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The Artificial Sweetener

Even nature's forbidden fruit now falls short of man's desire for sweetness. At least, that's what our pursuit of artificial sweeteners would seem to indicate. The sweetness of natural sugar, the natural taste-enhancer sucrose, cannot meet our endless desire for foods' sweetness. Artificial sweeteners, in scientific names of saccharin, aspartame, sucralose, and cyclamate, are being manufactured and consumed at every-increasing rates. Yet 125 years ago, they were nonexistent in supermarket shelves and scientific laboratories. Now, these sweeteners, embraced so willingly by both consumers and producers, are steadily replacing sugar. The cause lies in a unique combination of market economics, consumer views on nutrition, corporations' marketing rhetoric, and the culture of modern American society.

Artificial sweeteners have a history dating back to 1878, when two chemists at Johns Hopkins University accidentally discovered saccharin. The sweet substance subsequently exploded in popularity upon an 1885 London exposition. Two German patents and a decade later, Saccharinfabrik A.G. was producing 190,000 kg of the substance annually. By the late 1890s, John F. Queeny had carried the concept to the United States with his newly formed company named after his wife's maiden name: the Monsanto Chemical Company (Nabors 127-129).

Although the substance was initially greeted with skepticism, circumstances later concentered saccharin at its place on our tabletops and in our foods and beverages. It was criticized for having no nutritional value or calories, but "saccharin remained approved for use in the United States [at the turn of the century] partly through the influence of President Theodore Roosevelt, who was enraged when told by a federal health official that it might be banned" (Nabors 129).

Also ensuring its lasting place in the American diet was the occurrence of the two World Wars. As sugar rationing came into effect, the cheaper and artificially manufactured saccharin found itself more and more popular during wartime. During and following the two World Wars, the artificial sweetener market exploded. Cyclamate was first discovered in 1937, aspartame

serendipitously in 1965, acesulfame K accidentally in 1967, and sucralose unplanned in 1976 (Nabors 71, 39, 11, 173). Multiple other minor sweeteners were also discovered during this period of time. These intense sweeteners, which are multiple times sweeter than sucrose, can be used in such lesser amounts than regular sugar that they contribute no effective caloric value to a food. In addition to these sweeteners, there are caloric alternatives: high-fructose corn syrup, cyclamate, and stevia being used most extensively.

Although these caloric sweeteners have an interesting history themselves, the intense artificial sweeteners have become more a topic of public discourse than those that are caloric. Currently, there are five artificial sweeteners approved for use in the United States: saccharin, aspartame, sucralose, neotame, and acesulfame potassium (Shadix 1). Each of these sweeteners, in addition to others presently banned from public use, has undergone some controversy and public scrutiny. Controversy takes the form of attacking both the product's immediate safety concerns and its place in a long-term nutritional diet.

As with any newly introduced foodstuff, there must be extensive testing conducted before the food can go to market. Congress's 1958 addition of the Food Additives Amendment to the Federal Food, Drug and Cosmetic Act (Manfred 6) first mandated "extensive premarket safety testing for food additives but exempted those substances 'generally recognized as safe' (GRAS) on the basis of previous scientific testing or a history of safe use in foods" (Manfred 7). Included in this amendment was a section entitled the Delaney Clause, which states " 'No additive shall be deemed to be safe if it is found to induce cancer when ingested by man or animal, or if it is found, after tests which are appropriate for the evaluation of the safety of food additives, to induce cancer in man or animals' " (Manfred 7). With this basis for testing of artificial sweeteners, the scientific community set off to evaluate the safety of the substances currently available and those working their way toward the market.

The resulting studies have given insight into the safety of artificial sweeteners, and even lead to the total ban of some substances. A 1969 study testing cyclamate seemed to implicate cyclamate as a bladder carcinogen in rats, leading to its ban in 1970 from use in all foods,

beverages, and drugs (Nabors 72). “In the next few years, many toxicity and carcinogenicity studies were conducted with cyclamate and the 10:1 cyclamate-saccharin mixture the original study used, but they failed to confirm the original findings” (Nabors 72). A petition filed in 1982 for removing the ban on cyclamate is still pending, even though numerous other countries have declared the additive safe. The European Commission’s Scientific Committee on Food even declared in 2000, “the new epidemiological data revealed no indications of harmful effects on human reproduction parameters of cyclamate used as food additive” (“Revised”). In this case, the law’s ban on cyclamate seems to contradict the modern scientific evidence, and has displayed the inertia of bringing artificial sweeteners on and off the public market.

