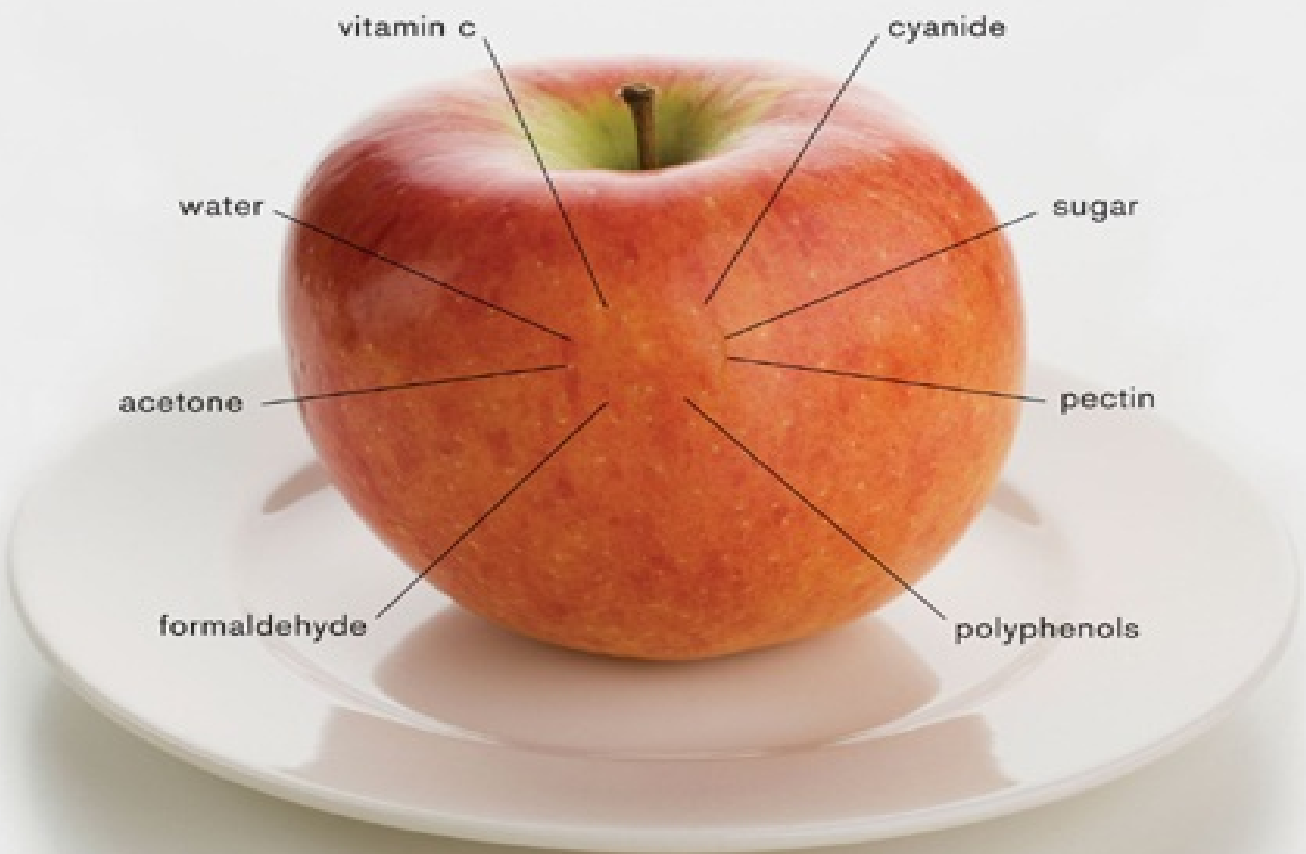
# an apple a day

## THE MYTHS, MISCONCEPTIONS, AND TRUTHS ABOUT THE FOODS WE EAT




JOE SCHWARCZ, PhD

# AN APPLE A DAY

THE MYTHS, MISCONCEPTIONS,
AND TRUTHS ABOUT THE FOODS WE EAT

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*It is a capital mistake to theorize before one has the data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts.*

**—SHERLOCK HOLMES**

*Almost all aspects of life are engineered at the molecular level, and without understanding molecules we can only have a very sketchy understanding of life itself.*

**—FRANCIS CRICK**

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# INTRODUCTION

Eating used to be simple. As long as the food was tasty, looked reasonably appetizing an was plentiful, we were content. But then science came to dinner, and all of a sudde sitting down at the table became a laboratory experience, and a confusing one at that. E fish, we were told, it's chock full of omega-3 fats. Be careful, urged another report, fish ma harbor "good" fats, but it's also loaded with PCBs and mercury. We switched to margari from butter because it had fewer saturated fats. But then came accusations that the trans-fat acids it contained clogged arteries just like saturated fats. Eat soy, we were told, it lowe your cholesterol. Don't eat soy, it affects thyroid function. Drink milk, you need the calciu Don't drink milk, it forms mucus. Drink coffee, it is full of antioxidants. Don't drink coffee, raises blood pressure. Then there are those little gems that "they" say. Stay away from MS Don't touch foods preserved with nitrites. Or with sulphites. Beware of pesticide residue Ban foods that contain genetically modified organisms. Don't cook in Teflon pots. Or microwave ovens. Stay away from sugar. And don't even think about artificial sweetener But just who are "they"? We've been advised to load up on foods like oats, flax, mangostee juice, garlic, and oregano because some researchers showed each of these to be of som benefit. Whole-grain bread may be in one day—lots of useful fiber and vitamins—but out th next because acrylamide, a purported carcinogen, was detected in the crust.

