

Sugar: The Sweet Reed

It is a pleasure to be invited to address you this afternoon. As Mr. Goodwin has said, I am a cultural geographer trained in nutrition science. My research focuses on the geographical regions of Africa, the Mediterranean states, and the Middle East. Most of my work considers human behavior and the nutritional-health consequences of these behaviors, whether from a historical or contemporary context. If my memory serves me right, the geographical area near San Ardo, California, remains in sugar beet production and I recall harvests there when I worked at the San Ardo Texaco leases during my college years.

My goal this afternoon is to speak briefly, and hopefully to be entertaining. I will explore with you several facets of the history and evolution of sweeteners in general, then will turn to selected themes in the history and development of cane sugar and beet sugar; my concluding remarks will consider sugar and nutrition and examine some of the misconceptions held by the general public regarding the role of sugar as part of an overall, balanced diet.

The words for sugar in modern European languages originate from the ancient Indian language called Sanskrit. The Sanskrit word is *sarkara*, which translates as -- gravel. This ancient word for sugar changes through the centuries and subsequently appears in Persian as *shakar*.

The oldest archaeological evidence known for sweeteners is not for cane or beet sugars -- but for honey. Stone-age paintings dating to before 10,000 B.C. are found in the mountains of southern Spain that depict men robbing nests of wild bees.

Honey clearly was the most ancient sweetener source that found world-wide acceptance. Numerous paintings in ancient Egyptian tombs that I have studied attest to the prominent role of honey as a medicinal mixing agent. Honey was used by ancient Egyptian physicians as an ointment base and frequently was used as a dressing for external wounds. Other uses of honey in ancient Egypt was to treat hemorrhoids, and gastro-intestinal problems. Diluted honey was used by the ancient Egyptians as a mouthwash. While numerous scenes in ancient Egyptian art depict the care of hives and honey production, honey was not the sweetener of choice of the ancient Egyptians -- they used juices extracted from fruits, especially dates.

While many today praise dietary uses of honey, it should be remembered that consumption of honey is not without considerable risk to certain categories of consumers. Instances can be documented where consumers went into shock after eating honey -- because of allergic reaction to specific pollen types; improperly prepared honeys contaminated with botulism tragically have caused the deaths of infants whose parents fed honey to their babies; and consumers of honey sometimes are poisoned even today, when bee hives have been placed -- unknowingly -- near plants toxic to humans. It is perhaps interesting to note that the first account of human poisoning from honey stems from an ancient Greek record of Greek troops in Turkey having suffered after eating honey from bees who used as the pollen source Mediterranean rhododendron pollen: The Greek account records that the soldiers complained of a tingling of the skin, numbness in their limbs, weak pulse, and subsequent, loss of consciousness. The face of those effected turned blue and resembled a heart attack but without angina. As the poisoning from honey progressed, the

consumers then broke out into cold sweats. The soldiers recovered, but remained weak for several days. The toxic agent was *Rhododendron ponticum*, the standard beautiful Mediterranean rhododendron used throughout the United States as a decorative garden plant.

Other sweeteners used in antiquity included carob, dates, figs, and grapes. Syrups from these plants served as sweeteners in ancient Egypt and throughout the Mediterranean states.

Regarding sugar cane -- first use and domestication of sugar cane points to India, as revealed by ancient Sanskrit manuscripts. Accounts survive detailing events of Alexander the Great's march from Greece to India and these texts report use by the Indians and Greek soldiers of "sweet reed," as a food source. Even earlier ancient Indian records reveal that technology existed for extracting sugar cane juice, and for production of crystal sugar. These accounts that date to about 1000 B.C. state that sugar was crystalized and prepared with a range of spices.

Several ancient Greek and Latin writers describe a product called "Indian salt," or "solid honey," and use the word *saccharon* which derived from the term *sarkara* that I already mentioned. It is, of course, this ancient Greek word *saccharon* -- that found its way into English as saccharine.

