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A Natural Antimicrobial Agent: Curcumin

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INTRODUCTION

The Curcuma longa variety of plants generate curcumin, a substance that is bright yellow in colour. It is the main curcuminoid found in turmeric (Curcuma longa), which belongs to the Zingiberaceae family of ginger plants. It is offered as a culinary flavouring, food colouring, cosmetic ingredient, and herbal supplement. This lipophilic polyphenol, which has a distinctive yellow-orange colour, is a natural pigment that is mostly present in the root systems of turmeric. The main bioactive component of turmeric powder an oriental spice frequently derived from this plant is curcumin, along with essential oils and other curcuminoids. It is often used in Middle Eastern and South Asian cooking, particularly when making curries. Nearly 4000 years ago, the Indian Vedic culture used C. longa as a culinary spice and in religious rituals. The Ayurvedic and Unani medical systems, Traditional Chinese Medicine (TCM), as well as folk medicine in Pakistan, Bangladesh, and Afghanistan have all made extensive use of this plant.

Traditional uses of turmeric include the treatment of wounds and burns, gastrointestinal and liver disorders, respiratory illnesses (such as asthma, cough, runny nose, and sinusitis), anorexia, and rheumatism. Turmeric also has antiseptic, antibacterial, anti-inflammatory, choleretic, and carminative properties. As food additives with colouring, flavouring, and preservation characteristics, turmeric and curcumin (the code for E100) are frequently used in food today (for example, in mustard, margarine, butter, cheese, pasta, and beverages). Curcumin has historically been used to treat a wide range of gastrointestinal illness symptoms, including diarrhoea, indigestion, efflux, and even gastric and duodenal ulcers. Additionally, it can lessen side effects from medicine by protecting the mucosa from the gastrointestinal damage brought on by non-steroidal anti-inflammatory drugs.

Curcumin has been shown to have positive health effects in numerous in vitro and in vivo investigations, which are mostly due to its potent antioxidant and anti-inflammatory properties. Additionally, this organic compound has antiviral, antiviral, antiprotozoal, and antiparasitic activities. In patients with inflammatory diseases (arthritis, inflammatory bowel disease, peptic ulcer, and H. pylori infection), metabolic syndrome, neurodegenerative diseases, and cancer, including colorectal, pancreatic, and breast cancers, clinical trials have shown the therapeutic benefits of curcumin supplementation. Researchers have been very interested in curcumin because of its diverse spectrum of biological activities and its pleiotropic medicinal potential.

Curcumin's antimicrobial properties were initially reported in Nature in 1949. Researchers have found that curcumin had a high level of in vitro effectiveness against spore-forming bacilli (*Bacillus* and *Clostridium* species), some Gram-negative bacteria (*Acinetobacter lwoffii, Alcaligenes faecalis*), Gram-positive cocci (*Staphylococcus aureus, S. epidermidis, Streptococcus pyogenes, Micrococcus tetragenus* (e.g., *Candida stellatoidea, Cryptococcus neoformans, Microsporum gypseum, Saccharomyces cerevisiae, Scopulariopsis brevicaulis).*

Despite curcumin's poor solubility in water, low bioavailability, and unfavourable pharmacokinetic profile, contemporary investigations have supported the substance's significant antibacterial properties. According to studies, curcumin inhibits bacterial quorum sensing (QS) systems and breaks up biofilms that have already developed. The formation of deadly reactive oxygen species (ROS) by this plant chemical was reported to have a photodynamic activity against both planktonic and biofilm forms of bacteria. Additionally, studies in the literature have demonstrated its protective benefits against Gram-negative uro-pathogens like *Escherichia coli, Pseudomonas aeruginosa, Proteus mirabilis, and Serratia marcescens* and its ability to inhibit the development of struvite stones linked to UTIs. Additionally, methicillin-resistant S. aureus, Pseudomonas aeruginosa, enterotoxigenic *Escherichia coli* and *Candida albicans* have all been shown to be resistant to curcumin when combined with antibiotics and antifungals. Curcumin was also taken into consideration for the treatment of *H. pylori*-related gastritis, peptic ulcers, and gastric cancer due to its potent anti-inflammatory and anti-Helicobacter pylori activities.

Despite several studies on the antibacterial and antifungal activities of curcumin, there is a lack of information on how it affects diverse types of microorganisms, particularly clinical isolates and MDR strains. Furthermore, it has not yet been possible to define the minimum inhibitory concentrations (MICs) of this natural plant compound against planktonic forms of numerous common human diseases. *A. lwoffii, Proteus mirabilis, Serratia marcescens, Stenotrophomonas maltophilia, and Streptococcus agalactiae* have all been studied sporadically in relation to curcumin's effectiveness against these bacteria. In recent studies, the in vitro potential of curcumin to reduce microbial growth has frequently been evaluated against a small (4-6) number of species, mostly *E. coli, P. aeruginosa and S. aureus* and less frequently against other taxa. In some publications, the minimum inhibitory concentration (MIC) value was given for just one species and one strain, often the reference strain. Curcumin concentrations as low as 64 - 256 g/mL have occasionally been employed to test the antibacterial activity of the compound. Therefore, there is still a need for in-depth investigation into how curcumin works against a wide range of microbial strains and species using a standardised approach. The widely used broth microdilution assay allows for the comparison of the results with data from the literature.