Many people throw up their arms in bewilderment at all this confusing nutrition information, and go back to their old dietary regimens. And that is too bad. Nutrition important. The challenge is to separate the wheat from the chaff, and come to some practic conclusions about what to eat, based not on hearsay but on sound science.

This is not easy to do, especially when we consider that the human body is the mo complex machine on the face of the earth. The diversity of its molecular components is astounding that by comparison, computers, medical scanners, and space vehicles are simp devices. What we call life is really the result of astonishingly complex molecular activity th goes on in every cell in our body every second of the day. And where do the molecules th engage in these intricate gymnastics come from? One way or another, they come from th food we eat.

It seems obvious then that the composition of our diet can affect our molecular makeu and consequently our health. But the relationship between diet and health is not a simp one. Food is chemically very complex. An apple, for example, is composed of over 30 different compounds. A single meal can flood the body with thousands of compounds, man of which have never been isolated or identified. While nutrition is obviously an importa determinant of health, it is folly to think that one can introduce something as complicated food into something as complex as the human body and make easy predictions about th outcome. Curing disease by dietary manipulation must therefore be looked at with a health degree of skepticism. But *preventing* disease by modifying our diet is realistic. The question i how?

Separating sense from nonsense has been the focus of my educational activities ever since began teaching chemistry back in 1973. This book does not purport to be an encyclopedia nutrition or a comprehensive guide to healthy eating. It does, however, provide a framewo

for sound nutritional thinking, along with a perspective on what is worth worrying about an what is not as we ply ourselves with the mélange of molecules we call food.

People have different appetites when it comes to sampling food issues. Some are intereste in the nutritional merits of specific foods; some are fascinated by the action of antioxidant and others worry about the safety of additives. Chances are that most of you will be as pick with this book as you are with your food. Each of the chapters in this volume has bee designed to stand on its own and to provide you with up-to-date information on a specif food-related issue. In Part One, we examine the role played by food's natural component What is there in tomatoes, soy, or broccoli that can contribute to good health? Why do gluten in wheat cause problems for some people? Part Two investigates the consequences human intervention in our food supply. What are the risks and benefits of food additives of genetic modification? What promise lies in adding specific bacteria to foods? Part Thre deals with substances—such as pesticide residues, remnants of antibiotics, trans fats, an chemicals from plastics—that end up in our food supply unintentionally as a result of foo processing. And for good measure, after you've waded through the science, in Part Four, we throw in a discussion of some dubious nutritional ideas.

These are all fascinating issues. Now, on to the fun part: let's try to digest them.

# PART ONE

## NATURALLY OCCURRING SUBSTANCES IN OUR FOOD SUPPLY

# AN APPLE A DAY

Is there a better subject with which to begin a discussion of the relationship between foo and health than apples? After all, doesn't "an apple a day keep the doctor away"? Maybe does, if you throw it at her! There is no single food that has magical health properties. Ther are good diets and there are bad diets. It is certainly possible to have a good diet and neve eat apples, just as it is possible to gorge on apples and have a horrible diet. What reall matters in terms of nutrition is the net effect produced by all of the chemicals that wend the way into our bodies from the food we eat. Yes, chemicals. I can practically see thos eyebrows being raised. It may seem unusual to see the word *chemical* without an adjectiv like *poisonous*, in front of it. Actually, without appropriate context, *toxic chemical* is meaningless term.

Take salicylic acid as an example. It occurs naturally in a variety of fruits and plant including apples. It is also formed in our body when aspirin is metabolized. Indeed, salicyl acid is responsible for the physiological effects of aspirin, which include reducing the risk o blood-clot formation. That's why aspirin is used to treat a heart attack, and why it commonly taken in small doses to prevent one. But in an overdose, salicylic acid can ki Before childproof packaging was introduced, aspirin poisoning was a common cause of deat in children. So how do we react if a test detects salicylic acid in our blood? Panic because the presence of a "toxic chemical," or relief because of possible protection against hea disease? Of course, without the proper context there can be no appropriate reaction. T decide whether to laugh or cry, we need to know what blood levels of salicylic acid hav been linked to risk and what levels to protection from disease. The mere presence of th chemical says nothing. As Paracelsus insightfully and wisely noted some 500 years ago, "On the dose makes the poison." And to this we can add, "And only the dose makes the cure!"

So let's not get paranoid about chemicals in our food. Everything in the world is made o chemicals, and if you restricted yourself to a diet free of chemicals, you would be dining in vacuum! With that in mind, let's investigate the chemicals in an apple. So tell me, would yo like some nail polish remover in your diet? Or rubbing alcohol? Then have an apple! Yes, a apples contain acetone and isopropanol. And if these don't sound toxic enough, you can thro in some cyanide. It's there too. Added by nature, not by humans! Should you then be worrie about eating apples? Of course not! The amounts of these chemicals are too small to be o any consequence. Apples, as already mentioned, contain over 300 naturally occurrin compounds, and whatever effect the fruit has on our health is a reflection of all of these Researchers are particularly excited about one class of compounds, the polyphenols. Why Because they have powerful antioxidant properties.