The rise of the religion of Islam dates to the 6th century A.D. The Muslims receive recognition for introducing sugar cane into western Asia and North Africa, where chief centers of cane cultivation were situated in Egypt, Jordan, and Morocco. The Muslims also were responsible for the spread of sugar cane into Europe during the 8th century A.D. and with the Muslim-Christian contacts with Europeans sugar cane cultivation received prominence in Cyprus, Sicily, and Spain.

About the year 1000 A.D. the Muslim technicians constructed the first industrial sugar refinery on the Mediterranean island of Crete. At this time, however, the island of Crete was known by the name -- Candia. This word, *candia*, was Arabic and meant "crystalized sugar." And thus it was that the Arabic word, *candia*, ultimately found its way, linguistically, into English and into common use by everyone here today -- as *candia* ultimately became -- candy.

As part of the industrial process of sugar manufacturing, the solution containing dissolved sugar components was decanted and then crystalized. What remained in the industrial process was a dark brown, sticky, fragrant product also with an interesting Arabic name -- *kurat al milh* -- which translates as "ball of sweet salt." This word -- *kurat al milh* -- also would undergo linguistic shifts and would emerge in English as -- caramel. Such *kurat al milh* or caramel "balls" were highly desired by Mediterranean Christian, Jewish, and Muslim women and were used not for chewing -- but as depilatory or hair-removing products. Even today in 1994 Mediterraneans I know boil down sugar and lemon solutions into a resulting sticky, workable mass that is used to remove unwanted body hair. Such depilatory products, in fact, are known widely throughout various Mediterranean societies by the Arabic name -- *halawa* -- which translates as "sweet."

In Medieval Europe sugar was called "white salt," or "grey salt" because in most instances the sugar product was not refined.

Subsequent increased demand for sugar followed the introduction of coffee and tea into Europe.

The coffee plant was first domesticated at an unknown date in the southern Arabian Peninsula, or in eastern Africa. For thousands of years coffee was used only locally in this region of the world and was unknown elsewhere. The Muslim expansion out of the Arabian peninsula in the 6th and 7th centuries also led to the introduction of coffee into Spain and southern Italy by the Muslims at least by the 8th century A.D.

The tea plant, on the other hand, was first domesticated at an unknown date in ancient China and like coffee -- remained a local, Asian beverage until trade between China, and Holland became established during the 18th century. I find it especially intriguing that the famous 13th century merchant-traveler from Venice, Marco Polo, visited China 500 years earlier -- but nowhere in the account of his historic visit -- does he mention tea? Why did it take 500 years after Marco Polo -- for tea to arrive in Europe?

Think, too, for the moment, about the importance of these beverages and about the dates of their introduction to Europe. The British had no coffee or tea before the early 1700's; the principal beverages consumed throughout the British Isles before that time were ale and beer -- imagine it -- ale and beer for breakfast; ale and beer for lunch; ale and beer for dinner. So university students at Cambridge and Oxford, and for that matter, students at Harvard University in 1635 -- for which we have historical records for food patterns and dietary intakes -- could not have experienced coffee or tea breaks -- only breaks for ale and beer.

As it happened -- tea won out over coffee in England. In both England and throughout the British colonies -- tea prevailed as the non-alcoholic beverage of choice (except in America, of course, which shifted as a result of the Boston Tea Party -- to become a coffee-drinking nation).

As it happened -- coffee won out over tea in the Iberia peninsula where two competing nation-states, Portugal and Spain, spread the use of coffee throughout their colonies.

Think, too, what the world-wide distribution of coffee and tea mean, historically, not only in an economic sense for trade and profit, or in the sense that increased demand for sugar followed coffee and tea distribution -- think about the impact of world-wide distribution of coffee and tea on public health and general human well-being. To be prepared properly, both tea and coffee must be boiled -- and boiled water, of course, is generally pathogen free and safe to drink. Not unexpectedly, therefore, drinkers of tea or coffee have tended, through the centuries, to have been healthier than others who disdained tea or coffee and whose choice of beverage plain, unboiled ditch water, or water from contaminated wells.

