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Food Processing for Improved Cancer Protection

How we cook and process our foods can influence how well food protects against cancer, according to recent research. In some cases, food processing can minimize potential carcinogens. Scientists at last month's AICR Research Conference shared the latest findings.

Food processing is typically associated with sophisticated industrial technologies that produce the foods found on our supermarket shelves. However, food processing occurs on a much simpler scale in home kitchens every day: common food preparation techniques such as chopping, steaming, sautéing, and blending are well-known means of processing food.

How these food-processing techniques contribute to enhancing a food's health benefits – and minimizing its harms – is a burgeoning field of cancer prevention research.

Many people assume that processing foods causes harmful changes that increase cancer risk, but the research is showing the opposite also holds true, says John Erdman, PhD, Emeritus Professor of Food Science and Human Nutrition at the University of Illinois, Urbana and the co-chair of the conference session on food processing.

"While excessive heating or grilling of meats is associated with production of harmful chemical components, mild heating actually enhances the bioavailability of a number of protective components [in other foods]," says Erdman.

Maximizing Phytochemicals

Many phytochemicals and other plant-based nutrients are bound up by the cell wall or other structural components. That can result in relatively low bioavailability – how fast and how much of the compounds are absorbed.

One of the best-known examples of the beneficial effects of processing is seen with lycopene, a carotenoid in many red or orange fruits and vegetables such as tomatoes and carrots. AICR's expert report and its continuous updates concluded that foods containing lycopene protect against prostate cancer. Thermal processing techniques of fruits and vegetables – such as cooking and canning – can increase lycopene's bioavailability by changing its molecular configuration.

Now Mark Hendrickx, PhD, senior professor in food technology at Katholieke Universiteit Leuven in Belgium, who spoke at the AICR Research Conference, has found that blending, mixing or other forms of mechanical processing further enhances lycopene's bioavailability. The process breaks down the plant cell walls, liberating the phytochemical.

> "Processing can ensure that the beneficial compounds arrive in your digestive system in a bioavailable form."

And because carotenoids are fat-soluble, adding a fat such as olive oil to the dish or meal will enhance the bio-accessibility of carotenoids, said Hendrickx.

Processing cruciferous vegetables such as broccoli poses different challenges. Sulforaphane is one phytochemical in broccoli well studied for its cancer-fighting properties. But sulforaphane starts out as a glucosinolate, a sulfur-containing compound that contributes to the vegetables' pungent aroma and sharp flavor. The enzyme myrosinase, also in the broccoli, converts the sulfur compound into sulforaphane when the two come into contact.

At the University of Illinois, Urbana, Elizabeth Jeffery, PhD, Emeritus Professor of Food Science and Human Nutrition, has observed that myrosinase is heat sensitive. Thermal processing techniques such as boiling or microwaving can destroy the enzyme in less than one minute. Steaming, however, is a slower process and allows for maximal retention of myrosinase in fresh broccoli.

Her research has shown that "to get the most benefit from broccoli, steam it for just three to four minutes until it turns bright green and is tender crisp," said Jeffery.

Many home cooks prefer frozen broccoli for its convenience, lower cost and year-round availability. In the processing of freezing broccoli, a key step in blanching is briefly plunging the fresh vegetables into boiling water to reduce enzymatic changes that can cause loss of flavor, color and texture. Blanching destroys myrosinase, preventing the formation of sulforaphane.

Jeffery's research shows that adding raw crucifers to a meal with previously frozen cruciferous vegetables will provide the myrosinase that was lost in cooking or blanching. "Eating a little mustard, radish or other uncooked crucifer such as slaw with the meal provides the myrosinase … to release the broccoli's sulforaphane," she said.

Minimizing Potential Carcinogens

Whereas processing techniques can enhance the cancer-protective properties of fruits and vegetables, research involving processing and cooking meats focuses on reducing their potential carcinogens.

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"There are multiple potential mechanisms relating meat to cancer, several of which involve the formation of compounds that have been shown to be carcinogenic in animal models," said Amanda Cross, PhD, senior lecturer at Imperial College London who focuses on lifestyle and colorectal cancer risk. AICR's reports found that diets high in red meat or processed meat are a cause of colorectal cancer.

