

2002 MAFMA Final Report

Project Title	Influence of processed tomato products consumption on oxidative and defense status in men with prostate cancer
PI	Steven J. Schwartz, Ph.D.
Co-PI (s)	Elena Vittadini, Ph.D., Steve Clinton, M.D., Ph.D
Academic Institution	The Ohio State University, Department of Food Science and Technology, Department of Internal Medicine
Award Date	November 1, 2002

1. Objective Summary

The overall objective of this study is the evaluation of the effect of processed tomato products consumption on biomarkers of oxidative stress and defense status in men with prostate cancer.

2. Objective Accomplishments

IN VIVO PHYTOCHEMICAL CONCENTRATIONS AND HORMONE MODULATION FOLLOWING TOMATO-BASED PRODUCT OR SOY CONSUMPTION IN PROSTATE CANCER PATIENTS

Consumption of tomato-based products and soy has been associated with a reduced risk for prostate cancer. This study was designed to determine if men with prostate cancer would consume tomato-based products or soy daily during the period between their diagnosis and surgery. In addition, this study was conducted to examine in vivo concentrations of phytochemicals from these foods and their effect on modulating hormone levels. Prostate cancer patients consumed a lycopene-free and soy-free diet for 1-2 weeks and were subsequently randomized to receive 25-30 mg lycopene/day from Prego® spaghetti sauce, Campbell's® tomato soup, or V8® vegetable or 80±4 mg isoflavones/day from a soy protein supplement for 2-4 weeks. All study participants were extremely compliant during the washout and treatment phases. Dietary intervention with tomato-based foods showed that the consumption of sauce or soup produced much higher and significantly higher ($P<0.01$) levels of plasma total lycopene ($\mu\text{mol/L}$) when compared to men consuming juice (0.92 ± 0.09 or 1.10 ± 0.08 vs. 0.72 ± 0.07 , respectively).

When consumption of any tomato-based product or soy was considered, the percentage of plasma all-trans lycopene increased from 50% to 54% ($P<0.01$), or decreased from 52% to 49% ($P<0.05$), respectively. For tomato-based product groups, prostate total lycopene concentrations (nmol/g) were significantly lower in men consuming juice (0.37 ± 0.07) versus levels after the consumption of sauce (0.60 ± 0.10 , $P<0.05$) or soup (0.58 ± 0.06 , $P<0.05$). Prostate contained a complex array of lycopene isomers. Although isoflavones in urine were not detected after washout, urinary levels ($\mu\text{mol/L}$) of daidzein (2.95 ± 0.94), genistein (2.54 ± 0.58), glycitein (0.43 ± 0.10), O-desmethylangolensin (ODMA) (11.92 ± 3.08), and dihydrodaidzein (2.20 ± 0.73) significantly increased following consumption of soy ($P<0.0001$ for each). Daidzein and genistein were also detected in prostate after soy consumption (pmol/g; 2.49 ± 0.69 and 5.09 ± 0.81 , respectively). In addition, when intake of any dietary product was considered, PSA concentrations (ng/mL) decreased from 5.35 ± 0.54 to 5.21 ± 0.52 . This study indicates that consumption of tomato-based foods or soy results in unique, yet complex, in vivo profiles of phytochemicals, including carotenoids and isoflavones. Information on these phytochemical patterns may improve our understanding of their role in the risk and/or progression of prostate cancer. It also appears that sauce and soup provide a more bioavailable form of lycopene than juice. Finally, this study shows that dietary intervention with tomato-based products and soy may influence prostate cancer development by modulating serum PSA concentrations.

EVALUATION OF ADDITIONAL MARKERS OF OXIDATIVE STRESS USING NEW TECHNOLOGIES

Consumption of tomato-based products is thought to modulate the antioxidant/oxidative environment. This evaluation was conducted to assess the effect of tomato-based product consumption on changes in antioxidant capacity as well as urinary F_2 -isoprostane 8-iso-PGF $_{2\alpha}$ levels in healthy individuals and prostate cancer patients from the first two clinical trials using new technologies. For stored samples from selected healthy participants in the first clinical trial, plasma total lycopene concentrations increased 144%, 87%, and 152% ($P<0.0001$ for each) while plasma lipid-soluble antioxidant capacity (LS-AC) increased 21% ($P<0.01$), 16% ($P<0.001$), and 15% ($P<0.0001$) following consumption of soup, RTS soup, and juice, respectively. As described in the second clinical trial, total lycopene levels in plasma for prostate cancer patients increased after consumption of sauce (77%, $P<0.01$), soup (55%, $P<0.05$), or juice (112%, $P<0.05$). Upon evaluation of stored plasma samples from these men, LSAC

increased 56% ($P < 0.05$), 50% ($P < 0.01$), or 27% ($P < 0.05$), respectively. Although no statistical differences in urinary concentrations of 8-iso-PGF_{2α} were noted in samples obtained from either clinical trial, levels for prostate cancer patients decreased 70%, 65%, and 37% after soup, juice, and tomato-based product intake, respectively. Evaluation of new technologies used to measure additional markers of oxidative stress shows that consumption of tomato-based products rapidly increases plasma lipid-soluble antioxidant capacity while decreasing lipid peroxidation in healthy individuals and/or prostate cancer patients.

3. Practical impacts of research efforts.

a. Short Term Impacts

Short term this study indicates that tomato based nutritional interventions in prostate cancer patients are well tolerated and excellent compliance was achieved with all subjects. Generating the bioavailability data for lycopene in this select group of subjects (prostate cancer patients) was necessary to consider further research in this area.

b. Long Term Impacts

The data collected in this study on oxidative defense biomarkers such as lycopene levels and lycopene isomers in the bloodstream, carotenoids in prostate tissue and urinary F₂ isoprostanes from the prostate cancer patients provided invaluable data for use in a National Institute of Health (NIH) grant that has been recently funded between OSU's Medical School and Food Science Department. The support provided by MAMFA was instrumental in assisting us to obtain the necessary data to submit a competitive NIH grant.

5. Publications resulting from this research.

We will be writing and submitting a publication on the results of this study. The support provided by USDA Cooperative State Research, Education and Extension Service will be acknowledged.