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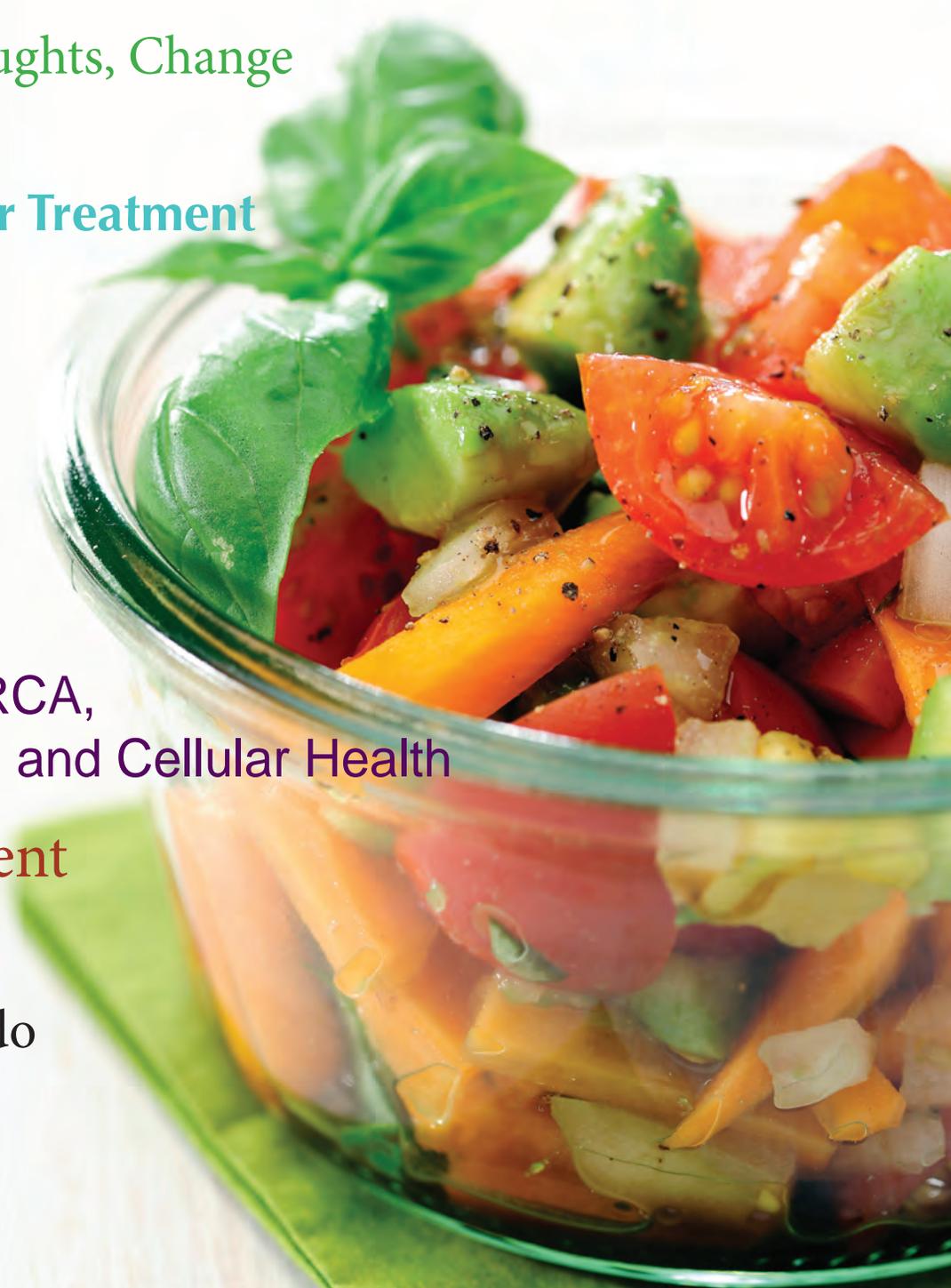
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Cancer Cells Are Sugar Addicts

