



## Molecular Mechanisms of Honeybee Products in the Fight against Tumors

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### Editorial

Chemoprevention *via* nontoxic agents could be one approach for decreasing the incidence of cancer. Many naturally occurring agents have shown chemo preventive potential in a variety of bioassay system and animal models. Chemoprevention of tumor with natural components, including honey bee products, especially propolis and propolis related polyphenolic/flavonoid compounds and honey bee venom compounds has recently drawn attention as a strong antitumor approach to be used. Honeybee product are known to affect proliferation, differentiation and apoptosis in cancer cells and may play an important role in cancer chemoprevention. Flavonoids and honey bee venom components, including melittin, phospholipase A2, and stingins (apamin-derived peptide), a novel class of p53 activators and antagonists of MDM2/MDMX, has been shown to inhibit proliferation, invasion, angiogenesis and metastasis of different cancers through interaction with multiple cell signaling proteins. In addition, our studies and those by others showed that honey bee products could "sensitize" cancer cells to chemotherapeutic agents, likely by blocking NF- $\kappa$ B activation induced by chemotherapeutic agents both *in vitro* and *in vivo*.

This review summarizes the current knowledge regarding potential of polyphenolic/flavonoids components present in propolis, honey, and royal jelly, and bee venom compound son tumor growth and metastasing ability and possible molecular modes of antitumor action. Their chemo preventive activity in animal models and cell cultures are likely to be the result of their ability to inhibit DNA synthesis in tumor cells, their capability to induce apoptosis of tumor cells, and their property to activate macrophage to produce factors capable to regulate the function of B-, T- and NK-cells, respectively. In addition, mechanism of anticancerogenic, anti-inflammatory and antiproliferative activities as well as wound healing capability and they control of macrophage polarization activity are also described. Taken together, this information provides a basis for attempts to use the honeybee product in preclinical and clinical practices for many diseases, since these components have wide pharmacological and biological activities.

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