Chances are that if you haven't heard chapter and verse about antioxidants in recent year you've been spending too much time in the butcher shop. These highly publicized substanc are found in fruits and vegetables and can neutralize free radicals, those rogue molecula fragments produced whenever we inhale oxygen. We can't live without oxygen, of course, b there is a cost to be paid for living with it: illness and eventual death! About 2 to 3 percent o the oxygen consumed by our cells is converted into free radicals that are so reactive, they ca rip other molecules apart. When the victims are proteins, fats, nucleic acids, or oth

essential biomolecules, the result can be heart disease, cancer, or dementia. Even plain o aging has been linked to cumulative free-radical damage.

Since antioxidants can mop up excess free radicals, they obviously merit serious scientif investigation. One of the difficulties, though, is the large variety of antioxidants that a present in plant products. Vitamins C and E, along with carotenoids, have received a gre deal of attention, but most of the antioxidant activity of fruits and vegetables can b attributed to polyphenols. The term *polyphenol* actually refers to several related families molecules that include the flavonoids, anthocyanins, chalcones, and hydroxycinnamates. T complicate things further, each family in turn comprises many compounds that are linked b some common feature of their molecular structure. As one might expect, because thes antioxidants have different molecular structures, they also have different degrees antioxidant activity. Obviously, knowledge about the distribution of polyphenols in our die coupled with knowledge about which ones have the most activity, would be very useful.

But before we start jumping on the polyphenol bandwagon, we need to ask a pertine question: What evidence do we have that polyphenols in the diet can contribute to goo health? Demonstrating that these chemicals can neutralize free radicals in a test tube is on thing, showing that they can prevent cancer or heart disease is quite another. The first maj study to suggest such a possible benefit appeared in *The Lancet* in 1993. Dutch researche measured the amount of flavonoids in various foods, and by means of a dietary questionnai assessed the flavonoid intake of 805 men ages sixty-five to eighty-four who were the followed for five years. Even when adjustments were made for smoking, body weigh cholesterol levels, blood pressure, physical activity, and vitamin and fiber intake, th polyphenol content of the diet was inversely associated with death from heart disease. Th major sources of polyphenols in this study were tea, onions, and apples. A single apple a da made a difference!

There is evidence for the anticancer effects of polyphenols as well. Researchers at Corne University found that treating colon or liver cancer cells in the laboratory with apple extra inhibited their proliferation, with extracts from the skin performing even better than extrac from the flesh. The same Cornell team also showed that apples may play a role in reducin the risk of breast cancer. Rats exposed to a substance known to trigger breast cancer were fe apple extract in amounts equivalent to a human eating one, three, or six apples a day. Lo an behold, the chance of developing the disease was reduced by 17, 39, and 44 perce respectively! Even when cancer set in, maintaining the apple diet blocked the spread of th disease, and after six months reduced the number of tumors by 25 percent. And that with ju one apple a day! These researchers did not stop at investigating cancer. When they expose rat brain cells to a specific polyphenol, quercetin, they found that the cells resisted oxidativ damage more, implying a potential reduction in the risk of developing Alzheimer's and oth such brain diseases. Indeed, a group at the University of South Florida found a great reduced risk of Alzheimer's disease in seniors who drank fruit or vegetable juices at lea three times a week compared with those who drank these juices less than once a week.

Other studies have found that quercetin reduces the growth of human prostate cancer cel in the lab and that its presence in the diet is inversely associated with the risk of lung cance This is not that surprising, given that quercetin has very potent antioxidant activity. And it found in apples, along, of course, with many other polyphenols. But before we sta

attributing magical properties to apples, let's realize that there are foods with high antioxidant potential. Red kidney beans, blueberries, and cranberries all have great antioxidant capacity per serving. And oregano has forty times the antioxidant activity apples. What matters, though, is the total intake of polyphenols. Let's face it, eating appl every day is easy. Kidney beans are more challenging.

But the real key to antioxidant intake is variety. The more varied the fruits and vegetabl consumed, the greater the chance that we equip ourselves with the complex array antioxidants that may be needed for good health. Studies indicate we should be aiming for daily polyphenol intake of around one gram. Apples, depending on the variety, can contribu anywhere from 100 to 300 milligrams. Eating a couple a day is certainly a good idea. And someone tries to scare you by pointing out that apples contain embalming fluid, you ca respond that whatever the detriments of the traces of the naturally occurring formaldehyd may be, they are more than countered by the benefits of the polyphenols. Eat those apple and make the undertaker wait longer with his embalming fluid.

# TOMATOES AND LYCOPENE

Researchers are really excited about lycopene, the compound responsible for the red colo of tomatoes. So is the public. Prompted by ads in magazines and by seductiv promotions in health food stores, lycopene supplements are enjoying brisk sales, especiall among men worried about prostate cancer.

Why should lycopene have any effect on prostate cancer? Because studies have shown tha men who consume lots of tomato products have a lower incidence of the disease. A study b the Harvard School of Public Health showed that men who had ten or more servings o tomato-based foods a week had a 45 percent reduction in the rate of prostate cance Spaghetti sauce was the most common tomato-based food consumed, and cooked tomato seemed to be more protective than raw tomatoes or tomato juice, perhaps because he releases lycopene and other nutrients from tomato cells. Also, the sauce is commonly mad with olive oil, which enhances the absorption of the fat-soluble lycopene. And the sauce is concentrated tomato product, so it provides more nutrients per gram than fresh tomatoes.

