Modulatory effects of thymol and carvacrol on inflammatory transcription factors in lipopolysaccharide-treated macrophages

Gholijani N, Gharagozloo M, Farjadian S, Amirghofran Z


Abstract

© 2015 Informa UK Limited trading as Taylor & Francis Group. Inflammation is a crucial factor in the pathogenesis of numerous diseases. This study sought to evaluate the effects of thymol and carvacrol, the main components of Thymus vulgaris (thyme) essential oil, on transcription factors regulating inflammation. Lipopolysaccharide (LPS)-stimulated J774.1 mouse macrophages were examined by real time-PCR for interleukin (IL)-1β and tumor necrosis factor (TNF)-α gene expression in the presence of these compounds. Levels of inducible phospho-nuclear factor-κB (pNF-κB) p65, activator protein-1 [AP-1(c-Fos/c-Jun)], and nuclear factors of activated T-cells (NFATs) were also measured using Western blots. Levels of phosphorylation of stress-activated protein kinases (SAPKs)/c-Jun N-terminal kinase (SAPK/JNK), signal transducer, and activator of transcription (STAT-3), p38, IκBα, and NF-κB p65, as well as total levels of IL-1β and TNFα were determined. The results indicated carvacrol significantly reduced both IL-1β and TNFα at the protein and mRNA levels; thymol also significantly reduced IL-1β expression. Western blot analyses of nuclear cell extracts revealed both agents caused significantly decreased expression of c-Fos, NFAT-1, and NFAT-2; decreased expression of c-Jun was only caused by carvacrol. Neither agent inhibited p-NF-κB p65 expression. At the protein level, carvacrol and thymol each caused decreases in inducible phospho-SAPK/JNK and phospho-STAT3 levels, whereas only carvacrol resulted in increased p-p38 levels in the total cell extract. Despite the reduction of phospho-IκBα caused by both agents, p-NF-κB p65 still increased in the presence of carvacrol. Based on these findings, it is concluded that carvacrol and thymol could contribute to reduction of inflammatory responses through modulation of the expression of JNK, STAT-3, AP-1, and NFATs.