Let me turn next to sugar from beets. The earliest account known to me regarding sweet beets dates to 1575, when Olivier de Serres described "A kind of root which [comes] from Italy...the juice of which yields in the cooking [something like] sugar syrup, and its vermilion color is very handsome to behold." It appears, however, that no one in Europe or elsewhere seemed particularly interested in de Serres' account -- until about 170 years later.

In 1745 the German chemist Marggraf was the first to discover and extract sugar from beets and carrots. In the 18th century both of these root crops yielded a modest percentage of sugar, generally in the range of 6%. Marggraf's scientific finding, however, only confirmed what residents of the British Isles had known for centuries -- that parsnips and beets were sweet. Indeed, wild carrots in the Scottish Hebrides had been highly acclaimed for their sweet flavor since the 9th century A.D. and local varieties, in fact, were called -- *Is e mil fe'n talmah* -- which translates as "the honey underground."

Marggraf's discovery of beet sugar had limited economic interest until the end of the 18th century when England established a military naval blockade against the French West Indies, an event that kept France's sugar cane supplies from reaching the European continent. It was only then that the French turned their attention to extracting sugar from root plants.

The first sugar-beet factory to extract sugar was built in 1786 in the geographical region known today as Silesia, an area which lies in southwestern Poland and extends southward into parts of former Czechoslovakia. After encouragement by Napoleon, France began rapid production of sugar from beets, and the first beet sugar refinery in France was built at Passy in 1813. By the 1840's the French could produce enough sugar from root stock to provide two pounds of sugar per person per year.

The domesticated sugar beet was first cultivated in England for industrial purposes in 1868. And today -- as you in the audience recognize -- beet sugar accounts for about one-third of the world's sugar production.

I would like to shift now into an examination of several wide-spread misconceptions held by many Americans -- that sugar -- in and of itself -- is a "bad" food. Speaking from the perspective of a nutrition scientist, I reject any dichotomy of "good" and "bad" foods. There are foods -- periods -- and there are patterns of food intake. It is the pattern -- not any specific food -- that results in excellent, good, poor, or abysmal diets. It is the combination of the foods consumed -- and the pattern of these combinations -- that determines whether or not one's dietary practices are sound or unsound.

Sugar is a product; sugar is a commodity. There is nothing specifically good or bad about sugar. Detractors, however, argue that sugar contributes to coronary-artery disease, diabetes, and a broad range of perceived illnesses, and even anti-social behaviors. How often in recent years have Americans been exposed to the following nonsense: "eat a Twinkie -- pick up an Uzi -- harm or murder "X" number of innocent people -- and have the guts and audacity to stand before a judge and claim -- Your Honor, it was the Twinkie, the fast-food, the sugar, the "X," the "Y," the "Z" that made me do it. Who stands anymore for basic -- individual responsibility for personal behavior? Twinkies, fast-food, and sugar do not cause criminal behavior and any such assertions are incorrect and cannot stand scientific, let alone intellectual, scrutiny.

There is only association between sugar and a medical problem that has been identified by nutrition science and supported by scientific evidence: it is the association between sucrose

contact with teeth and resulting dental carries. Sugar does not cause diabetes; sugar does not cause heart disease; sugar does not cause obesity; sugar does not cause cancer, stroke, kidney disease, or the tragedy of Alzheimer's.

And even with the association between sugar and dental carries, there is an important caveat: sugar, specifically, does not cause cavities -- it is the "the number of sugar exposures" and "the length of time sugars remain in contact with dental enamel" that form the association between sugar and dental carries.

While this is logical to me, and after review of the scientific evidence, persons should be able to draw the same conclusions -- many in the general public remain unconvinced.

But consider the following scenario: It is the rest period between the 1st and 2nd sets at the United States Tennis Open; tennis star Jimmy Connors sits down, pops a can of Classic Coca-Cola (not Diet Coca-Cola), swigs it down, and wipes off his lips, then resumes playing. And for the Grand Prize -- please answer the following question: how many cavities will Jimmy Connors get in the remaining sets of tennis: ten, five, one, or zero?

