasis on research from the past 10 years to ensure relevance and timeliness. All selected studies were evaluated and approved by the co-authors.

Results

Weight Management Properties and Metabolic Benefits

The anti-obesity effects of yerba mate represent one of its most extensively studied therapeutic applications, with mechanisms involving thermogenesis enhancement, appetite regulation, and adipogenesis modulation. Clinical trials have demonstrated significant weight reduction and body composition improvements following yerba mate supplementation. Kim et al. (2015) conducted a randomized, double-blind, placebo-controlled trial with 30 obese Korean subjects and found that 12 weeks of yerba mate capsule consumption (3 g/day) resulted in significant decreases in body fat mass and body fat percentage compared to placebo. The waist-hip ratio was also significantly reduced, indicating preferential reduction in abdominal adiposity, which is particularly relevant for metabolic health improvement (Kim et al., 2016). Yerba mate consumption increases hepatic activities of superoxide dismutase, catalase, and glutathione peroxidase while reducing lipid peroxidation markers such as malondialdehyde (Conceição et al., 2016). Studies have shown that yerba mate consumption increases glucagon-like peptide-1 (GLP-1) and leptin levels while enhancing leptin sensitivity in the hypothalamus (Hussein et al., 2011). A clinically relevant, repeatable effect of yerba mate is body-fat reduction and central adiposity improvement in adults with obesity. In the randomized Korean trial, 3 g/day of standardized extract for 12 weeks resulted in statistically significant reductions in body fat mass and percent body fat compared to the placebo, accompanied by an improved waist–to–hip ratio, without any clinically significant changes in safety laboratory tests or vital signs (Kim et al., 2015). These outcomes align with earlier human observations of appetite modulation and gastric emptying delay in multi-ingredient

formulations and with rodent data showing reduced adiposity, improved lipid oxidation, and smaller adipocyte size, strengthening biological plausibility (Gambero & Ribeiro, 2015; Kim et al., 2015). Mechanistically, high-resolution respirometry demonstrates increased ATP coupling efficiency in skeletal muscle and a thermogenic, energetically inefficient shift in white adipose (increased oxygen consumption with decreased ATP production), both of which would favor higher energy expenditure at rest and during exercise, while hepatic glutathione redox becomes more reduced, buffering oxidative stress that accompanies metabolic overload. These bioenergetic changes are clinically pertinent in individuals with sarcopenic obesity or insulin resistance, where supporting muscular ATP efficiency while promoting adipose uncoupling could enhance glycemic and weight trajectories without sympathomimetic stress (Walton et al., 2023).

Lipid management data are mixed in aggregate analyses but potentially favorable in selected patients. A systematic review and metaanalysis of seven experimental studies (n=378) found no pooled differences in LDLC, HDLC, total cholesterol, or triglycerides versus controls; however, metaregression suggested baseline imbalances influenced effects, and several individual trials in dyslipidemic subjects showed LDLC reductions, including additional LDLC lowering in statin users (de Morais et al., 2009; Masson et al., 2022). Clinically, yerba mate may be reasonable as an adjunct in moderate dyslipidemia where patients prefer nutraceuticals or as a complement to statins in partial responders, while counseling expectations given the overall heterogeneity (Masson et al., 2022). Importantly, daily infusion can contribute meaningful micronutrients and phenolics with antioxidant activity; Brazilian samples showed high phenolic content and antioxidant capacity and demonstrated that approximately 1 L/day of infusion can contribute significantly to magnesium and zinc intakes but may exceed manganese recommended intakes, guiding moderation and monitoring in heavy consumers (RząsaDuran et al., 2022; Boaventura et al. 2015).

Table 1. Weight Management Properties and Metabolic Benefits of Yerba Mate

Parameter	Effect	Clinical Evidence	Clinical Relevance
Body Fat Mass & Percentage	Significant decrease	RCT: 12 weeks, 3g/day, n=30 (Kim et al., 2015)	Preferential abdominal fat reduction; improved metabolic health
Waist-Hip Ratio	Significant reduction	RCT: 12 weeks, 3g/day (Kim et al., 2015)	Decreased central adiposity; cardiovascular risk reduction
Lipid Profile (LDL-C, HDL-C, TC, TG)	No pooled effect; LDL-C reductions in dyslipidemic subjects	Meta-analysis: 7 studies, n=378 (Masson et al., 2022)	Potential adjunctive therapy in dyslipidemia; heterogeneous effects
Energy Metabolism	Increased ATP coupling efficiency (muscle); thermogenic shift (adipose)	High-resolution respirometry (Walton et al., 2023)	Enhanced energy expenditure; beneficial for sarcopenic obesity
Appetite & Gastric Function	Appetite modulation; delayed gastric emptying	Human observations; multi-ingredient formulations	Weight management support through satiety enhancement

