

## New Food Ingredients: Sweeteners

Lyn O'Brien Nabors, Calorie Control Council

Thank you. I would like to thank you for inviting me to share with you the latest on alternative sweeteners. I will be discussing both low-calorie sweeteners and sugar alcohols. But first, as mentioned, I work for the Calorie Control Council. The Council has represented the low-calorie food and beverage industry for over 25 years. Today we have over 60 members, including manufacturers of "light" and low-calorie foods and beverages, as well as the manufacturers of alternative sweeteners, fat replacers, and reduced calorie bulking agents. Over the years the Council has addressed sweetener safety; low-calorie benefits issues; numerous labeling issues; and , since 1978, the Council has conducted consumer research on dieting and the use of low-calorie products.

What we now refer to as low-calorie, sugar-free, low-fat and often "light" foods and beverages were originally known as dietetic or "diet" foods. These products were developed for people with diabetes or others with specific medical conditions, including obesity. They were found in health food stores or on obscure shelves in the special dietetic section of the grocery. They were not known for their variety or taste but for their high prices. Today, these products are found in virtually every department of the supermarket, are greatly improved in taste and are priced competitively with comparable full calorie products. As a result, the popularity of low-calorie, low-fat, and "light" products continues to grow, as does the demand.

### Light Product Use

Light foods and beverages -- i.e., products with reduced calories, fat or cholesterol -- are more popular than ever. In the United States, according to a 1994 survey conducted for the Calorie Control Council by the Gallup Organization, 90% of U.S. adults consume low-calorie, sugar-free and/or reduced-fat foods and beverages. That projects to 173 million consumers of light products -- a significant increase from the 152 million light consumers we found in our survey just over one year ago.

The 1994 survey revealed a number of important findings. For example, 93% (94 million) American women and 87% (79 million) American men are regular consumers of the low-calorie, sugar-free and/or reduced-fat foods and beverages, which make up the "light" category. Thirty-four percent of light food consumers use light foods every day, while 62% use them several times a week. Thirty-six percent of light beverage consumers use light beverages every day while 49% use them at least several times a week.

The most popular light products in the U.S., according to the survey, are: low-fat milk, reduced-fat butter and margarine, reduced-fat salad dressings and mayonnaise, diet soft drinks, low-fat cheese, and sugar substitutes.

The survey provides strong evidence that American adults are maintaining healthier diets today than in the past. The survey found that 77% of adults agree with this statement: "Overall, I am eating a healthier diet today than three years ago." Additionally, "better health" was the top reported reason why people use light products, following a trend seen in previous Council surveys.

Nearly two-thirds of American adults, about 119 million people say they always try to check the nutrition labels of the foods and beverages they buy. Furthermore, the survey found that 62% said they always try to check the nutrition label to determine the fat content; 57% said they always try to check the calories. Interestingly, the survey found some Americans are engaged in a dietary balancing act --

occasionally indulging in higher calorie foods despite their commitment to healthy eating and use of light products. In fact, half (50%) of Americans say that they choose light foods and beverages so they can enjoy other, higher-calorie foods and beverages while still controlling their total caloric intake.

That's a summary of the current situation relative to light foods in general. Now I'll discuss the Council's survey data particularly on the use of low-calorie, sugar-free foods and beverages -- the products containing the alternative sweeteners I'll discuss in a few moments.

The Calorie Control Council has been specifically tracking the use of low-calorie, sugar-free products since 1978, when 42 million adult Americans consumed low-calorie products. At that time saccharin was the only available low-calorie sweetener in the U.S. marketplace. Since that time, as you know, we have witnessed phenomenal growth in the sugar-free market thanks to the introduction of aspartame and its expanded approvals throughout the 1980s, and then the introduction of products containing acesulfame K in the late 1980s. Between 1991 and 1993 alone the number of consumers of sugar-free foods and beverages increased by 8 million, reaching a total of 109 million people --nearly 3 out of every 5 adult Americans.

Between 1978 and 1986 there was steady growth among both men and women, though the number of female consumers of low-calorie products increased at a slightly faster rate. Since 1986, we have seen further growth among both men and women; however, the highest rate of growth has alternated by sex with each survey. Today, for the first time ever, a majority of adult American men consume low-calorie, sugar-free foods and beverages. In all, 54% of men in the U.S. and 63% of women consume low-calorie products.