Lycopene is a good candidate for biological activity because the tomato actually uses th compound to maintain its own health. It protects the seeds in the fruit from damage b oxygen and light. Lycopene can absorb ultraviolet light, and its antioxidant activity allows to neutralize free radicals generated by exposure to oxygen. Of course, there's more t tomatoes than lycopene. Like other plant products, tomatoes are very complex chemicall and contain hundreds of different compounds. Is lycopene the most important one Researchers at Ohio State University decided to find out.

Since triggering cancer in humans is out of the question, researchers focused on rats, whic actually are very good models for human prostate cancer. They caused prostate cancer i about 200 rats by treating them with a cancer-inducing mix of testosterone and N-methyl-N nitrosourea. Some of the rats were then fed diets that contained whole-tomato powder whi others were treated to rat chow fortified with lycopene. The lycopene-fortified rats wer actually getting more lycopene than the tomato-powder rats. That's what made the results o the experiment so surprising. The risk of death from prostate cancer was significantly greate in the rats that were fed the pure lycopene extract! This would seem to suggest that there ar other components in tomatoes that have a protective effect and that the whole food beneficial, while isolated components may not be. True, the study was done in rats, but does send us a message. Eat a balanced diet, with lots of vegetables and fruits, becaus shortcuts may not work.

There was another significant finding in this study. The researchers also put some of th rats in each group on a calorie-restricted diet. While their companions were allowed to eat a much as they wanted, these rats were given a diet that contained 20 percent fewer calorie than what rats usually consume. Guess what? These hungry rats lived longer than the ra who ate freely. So, just eating less food reduces the risk of prostate cancer. What's the overa message for human beings? We should reduce our calorie intake and eat lots of tomat products. And eating those tomato products may even play a role in protecting the heart. A least that's one conclusion that can be drawn from an intriguing Italian study.

Imagine being admitted to a hospital with a heart attack and a doctor asking how man

times a week you eat pizza. This was the actual question that was asked of 507 heart attac victims and 478 others who had been admitted to a hospital in Milan, Italy, between 199 and 1999. Why? To find out if most Italian foods had any role to play in heart disease. We'v all heard about the benefits of the highly touted Mediterranean diet, and Italian researche decided to find out if pizza specifically played a role in protection against cardiovascul disease.

After admission to the hospital, the patients were interviewed about their lifestyle habi and their diets. They filled out a seventy-eight-item food-frequency questionnaire on the bas of which they were divided into non-pizza eaters, occasional pizza eaters (one to fou portions a month), and regular pizza eaters (more than one portion per week). Heart attac victims reported they had exercised less than controls, smoked more often, consumed mo coffee, and drank less alcohol. No surprise here. They also had more of a history of hig blood pressure, consumed more calories, and ate fewer fruits and vegetables. Still n surprise. But the surprise came when pizza eating was considered. Regular pizza eaters we 40 percent less likely to suffer a heart attack than those who never ate pizza! Why this shou be so is somewhat of a mystery. Perhaps pizza eating is just an indicator of following Mediterranean diet, which tends to be lower in fat than the North American diet.

We have to remember that we are talking about pizza as served in Italy, not the America version. No double cheese, no cheese-filled dough, no piles of pepperoni or globs of trans fa laden shortening. The dough is thin, the pizza is dressed with olive oil and cheese, and the is plenty of fresh tomato sauce. The answer to this pizza mystery may lie not in what th people are eating, but rather in what they are *not* eating. Perhaps the pizza is displacing hig fat hamburgers and fries from the diet. Let's note that a portion of pizza in the Italian stud was defined as 200 grams, and even the so-called regular eaters averaged only 500 gram (just over a pound) of pizza per week. Indeed, pizza may be displacing higher-calorie food from the diet. Or maybe it's the yellow stuff around the tomato seeds that matters. This flui contains flavonoids that have anticlotting properties, and could, at least in theory, reduce th risk of heart attacks.

The producers of Fruitflow certainly think this is the case. This patented tomato-extra product is being added to various drinks with hopes of improving cardiovascular health. I one study, blood "stickiness" was reduced by an average of 70 percent in 220 volunteers wh drank a juice containing Fruitflow, with the effect lasting for eighteen hours. Tomato juic itself may provide a similar benefit. And it may be especially helpful on long-distance flight where a potentially life-threatening condition called deep-vein thrombosis can occur. Sittin in one position, such as in an airline seat, without moving for extended periods increases th chance of blood clots forming in the legs. These clots can travel to the heart or lungs an cause a catastrophe. So loading up on the tomato juice (without the vodka) is a good idea o long flights. Fruitflow is not the only tomato extract under investigation. Israeli researcher found that a supplement sold as Lyc-O-Mato, capsules that contain nutrients equivalent t those found in about four tomatoes (along with some fat to aid absorption), reduce moderately elevated blood pressure significantly. Hmm … tomatoes and fat … bring on th pizza! And top it with broccoli!

