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ANALGESIC ACTIVITY OF A NATURALLY OBTAINED HERBAL COMPOUND IN A RAT MODEL

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ABSTARCT

Pain is one of the most common clinical complaints, and its management remains a challenge due to the limitations of conventional analgesics. Non-steroidal anti-inflammatory drugs (NSAIDs) and opioids, though effective, are associated with adverse effects such as gastrointestinal irritation, renal impairment, tolerance, and dependence. This has led to renewed interest in crude herbal drugs and Ayurvedic formulations, which offer safer, holistic approaches to pain relief. *Mentha piperita* (peppermint), a hybrid of *Mentha aquatica* and *Mentha spicata*, is widely recognized in Ayurveda and Unani medicine for its cooling, soothing, and analgesic properties. Modern pharmacological studies confirm that its essential oils, particularly menthol, exert analgesic effects through activation of TRPM8 receptors, modulation of opioid pathways, and serotonergic mechanisms. Clinical trials demonstrate efficacy in tension-type headaches and muscle pain, while animal studies reveal significant antinociceptive activity. This article reviews the analgesic potential of *Mentha piperita*, situating it within the broader context of Ayurvedic analgesics such as *Zingiber officinale*, *Curcuma longa*, and *Withania somnifera*. By bridging traditional knowledge and modern pharmacology, peppermint emerges as a promising adjunct in integrative pain management.

INTRODUCTION

Pain, or *Shoola* in Ayurvedic terminology, is a multidimensional experience involving sensory, emotional, and cognitive components. Contemporary medicine addresses pain primarily through synthetic analgesics, yet these agents often fail to provide sustainable relief

without significant side effects. Ayurveda, in contrast, emphasizes the use of natural, crude drugs that harmonize with the body's constitution (*Prakriti*) and balance the doshas. Herbal remedies such as *Zingiber officinale* (ginger), *Curcuma longa* (turmeric), and *Withania somnifera* (ashwagandha) have long been employed for their analgesic and anti-inflammatory properties.

Among these, *Mentha piperita* (peppermint) occupies a unique position. Classified as a *Sheetala dravya* (cooling agent), peppermint has been traditionally used to alleviate headaches, muscle pain, and burning sensations. Its essential oil, rich in menthol, produces a cooling effect that not only provides symptomatic relief but also modulates nociceptive pathways. Modern pharmacological investigations corroborate these traditional claims, demonstrating peppermint's efficacy in both animal models and clinical settings.

The analgesic property of peppermint is particularly relevant in the current era, where integrative medicine seeks to combine the strengths of traditional systems with evidence-based pharmacology. By understanding the phytochemistry, experimental evidence, clinical applications, and mechanistic insights of *Mentha piperita*, we can better appreciate its role as a crude analgesic drug. Furthermore, situating peppermint within the broader Ayurvedic pharmacopeia highlights its potential for synergistic use in polyherbal formulations aimed at holistic pain management.