In a similar vein, aspartame has current FDA approval, but there seems to be stronger scientific evidence against the sweetener. In a recent study conducted by the European Ramazzini Foundation Institute, aspartame is given demonstrable evidence of a link to cancer in rats: “The results of this carcinogenicity bioassay not only confirm, but also reinforce the first experimental demonstration of APM’s multipotential carcinogenicity at a dose level close to the acceptable daily intake (ADI) for humans. Furthermore, the study demonstrates that when lifespan exposure to APM begins during fetal life, its carcinogenic effects are increased” (Soffritti). In the ensuing discourse, other sources disputed the authenticity of the effort. Without a strong background in chemistry and intimate knowledge of the artificial sweetener culture and most major studies over the last several decades on the major sweeteners, personally drawing a valid conclusion is extremely difficult. And summaries tend to be more a function of the corporations controlling a person’s checkbook than they do the unbiased truth. Still, there are non-scientific nutritional concerns that attack artificial sweeteners at the very core of their purpose.

People use artificial sweeteners in order to avoid consuming the natural sugar sucrose. Apart from the minority of users, diabetics with issues controlling blood sugar, most people consuming the substances are doing so for dietary reasons. The sugar substitutes are used extensively in chewing gum, diet sodas, and many other foods labeled “diet” or “sugar-free”. But do they really help control one’s weight?

According to the authors of *The Bitter Truth About Artificial Sweeteners*, using the substances represents a fundamentally flawed approach to the high-powered problem of weight and obesity in America. Traditional views of weight gain say that stored fat is a simple function of how many calories are taken in, compared to how many are expended. If a person takes in fewer calories or burns up more of them, then he or she will lose weight. Unfortunately, scientific data doesn't support this simple energy balance theory of obesity. In a study of caloric intake for 6219 men and women of various body weights, "the thinnest people ate the most, and up to 149 percent above ideal weight, the more overweight people were, the less they ate" (Remington 4). The book's authors continue, "we want to make it very clear that we are not trying to deny any basic laws of physics and thermodynamics. We are not even saying that calories do not have some influence on body weight. All we are saying is that there are many factors (in addition to the number of calories you eat and the number you burn up) that control body weight and fat storage" (8). Eight study situations in subsequent pages (9-11) analyze the effect of sugar calories compared to normal foods, one daily meal, activity level with equal energy gain-expenditure ratios, brain damage, and morphine injections on obesity rates in lab rats. In all, it is readily apparent that weight gain is not as directly correlated to caloric intake as would be thought.

Artificial sweeteners fit into this nutritional analysis quite readily. By simply reducing the number of calories ingested, people are in no way ensuring weight loss. In fact, data presented by the American Cancer Society shows that in five divisions of weight, very low, low, average, high, and very high, the percentage of people gaining weight was 6% higher for those using artificial sweeteners than those without them (Remington 12). Much of the issue can be traced back to the human body's absorption of nutrients during the eating cycle. When the body senses a sweet taste, it releases a surge of insulin, known as the cephalic phase of insulin release (17). This insulin is released into the bloodstream, binding to receptor sites on the outside of each cell and assisting sugar's entrance to the cells. Any sweet tasting food produces this insulin surge, even before the blood sugar rises. Increased insulin also primes the liver for sugar storage, a vital function in regulating blood sugar and fat levels within individual cells. The entire cycle ends within ten

minutes, beginning in the first minute and peaking five minutes after the body's first ingestion of food (Powley 992).

