Introduction to the Workshop1–3

John D. Fernstrom4* and Juan L. Navia5

4University of Pittsburgh School of Medicine, Pittsburgh, PA; and 5McNeil Nutritional, LLC, Ft. Washington, PA

Americans consume about 50% of their daily energy intake in the form of carbohydrates; of this, ~15% of daily energy intake is represented by added sugars (1). In 2008, ~75 g of added sugars were ingested each day, down from ~100 g/d in 2000 (1). Another estimate of sugar intake by Americans is available from economic data. The USDA Sugar and Sweetener Team of the Economic Research Service (2) makes calendar year estimates of total and per capita sweetener deliveries available for food and beverage consumption by U.S. consumers. The May 2011 report estimates that caloric sweetener use in foods and beverages rose from 137.5 lb/(person·y) [171 g/(person·d)] in 1992 to ~154 lb/(person·y) [191.5 g/(person·d)] in 1999 and then declined to 136 lb/(person·y) [169 g/(person·d)] in 2010.

In contrast, the intake of low-calorie sweeteners (LCS) has generally been rising, though because of the variety of LCS presently available and differences in their relative sweetness levels, calculation of average LCS intake is not reported (3). Nevertheless, the USDA report also provides estimates of LCS use, expressed as sucrose-sweetness-equivalent grams (SEG) to permit comparison of caloric and noncaloric sweetener use in foods and beverages. By this measure, LCS use has increased from 28 SEG/(person·d) in 1992 to 37 SEG/(person·d) in 2004 and 2008. From an energy intake perspective, 37 SEG/(person·d) spared consumers ~150 kcal/(person·d) (2).

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3 Author disclosures: J. D. Fernstrom is a scientific consultant to the Ajinomoto Company. J. L. Navia is a Research Fellow at McNeil Nutritional, LLC.

4 To whom correspondence should be addressed. E-mail: fernstromjd@upmc.edu.

LCS are considered useful in the nutritional management of diabetes (4) and dental caries (5). Despite initial disagreement regarding whether LCS stimulate appetite and hunger (and thus might increase food intake and body weight) (6,7), studies of the effects of covertly substituting LCS for sugar in the diet indicate that LCS do not increase food intake. Research has shown that they either reduce energy intake and body weight or are without effect, depending on the duration of the study (8–11). The effect of LCS, under covert conditions, to reduce energy intake is compatible with the notion that humans are poor modulators of energy balance and imperfect sensors of the energy content of foods (12). However, the problem remains unsolved: humans do not use LCS covertly and weight reduction using LCS under covert conditions is not nearly as impressive as that seen in covert studies (13). Moreover, debate continues concerning whether the use of LCS promotes aberrant energy sensing by the brain (at least in rats) (14) and the abnormal release of gut hormones that influence homeostasis (15,16), thereby promoting eating and weight gain. In addition, epidemiologic studies that have associated LCS use with increased BMI are often used to support the notion that LCS may promote weight gain (17). The growth in the proportion of children who are overweight and obese (18) intensifies the focus on all aspects of the diet, including LCS use (4). The recent release of the 2010 Dietary Guidelines for Americans further underscored the state of ambiguity about the use of LCS, stating “The replacement of sugar-sweetened foods and beverages with sugar-free products should theoretically reduce body weight. Yet many questions remain, as epidemiologic studies show a positive link with use of nonnutritive sweeteners and BMI. Additionally, whether use of LCS is linked to higher intake of other energy in the diet remains a debated question” (19).

A fresh discussion of the evidence linking energy-containing sweetener and LCS use, energy intake/balance, and body weight therefore seemed timely. Accordingly, the North American Branch of the International Life Sciences Institute sponsored a workshop, “Low-Calorie Sweeteners, Appetite and Weight Control: What the Science Tells Us,” on April 7–8, 2011, in Washington, DC. The aim of this event was to examine the potential of LCS to serve as a useful tool in weight management. The workshop provided a forum for researchers from varied disciplines to discuss ideas and approaches to the study of LCS and to identify knowledge gaps in the current understanding of the role of LCS as part of the human diet. Presenters in each session were asked to coauthor a joint paper that reflected their shared understanding of this issue in their particular areas of expertise.

The workshop sessions focused on several key topics. The first session covered key aspects of the basic science of sweet taste, including the structure of the sweet taste receptor and its interaction with energy-containing sweeteners and LCS, the presence and function of sweet receptors in different portions of
the alimentary canal and their roles in energy homeostasis, the neuroanatomy of sweet taste perception, the study of energy and LCS preferences, and the role of taste receptors and nontaste mechanisms in determining food preferences. The second session focused on sweet preferences in humans at all ages, the physiologic, genetic, behavioral, and cultural factors that influence them, and the role of sweet taste in guiding the selection of foods. The third session considered the satiating effects of foods with energy-containing sweeteners and LCS, the impact of taste and nontaste features of such foods in determining satiety (volume, nutrient and energy contents, liquid vs. solid), and the role of brain mechanisms of food “reward” in governing the intake of sweet foods. The fourth session focused on the usefulness of LCS in reducing energy intake and aiding in weight management in children, whereas the fifth session addressed the same issue in adults. Consideration was given to the reliability of population-based and observational studies in revealing causal relationships between LCS use and body weight/obesity. The appropriateness, reliability, and validity of particular experimental approaches to the study of the interrelationships among sweet taste, energy-containing sweetener and LCS use, food intake, and body weight in animals and humans were also an important part of the discussion. The articles in this supplement summarize each session, with the speakers from each session contributing as authors.

International Life Sciences Institute North America and the symposium organizing committee hope that these proceedings will help to guide future work aimed at understanding both the role of LCS in food selection as well as their usefulness as an aid in the management of food intake, energy balance, and body weight, with the goal of contributing to the reduction in obesity in society.

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Literature Cited