Using a Ketogenic Diet to Treat Cancer

By Ellen Davis

IN 1924, OTTO WARBURG, PH.D., a Nobel Prize winning biochemist, proposed the hypothesis that cancer is a metabolic disease, that affects the way cells use food to make energy. Warburg believed that cancer cells exhibit a preference for using sugar to fuel themselves, even when the oxygen needed for normal cellular energy processes is available.^{1,2,3,4} He wrote:

“Cancer, above all other diseases, has countless secondary causes. But, even for cancer, there is only one prime cause. Summarized in a few words, the prime cause of cancer is the replacement of the respiration of oxygen in normal body cells by a fermentation of sugar.”¹

Until recently, Warburg’s hypothesis had been marginalized by the persistent belief in the oncology world that cancer is a genetic disease. However, in his new book, *Cancer as a Metabolic Disease: On the Origin, Management, and Prevention of Cancer*, Thomas Seyfried, Ph.D., has put Warburg’s work back in the medical limelight.⁵

In his book, Seyfried argues that cancer is not a genetic disorder, but is, indeed, a metabolic disease. He suggests that the focus on genetic causes is why so little progress in curing or even treating cancer

has been made. This is evident when we look at the milestones for cancer research. For the last forty years, the oncology research community has been focusing on genetic causes and drug-based treatments, and the results for the patients have been dismal.

What does it mean to say that cancer is a metabolic disease? Metabolic diseases are conditions in which the metabolism, or the making of energy from the food we eat, is dysfunctional or abnormal in some way.

Normal body cells are able to efficiently use the food we eat and the oxygen we inhale to complete normal cellular respiration and make adenosine triphosphate (ATP), our main cellular energy source. Most of this energy-making process happens in the mitochondria, tiny organelles that are the “powerhouses” of the cell. There are two types of primary food-based fuels that our cells can use to produce energy.

The first cellular fuel is glucose, which is also called blood sugar. Glucose mostly comes from carbohydrates in our diet, and is converted into energy in our cells via a process called glycolysis. In normal cells, glycolysis is a source of other molecules

that flow into the mitochondria to complete normal cellular respiration.

The second type of cellular fuel, ketone bodies, come from fatty acids. There are various kinds, and they come from fats we eat or from the metabolism of fats that have been stored in our fat cells. This fat metabolism process is called *ketogenesis*, and the shift in metabolism that favors fats as the primary source of energy is called *ketosis*.

Ketone bodies, or ketones, are an important part of human metabolism. They act as a backup system when blood glucose levels fall, through either starvation or carbohydrate restriction. Ketones allow normal cells to be metabolically flexible, so to speak. When glucose levels are low, most normal cells will switch to using ketone bodies for fuel. Even the brain and nerve cells, which are highly dependent on glucose, can use some ketone bodies if there are enough of them circulating in the blood. This ability of a normal cell to use ketones when glucose is unavailable is a sign of good cellular health. It indicates the cell's mitochondria are working correctly.

In contrast, cancer cells are unable to utilize ketones when glucose is low. Cancer cells have damaged mitochondria, and they lack metabolic flexibility. Since they can't use ketones, cancer cells must have glucose to stay alive and grow.

In other words, most cancer cells are vulnerable to any metabolic change that denies them blood sugar or a source of sugar for fuel.

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What Does the Scientific Evidence Say?

The general direction of cancer research in the last forty years has been overwhelmingly biased toward genetic factors, and little progress has been made toward a cure or even effective care. Thomas Seyfried has shown in his studies that cancer can be treated with metabolic dietary therapy with good results.

The types of cancers that are most vulnerable to a restricted ketogenic diet are generally those which are more visible on a FDG-PET scan. FDG stands for 18F-fluorodeoxyglucose, which is a drug used to detect cancers. The drug is a metabolically neutral glucose analog (it can't be broken down like normal glucose) to which a radioactive isotope has been added. Since cancer cells have an affinity for glucose, the glucose

After the introduction of the dietary guidelines for Americans in 1977, our intake of saturated fat decreased and our intake of carbohydrates increased. A few years later, an obesity and diabetes epidemic started, and it has continued.

