

# Propolis and Some of its Constituents Down-Regulate DNA Synthesis and Inflammatory Cytokine Production but Induce TGF- $\beta$ 1 Production of Human Immune Cells

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Propolis, the resinous product collected by honey bees from plants, is used as folk medicine since ancient time. Recently, immunoregulatory and *anti*-inflammatory properties of propolis have been published. The detailed mechanisms of actions of propolis and its components on immune cells, however, are still unknown. Therefore, we studied the effects of different propolis extracts, of the flavonoids hesperidin and quercetin as well as of caffeic acid phenethyl ester (CAPE) on basic human immune cell functions. In detail, we measured the effects on DNA synthesis and production of different types of cytokines, namely IL-1 $\beta$ , IL-12, IL-2, IL-4, IL-10 and TGF- $\beta$ 1, of mitogen-activated peripheral blood mononuclear cells (PBMC) as well as of purified T lymphocytes.

Our data clearly show that propolis as well as its constituents studied are capable of dose-dependently suppressing phythemagglutinin (PHA)-induced DNA synthesis of PBMC and T cells. Moreover, cytokines produced by monocytes/macrophages (IL-1 $\beta$ , IL-12), by Th1 type (IL-2) as well as Th2 type (IL-4) lymphocytes were found to be also suppressed, whereas the production of TGF- $\beta$ 1 by T regulatory cells was ascertained to be increased. These data convincingly demonstrate that propolis has a direct regulatory effect on basic functional properties of immune cells which may be mediated by the Erk2 MAP-kinase signal pathway. Thus, the bee product propolis can be considered as a powerful natural *anti*-inflammatory medicine influencing different types of immune-responses probably *via* immunoregulatory T cells.

*Key words:* Propolis, Immune Cells, Cytokines