



Chemistry & Dentistry

AND

Herbs, Hype and Hope

Dr. Joseph Schwarcz

Dental Health and Heart Disease

Health Canada doesn't allow health claims on consumer products easily. So you can be sure that regulators were satisfied with the evidence submitted when they approved a claim that Listerine mouthwash can reduce the amount of germs that travel from the mouth to the bloodstream in people with mild to moderate gingivitis. Why should anyone care about this? Therein lies an interesting story. And it all started with a headline that appeared roughly twenty years ago in a number of newspapers around the world. It was short but powerful. "Floss or Die!"

Was this some sort of inane fear mongering designed to sell newspapers? As it turns out, not exactly. The headline may have been over the top, but we now know that there is a significant connection between poor oral health and heart disease. And it all has to do with bacteria. Creatures so tiny that over a hundred million of them can be found in every milliliter of saliva. Our mouth is teeming with over 600 varieties!

Bacteria are neither plants, nor animals, but they are living creatures, likely the first forms of life that appeared on Earth roughly 4 billion years ago. They are single-celled organisms that unlike plant or animal cells do not have a nucleus, and are therefore termed "prokaryotes" from the Greek "before kernel." Plants and animals are "eukaryotes," multi-celled organisms with each cell having a nucleus, where the reproductive machinery in the form of DNA is contained. By contrast, bacterial DNA is free-floating throughout the bacterial cell.

The first person to get a glimpse of bacteria was the Dutch gentleman scientist Antony van Leeuwenhoek way back in the late 1600s. Contrary to popular belief, he did not invent the microscope. Forty years before Leeuwenhoek was born, Robert Hooke was already experimenting with compound microscopes, instruments that used more than one lens. Leeuwenhoek's contribution was his skill at grinding lenses. He managed to make lenses that magnified over 200 times, far greater than any previous instrument. But what distinguished him further was an innate curiosity that led him to examine almost anything that could be placed under his lens. And so it was that Leeuwenhoek discovered bacteria, first by examining the plaque between his own teeth.

Here are his very words: "I saw with great wonder that there were many very little living animalcules, very prettily moving. The biggest sort had a very strong and swift motion and shot through the spittle like a pike through water. The second sort oft-times spun round like a top." Leeuwenhoek then went on to examine spittle from the mouths of two old men who had never cleaned their teeth in their lives and described "an unbelievably great company of living animalcules, a-swimming more nimbly than any other I had seen up to this time. The animalcules were in such enormous numbers, that all the water



seemed to be alive.” What happened to these two gentlemen we do not know, but there is a good chance they succumbed to heart disease. Here’s why.

Our mouth is a battleground. On one side are the armies of bacteria that look to feast on the remnants of chewed food. They coat the teeth with “biofilms” and also sneak into the gums around the teeth where they can live in comfort. On the other side are white blood cells that don’t take kindly to the invaders and flock to the scene to engulf the bacteria and attempt to destroy them. The result is inflammation, a swelling and reddening of the gums, commonly referred to as gingivitis. While gingivitis is non-destructive, it can progress to periodontitis, or inflammation of the tissues that support the teeth. This can lead to bone deterioration and loss of teeth. And loss of life.

How can anyone die from a toothless smile? Of course they can’t. But that toothless smile is associated with heart disease. Our first hint came in the early 1990s with the publication of a study showing that people with periodontal disease had a 25% higher risk of coronary heart disease and a 46% higher risk of death from all causes than those without gum problems. Several studies since have come up with similar results.

For example, the ongoing Veterans Affairs Dental Longitudinal study in the U.S. has shown that those with the worst periodontal disease are twice as likely to suffer a stroke even when other factors such as smoking and blood cholesterol are accounted for. Associations such as these, however, cannot prove cause and effect because it may just be that people who do not take care of themselves in terms of diet and exercise also neglect their teeth. But there is more.

A study at the University of Buffalo has recently shown that the total number of bacteria in the mouth are associated with a risk of heart attack. Researchers examined 386 men and women between the ages of 35 and 69 who had suffered a heart attack and collected samples of their dental plaque. Plaque is a thin film of bacteria that sticks to teeth and is a prime cause of cavities as the bacteria metabolize sugars into acids that eat away the enamel. The bacteria can also irritate the gums, giving rise first to gingivitis and later to periodontal disease. If plaque isn’t removed within 48 hours by proper brushing it begins to harden into a yellowish scaly material known as tartar that can only be removed by special instruments. Furthermore tartar is a medium for further plaque formation that then threatens the gums.

When the samples of dental plaque taken from the heart attack victims were compared with those taken from 840 people free of heart trouble, it became clear that the patients harboured more of each type of the six common oral bacteria that were tested for. An increase in the different types of bacteria increased the risk of a heart attack, but the most important factor was the total number of germs, regardless of type.