—Uffe Ravnskov, M.D., Ph.D., www.ravnskov.nu/uffe

Ketogenic Diets: A Key to Excellent Health

Ketogenic diets are those in which fats provide most of the calories. Carbohydrates (sugars and starches) are severely limited, and protein intake is moderate. The term *ketogenic* refers to the fact that when the body metabolizes fat for fuel, ketone bodies are created through ketogenesis. Ketone bodies are fragments of fatty acids created when your liver and kidney cells metabolize fats. Your cells can use ketones for fuel, and if fat burning is increased, it results in ketosis, which is an elevated level of ketones in the bloodstream.

Ketogenic diets are powerful, metabolically speaking. Switching to a high-fat, low-carbohydrate ketogenic diet can eliminate heartburn, improve cardiac risk factors, and reverse the elevated blood pressure, high blood sugar, and dyslipidemia associated with metabolic syndrome.

In addition, research has shown that the metabolic effects of eating more fats and less carbohydrates can alleviate many other serious health issues. Medical researchers and some physicians are using ketogenic diets to reduce the tremors of Parkinson's disease, help Alzheimer's patients regain memory and thought function, drive various cancers into remission, give diabetics better control over their blood sugar and lipid profiles, and improve

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Ketogenic Diets: A Key to Excellent Health

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epilepsy treatment outcomes.

How can a simple diet have so much power? The secret is in the effect that eating ketogenically has on blood sugar, insulin, and ultimately cellular energy processes.

Eating foods that are high in carbohydrates leads to increased reactive oxygen species and inflammation because these foods increase the amount of glucose and insulin in the bloodstream. This is the main problem with high-carbohydrate diets. While glucose is an important fuel for the body, too much of it circulating in the bloodstream can harm body systems. How much is too much? Typically, a healthy individual will have less than one teaspoon of sugar dissolved in the bloodstream at any one time.

Compare that to a typical canned soft drink, which contains about ten teaspoons of sugar, or a bagel, which breaks down into about sixteen teaspoons of sugar in the bloodstream. These high-carbohydrate foods provide much more glucose than the human body can handle efficiently. Blood glucose is basically liquid sugar, and if you have ever spilled fruit juice or syrup on your hands, you know how sticky it can be. In the body, this "stickiness" is called glycation.

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analog in the injected drug accumulates in the tumor and the radioactive signal can then be easily seen on a PET (positron emission tomography) scan. The more sugar the particular type of cancer uses, the more likely that a restricted ketogenic diet will put metabolic pressure on it and slow or stop its growth.

This has been proven in several studies. In 1995, Linda Nebeling, Ph.D., and her research team put two young girls with brain cancer on a ketogenic diet with the idea that reducing glucose availability should slow the growth of the cancer. The results were very positive. There was a 21.8 percent decrease in glucose uptake at the tumor sites in both girls, indicating that tumor growth was slowing.⁶

Recently, Eugene Fine, M.D., completed a trial study using a ketogenic diet to treat ten people with advanced, so-called incurable cancer. His results were also promising. At least five of the patients were able to achieve very high ketone levels, which resulted in disease stabilization or remission. Patients also reported that when their ketones were elevated, the side effects of standard radiation therapy and chemotherapy weren't as debilitating.⁷

Several studies have shown that ketone bodies help diminish the side effects and increase the efficacy of more mainstream cancer treatments such as radiation and chemotherapy. In short, the presence of high levels of ketones make cancer cells more vulnerable to the standard cancer treatments. And there is compelling evidence that ketone bodies are protective of normal cells because they help reduce the inflammation caused by mitochondrial oxidative stress.^{8,9}

Thomas Seyfried's team has shown in several studies that calorie restriction in conjunction with a restricted ketogenic diet improves cancer outcomes because the diet can reduce tumor blood vessel growth; promote cancer cell suicide factors (apoptosis), destabilize the tumor DNA, reduce tumor size, reduce cancer-growth-stimulating IGF-1 hormone, and reduce inflammation.¹⁰⁻¹⁴

That's a good track record for a dietary treatment. And a big, big plus for the patient because the diet is inexpensive, as cancer treatments go, and there are no toxic side effects associated with the diet as there are with mainstream treatments.

Treatment Goals of a Restricted Ketogenic Diet

The first and most important fact to know about using a restricted ketogenic diet is that it is very powerful, metabolically speaking. It is advisable, before implementing the diet, to make arrangements to have a health care professional who is knowledgeable about ketogenic diets monitor patient progress.