By far the most popular low-calorie sugar-free product category is diet soft drinks, consumed by 76% of low-calorie food and beverage consumers and 44% of all adult Americans. Other popular products are sugar substitutes (consumed by 34% of the adult population); sugar-free gum (28%); sugar-free puddings and gelatin (20%); sugar-free yogurt (18%); sugar-free frozen desserts (15%); sugar-free powdered drink mixes (14%); sugar-free cakes and cookies (12%); sugar-free jams and jellies (12%); and sugar-free candy at 11% of the adult population.

Regarding the motivation for using low-calorie, sugar-free products we find that the theme of a healthy lifestyle is dominant. "To stay in better overall health" was clearly the most important reason for using low-calorie products among Americans, as we see in this chart. No longer are sugar-free products for dieters -- indeed, two-thirds of the users of these products are not on a diet.

Now let's look at the ingredients that make low-calorie, sugar-free products possible.

### **Multiple Sweeteners**

For nearly a century, low-calorie products were almost entirely dependent on saccharin, the oldest of the low-calorie sweeteners. Now with the addition of aspartame and acesulfame-K, and possible future approval of sweeteners like cyclamate, alitame and sucralose, a multiple sweetener approach is being utilized -- providing new product and taste choices.

A variety of sweeteners is important because neither sucrose, saccharin, aspartame, acesulfame-K nor any of the new sweeteners is perfect for all uses. But with several available, each sweetener can be used in the applications for which it is best suited. Manufacturers also can overcome limitations of individual sweeteners by using them in blends.

During the 60s, cyclamate and saccharin were blended together in a variety of popular diet soft drinks and other products. This was really the first practical application of the multiple sweetener approach. The primary advantage of the sweetener blend was that saccharin boosted the sweetening power of cyclamate, while cyclamate masked the aftertaste that some people associate with saccharin.

The two sweeteners when combined have a synergistic effect -- that is the sweetness of the combination is greater than the sum of the individual parts. And this is true for most sweetener blends. As you may know, cyclamate was taken off the U.S. market in 1970, leaving saccharin as the only available low-calorie alternative to sugar.

### **Saccharin**

Saccharin, the first low-calorie sweetener, is over 100 years old. Millions of people have relied on it for decades.

Saccharin, 300 times sweeter than sucrose, is a versatile sweetener appropriate for most food, beverage, drug and cosmetic products because it is stable in storage and at its melting point of 228°C; it has an excellent shelf life; combines well with other sweeteners; and is suitable for incorporation in dry and liquid mixtures. Saccharin is non-cariogenic and may help inhibit the development of dental caries. Though a popular sweetener, some people detect an aftertaste in saccharin-sweetened products. This generally can be eliminated by blending saccharin with another sweetener.

Saccharin is used in the United States in soft drinks, most frequently in combination with aspartame in fountain drinks. It remains very popular as a tabletop sweetener.

Although the total amount of saccharin used today is less than in the past, saccharin remains an important, and necessary ingredient for many food, pharmaceutical and cosmetic products. Its safety has been confirmed by numerous scientific groups and regulatory agencies around the world. Saccharin is currently approved for use in over 90 countries.

### **Aspartame**

It wasn't until 1981 that aspartame made its debut in the U.S. food supply. Since then aspartame's approved uses have been expanded considerably. Thousands of products containing aspartame are currently available in over 90 countries. Aspartame -- under the brand NutraSweet -- has been the driving force behind the booming popularity of low-calorie products in the United States. Aspartame, 180 times sweeter than sugar, has a clean sweet taste; enhances and extends flavors, especially fruit flavors; acts synergistically with other sweeteners; and does not promote tooth decay.

Aspartame can be used successfully in both high temperature short time and ultra-high temperature pasteurization systems with minimal loss but it cannot withstand prolonged heating environments such as in baking.

An encapsulated form of aspartame, however, which can withstand oven temperatures, has been approved by FDA and should appear in products soon. The FDA has set an acceptable daily intake (ADI) of 50 mg/kg body weight for aspartame. A 132 lb. person would have to consume 18 cans of soft drink every day to reach this ADI.