Both before the meat reaches a consumer and how it is prepared at home may influence the associated risks, says Cross. Before processed meat gets to the shelf, it is often treated with nitrate and/or nitrite preservatives that provide the characteristic red-pink color. Nitrate and nitrite can form carcinogenic N-nitroso compounds (NOCs) within meat.

To inhibit the formation of NOCs from nitrate or nitrite, ascorbic acid (vitamin C) is often added to processed meats by the manufacturer.

Cooking any meat well-done or by high temperature methods such as grilling and pan-frying induces the formation of heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs), also known carcinogens.

Cooking meat at lower temperatures, such as baking, can decrease HCAs and PAHs, says Cross. Pre-heating meat in the microwave also helps, because it reduces the creatine needed for HCAs to form.

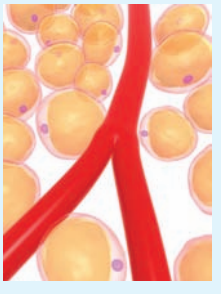
From Basics to Bioavailability

Future research in the field of food processing likely will yield other ways in which the foods we eat can protect us from cancer. "Past processing has tended to focus on improving taste, visual appearance and microbiological safety," notes Jeffery. "Now our task is to go further. Processing can ensure that the beneficial compounds arrive in your digestive system in a bioavailable form – but research is not quite there yet."◆

AICR Research Conference Highlights

Unraveling the Obesity-Cancer Link

Being at a healthy weight is the most important thing people can do to prevent cancer, after not smoking, according to research. Yet, experts said, too many Americans remain unaware of the link.



"As time goes on, we are finding that obesity appears to be playing a role in more and more cancers," said session co-chair Wendy Demark-Wahnefried, PhD, RD, a nutrition scientist at the University of Alabama at Birmingham Comprehensive Cancer Center. "It not only affects primary risk, but also prognosis and survival."

Studies by Stephen D. Hursting, PhD, Professor and Chair of the Department of Nutritional Sciences at the University of Texas at Austin, have identified several potential pathways by which obesity promotes cancer. Animal studies by Hursting and his colleagues have found that obesity alters levels of insulin and other hormones, regulators of inflammation and the health of blood vessels.

Food Store Strategies for Healthy Behaviors

Adding new varieties of fruits to grocery shelves, simple signage and educational posters are among the strategies that helped low-income minority and ethnic groups choose healthier foods and lose weight, according to new research.

The findings can have important public health significance as low income and ethnic populations are at greater risk of obesity compared to non-Hispanic whites. Obesity puts people at increased risk of cancer, along with heart disease and type 2 diabetes.

"We know that people will eat healthier foods if these foods are more accessible," said Joel Gittelsohn, PhD, MSc, a medical anthropologist at Johns Hopkins University and a leading researcher in food store-based interventions programs.

"But accessibility includes many things, including availability, cost, location within stores, and transportation to get to stores. But in addition to increasing supply, you also need to increase demand for these foods, by promotions and education."

Preventing Bone Loss for Cancer Survivors

Recent years have seen a growing body of research involving the benefits of exercise for cancer survivors. Researchers presented new findings on how exercise may affect breast cancer survivors and help them avoid the broken bones, fractures or falling that accompanies osteoporosis and low bone mass.

Evidence is clear that excess body fat increases women's risk of postmenopausal breast cancer, and it may also increase risk of recurrence and secondary cancers.

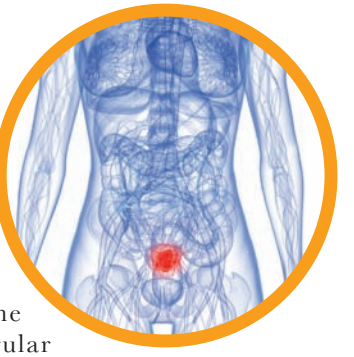
Yet people who are overweight also tend to have denser bones, which lowers the risk for osteoporosis.

At Loyola University Chicago, Kathleen Wolin, ScD, a behavioral epidemiologist is leading the first prospective investigation into whether planned weight loss and physical activity interact to influence bone health.

"We want cancer survivors to lose weight because of their risk for comorbid conditions, as well as cancer," said Wolin. Yet weight is bone loading, it is putting pressure on the bone and that signals the bone to develop and grow. "Weight loss is a huge focus for breast cancer survivors … and we were wondering if when we tell women to lose weight, are we inducing some level of bone loss?