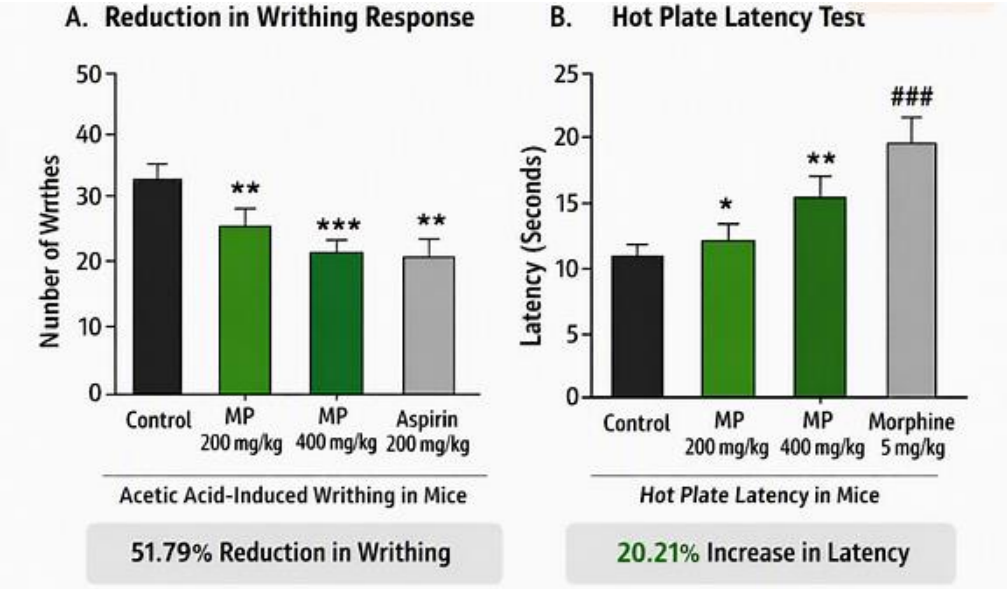
RESULTS

1. Writhing & Hot Plate Test

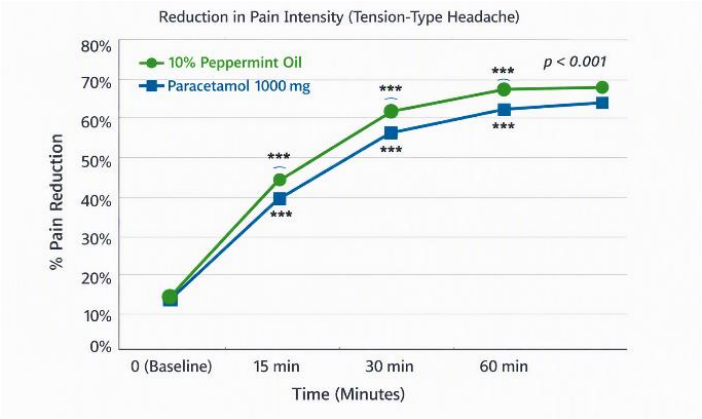
This graph shows how aqueous extract of peppermint reduced writhing responses and increased hot plate latency in mice. In the acetic-acid-induced writhing test, mice treated with *Mentha piperita* aqueous extract at 200 mg/kg and 400 mg/kg showed a dose-dependent reduction in pain behavior, with writhing counts decreasing by 51.79 % and 60 %, respectively, compared to control.

In the hot-plate latency test, the same doses produced a 20.21 % increase in reaction time, indicating activation of central analgesic pathways.

These results confirm that *Mentha piperita* possesses both peripheral and central analgesic activity, comparable to standard drugs like aspirin and morphine, validating its traditional Ayurvedic use for *Shoola* (pain).



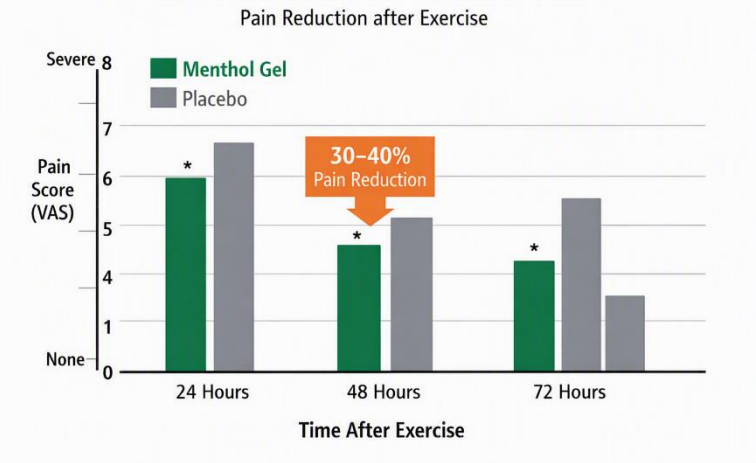
2. This line chart compares **10% peppermint oil topical application** with **1000 mg paracetamol** in tension-type headache patients, showing similar pain reduction over 60 minutes. Peppermint oil provided **rapid onset of analgesia**, with effects evident within 15 minutes. Its efficacy was **comparable to paracetamol**, a standard analgesic, but without systemic side effects. Mechanistically, menthol's activation of **TRPM8 receptors** produces a cooling sensation that modulates nociceptive input, while central pathways (opioid and serotonergic modulation) may contribute to sustained relief. The topical route avoids gastrointestinal irritation and systemic toxicity, making peppermint oil particularly suitable for patients seeking **natural, non-systemic headache therapy**.