## **Acesulfame-K**

In 1988 FDA approved a new low-calorie sweetener, acesulfame-K. It works well in combination with other sweeteners and is 200 times sweeter than sucrose with a clean, quickly perceptible sweet taste that does not linger. Acesulfame-K, a derivative of acetoacetic acid, is not metabolized and is excreted from the body unchanged. Its initial approved uses in the United States include dry beverage mixes, instant coffee and tea, puddings, gelatins, chewing gum, dairy product analogs and tabletop sweeteners. It was recently approved for use in candies. It is currently available under its trade name, Sunette, in the tabletop sweetener, Sweet One, in Trident gum, Bazooka gum, Sweet 'N Low candy, Jell-O and a number of regional products. Soon Acesulfame K is expected to be approved in the U.S. for additional uses, including baked goods. Earlier this month Canada proposed the approval of acesulfame K for a broad range of products including beverages, beverage mixes, tabletop, salad dressings, confectionery and baked products.

Acesulfame-K can be stored in solid form for many years if stored under dry conditions and protected from light. It has excellent stability in aqueous solutions. At pH 3 and above -- the usual pH range of soft drinks -- no reduction in sweetness was observed over several months.

## **Low-Calorie Sweeteners -- The Next Wave**

Sucralose, cyclamate and alitame could be added to FDA's list of approved low-calorie sweeteners.

### **Sucralose**

Sucralose was discovered in 1977. It is being developed in the U.S. by McNeil Specialty Products Company, a division of Johnson & Johnson. In February of 1987, McNeil filed a petition with the Food and Drug Administration for the approval of sucralose in the U.S.

Sucralose is made from common table sugar through a multi-step process. The result is a white crystalline solid which is freely soluble in water as well as ethanol and methanol. Sucralose has a clean, high-quality taste with an average sweetness intensity of about 600 times that of sugar. It is both non-caloric and non-cariogenic and resistant to hydrolysis and breakdown by microorganisms. Sucralose is remarkably stable with an estimated storage life of four years at 20 degrees centigrade. In dry products sucralose has an even longer shelf life.

FDA has been petitioned for the use of sucralose in 14 categories including baked goods; beverages; chewing gum; dairy product analogs; salad dressings; frozen dairy desserts; fruit and water ices; gelatins and puddings; jellies and jams; milk products; and sugar substitutes. -- And approval in the US could come later this year. Sucralose is currently approved for use in Australia, Canada, Mexico and Russia.

### **Cyclamate**

Cyclamate is a sweetener that may be familiar to many of you. We were very pleased that an FDA official was quoted in the Washington Post and other media as saying that the agency made a mistake when it banned cyclamate.

During the 1960s the cyclamate-saccharin combination made some very popular low-calorie products possible. Cyclamate is currently approved in more than 50 countries worldwide, although not in the United States. In late 1982, a petition to FDA for the reapproval of cyclamate was submitted jointly by the Calorie Control Council and Abbott Laboratories. If cyclamate is reapproved, it will be used in

combination with other sweeteners for most products -- primarily because of its relatively low sweetness intensity, approximately 30 times that of sucrose.

Cyclamate has a number of technological attributes. It is stable in heat and cold; micro biologically inert; non-hygroscopic; easily soluble in water; compatible with a broad range of foods and food ingredients; and has an extensive shelf life. Approval has been requested for the use of cyclamate in beverages, processed fruits, gelatin desserts, jellies, jams, toppings, salad dressings, chewing gums, confections and as a sugar substitute for cooking or tabletop use.

Cyclamate was the major factor in launching the diet segment of the carbonated beverage industry. By the time it was banned, the products and trademarks had been well established. Such a large market for diet beverages provided a tremendous incentive to develop new sweeteners. We hope that cyclamate will indeed be reapproved in the United States.

### Alitame

The third low-calorie sweetener pending FDA approval is alitame. Like aspartame, it is chemically synthesized. Pfizer filed a food additive petition with the U.S. Food and Drug Administration in August 1986. Alitame was recently approved for use in Australia and petitions are currently pending in a number of other countries.

Alitame is a dipeptide based high intensity sweetener formed from the amino acids, L-aspartic and D-alanine, and a novel amine. Alitame is partially caloric, since the aspartic acid portion of the molecule is available for normal amino acid metabolism. The maximum caloric contribution of 1.4 calories per gram of alitame is clearly insignificant at use levels in the diet. Alitame only contributes about 0.02% of the calories of the replaced sucrose, because of its intense sweetness -- 2000 times that of sucrose.

The food additive petition for alitame requests broad clearance for alitame in foods for which standards of identity do not preclude such use. Categories petitioned include; baked goods; presweetened, ready-to-eat cereals; milk products; frozen desserts; fruit drinks; jellies and jams; sweet beverages; and tabletop sweeteners. FDA's review of alitame is continuing.