Radiologist reviews an axial PET/CT fused image through mid chest showing increased uptake (red area/lung cancer) in right hilum. This scan is from the lower torso looking up, the heart is the green area on the patient's left side (right of frame center).

The successful implementation of a restricted ketogenic diet has three goals:

The primary goal is to reduce circulating blood sugar and insulin levels and, at the same time, increase ketone levels significantly. When blood sugar levels fall low enough and blood ketones are high, cancer cell metabolism and growth can be slowed or stopped. The purpose of higher levels of circulating ketones is to make it possible for the patient to tolerate the very low blood sugar levels that will starve the cancer. Normally, when blood sugar is very low, the brain triggers a hormonal cascade to tell the liver to break down glycogen, a form of stored glucose, to increase blood sugar. This results in the uncomfortable symptoms of low blood sugar, or hypoglycemia. But when ketones are available at high levels in the blood, the brain switches over to using ketones for about half of the fuel it needs, which reduces the likelihood of a hypoglycemic warning. This is metabolic flexibility in action.

The second goal is to use caloric restriction and targeted fasting to minimize any “after meal” blood sugar and insulin spikes that can fuel the cancer. Caloric restriction and intermittent fasting help reduce baseline glucose and insulin levels, and boost ketone production. The ketogenic diet is an excellent tool for this purpose because high-fat

Ketogenic Diets: A Key to Excellent Health

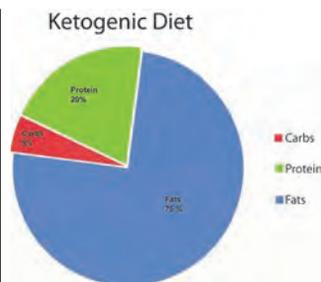
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Glycation is a process in which excess blood sugar sticks to and damages the proteins of body tissues. These injured proteins stop functioning correctly, and this results in a chain of events that increases inflammation and creates substances called advanced glycation end-products (AGEs). AGEs interfere with cellular function, and are linked to the progression of many disease processes, including Alzheimer's, cardiovascular disease, stroke, cancer, and autism.

From “Ketogenic Diets: A Key to Excellent Health,” by Ellen Davis; full article, with references: *Well Being Journal*, July/August 2012, Vol. 21, No. 4, 775-887-1702 or www.wellbeingjournal.com.

The Basic Concepts of Ketogenic Nutrition

There are many low-carbohydrate, ketogenic diet plans from which to choose. (The Atkins diet is just the most famous). They all involve following a higher-fat, moderate-protein, low-carbohydrate food plan.



The main difference between a regular low-carbohydrate diet plan and a ketogenic diet plan is the amount of carbohydrate and protein allowed on a daily basis. A ketogenic diet plan requires keeping carbohydrate intake between 20-50 grams per day. The daily protein requirement will be moderate, and depends on height, gender and how much exercise is done. The balance of calories will be from fats. This proportion or balance in food consumption ensures that most people will go into ketosis and stay there, which is the main objective of the ketogenic diet.

The nutrient intake on a ketogenic diet typically works out to about 70-75 percent of calories from fat, 20-25 percent from protein, and 5-10 percent from carbohydrate on a daily basis. Since a ketogenic diet reduces hunger, most find they don't really need to get involved in calorie counting.

The key to understanding a ketogenic diet plan is to remember that one is swapping out the carbohydrates in the diet with a higher fat and a moderate protein intake.

Why high fat and moderate protein? Fats have no effect on blood sugar and insulin levels. Protein does affect both blood sugar and insulin, if large quantities are consumed. If you overeat protein, about 56 percent of any excess protein will be converted to glucose (sugar) in the body, and that extra glucose hanging around will increase insulin, and put the brakes on the body's ability to release and burn fatty acids (go into ketosis).

In addition, eating a diet that is heavy on lean protein (without enough fat) can make one sick with a condition know as “rabbit starvation.” It can also wreck the metabolism in other ways.

—Ellen Davis at <http://www.ketogenic-diet-resource.com/ketogenic-diet-plan.html>

Mediterranean Diet and Heart Health

The editors of the *New England Journal of Medicine* recently published more research news highlighting the beneficial effect of the Mediterranean diet on cardiovascular health. This diet calls for liberal use of vegetables, fruits, legumes, nuts, olives and olive oil, as well as some cheeses, yogurts, fish, poultry, and small amounts of red meat, eggs, and sweets. Real food advocates advise cutting out refined carbohydrates and sugars as much as possible.

