

## ABSTRACT

Dental caries, a prevalent multifactorial infection, results from the interaction between acid-producing microorganisms and a diet high in carbohydrates. This study harnesses the potential of a polyherbal remedy that offers a holistic approach to promote overall dental health and combat tooth decay with its natural antibacterial properties. To identify effective oral agents twelve plant extracts, *Achyranthes aspera* root (AAR), *Acalypha indica* leaf (AIL), *Azadirachta indica* leaf (AZL), *Abrus precatorius* leaf (APL), *Barleria cuspidata* leaf (BCL), *Euphorbia hirta* leaf (EHL), *Ficus benghalensis* prop root (FBP), *Piper betle* leaf (PBL), *Psidium guajava* leaf (PGL), *Pongamia pinnata* leaf (PPL), *Tridax procumbens* leaf (TPL), and *Solanum virginianum* fruit (SVF) traditionally used by local tribal populations in Thottakombai Hill, Erode district of Tamil Nadu, were studied. Methanol extracts of AAR, BCL, EHL, FBP, PBL, PGL, PPL, TPL, and SVF demonstrated a higher phytochemical content and exhibited stronger DPPH radical scavenging activity than other plants. Furthermore, clinical plaque isolates, such as *Streptococcus mutans* (SMU), *Streptococcus salivarius* (SSA), *Streptococcus oralis* (SOS), *Streptococcus parasanguinis* (SPSA), *Klebsiella pneumoniae* (KP), *Pseudomonas aeruginosa* (PA), *Acinetobacter baumannii* (AB), and *Candida albicans* (CA) were significantly susceptible to AAR, BCL, EHL, FBP, PGL, and SVF. Hence, further investigation of phytocompounds from these six plants through molecular docking studies revealed a high binding affinity for glucosyltransferase-C, a key virulence factor synthesized by SMU. Consequently, all six plants were optimized for the development of a polyherbal dentifrice (PHDF) in toothpowder tablet form. The PHDF demonstrated low toxicity, and showed the presence of essential minerals proving its safe use. Furthermore, PHDF effectively reduced the pH, and hydrophobicity of SMU, thereby eradicating its biofilm formation and outperforming marketed standards. The network pharmacological approach provided valuable insights into PHDF's mechanism of action, highlighting its potential as a promising natural remedy for the prevention and treatment of dental caries. Thus, this study validates the formulation's strong effect against oral pathogens and suggests a novel, comprehensive approach to oral health care.