

ROLE OF TOMATOES AND DIETARY LYCOPENE IN THE PREVENTION OF OSTEOPOROSIS

EXECUTIVE SUMMARY

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Osteoporosis is one of the major chronic diseases responsible for much suffering and deaths in Canada and other countries around the world. Recent studies have identified oxidative stress as an important causative agent in the etiology of cancer, cardiovascular disease, diabetes and osteoporosis. Use of antioxidants provides an attractive alternate strategy for the management of many of such chronic diseases. Lycopene, one of the most potent carotenoid antioxidant that is found predominantly in tomatoes and processed tomato products has been the subject of much research since epidemiological studies showed inverse association between tomato intake or blood lycopene level and the risk of cancer and other chronic diseases. We have an active ongoing basic and clinical research program to investigate various aspects of the role of lycopene in human health. More recently we initiated research to study the role of lycopene in osteoporosis. Bone is a dynamic tissue involving the activity of the 'bone forming' osteoblast cells and the 'bone resorbing' osteoclast cells. A balance between the activity of these cell types is essential for maintaining healthy bone. However, as a result of imbalances either due to increased activity of osteoclast cells, inhibition of the osteoblast cells or a combination of both, bone disorders including osteoporosis can result.

A study was undertaken with partial financial assistance from the Ontario Tomato Research Institute (OTRI) with the overall objective of studying the role of lycopene on the formation of osteoclast bone cells, bone resorption and the formation of reactive oxygen species (ROS). Our long term objective is to provide scientific basis for formulating dietary guidelines that will recommend increased consumption of lycopene containing tomatoes and tomato products for the prevention and management of osteoporosis.

Our specific objectives were to (a) evaluate the effect of lycopene on the formation of osteoclast bone cells. (b) Dose-response effect of lycopene on resorption of calcium phosphate substrate from osteologic slides by osteoclast bone cells. (c) study the effect of lycopene on the production of ROS by osteoclast bone cells.

Results from our study have indicated the following conclusions:

1. Lycopene inhibited the formation of TRAP⁺ multinucleated osteoclast cells
2. Lycopene inhibited in a dose-dependent manner the activity of osteoclast cells as demonstrated by reduced formation of resorption pits on the Osteologic slides.
3. Percent reduction in resorption by lycopene was statistically significant both in the absence and the presence of PTH.
4. Lycopene reduced the formation of ROS-producing osteoclast cells.

In this pioneering study we tested the hypothesis that tomato lycopene, acting as an antioxidant can inhibit the bone resorbing activity of osteoclast cells in culture. This inhibitory effect of lycopene on bone resorption was dose-dependent. Further, our study has shown that it is through the inhibition of oxidative stress that lycopene affords its action.

Clearly, the results of this study have significant implications in the management of osteoporosis in the future. Dietary guidelines may recommend increased consumption of tomatoes and tomato products that are good sources of lycopene. Such recommendations can result not only in maintaining good health but also benefit the tomato growing and processing industry in Canada.