The cephalic cycle of insulin release is largely a conditioned response. Just as Pavlov's famous study involving dogs trained to expect food upon the ringing of a bell, human bodies are trained to trigger this cycle upon the taste of sweetness. The implications that this conditioned response has on weight gain in regards to artificial sweetener use are enormous, possibly contributing to weight gain in the following ways: 1) "Artificially sweetened products with few or no calories will trigger an inappropriate cephalic phase of insulin release." 2) "By routinely using artificially sweetened products with no calories, especially diet drinks, the cephalic phase of insulin may eventually be extinguished." 3) Artificially sweetened food "may cause an exaggeration in the cephalic phase of insulin release" 4) Extended periods of eating less food, enabled by artificial sweeteners, can trigger starvation defenses, including lessened metabolism" (Remington 21-22). In all of these cases, the use of artificial sweeteners modifies the body's natural cycle of food consumption and storage, in ways that conflict with a person's goals of weight loss.

Artificial sweeteners pose themselves as the silver bullet solution to weight gain and obesity. Just replace all dietary sugars with no-calorie substitutes and watch the weight fall away! Unfortunately, artificial sweeteners do not have this desired response. Our culture has become so infatuated with instant-access to fulfilling our every needs, from on-demand television and instant oatmeal and coffee to faster airplanes and speedier Internet. The fast-food style of living conflicts with the fast-dieting principles espoused on so many grocery store magazine racks. Artificial sweeteners may possess legitimate uses for diabetics and those with issues controlling sugar levels, but for the average dieter responding to the scales with artificial sweeteners only hurt the cause of weight loss. So why do consumers continue to purchase and make use of these products?

A lot of the motivation, as with any product, comes from marketing strategy. Rhetoric in advertisement creates an appeal for the product that scientific studies simply fail to do. Between the sides for and against the technology, conflict has erupted that is being fought on safety, nutritional, and rhetorical fronts. Just as in the controversy surrounding GM foods, it is hard to tell which side

is telling the most accurate truth. The scent of money hangs over the projected \$1.1 billion 2010 US alternative sweetener industry (“Alternative”), an industry built on a product manufactured much more cheaply than the natural sucrose it replaces. Fighting the rise of alternative sweeteners are the companies that stand to lose the most from their widespread influence, sugar beet and sugar cane producers. In working to combat the increased use of artificial sweeteners and secure their home turf, they have banded together into the Sugar Association, launching websites such as the “Truth About Splenda” website (“Facts”) and releasing statements to the press expounding the benefits of natural sugar over alternatives (“All- Natural”). Promoters of artificial sweeteners do the same, with the homepages of Sweet’N Low, Equal, Splenda, and NutraSweet promoting the safety and appeal of their products through rhetorical devices, including bright colors (Splenda, Sweet’N Low), ad populum appeal to the bandwagon effect (NutraSweet), celebrity appeal (Sweet’N Low), and plain back-to-nature approach (Equal).

In addition to the efforts being made on the web, the simple naming of the products themselves is a stab in the battle. Attempting to make artificial sweeteners more appealing to a mainstream audience uninterested in standard scientific names, companies have marketed their products under words more appealing. Saccharin has been named Sweet’N Low and SugarTwin; aspartame, NutraSweet and Equal; acesulfame K, Sunett and Sweet One; and sucralose, Splenda (“Artificial”). As with all products, much of its appeal lies in an artificial sweetener’s name. “Sweet One” is much more descriptive of the end product than “acesulfame K”, and helps the product’s marketability and market penetration. This is another example of the rhetorical strategies employed to reduce consumer inhibition against the technologies.

In all, the history of the artificial sweetener is long and interesting. These accidentally discovered substances have undergone attack from consumers and scientists, constantly probing for safety issues in their use by humans. Because they are cheaper than natural sugar, corporations manufacturing the products are successfully able to promote them to food manufacturers, who fiercely compete on taste, image, and most importantly, price. In a market swiveling on swim margins, the difference between profit and loss, corporations seize on any opportunity at lesser

costs. At the same time, consumers willingly embrace the new sweeteners, deluded by an onslaught of fad diets and magazines advertising weight loss techniques in any unreasonable form. As the future brings more types of sweeteners, more awareness of rhetorical issues, more consensus on their safety, and more information of adequate dieting techniques, the history of artificial sweeteners will continue to be written.

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Further Research:

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