The mouth is sort of a gateway to the body. In periodontal disease pockets inhabited by bacteria form where the teeth meet the gums. The problem is that bacteria can escape from these pockets directly into the bloodstream. Once in the bloodstream, they can get embedded in plaque, the deposit that builds up in the coronary arteries and is responsible for restricting blood flow. Bacterial buildup increases the size of the deposit and possibly makes it more prone to rupture, which in turn triggers the formation of a blood clot that can choke off the flow of blood completely. An alternate possibility is that oral bacteria byproducts enter the bloodstream and stimulate the release of C-reactive protein from the liver. This is a protein that can inflame arteries and promote blood clot formation.



Numerous studies have found that the higher the C-reactive protein in the blood, the higher the risk of having a heart attack. And now we have a study showing that C-reactive protein levels are linked to tooth brushing habits. An analysis of data accumulated from a survey of more than 11,000 Scottish adults revealed that the less they brushed their teeth, the greater the risk of heart disease. The less they brushed, the higher was the concentration of C-reactive protein and of fibrinogen, a biochemical that causes blood clots to form. Of course finding that people with poor oral hygiene are more prone to heart disease does not mean that the poor hygiene is the cause. It may be that some factor that makes people more prone to heart disease also makes them more prone to periodontitis.

But the evidence for a cause and effect relationship between oral bacteria and heart disease is mounting. Dr. Ann Progulsk-Fox at the University of Florida has been able to place oral bacteria at the scene of the crime, in other words, the plaque in coronary arteries. It seems this plaque shares more than a name with dental plaque. It shares the same type of bacteria. The Florida scientists obtained a section of a diseased artery from a 74 year old toothless patient, pureed it, and incubated it in a brew of healthy arterial cells. Microscopic examination of these cells showed that they had been infected with bacteria, proving that live bacteria had been present in the original plaque removed from the patient. Clearly, live bacteria from the mouth can become inhabitants of plaque in the arteries. So now not only do we have an association between dental health and heart disease, but we have the smoking gun. Oral bacteria are found at the scene of cardiac crime.

Heart disease is not the only condition that has been associated with oral bacteria. As unlikely as it may seem, poor dental health may increase the risk of pneumonia, ulcers and strokes. It has also been linked with poorer management of diabetes and lower birth weight. As far as strokes go, oral bacteria may increase the risk of fatty deposits in the carotid arteries. The majority of ulcers are caused by *Helicobacter pylori*, a type of bacterium that can be found in dental plaque. Bacteria from the mouth can also be inhaled and cause respiratory problems in people with compromised immune systems. And to add further fuel to the fire, a Harvard study of more than 51,000 male physicians revealed that men with a history of gum disease had a significantly higher risk of pancreatic cancer. Why this should be so remains a mystery but it is interesting to note that diabetic complications which of course also involve the pancreas are also linked to poor oral health.

Although none of these links are iron-clad, there is certainly no harm in taking measures to reduce bacterial entry into the bloodstream. Aside from brushing and flossing to keep gums healthy, we now have evidence that use of an antiseptic mouth rinse with essential oils derived from mint, thyme and eucalyptus can reduce the number of bacteria that invade the bloodstream after regular chewing in individuals with gingivitis. We know that what goes into our stomach from our mouth is a factor in heart disease, but what goes into our blood from damaged gums may be as important. So brush, rinse and floss to your heart's content.

It's interesting to note that Antony von Leeuwenhoek lived to the then astounding age of 91. Perhaps he had been motivated to brush his teeth regularly after seeing all the little animalcules cavorting in dirty mouths.

Herbal Issues

Why would anyone buy an herbal product that according to its supporting documentation “is not intended to diagnose, treat, cure or prevent any disease?” A puzzling question, isn’t it? Be assured, we’re not talking about some theoretical scenario here, we’re talking about millions of people who actually purchase such products on a regular basis. Consider for a moment what would happen if a physician suggested taking a pill that doesn’t treat, cure or prevent any disease. He or she would be regarded as wacky. Yet, the same words featured in an ad for an herbal supplement do not seem to deter use. Strange, isn’t it?

I’m not sure what people think when they see this peculiar disclaimer in an ad, but I suspect many believe that it is just legal lingo that supplement producers have been forced into using to protect themselves from harassment by regulatory agencies. Why? Because such agencies are of course in cahoots with the medical and pharmaceutical establishments in order to keep cheap, effective herbal remedies off the market in favour of high-profit prescription drugs. Yeah, sure.