Immunometabolic and gastrointestinal applications

Beyond weight and lipids, yerba mate exerts immunomodulatory effects relevant to metabolic inflammation and mucosal disease. In DSSinduced colitis, oral yerba mate significantly reduced disease activity index, rectal bleeding, and histologic injury, with improved survival; systemic IL6 and IL1β levels fell early and remained lower, and colonic explants showed reduced cytokines by day 8 (OlateBriones et al., 2024). Mechanistically, colonic infiltration of CD206+ M2 macrophages increased, and gut microbiota shifted—reducing Enterobacteriaceae and Eubacterium rectale/Clostridium coccoides while increasing Lactobacillus/Lactococcus—suggesting that microbiomeimmune crosstalk mediates part of the benefit (OlateBriones et al., 2024). In vitro, mate did not directly polarize bone marrow-derived macrophages toward M2, implying an indirect host–microbiome interaction, consistent with the broader literature that yerba mate phenolics modulate gut bacteria, promote beneficial taxa (e.g., lactobacilli and bifidobacteria), and yield bioactive microbial catabolites such as dihydrocaffeic acid with antiinflammatory and antioxidant activities (Santos et al., 2022; de Vasconcellos et al., 2022). Clinically, these data support considering yerba mate as an

adjunct to standard care in mild ulcerative colitis or for remission maintenance, where patients seek dietary anti-inflammatory strategies, with an emphasis on consistency of intake, caffeine tolerance, and avoidance of extremely hot preparations, which may irritate the mucosa.

Yerba mate's systemic antiinflammatory effects also integrate with improved insulin signaling. Preclinical models demonstrate attenuation of hypothalamic and adipose inflammation, normalization of insulin receptor β, IRS1, and AKT signaling in the hypothalamus, reduction of hepatic steatosis, and restoration of antioxidant enzymes (SOD, catalase, glutathione peroxidase), collectively improving insulin sensitivity and reducing lipid peroxidation (Gambero & Ribeiro, 2015). Such central and hepatic effects are clinically relevant to patients with metabolic syndrome, where nutraceutical approaches that improve PI3K–AKT signaling and reduce cytokinemediated insulin resistance may complement pharmacotherapy and lifestyle interventions, especially in those with low adherence to exercise or dietary changes alone (Gambero & Ribeiro, 2015). From a practical standpoint, standardized extracts with defined chlorogenic acid content facilitate dosing reproducibility; clinical trials used 3 g/day of extract or approximately 1 L/day of infusion equivalents, whereas preclinical studies used higher weightnormalized doses, highlighting the need for human dosing studies across preparations (Kim et al., 2015; RząsaDuran et al., 2022).

Discussion

Formulation, dosing, safety, and counseling considerations

Clinical trials demonstrating body-composition benefits used 3 g/day of standardized green mate powder extract, divided before meals, for 12 weeks a regimen that balanced efficacy and tolerability without significant adverse events in obese adults (Kim et al., 2015). Traditional infusions commonly range from 0.5–1.0 L/day; chemical analyses show high phenolic and caffeine content, robust antioxidant capacity, and substantial magnesium and zinc contributions, but they also highlight potential manganese excess with ≥1 L/day and reduced phenolics after roasting, favoring green/nonroasted preparations for maximal antioxidant delivery (RząsaDuran et al., 2022). Clinically, patients with iron deficiency should separate yerba mate and iron-rich meals due to polyphenol-iron interactions. Those with anxiety, arrhythmias, or reflux may require moderation or decaffeinated options, noting that some metabolic benefits persist with decaffeinated polyphenol extracts in animals (Gambero & Ribeiro, 2015). Importantly, epidemiologic concerns about hot mate and esophageal cancer are largely linked to the consumption of very high-temperature products and smoke-dried products containing polycyclic aromatic hydrocarbons; patients should be counseled to drink warm infusions rather than scalding ones and to choose brands that use low-PAH drying practices or aqueous extracts (Santos et al., 2022). Polypharmacy interactions appear minimal, though vigilance is warranted in patients on stimulants or anticoagulants (Masson et al., 2022).

Conclusions

Yerba mate is a clinically promising nutraceutical for cardiometabolic and inflammatory care with converging evidence for body fat reduction, central adiposity improvement, and immunometabolic modulation, underpinned by tissue-specific bioenergetic reprogramming, antioxidant reinforcement, and gut immune pathways. While pooled lipid effects are inconsistent, selected dyslipidemic patients—particularly as adjuncts to statins—may benefit, and the anti-inflammatory and microbiome-modulating actions support exploration as an adjunct in mild colitis and metabolic inflammation. Practical use favors standardized extracts at 3 g/day or moderate warm infusions, preference for nonroasted/lowPAH preparations, and monitoring for caffeine tolerance and manganese intake. Future work should refine dose–formulation–responder relationships, identify responder phenotypes, and integrate microbiome and immunologic biomarkers to personalize therapy. In the interim, yerba mate can be reasonably incorporated into comprehensive lifestylebased cardiometabolic programs as a safe, evidenceinformed adjunct with measurable benefits on body composition and inflammatory tone.

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