University of Illinois nutrition professor John Erdman fed a diet containing 10 percen dehydrated tomato powder, or 10 percent broccoli powder, or a combination of both, to ra

implanted with human prostate-cancer cells. Another group of rats was treated wi supplemental lycopene, and yet another group was castrated, a possible treatment f prostate cancer. After twenty-two weeks, Erdman's team found that the tomato-brocc combination was most effective in reducing the size of tumors. This was an animal study, s it is more meaningful than a test-tube experiment, but more importantly, the dose of brocc and tomato needed to achieve the reduction in tumors is within the norms of the human die Conversion of the amounts fed to the animals to a human dose suggests that a cup and a ha of broccoli a day coupled with two and a half cups of fresh tomato, or a cup of tomato sauc can be effective in reducing the growth of prostate tumors and probably in reducing the occurrence as well. Why a combination of broccoli and tomato works better than th individual foods is not known, but compounds in foods can inhibit cancer in various way ranging from stimulating detoxicating enzymes to triggering cell death. Maybe there is market out there for broccoli-flavored tomato ketchup.

Eating tomatoes may not only make you healthier, it may also make you look bette Lycopene is fat-soluble and concentrates in fatty tissue, such as the fatty layer ju underneath the skin. Since the molecule is an efficient absorber of ultraviolet light, it offe some protection against sun-induced skin damage. In conjunction with the BBC televisio series *The Truth About Food*, two dermatologists in Britain put this notion to a test. The recruited twenty-three women aged twenty to fifty who were willing to bare their botton and expose them to ultraviolet light for the sake of science.

Half the volunteers consumed sixteen milligrams of lycopene daily, the amount containe in three teaspoons of tomato paste, along with ten grams of olive oil to help with absorptio of the fat-soluble lycopene. The other volunteers got only the olive oil. Otherwise, bo groups had identical diets. The results? Less reddening of the skin and less DNA damage the lycopene group. And if you don't like tomato paste, a glass of tomato juice or a cup tomato soup will do. But as for fresh tomatoes, well, you would need to eat at least half dozen to achieve the same effects.

All of these intriguing studies have prompted producers to petition the Food and Dru Administration in the United States to allow health claims on the labels of tomato product After all, foods containing soy and oats can have labels that claim they reduce cholesterol and calcium-supplement labels can claim that the supplements reduce the risk of osteoporosi so why shouldn't tomato-product labels be allowed to make claims about reducing the risk cancer? The FDA responds that there simply is not enough evidence to support the cance reduction claim. But the FDA does agree that there may be some health benefits to eatin tomatoes. So it allows the tomato-product labels to include statements such as this: "Ver limited and preliminary scientific research suggests that eating one-half to one cup tomatoes and/or tomato sauce a week may reduce the risk of prostate cancer. The FD concludes that there is little scientific evidence supporting this claim." Of course, the toma producers believe that the FDA is too stringent in its requirements and that there is enoug evidence about lycopene to warrant a stronger health claim.

Researchers at the National Cancer Institute and The Fred Hutchinson Cancer Researc Center share the FDA's skepticism about lycopene. If lycopene does indeed offer protectio from cancer, then people who have higher levels of this compound in their blood should hav a reduced risk of cancer. But this does not appear to be the case. Researchers followed ov

28,000 men between the ages of fifty-five and seventy-four who had no history of prosta cancer. During eight years of follow-up, 1,320 of the men were diagnosed with prosta cancer, but no relationship was found between the blood levels of lycopene and occurrence the disease.

Of course, this research does not signal the end of the debate. We cannot just dismiss th studies that have shown an association between consuming tomatoes and protection fro cancer. Let's remember that tomatoes are chemically complex and contain numero compounds besides lycopene, compounds that may—either alone or in combination wi lycopene—act as anticancer agents. Perhaps the most important point is that the scientif evidence does not support the concept of a "superfood" or a "super" ingredient. Vegetable fruits, and whole grains are loaded with compounds that have shown a potential f protection from cancer. Loading up on any single food or supplement is not the answer. Th key is to eat a variety of foods that contain these beneficial chemicals, including, of cours tomato products.

Lycopene supplements may be useful in the future, but so far, there is no compelli evidence that these are as effective as tomato products.

# CRANBERRIES AND PROCYANIDINS

Cranberries and turkeys make a pretty good combo. But so do cranberries and peopl Don't worry, I'm not proposing cannibalism, just a scientific evaluation of the possib health benefits of cranberries.

Mention cranberry juice and "urinary tract infection" springs to mind. Most women ar many men are familiar with the frequent urination and accompanying burning sensation th signals a bacterial invasion of the urinary tract. Today antibiotics solve the problem, but wh did people do before? "Flushing the system" seemed a logical approach. I suppose all sorts beverages were tried, but by the mid-1800s books on folkloric medicine were suggesting th use of cranberry juice. Based on anecdotal evidence, the juice developed a solid reputatio for treating and preventing urinary tract infections.

Once bacteria had been identified as the cause of UTIs, scientists began to explore possib mechanisms by which cranberry juice could offer relief. Acidifying the urine to make it mor inhospitable to bacteria was a possibility, as was the antibacterial action of hippuric acid, component of cranberries. But trying to explain how cranberry juice worked before clear demonstrating that it did was putting the cart before the horse. Finally, in 1994, Harvar researchers decided to mount a proper clinical study of the claims. They enrolled 153 old women, half of whom were given ten ounces (285 milliliters) of cranberry juice every da while the other half were given a look-alike drink containing no cranberry. The women wh drank cranberry juice were 58 percent less likely to have levels of bacteria in their urine th would be expected to cause infections. As we would eventually learn, the effect was not du to acidity of the urine, nor to the antibacterial effect of hippuric acid. It had to do wit compounds that prevented bacteria from adhering to the lining of the urinary tract.