Actually, if there is any legal consideration here, it is by the marketers of such remedies concerned about potential complaints by consumers dissatisfied with the product’s claims. And indeed, in spite of the disclaimer, they do make claims. Let’s just take as an example a product I’ve recently been asked about, Padma Basic. This mixture of 18 dried and milled herbs and spices, natural camphor and calcium sulphate came into the hands of Karl Lutz, a Swiss researcher, after it was smuggled out of Tibet in 1950 when the country was invaded by the communist Chinese. Believing that he had chanced upon a prescription that accounted for Tibetans longevity and good health, Lutz began to produce and market Padma Basic.

I must admit that I hadn’t heard about this product previously, but a few key strokes quickly revealed it to be a virtual miracle. At least according to its promoters. For a start, I learned that Padma offers relief from fatigue, memory problems, back and joint pain, angina and dizziness. But that’s not all. It’s also effective against inflammation, asthma, diabetes, circulatory problems and multiple sclerosis. Furthermore, Padma is said to be capable of blocking the spread of cancer by strengthening the immune system and removing excess toxins. Quite a salvo of seductive claims, albeit tempered by the appearance of “this product is not intended to diagnose, treat, cure or prevent any disease” no less than five times in the ad on the web! So, what are we to believe? Is Padma a wonder product like the ad claims, or is it useless, like the ad repeatedly warns. Quite a conundrum. Time to go to the scientific literature.

Clearly, the potential of Padma has not jolted the world’s research community into frenzied action, but there are some publications of interest. A few laboratory experiments have suggested that this combination of herbs may have an anti-inflammatory effect as well as an ability to reduce a type of cell multiplication that is involved in atherosclerosis. One study on humans even showed that people with circulatory problems in the legs were able to slightly increase their pain-free walking distance. All in all, not very impressive. Certainly, no vestige of any miracle. How then can this product be allowed to make health claims that are not substantiated?



Technically, such claims are not allowed, but effectively policing such matters is nearly impossible. The Canadian government has decided, however, to give it a shot through the creation of the Natural Health Products Directorate, which has been charged with reviewing herbal products for safety, efficacy and honesty in advertising. Any company wishing to make a health claim for a product has to have that claim approved by this august body. Sounds good. But there's a nagging concern here. The Expert Advisory Committee that reviews claims on behalf of the Natural Health Products Directorate, has a number of members, including herbalists and homeopaths, who have based their careers on promoting a favourable view of herbal products. Maybe that explains why certain claims that have been approved leave something to be desired from a scientific perspective. Actually, some may not even be based on science at all. And it seems NHPD is OK with that. It has decided that approval can be based either on scientific evidence or on "traditional use." (So much for the belief that the government is trying to undermine the sale of herbal products.)

Remarkably, to qualify for a traditional claim, all that is required is documentation that an herbal product has been used for at least fifty years within a "cultural belief system or healing paradigm," whatever that means. Concoctions made from the berries of the saw palmetto plant, for example, can, according to NHPD, claim to have an appetite increasing effect. There is no scientific evidence for this, but native North Americans have traditionally used the berries to stimulate appetite. That's enough evidence for a claim as far as NHPD is concerned. Other questionable claims have also been approved. Echinacea preparations can profess to provide supportive therapy for urinary infections. While there is some very sketchy evidence that Echinacea may have immune boosting properties, there is no evidence of benefit in urinary tract infections.

The lax regulatory process can result in consumer overconfidence in the benefits of herbal products and an underestimation of potential negative effects. Echinacea has been known to cause skin rash, asthmatic attacks and even rare cases of anaphylaxis, something of which few consumers are aware. (They are also unaware of how little evidence there actually is for echinacea's effect against the common cold.)

Herbal products can also interact with prescription drugs as well as with each other in unpredictable ways. St. Johns' Wort, sold as a mild antidepressant, can reduce the effectiveness of a number of prescription medications. I have no idea whether anyone has even considered if the herbal mix found in Padma can interact with other drugs.

Consumers should realize that in the case of herbal remedies, government "approval" does not have the same meaning as it does for prescription products. The Natural Health Products Directorate, (in its wisdom) has even approved a claim for preparations of the European pennyroyal plant as "traditionally used to reduce giddiness." Laughable. If there were any evidence of efficacy, I would treat myself with it.



Parsley, Sage, Rosemary and Thyme

In the Middle Ages the town of Scarborough in Yorkshire, England featured an annual fair that attracted merchants from all over the country as well as from the Continent. An array of fabrics, dyes, skins, pots, and foods vied for customers' attention. And then there were the herbs. There would have been a large assortment, but surely parsley, sage, rosemary and thyme would have been among them. After all, Simon and Garfunkel told us so in the lyrics of "Scarborough Fair," the memorable ballad featured on the soundtrack of classic movie, *The Graduate*.

"Are you going to Scarborough Fair?
Parsley, sage, rosemary, and thyme
Remember me to one who lives there
She once was a true love of mine."