"We wouldn't tell women not to get to a healthy weight, but the way we go about approaching it might be different for a cancer population."◆

New CUP Report: Preventing Endometrial Cancer



Women can reduce their risk of endometrial cancer with physical activity and being a healthy weight, according to the new AICR and World Cancer Research Fund (WCRF) report, which analyzed the global research on diet, physical activity and weight to the risk of this cancer.

Based on the findings, AICR/WCRF estimates that 59 percent, or about 29,500 cases every year, could be prevented in the United States if women were active for at least 30 minutes a day and maintained a healthy body weight, between 18.5 and 25 BMI.

The AICR/WCRF report, *Continuous Update Project: Preventing Endometrial Cancer*, also found that drinking coffee – both decaffeinated and caffeinated – can reduce the risk of endometrial cancer. A high-glycemic-load diet was found to increase risk

Obesity: The Strongest Link

Endometrial cancer – cancer of the lining of the uterus – is the most common cancer of the female reproductive system. More cases of endometrial cancer occur each year in the United States (approximately 49,600) than ovarian cancer and cervical cancer combined.

Leading expert Elisa Bandera, MD, PhD, is an AICR/WCRF CUP panel member and Associate Professor of Epidemiology at Rutgers Cancer Institute of New Jersey. "Many women are not aware of the strong link between obesity and cancer, which is particularly strong for endometrial cancer," she said, "however, it is good news that many cases could be prevented every year by maintaining a healthy weight and being physically active.

"The AICR/WCRF report on preventing endometrial cancer follows previous Continuous Update Project reports on pancreatic, breast and colorectal cancers in showing the importance of lifestyle factors in preventing cancer and, like those previous reports, uses the most up-to-date research to inform people how we can cut our risk."

Most cases of endometrial cancer are diagnosed in women over age 60. There is no reliable screening system to detect endometrial cancer.

Scientists list several reasons that body weight, physical activity and other lifestyle factors affect the risk of cancer. Notably, fat cells release hormones that can spur the development of some cancers. Regular activity can help regulate hormone levels, strengthen the immune system and help maintain a healthy digestive system.

In laboratory studies some coffee components, including chlorogenic acid, have displayed strong antioxidant properties that may prevent DNA damage, improve insulin sensitivity and inhibit glucose absorption in the intestine, all of which could reduce risk.

FOOD, NUTRITION, PHYSICAL ACTIVITY AND ENDOMETRIAL CANCER 2013

	DECREASES RISK	INCREASES RISK
Convincing		Body fatness
Probable	Physical activity Coffee	Glycemic load

Coffee and Glycemic Load

In previous judgments of the AICR/WCRF experts, coffee was found to have no effect on risk for cancers of the pancreas and kidney. And aside from endometrial cancer, there is currently no consistent evidence that coffee has an effect on the risk of other cancers.

Experts at AICR cautioned, however, that there is not yet enough information to definitively determine the amounts of coffee that protect against the disease.

This is also the first time the evidence has been strong for the AICR/WCRF reports to link cancer prevention to glycemic load, a

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A Continuous Update

Today, AICR/WCRF has published four updates of the 2007 report, ***Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective***. Cancer site by site, AICR/WCRF is systematically collecting and analyzing the evidence.

In the first undertaking of its kind, AICR/WCRF is also now developing a process to review the mechanistic research in relation to food, nutrition, physical activity, body fatness and the development and progression of different cancers.

The findings will help inform both future research and cancer prevention recommendations, says Rachel Thompson, PhD, WCRF's Science Program Manager, who manages the Continuous Update Project.

Karen M. Basen-Engquist, PhD, MPH

A speaker at the 2013 AICR Annual Research Conference, Karen Basen-Engquist, PhD, MPH, is a psychologist who works with cancer survivors to improve their well-being and quality of life by seeing how to best help them adopt healthier lifestyles. Basen-Engquist, a professor at the University of Texas M.D. Anderson Cancer Center, is directing a new research center called the Center for Energy Balance in Cancer Prevention and Survivorship that takes a transdisciplinary approach to health and surviving cancer.

Q: Tell us about your research with cancer survivors and why it's important.

A: My research relates to cancer survivorship and the impact of exercise, weight management and healthy eating on quality of life. We study behavior change processes to find out what helps people make positive changes in their lives and do intervention trials to look at how outcomes, such as weight loss, can affect the lives of cancer survivors.