Bacteria produce adhesives that enable them to stick to tissues so they can pick u nutrients more readily. These molecules fit into specific receptor sites on the epithelial cel that line the urinary tract. As was cleverly shown by Yale University researchers in 199 compounds in cranberries block these receptors. Urine samples were collected fro volunteers who were then given four ounces (115 milliliters) of cranberry juice to drink. Fou to six hours later urine was again collected and incubated with *E. coli* bacteria, the kind th normally are responsible for urinary tract infections. The experiment was then repeated wi eight ounces (230 milliliters) of juice. Separately, the scientists cultured cells taken from th lining of the human bladder and then mixed them with the urine samples. Lo and behold, th bacteria did not stick as effectively to the cells when the urine samples came from wome who had consumed cranberry juice! Furthermore, the more juice consumed, the less th bacteria adhered to the cells. Although the specific ingredients in the juice responsible for th effect have not been conclusively identified, speculation is that substances known as trimer procyanidins may be responsible.

These procyanidins may do more than prevent urinary tract problems. Most ulcers ar caused by infection with the *Helicobacter pylori* bacterium. Well, it seems that th procyanidins may also prevent these bacteria from infecting the stomach. Researchers China chose a population with a high rate of *Helicobacter* infection, and in a placeb controlled, double-blind study, gave ninety-seven people 500 milliliters (just over two cup

of cranberry juice for ninety days, while ninety-two others got a placebo. They found that *H. pylori* was eradicated in fourteen people in the cranberry group but in only five in the placeb group. Not an earth-shaking difference, but significant nevertheless, especially given th resistance problems we are now encountering with antibiotics.

Cranberries may even help reduce cavities by preventing *Streptococcus mutans* bacter from clinging to teeth. These are the bacteria that digest sugars and convert them into aci that eat away tooth enamel. When researchers at the University of Rochester used cranber juice to coat a sample of hydroxyapatite, the material of which tooth enamel is made, the found significant protection against bacterial adhesion. But nobody is suggesting swishing th mouth with cranberry juice. The commercial varieties often have loads of added sugar, n the best thing for the teeth, or indeed for the rest of the body, and you can't drink pu cranberry juice: it's much too sour. That's why researchers are trying to isolate the activ ingredients in cranberries and make them available in a capsule form.

There may be even more to cranberries than their effect on bacteria. At the University Western Ontario, twenty-four female mice were fed a normal diet for twelve weeks, twenty four others drank cranberry juice instead of water, and another twenty-four had their di supplemented with cranberry solids (the stuff left after the juice is squeezed) to make up percent of their chow. Then one week later, one million human breast tumor cells we injected into the animals' mammary glands. These were a special breed of mice, genetical engineered to have a compromised immune system, so they all developed cancer. But th ones that drank the juice took two weeks longer to be affected, and the ones that ate th cranberry solids took four weeks longer to develop tumors than the mice on ordinary la food. Autopsies showed that ingesting cranberry cut—by more than half—the number tumors that spread to the lungs and lymph nodes. Want even more good news? Researche at the University of Prince Edward Island have shown that cranberries may even prote against brain damage caused by stroke.

So, you're now reaching for a glass of cranberry juice. Ready for the downside? Cranberri contain compounds that may inhibit enzymes used to break down certain medications. The have been a handful of reports of people on Coumadin (a common blood thinner) developi bleeding disorders after consuming cranberry juice. To be on the safe side, it seems a goo idea for anyone on Coumadin to limit the amount of cranberry juice consumed. And on more thing. When researchers studied the ability of scents to stimulate men sexually, the found that the most enticing smell was a combination of lavender and pumpkin pie. The lea enticing? Cranberry!

# GRAPEFRUIT AND FURANOCOUMARINS

Grapefruit growers don't know whether to laugh or cry. There is some evidence th eating the fruit or drinking its juice can reduce blood cholesterol. But there are als those troublesome studies about grapefruit interfering with the effectiveness of certa medications, including some of the statin drugs used to fight high cholesterol. What conundrum! Do we give up the juice or the drug? As you might expect, the situation is mo complicated than it first seems.

"A chance finding of our study on ethanol–drug interactions was that citrus fruit juices ma greatly augment the bioavailability of some drugs." So began a paper published in 1991 *The Lancet*, one of the most respected medical journals in the world. Dr. David Bailey an colleagues at the University of Western Ontario had been studying felodipine, a bloo pressure–lowering drug, and wondered if it interacted with alcohol. They decided on double-blind trial in which some subjects were to take the drug with alcohol and som without. This meant that the taste of alcohol had to be masked, and after som experimentation Dr. Bailey concluded that grapefruit juice was up to the task. To th researchers' surprise, the alcohol had no effect, but in both groups the blood levels felodipine were three times higher than expected. Bailey knew he was on to something. An he certainly liked a challenge. After all, he had been the first Canadian to run a sub-fou minute mile!