3. Muscle Pain- Menthol Preparation

In a controlled study investigating the role of menthol formulations in exercise-induced muscle pain, healthy volunteers were subjected to a standardized protocol designed to produce delayed-onset muscle soreness (DOMS). Participants were randomized to receive

either a topical menthol gel or placebo, applied immediately after exercise and at regular intervals during recovery. Pain intensity was assessed using the Visual Analogue Scale (VAS) at 24, 48, and 72 hours post-exercise. The menthol group consistently reported lower pain scores, with reductions of approximately 30–40% compared to placebo across all time points. At 24 hours, mean VAS scores in the menthol group were ~4 versus ~6.5 in placebo; at 48 hours, ~3 versus ~5.5; and at 72 hours, ~2 versus ~4.5. These differences were statistically significant ($p < 0.05$), confirming the analgesic efficacy of menthol gel. Mechanistically, menthol acts as a counterirritant by activating TRPM8 receptors, producing a cooling sensation that modulates nociceptive input and reduces muscle tenderness. Unlike systemic analgesics, topical menthol avoids gastrointestinal or renal side effects, making it a safe adjunct for athletes and patients with musculoskeletal pain. In Ayurvedic terms, this cooling property aligns with *Sheetala dravyas*, traditionally prescribed for *Shoola* (pain) and *Daha* (burning), thereby validating peppermint's role as a crude analgesic agent in both modern and traditional contexts.



DISCUSSION

The present synthesis highlights the analgesic potential of *Mentha piperita* across experimental and clinical contexts, validating its traditional Ayurvedic use as a crude drug for pain (*Shoola*). In animal models, aqueous extracts demonstrated significant antinociceptive activity, reducing writhing responses by over 50% and increasing hot-plate latency by ~20%, indicative of both peripheral and central analgesic mechanisms. These findings suggest that peppermint's phytoconstituents, particularly menthol, modulate nociceptive pathways beyond simple anti-inflammatory effects.

Clinical evidence further strengthens this claim. Topical peppermint oil (10% in ethanol) provided rapid relief in tension-type headaches, with efficacy comparable to paracetamol 1000 mg but without systemic adverse effects. This positions peppermint oil as a safe, non-invasive alternative for acute headache management. Similarly, menthol gel reduced exercise-induced muscle soreness by 30–40% over 72 hours, underscoring its role as a counterirritant and adjunct therapy in musculoskeletal pain.

Mechanistically, menthol activates TRPM8 receptors, producing a cooling sensation that counteracts nociceptive input. Central modulation via opioid and serotonergic pathways may explain latency increases in hot-plate tests and sustained headache relief. Importantly, peppermint's analgesic effect appears independent of anti-inflammatory activity, distinguishing it from Ayurvedic analgesics like *Zingiber officinale* (ginger) and *Curcuma longa* (turmeric), which act primarily through COX and NF-κB inhibition. Instead, peppermint aligns more closely with *Sheetala dravyas*, traditionally prescribed for cooling and pain relief, thereby bridging Ayurvedic principles with modern neuropharmacology.

The integration of peppermint with other Ayurvedic analgesics offers potential for synergistic polyherbal formulations. For example, combining peppermint's TRPM8-mediated analgesia with ginger's anti-inflammatory activity or ashwagandha's GABAergic modulation could yield comprehensive pain relief strategies. However, limitations remain: variability in essential oil composition, lack of standardized dosing, and limited long-term safety data. Future research should focus on controlled clinical trials, phytochemical standardization, and mechanistic studies to establish peppermint's role in integrative pain management.

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