5. Summary and Conclusions

Phytochemistry has been making a rapid progress and plant products have become increasingly popular in various traditional, complementary and alternative systems as they are pharmacologically potent and have low or no side effects. Food-derived products cannot be perceived as "medicine" and are highly interesting for development as preventive and protective agents that may find widespread, long-term use in populations at normal/high risk.

*R. sativus* is a unique plant containing a rich and rare combination of phytochemicals. It is unparalleled in curing multitude of disorders and has aroused great interest for its potential role in helping in maintaining human health. The results obtained in this study led to the conclusion that,

- Different parts of *R. sativus* such as root, stem and leaves possess substantial biological activities.
- Root contains significant amount of ITCs, as compared to stem and leaves extract.
- Stem and leaves, often under-utilized parts of this vegetable, have high level of polyphenolics and show significant antioxidant and radical scavenging activity, as compared to root extracts. *R. sativus* could be regarded as a promising source of natural antioxidants and has a potential to be developed as an ingredient in health and functional foods.
- Root, stem and leaves possess significant antibacterial activity against both Gram-positive and Gram-negative bacteria, including drug-resistant strains, thus justifying its traditional use in herbal medicines. Antibacterial activity appears to be insignificantly influenced by their ITC content. It has considerable acid tolerance and thermal stability. *R. sativus* may be an economical source of natural antibacterial compounds that could be of significant importance in food-processing applications and for use against pathogens.
- *R. sativus* (hexane extract of root and methanolic extracts of stem and leaves) shows negligible cytotoxicity and genotoxicity to normal lymphocytes and exhibits potent protective effect against cell death and DNA damage in cells induced by H₂O₂ under *ex vivo* conditions. These could be related to the presence of isothiocyanates and polyphenolics in *R. sativus* extracts as they
possess significant capacity to remove reactive species by virtue of their ability to induce antioxidant enzyme system in the cells.

- *R. sativus* (hexane extract of root) significantly inhibited the proliferation of several human cancer cells through induction of apoptosis. Hexane extract contains different ITCs such as MTBITC, erucin, 4-methylpentyl isothiocyanate, 4-pentenyl isothiocyanate and sulforaphene, which could act on different pathways of cancer cell growth and survival. Induction of apoptosis by the hexane extract appears to involve up-regulation of pro-apoptotic genes and down regulation of anti-apoptotic genes along with the activation of caspases-3. Our findings suggest the use of *R. sativus* extracts in functional foods and food supplements designed for the prevention of various chronic diseases, including cancer. However, further studies are needed to prove that the protective effects observed *in vitro* do indeed translate *in vivo*. 