We also look at the effect of exercise and behavior change on biomarkers related to chronic disease and cancer. We mainly study gynecological and breast cancers. But we are doing a study right now with late stage colon cancer, working to help improve patients' physical functioning and quality of life.

Q: What led to your interest in this field?

A: I came to M.D. Anderson in 1996 with an interest in the quality of life of cancer survivors. Before the 1990s, we weren't doing a lot to encourage cancer survivors to change. At that time, most quality of life work was focused on measurement. I saw a need to do more work on what we can actually do to improve the quality of life for cancer survivors.

My tools were from health behavioral change and I applied them to quality of life work. The first question we asked was whether it was safe for cancer patients to incorporate exercise. We found out that the answer was "yes."

Q: What are the benefits to people with cancer who exercise and eat healthy?

A: There is evidence that exercise can lower cancer risk, but there's also strong evidence that exercise benefits quality of life. It helps with pain, fatigue and the ability to do the tasks required of daily living. It can also improve other chronic conditions and protect against heart disease, stroke and diabetes. The reality is that a lot of cancer survivors will die of something other than cancer, like cardiovascular disease.

The evidence related to healthy eating is more incomplete, but a lot of data shows that for most types of cancer, obesity is negatively related to recurrence, especially with breast and prostate cancers. While behavior change is a very individual process and often depends on peoples' beliefs, it may be best to address both diet and exercise at the same time.

"The first question we asked was whether it was safe for cancer patients to incorporate exercise. We found out the answer was "yes."

Q: Your new center takes a transdisciplinary approach, why is that important to helping cancer survivors?

A: It's important to understand both the biologic and social/environmental influences on weight and behavior. We need a better understanding of things like what is driving over-eating, or how the physical environment can shape our physical activity. These types of questions can't be answered by research coming from any one specific disciplinary perspective.

Q: What are some of the studies you are working on now?

A: One of the studies we are doing is with endometrial cancer survivors. We are looking at the factors that affect the likelihood they pursue exercise. We're using many assessments, including an ecological momentary assessment, which is similar to a handheld computer that asks questions about barriers and outcomes at the moment exercise occurs.

We recently published this work in *Health Psychology* and found that confidence in the morning was related to how much exercise a person did that day. If they were confident, they were more likely to exercise. We also found that confidence varied day to day.

Q: You also are working with mobile health technologies, right?

A: We are particularly interested in influencing self-efficacy in real-time by using smart phone applications that assess behavior, as well as deliver messaging, to help motivate people. We also use mHealth as a way to self-monitor behavior and have found that it's a terrific way to help modify behavior. There are a lot of smart phone apps available to monitor behavior, but they aren't all evidence-based, so we are partnering with a company to develop and test new apps.

Q: Can you share any tips for those who want to help survivors incorporate exercise into their lives?

A: Exercising came to me later in life, so I am able to take the perspective of a non-exerciser. I think the best way to go about it is to make small and incremental changes. It's important for us to address the needs of people who aren't active at all and to get them to start slowly. Those are the type of people who will be helped the most by incorporating exercise.

There really aren't any guidelines that advise on the best time to adopt a healthier lifestyle once you've had cancer. But, "why wait?" There are really no good reasons to wait to become healthier.

We've found that once cancer treatment ends, people are a bit more receptive. It's kind of scary for treatment to end. All of a sudden, it stops, along with seeing your doctor and the constant care you received. Filling that void with something active can be empowering. ◆

measure of how much a serving size of food increases blood sugar. Foods high in glycemic load, such as sugary soda, increase blood sugar levels relatively quickly. That can result in high levels of insulin, and consistently high insulin levels link to increased risk of several cancers.

But glycemic load is only one sign of a healthy diet, says AICR's Associate Director of Nutrition Programs Alice Bender, MS, RDN. "A diet high in glycemic load is one we already know is not a healthy, cancer protective diet, says Bender. "But you can choose low glycemic load foods and not have a healthy diet."

The goal is to focus on a diet high in whole foods, with fruits, vegetables, legumes and only some lean animal protein, and limiting sugary, processed foods. "Overall this diet will also be a low glycemic load diet, and lower risk for cancer, heart disease and other chronic diseases," says Bender. ◆

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