And consider this scenario: You are working in the Peace Corps and are walking through a village in the highlands of Nepal when you encounter a child suffering from acute diarrhea; the child is dehydrated and at serious risk. The mother has about \$2.00 in cash and asks for help and says to you -- what should I do? I would say this to her as a nutrition scientist and professional: go to your local food shop and purchase six bottles of Classic Coca-Cola (not Diet Coca-Cola) and give the contents slowly to your dehydrated child and then take your child to the clinic in the next village. Why?

First, the child needs to be re-hydrated with a safe, clean fluid: the Coca-Cola is sterilized. Second, the child needs energy and the soda will provide enough to assist the child. After giving the child all the Coca-Cola, she then best serves the needs of her child by seeking medical assistance. When I offer this scenario to my beginning students at the University of California, Davis, someone in the class always raises their hand and says something like this -- Professor Grivetti, I don't understand why you could possibly tell the mother something like that, since everybody knows that sugar in Coca-Cola causes dental caries." And I smile and usually reply with something like this: "The issue is survival - not dental caries: rehydrating a malnourished child with Coca-Cola (or any other safe, sterile beverage) will not result in the child's teeth falling out. But even if it did -- what would you advise? Would you let the child die from acute diarrhea and dehydration in order to save the child's teeth?"

I am regularly challenged in the classroom regarding a range of popular misconceptions regarding food that have no scientific basis: eating gelatin will not strengthen one's fingernails; avoiding milk will not reduce mucus and phlegm production; eating a reasonable number of eggs will not solidify one's arteries; both vegetarian and meat-based diets can be nutritionally sound -- or nutritionally unsound.

I often hear students and members of the general public say: "You know, honey is better than sugar." As a scientist I don't see why. Students say -- well -- honey has so much more in it and sugar, you know, has only "empty calories." Honey does, in fact, have more of something than simple, granulated sugar. But more of what?

A tablespoon of honey contains 64 calories; a tablespoon of sugar contains 46 calories. Since there is essentially no protein or fat in either honey or sugar; since there are essentially no minerals or vitamins in sugar -- and the minerals and vitamins in honey are in such minor quantities as to constitute barely trace amounts -- then, in essence, the difference between honey and sugar is negligible -- except that a tablespoon of sugar contains 28% fewer calories than a comparative tablespoon of honey. So much for honey being better than sugar: both are foods, both are commodities; each has different taste and cooking properties; each have important roles to play as part of a balanced diet.

I frequently hear students and the general public say that the content and calories in dried fruits are more nutritional and better for you than the content and calories in sugar. Again, this view is based, in part, on the perception that consumption of sugar leads to dental disease, specifically to dental carries. But consider the following two types of consumers.

Consumer A follows a generally balanced diet; on a given day the menu at lunch consists of soup, salad, and bread, with a sugar-sweetened cola beverage, followed by a leisurely cup of coffee sweetened with sugar. Consumer B, follows a generally balanced diet but in contrast to Consumer A, believes that sugar is bad -- and therefore, avoids sugar and any so-called sugar-sweetened products; on a given day the menu at lunch of Consumer B consists of soup, salad, a product called "Nature's Bounty," that is, a food bar advertised as "healthy," and composed of pitted dried apricots, figs, chewy raisins, and oats, bound together and shaped into a rectangle by a sticky honey syrup.

Both Consumer A and Consumer B get up from their respective tables. Note that Consumer B is still working the "Nature's Bounty" sticky-stuff with his tongue, trying to remove the chunks of the "sticky-stuff" from sticking to the occlusive surfaces of his teeth.

Now consider that neither Consumer A nor Consumer B brush their teeth at the conclusion of lunch. Is that a reasonable expectation or not? Now really -- how many of you in the audience are packing toothbrushes and how many of you will race off to the men's or women's room to brush at the conclusion of my talk? Please -- raise you hands so we who aren't going to brush can applaud. Now really -- which consumer -- Consumer A or Consumer B -- is at the greatest risk for dental carries?

