

## Strawberries as a Functional Food: Chemoprevention of Bladder Cancer

Mark L. Failla and Russ Klein, Human Nutrition

### Background

According to the American Cancer Society, an estimated 70,980 new cases of bladder cancer will be diagnosed in 2009. In the United States, bladder cancer is the fourth most common malignancy in men and the ninth most common type of cancer in women, claiming the lives of approximately 14,330 annually. The National Cancer Institute estimates the United States will spend \$2.9 billion dollars in 2009 for the treatment of bladder cancer.

Epidemiologic and laboratory data from previous studies suggests that diets rich in fruits and vegetables are associated with a reduced risk of bladder cancer. The reduction in cancer risk may be attributed to the abundance of a family of specific compounds referred to as anthocyanins, which are found in various berries. Anthocyanins are water soluble pigments responsible for the blue, purple, and red color in many plant tissues. Strawberries and black raspberries contain high levels of anthocyanins and they are also well liked by consumers. Popularity of strawberries and black raspberries in the U.S. consumer market makes them an ideal focus for chemoprevention studies.

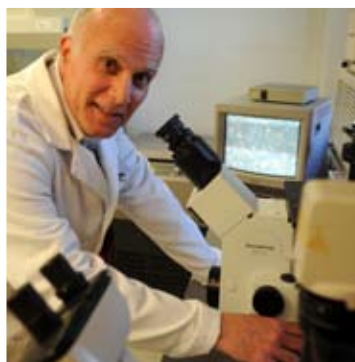
Because effective strategies are needed to reduce the development and progression of this aggressive form of cancer, a SEEDS grant was awarded to fund the timely research of bladder cancer chemoprevention. The Seed Grant Competition is designed to encourage new and innovative research and generate the preliminary data needed for successful application to competitive extramural funding sources.

### Objectives

The primary objectives of this SEEDS grant study were to examine the chemical stability of black raspberry anthocyanins, the ability of the bladder cancer cells to accumulate these anthocyanins, the effect of anthocyanin rich extract on the replication of bladder cancer cells, and also the digestion and absorption of these compounds in laboratory rats.

### Challenges

Initial studies using an extract from strawberries did not show signs of inhibiting bladder cancer cell growth and replication. OARDC researchers then compared a similar extract from black raspberries and observed inhibition of the replication of bladder cells. Subsequent studies with these cells characterized this preventative activity and examined possible





mechanisms responsible for the observed change. In order for these compounds to have the inhibitory activity in humans, the anthocyanins present in the berries must be absorbed and delivered to bladder tissue.

## Results

Armed with this newfound knowledge, OARDC scientists administered strawberry extract in a single dose to laboratory rats and examined the stability of the anthocyanins in the gut. The presence and abundance of the anthocyanins were also tested in the urine. The results of this study revealed that some anthocyanins from the extract were absorbed and present in urine found within the bladder. Thus, the compounds of interest were present in the fluid that came in contact with bladder cells lining the organ. These research findings support the need for further study using animal models to more critically assess the absorption, tissue distribution, and metabolism of ingested anthocyanins from berries.

## The Future

Since the activity of anthocyanins played such a central role in this research with chemoprevention implications, OARDC scientists have taken the research one step further and applied the knowledge to different parts of the human anatomy. OARDC scientists are collaborating with internationally recognized experts in the College of Dentistry to determine the effects of anthocyanins and their metabolites on oral health and the treatment of oral pathologies. A pilot human study has been initiated to investigate anthocyanin metabolism in the mouth as previous studies showed that berry extracts rich in anthocyanins inhibit proliferation of oral cancer cell lines, and diets enriched in berries inhibit chemically induced oral cancer in hamsters. The research team plans to submit a proposal to the National Institutes of Health in June 2010.



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