At this point, the eager scientist decided to become his own guinea pig. One day he too felodipine with water, the next day with grapefruit juice; each time he drew blood, and sen it for analysis of drug levels. He didn't have to wait for the results to confirm the "grapefru effect." After taking the medication with grapefruit juice, he began to feel faint an lightheaded, classic symptoms of low blood pressure. Clearly, when taken with grapefru juice, felodipine lowered blood pressure more than expected. A number of questio immediately arose. By what mechanism was grapefruit juice increasing the drug effectiveness? Did other juices have such an effect? What about interactions with othe drugs? What would happen if the juice were consumed not with the drug but at some oth time during the day? Was there a silver lining to this cloud? Could dosages of medications b reduced if they were taken with grapefruit juice?

Predictably, the *Lancet* paper unleashed a cavalcade of research. It wasn't long befo studies showed that only grapefruit juice had this unusual effect. Some compound specific t grapefruit inhibited the action of CYP3A4, an enzyme found in the wall of the intestine. Th enzyme is part of the body's detoxicating system and tackles intruders, such as medications. its action is impaired, blood levels of these foreign substances can be expected to rise. Sinc CYP3A4 is known to be involved in the metabolism of numerous drugs, researchers suspecte that felodipine would not be the sole medication to show a "grapefruit effect." Indeed it wa not. Various oral medications, ranging from heart-rhythm regulators and immunosuppressan to estrogen supplements and AIDS treatments, all interact with grapefruit juice. And th effect can last as long as twenty-four hours, meaning that drinking grapefruit juice at an time is contraindicated when taking drugs metabolized by CYP3A4. Since it isn't complete clear which drugs fall into this category and which do not, and because of the know

variation in CYP3A4 levels in different individuals, some experts suggest that grapefruit juic be avoided when taking any medication. Accordingly, many hospitals have taken grapefru juice off the menu.

The grapefruit industry has complained that it is being unfairly singled out. Spokespeop maintain, correctly, that there are numerous drug–food interactions. Dairy foods can interfe with some antibiotics, broccoli can reduce the effect of anticoagulants, foods high in tyramin (aged cheese, red wine, soy sauce, sauerkraut, salami) can cause dramatic rises in bloo pressure when coupled with antidepressants of the monoamine oxidase (MAO)–inhibito variety, and the absorption of digoxin (taken for congestive heart disease) is impaired b cereals such as oatmeal. While all of this information is factual, the existence of such effec doesn't let grapefruit off the hook.

So if, as mentioned earlier, grapefruit juice lowers cholesterol, why not forget the stat and just drink grapefruit juice? That's exactly what some people are asking after readin about Israeli researcher Shela Gorinstein's study showing that just one red grapefruit a da can reduce LDL, the "bad cholesterol" by as much as 20 percent. Furthermore, red grapefru reduces triglycerides significantly. But wait a minute. Gorinstein's subjects all had recentl undergone bypass surgery, had been resistant to statins, and were on a diet with only percent of calories coming from fat. So these results cannot be readily extrapolated to you average North American who is diagnosed with elevated cholesterol. What can he or she do First, eat a diet low in saturated and trans fats, with plenty of fruits, vegetables, and oa bran. And yes, grapefruit too! Throw in some persimmons, some pomelits (a cross between grapefruit and a pomelo), and pale lager beer, all of which have been shown by Gorinstein t reduce the risk of heart disease. And if that doesn't work, well, bring on the statins. But fo now, not with grapefruit juice. That restriction may change in the future, thanks t researchers at the University of North Carolina who have identified furanocoumarins as th troublesome compounds in grapefruit juice and have shown that they can be removed. Th resulting juice had no effect on blood levels of medications. This research may yet hav another benefit. Perhaps furanocoumarins can be added to medications, reducing the dos needed and reducing the risk of side effects. These developments should make grapefru growers somewhat less sour.

# BLUEBERRIES, ANTHOCYANINS, AND PTEROSTILBENE

Life is sort of like walking a tightrope. We try to keep our balance as we struggle wi diseases and aging, but we know that no matter what we do, eventually we will fall of Obviously, anything that helps us stay on that rope longer is most welcome. An anthocyanins in blueberries may do just that. They sure do it for rats. At least that's wh researchers at Tufts University in Boston found.

Why were these scientists interested in the unlikely combination of rats and blueberries the first place? Because anthocyanins, the compounds responsible for the blue color of th berries, are powerful antioxidants. In fact, when different fruits and vegetables are tested fo antioxidant activity, blueberries consistently rank near the top of the chart. And we kno that antioxidants have been linked with inhibiting blood-clot formation, improving nig vision, slowing macular degeneration, and generally reducing the risk of heart disease an cancer, as well as with protecting brain cells from aging. It is this anti-aging effect tha captured the imagination of the Tufts researchers. First, a group of elderly rats was put on blueberry-rich diet, while another group was treated to regular laboratory rat chow. Bot groups were then exposed to high levels of oxygen for forty-eight hours. Inhaling extr oxygen produces copious amounts of free radicals. The idea was to study the effects of th free radicals on rats that had anthocyanins scurrying around in their bodies as compared wi those that did not.

