# Unveiling Synergistic Anti-Inflammatory Effects of Neem Leaf Bioactives: A Low-Cost, Eco-Friendly Breakthrough for Sustainable Disease Treatment

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Inflammation is the body's natural response to combat infections, allergies, or injuries. The most commonly available treatments—non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids—have significant side effects, limiting their long-term use. This study aimed to identify a natural anti-inflammatory agent targeting neutrophils and macrophages, the most abundant leukocytes involved in inflammation. Neem leaf methanolic extract (NLE) and its purified bioactive compounds were evaluated for their ability to modulate pro-inflammatory functions of innate immune cells when stimulated with potent activators like Phorbol Myristate Acetate (PMA), Opsonized Zymosan (Op Zym), lipopolysaccharide (LPS). Neutrophils pretreated with NLE or Quercetin (Quer), a flavonoid in neem, showed significantly reduced intracellular reactive oxygen species (ROS) production upon stimulation with PMA or zymosan. Additionally, neutrophils and macrophages treated with NLE or Nimbolide (Nimb), a limonoid from neem, exhibited reduced expression of pro-inflammatory cytokines in response to LPS. NLE- and Nimb-treated neutrophils also underwent accelerated apoptosis and were more efficiently cleared by macrophages through efferocytosis, a critical process in resolving inflammation. These findings highlight the anti-inflammatory potential of neem-derived compounds, particularly Quercetin and Nimbolide, in modulating key inflammatory pathways. Their ability to reduce ROS production, suppress cytokine expression, and enhance apoptotic clearance suggests they could be valuable adjuncts to corticosteroids, offering a safer and more effective approach to managing chronic inflammation.

**Awards Won:**