Alitame is a crystalline, odorless, non-hygroscopic powder. It is synergistic with acesulfame-K and cyclamate and high quality blends may be obtained with these and other sweeteners, including saccharin.

There are a number of other low-calorie sweeteners in various stages of development including some plant derived sweeteners. For example, thaumatin and stevioside, two sweeteners from plants, are currently being used in some parts of the world.

A group of sweeteners which may be of interest to you is the sugar alcohols, or polyols. These sweeteners have been used for many years as alternatives to sucrose because they have desirable technical properties, are non-cariogenic, may be useful in the diets of people with diabetes and, more recently, have been considered as reduced in calories. The polyols generally available for use are isomalt, lactitol, maltitol, mannitol, sorbitol, xylitol, hydrogenated starch hydrolysates (HSH) and hydrogenated glucose syrups, also known as maltitol syrups. They are most frequently used in sugar free candy and gum.

The caloric contribution of the sugar alcohols or polyols is becoming an increasingly important issue. In 1990, the now European Union assigned a caloric value of 2.4 calories per gram to the polyols as a group. Some individual countries such as Switzerland have taken similar action. Other countries have

chosen to provide for individual caloric values. In the United States, polyols, as carbohydrates, are generally considered to have 4 calories per gram for labeling purposes. For many years polyols have been used primarily for their non-cariogenic properties rather than as lower calorie bulk sweeteners. However, studies on the absorption and metabolism of polyols have long confirmed that the U.S. "default value" overestimates their true caloric value. As early as 1946 the FDA issued a letter to Atlas Powder Company (now part of ICI Americas Inc.) which stated that the FDA would not object to the use of 2 calories per gram in calculating the caloric value of mannitol when present in foods for special dietary purposes.

In 1992 the Calorie Control Council on behalf of its Polyol Committee contracted with the Federation of American Societies for Experimental Biology, known as FASEB, to evaluate the available data on the metabolizable energy of sugar alcohols, specifically isomalt, lactitol, maltitol, mannitol, sorbitol, xylitol and hydrogenated starch hydrolysates, including maltitol syrup, and to determine or provide best estimates of the metabolizable energy value(s) for the selected polyols. The study scope was later expanded to include both the metabolizable and net energies of sugar alcohols as it is believed, for technical reasons, that the net energy is a better estimate of the true caloric contribution of polyols to foods than is metabolizable energy.

FASEB is completing its report and is expected to conclude that polyols have caloric values less than 4. This report may be used by individual companies or the Calorie Control Council's Polyol Committee as support for a request to FDA to provide for a reduced caloric value or values for the various polyols .

A caloric determination of three or less calories per gram for polyols is especially important to the polyol manufacturers and in turn to the manufacturers of polyol containing products. Under current regulations, reduced calorie foods must have a 25% caloric reduction from their full calorie counterparts and in many polyol containing products the polyol or a combination of polyols provides the principal ingredient. Therefore, with a caloric value of 3 or less the product might be able to make a reduced calorie claim. For example, products sweetened exclusively with polyols or a combination of polyols and low-calorie sweeteners may bear a "sugar-free" claim, however, unless the product is reduced-calorie the label must also state that the food is not a reduced-calorie food. To illustrate the label would read, "sugar-free, not a reduced calorie food." A reduced caloric value or values for polyols might also allow for "light" labeling although this would require a 33 1/3% reduction and is a little more complicated perhaps than using reduced calorie labeling.

Low-calorie sweeteners and the food and beverages they are used in can play an important role as part of an overall healthy diet and lifestyle. It's important to remember, however, that . . . no product is a panacea, and additional reduced-calorie food and beverages will not replace a person's need for moderation and overall good nutrition. However, when incorporated into a nutritionally balanced diet, low-calorie and light foods and beverages can contribute positively to a healthy lifestyle.

In conclusion, as Americans continue to choose healthy eating options, low-calorie, sugar-free products are not chosen just as a part of a healthy lifestyle but also for their taste. The number of consumers who say refreshment or taste is an important reason for consuming low-calorie, sugar-free products has increased significantly over the years. In 1993, 49% of low-calorie, sugar-free consumers said they choose these products for refreshment and taste and over half (56%) of users would like additional low-calorie sugar-free products to be available. And, as additional low-calorie sweeteners become available and the uses of those currently available are expanded, manufacturers can further incorporate the multiple sweetener approach leading to new and better tasting product choices to meet this tremendous consumer demand for sweetness and light.