This is why researchers consider a range of issues when examining relationships between dietary practices, sugar, and dental caries: number of sucrose exposures, types of exposures, and length of time sugars remain in contact with dental enamel all are important.

Finally, I wish to thank you again for inviting me to speak, and I will conclude with a personal story regarding sugar -- and how under certain circumstances sugar plays a critical, significant role in human nutrition and in this case prevents malnutrition.

I have worked in Egypt since 1964 and regularly return to Cairo, Egypt, to visit family members and friends, and to conduct research on food and diet with Egyptian colleagues and friends. Consider the following: in 1964 poor rural farmers in Egypt spent 75% of their available income on food; of that 75% of available income -- an astonishing 75% went for just two food items: tea and sugar. In 1969 when I worked in Egypt it was the same figure among the poor in rural Egypt -- 75% of available family income went to satisfy family demand for two food items -- tea and sugar. In 1974 the figure was the same; in 1979 it was the same figure; and three years ago, among the poorest of the poor Egyptian farmers, the focus still remained upon tea and sugar.

Egyptian tea is made this way: a handful of tea is thrown into a water-filled pot and boiled for 30-40 minutes until a thick, syrupy tea results. Tiny glasses about this size -- are used and into each glass is placed 1, 2, or 3 lumps or teaspoons of sugar -- and the syrupy tea is poured into the glass, and sometimes flavored with dried mint leaves.

The poorest of the poor in Egypt continue to drink such glasses of tea 5 to 8 times per day; to initiated and uninitiated alike tea brewed in provides a definite "jolt," and this sugar-sweetened beverage remains one of the few pleasures available to the rural poor living under conditions of abject poverty. After I am offered and accept one such glass of tea brewed and sweetened in this manner -- I remain "wired" for several hours -- not because of the sugar -- but because 30-40 minutes of boiling has extracted every tannin and tea-leaf alkaloid, brought these chemicals into solution, and their effect on me is dramatic.

Consider the contribution that this sugar plays in rural Egyptian diet: a teaspoon of sugar contains 15 calories; one sugar tablet or 2 small sugar cubes contain 19 calories; a packet of sugar like the ones on your luncheon table contain 23 calories.

Consider that the Egyptians use heaping teaspoons, whereby one heaping teaspoon would be equal to 20 calories: 1 teaspoon times 8 cups of tea is equal to 240 calories; if the Egyptian consumer preferred three teaspoons, which would be common, and regularly drank 8 cups of tea, the caloric contribution of sugar to daily diet would equal 720 calories. That would 720 carbohydrate calories -- not fat or protein calories -- calories that would be used for rapid energy and hard work in the agricultural fields. Furthermore, these 720 carbohydrate calories would not have to be found, so to speak, from other dietary sources, or catabolized from body fat or muscle stores in order for the farmer to perform hard work in the agricultural fields. And critically, these 720 carbohydrate calories would not jeopardize dietary protein sources -- that might otherwise have to be used for basic energy, instead of for growth or body maintenance. This is what nutritionists call a "protein-sparing" effect.

And after drinking all these 8 glasses of tea laced with sugar -- sugar from cane and sugar from beet sources -- what is the state of the teeth of the vast majority of rural Egyptians? Many such farmers suffer from periodontal disease and tooth loss from periodontal disease remains a

problem -- but these same rural Egyptians who suffer from periodontal disease often remain cavity-free.

So -- my recommendation is simple: enjoy life, enjoy good fellowship and friendships, and especially enjoy the taste of foods and beverages. And as with all things, practice the behavior first prescribed by the ancient Greeks: everything in moderation and nothing to excess. I like my coffee black; I like my tea sweetened with sugar and spiced with lemon; I like my soft drinks both with sugar and without; but most of all -- there is nothing quite like the memory I hold of warm sugar cookies cooling in my mother's kitchen -- when I was a child growing up on the prairie in Montana -- and I expect that your memories are similar to mine.

THANK YOU