Researchers studied 7,447 adults between 55 and 80 years of age at high cardiovascular risk but without cardiovascular disease who each had one of three diets. The diets included: Mediterranean diet supplemented with extra-virgin olive oil; Mediterranean diet supplemented with mixed nuts; control diet with advice to reduce dietary fat.

The researchers followed the subjects for close to five years, focusing upon the rate of cardiovascular events, including myocardial infarction, stroke, or death from cardiovascular causes.

They found, compared to those on the control diet, the risk of major cardiovascular events was reduced by 30 and 28 percent respectively for those on the Mediterranean diet of either olive oil or olive oil and mixed nuts. The researchers' concluded: "Among persons at high cardiovascular risk, a Mediterranean diet supplemented with extra-virgin olive oil or nuts reduced the incidence of major cardiovascular events."

Source: Estruch R, et al. *N Engl J Med*. 2013 Feb 25. [Epub ahead of print.]

foods are very satiating, and elevated ketone levels have the metabolic effect of reducing hunger.

The third goal is to provide treatment for any side effects associated with the diet. This could include introduction of medications to support dietary goals, or changes to medications as the diet progresses. This is another reason why a doctor or a qualified nutritionist or dietitian should be involved to monitor progress when the diet is implemented.

When blood sugar levels fall low enough, and blood ketones are high, cancer cell metabolism and growth can be slowed or stopped.

Given the successful use of a restricted ketogenic diet to treat cancer in controlled studies, one would think that mainstream medicine would at least be curious about metabolic dietary therapy. But, so far, little has been disseminated in the media, and many of the big cancer organizations have not embraced the idea.

Last December, *The 700 Club*, a news program on CBN, ran a story on using a ketogenic diet to treat cancer.¹⁵ On the day that show aired, my Ketogenic Diet Resource website (www.ketogenic-diet-resource.com) received over 10,000 visitors, and it continued to receive

several thousand visitors each day for weeks afterward.

Clearly, people were interested. I began to get emails from people all over the world, wanting to know how to implement a restricted ketogenic diet for cancer treatment. The emails were hopeful, and many people wrote and said they had asked their physician or a local dietitian for help, only to be refused because of either a lack of knowledge or an unwillingness to step outside the "standard of care."

Quite a bit of information about ketogenic eating has been available on my website for some time, and *Well Being Journal* has published two of my articles on ketogenic diets (November/December 2012, Vol. 21, No. 6, and July/August 2012, Vol. 21, No. 4); however, after several months of trying to cobble together bits and pieces of information to send back to the people who wrote, it became clear to me an ebook was needed so that a more comprehensive guide could be offered.

I contacted Thomas Seyfried, Ph.D., to ask for permission to reference material and studies from his book, and wrote to Dominic

Nothing beats stargazing for soothing frayed nerves, tired bodies, and overworked minds.

Simply staring at a star-filled sky takes the weight of the world off your shoulders

—James Mullaney in *Celebrating the Universe: The Spirituality & Science of Stargazing*, Hay House 2013

D'Agostino, Ph.D., a ketogenic diet expert at the University of South Florida to ask for assistance in writing the book. I'm happy to say the response was overwhelmingly positive from both gentlemen, and after several months of hard work, the book is now available on my website at: www.ketogenic-diet-resource.com/cancer-diet.html.

If you have cancer or know someone who does, I invite you to explore the possibility that a change in diet might help in the fight against that cancer. At the very least, it can offer some relief from the side effects of standard treatments. Δ

ELLEN DAVIS is the creator and owner of www.ketogenic-diet-resource.com, a website devoted to sharing information on the health benefits of ketogenic diets. She is an avid supporter of ketogenic diets in all forms, and attributes her devotion to personal experience. She reversed her symptoms of metabolic syndrome, regained excellent health, and lost over 80 pounds by switching from the standard American diet to a whole foods ketogenic diet. She lives in Cheyenne, Wyoming, and can be reached via email at ellen.davis.web@gmail.com.

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