It is well known that free radicals can attack all sorts of molecules in the body, includin those that play a role in the functioning of the nervous system. So it wasn't a great surpris that rats fed standard lab meals showed a significant impairment in neurological functio when compared with the blueberry-treated rats. Apparently the anthocyanins wer neutralizing the free radicals generated by the high dose of oxygen. But there was an eve more important practical finding.

Rats enjoy walking on narrow ledges and beams, and are apparently very good at th practice—at least until they begin to age. Researchers can actually estimate the age of a r by measuring the time it takes for the animal to lose its balance on a narrow beam. As ra reach the ripe old age of nineteen months, equivalent to between sixty-five and seventy yea in a human, the average balance time drops from thirteen seconds to five. Older rats are als less adept at negotiating mazes, which of course is a real problem for a lab rat. But no comes the kicker. After eating blueberry extract for eight weeks, the old rats managed to sta on the rod for eleven seconds. They also negotiated mazes better! No great shock that the la press seized upon this study, elevating blueberries to the status of a wonder food.

Of course there are no wonder foods. There are good diets and bad diets. And anthocyanin are present in various other fruits and vegetables as well. In fact, cherries are particularl rich in these compounds. Indeed, certain anthocyanins isolated from cherries have bee shown to have anti-inflammatory properties, possibly useful in fighting arthritis. Even certa diabetics may respond favorably to anthocyanins in the diet. Dr. Muralee Nair at Michiga State University showed that in animal pancreatic cells, anthocyanins increased insul production by some 50 percent.

The possible benefits of blueberries don't stop at anthocyanins. Recently researchers foun

that pterostilbene, another antioxidant present in blueberries, may reduce cholesterol
Interesting, but the study in question was not done on humans, and not even on live animal
It was done in the laboratory on rat liver cells. The researchers did manage to show th
pterostilbene activates a specific receptor on these cells that is linked with reducin
cholesterol and triglycerides. But nobody knows if this compound when ingested fro
blueberries acts the same way in a human liver, or indeed if it even gets there. Nobod
knows how many blueberries would have to be eaten to lower blood cholesterol, but for su
eating a blueberry muffin or a blueberry-studded bagel is not going to do it. Nor wi
blueberry pancakes. Eventually we may find that anthocyanin or pterostilbene supplemen
in a pill form are useful, but for now I try to eat half a cup of blueberries several times
week. I'm not sure exactly how beneficial this is in terms of health, but I am sure of on
thing: the berries taste better than pills.

# CITRUS FRUITS AND SUPER FLAVONOIDS

Take some hamsters and feed them lots of fatty stuff to drive up their blood cholesterol. Then add some *super flavonoids* to their feed and hope that they mitigate the effects of th high-fat diet. Why? Because if the flavonoids reduce cholesterol, you've got a marketabl product. Even better, since the super flavonoids derive from orange peel, you've got "natural" product with all the associated commercial appeal. Well, in hamsters at least, th orange peel extract does deliver the goods. And in the future, it is certainly possible th some sort of standardized version *of polymethoxylated flavones* (PMFs) extracted from orang peels may be recommended for people with high blood cholesterol. But let's not jump th gun.

To most people, cholesterol is a dirty word. If you go by information garnered from th media, you might get the impression that a diagnosis of high cholesterol should prompt swift meeting with an undertaker. While it is true that high cholesterol is a risk factor fo heart disease, it is only one of many. High blood pressure, family history of heart diseas diabetes, lack of physical activity, and exposure to polluted air all play a role. In fact, half o all people who have heart attacks have normal or below-normal cholesterol level Nevertheless, a finding of high cholesterol certainly should trigger efforts to reduce it. Bu how? Physicians often reach for the prescription pad and scribble instructions for a stati drug. These are highly effective medications, but they come with side effects. Muscle pain and liver problems are possibilities—and the cost of the drug can be considerable. So peop search for kinder, gentler therapies, hoping to find efficacy in "natural" products, which ar perceived to be safer than synthetic drugs. The truth, of course, is that the safety of substance does not depend on its source but on its specific molecular structure. Whether was made by a chemist in a lab or by nature in a bush does not matter. What matters are th results of studies that have been carried out on the safety and efficacy of the substance.

There is no shortage of cholesterol-reducing claims on behalf of dietary supplemen formulated from natural products. Some, such as guggulipids extracted from the guggul tre seem exotic, while policosanol from sugar cane or allicin from garlic sound more mundan Promoters of all such products muster up studies to hype their wares, but the scientif consensus is that the evidence is pretty thin. Still, the search for truly effective natur products continues, and justifiably so. After all, it is pretty clear that populations consumin more fruits and vegetables tend to have lower cholesterol levels. The question is whether th is due to what they are *not* eating, such as fatty meats, or to the presence of substances plant products that actually lower cholesterol. The quest for such substances has resulted the isolation of a variety of natural compounds that have been examined for possib cholesterol-lowering effects. Among these are the polymethoxylated flavones (PMFs), such a tangeretin, hesperidine, and naringin, which are found in citrus peel.

Why are these compounds of particular interest? For several reasons. First of all, PMFs ar antioxidants and therefore have the potential of preventing the conversion of cholesterol int its more dangerous oxidized form. Also, studies in cultured cells showed that, like the stati drugs, PMFs inhibit the synthesis of cholesterol and triglycerides (fats in the blood) in th liver. Add to this the fact that Florida alone produces about 700,000 metric tons of orang