While Simon and Garfunkel catapulted the song to fame, various versions of the melody and lyrics can be traced back to the seventeenth century. Some historians claim that these specific herbs were mentioned both because of their medicinal properties and the mystical belief at the time that herbs had the ability to influence emotions. Parsley, for example, was thought to remove bitter feelings the same way it eliminated bad odours. Chewing fresh parsley was a long-standing antidote to bad breath. The botanical name of sage, "*Salvia officinalis*," derives from the Latin "*salvere*," meaning "to be saved" and pays homage the Roman belief that the herb was a key to longevity. In the Middle Ages sage was actually one of the components of a concoction known as "Four Thieves Vinegar" which claimed to offer protection against the plague. It didn't.

Rosemary was also part of that potion, but historically the herb is better known for its supposed memory enhancing effect. In ancient Greece, so the story goes, students would hang rosemary around their neck to improve memory and concentration. That actually may have worked had they also prepared for their exams while sniffing rosemary. Modern studies have shown that recall is improved when subjects are exposed to the same smell during a test as during the learning process. The strong, lingering scent of rosemary may well have been responsible for its inclusion in medieval wedding bouquets as a symbol reminding lovers of their vows. Thyme also has a long lasting and pleasing scent which was thought to ward off melancholy. The ancient Greeks placed some in their baths.

There was also a more practical reason for sale of these herbs. Microbial contamination of food was a scourge at the time and many herbs and spices are known to contain compounds with antimicrobial activity. Thyme oil, for example, is being explored today for its antibacterial effect, particularly against *Listeria monocytogenes*. On top of being effective against bacteria, thyme oil can be labeled as a "natural preservative," a strong selling point. Thymol, the major active ingredient, also has potent antioxidant properties and can prevent fat from becoming rancid. Rosemary extract also contains the antioxidants carnosic acid and carnosol and has been approved for use in meats, baked goods, oils and fish-oil supplements. Curry may well have developed as a popular flavouring because of the antibacterial effects of turmeric, coriander and nutmeg.

Vendors at Scarborough Fair would surely have been hawking more than just parsley, sage, rosemary and thyme. There would have been mugwort to ease labour pains, burdock and savory to help pass flatulence, cottonweed for headaches and in the words of Nicholas Culpeper, the prime authority on



herbalism at the time, foxglove to “purge the body both upwards and downwards of tough phlegm and clammy humours and to open obstructions of the liver and the spleen.” Culpeper was a botanist, herbalist physician and astrologer who forged a system of treatments that mixed reasonable use of herbs with nonsensical “medical astrology.”

There was also belief in the “Doctrine of Signatures” which maintained that nature had provided humans with clues about the treatment of disease. Plants or herbs that resembled parts of the human body were to be used to treat ailments of that part of the body. Lungwort, for example, would help with disorders of the lung, bloodroot for diseases of the blood and beans were of help with kidney problems. Indeed, the history of herbal medicine is characterized by a curious blend of science and nonsense. Not too different from today. Just consider oil of oregano with its claims to treat sore throats, lice, colds, acne, infections, parasites, yeasts, diabetes, allergies or whatever one fancies.

No less an authority than Dr. Oz devoted a segment of his show to explaining how carvacrol, the “super ingredient” in oil of oregano destroys nasty bacteria and boosts the immune system. There was even a neat demo, in which a vile looking model of a bacterium was encased in what looked like a glass bubble. Dr. Oz attacked the bubble, which played the role of the bacteria's protective layer, with a kitchen knife. The attack wasn't exactly a challenge to the famed Psycho scene, and was not successful. Then Mrs. Oz stepped in with a kettle of hot water, which played the role carvacrol, and poured it over the bubble. It immediately cracked and her knife-wielding hubby now easily burst through and punctured the bacterium, deflating it like a balloon. A really neat demo. I think they must have cooled the glass first to make it crack so easily. They get points for that one. Of course the point is way over-hyped. There is some cursory laboratory evidence of oil of oregano having an antibacterial effect. When bacteria are bathed in the oil, they perish. Of course they also perish if bathed in a salt solution, alcohol, lemon juice or a variety of soft drinks. It isn't hard to kill bacteria in a Petri dish. But the body is not a large Petri dish.

There is no evidence that a dose of oil of oregano is absorbed into the bloodstream to an extent where it may have an antibacterial effect. What about its claimed "immune boosting" property? Here the evidence comes from nursing pigs. If they are given oil of oregano they produce somewhat more white blood cells in their milk. Hardly something to oink about. What we have here are a few studies that suggest an effect in the lab or in animals which are then over-interpreted by marketers. Perhaps just like the over-interpretation of parsley, sage, rosemary and thyme. Maybe those particular words just had the right cadence and rhyme to fit the song.