



## The Bittersweet Truth

# The Bittersweet Truth About Sugar Labeling Regulations: They Are Achievable and Overdue

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The recent Institute of Medicine recommendation to the Food and Drug Administration to include added sugar in a new front-of-package system provides new justification for reviewing outdated regulations pertinent to sugar and analyzing whether the government's previous resistance to sugar labeling remains valid given new and robust science.

I have provided an overview of US sugar consumption, its public health implications, and the science related to added sugar detection. I reviewed US and international sugar intake recommendations and suggested revised regulations to better inform and protect consumers.

I concluded by noting new directions in the area of sugar research for future public health policy. (*Am J Public Health*. 2012;102:e14–e20. doi: 10.2105/AJPH.2012.300732)

**SUGAR IS A SWEETENER,<sup>1</sup> A** crop,<sup>2</sup> a functional ingredient for baking, texturizing, and preserving<sup>3</sup>—and the subject of litigation<sup>4</sup> and international disputes.<sup>5</sup> It carries potential health implications<sup>6</sup> and has been the subject of national news.<sup>7</sup> Sugar occurs

naturally in fruit, vegetables, and milk, but the majority of sugar in the US diet is added to processed food and beverages (collectively food)<sup>8</sup> during preparation, manufacture, processing, or packaging and is derived from cane, beet, and corn.<sup>9</sup> Public health evidence continues to emerge indicating that added sugar consumption is a public health concern and that federal regulations pertinent to sugar labeling are outdated.

The Food and Drug Administration (FDA) announced its plan to develop a uniform front-of-package system, and shortly thereafter the food industry announced the same.<sup>10</sup> In 2011, the Institute of Medicine (IOM) issued its final recommendations to the FDA for a science-based approach to front-of-package labeling suggesting that added sugar be considered in the nutrition criteria.<sup>11</sup> The Grocery Manufacturers Association criticized the IOM approach<sup>12</sup> and launched its own front-of-package system that includes total, but not added, sugar disclosures.<sup>13</sup> The FDA has not indicated the course it will take, but the IOM's recommendation may encourage the agency to at least consider sugar in its front-of-package labeling efforts.

Currently, consumers have little guidance to help them make informed choices about sugary products. Robust science counsels in favor of revising labeling requirements for sugar and added sugar. Specific standards can be developed to increase information on the nutrition facts panel, create daily reference values, develop a disqualifying level for manufacturers to make health claims, and develop a front-of-package system that includes sugar in its nutritional criteria.

### BACKGROUND ON SUGAR REGULATIONS

Congress passed the Nutrition Labeling and Education Act of 1990 (NLEA), giving the FDA authority to require nutrition labeling on food packaging.<sup>14</sup> The FDA developed the nutrition facts panel and initially determined that sugar need not be included.<sup>15</sup> Because the FDA received extensive comments questioning this decision, the final regulations included a total, but not added, sugar disclosure requirement.<sup>16</sup>

During the NLEA proceedings, the FDA established a daily reference value for food components to recommend (e.g., fiber) or limit

(e.g., saturated fat), but it did not establish a recommended limit for sugar and added sugar.<sup>17</sup> The FDA also established criteria for manufacturers to make health claims; that is, manufacturers could not claim that food was healthy if it contained “disqualifying nutrient levels” of total fat, saturated fat, cholesterol, or sodium.<sup>18</sup> Sugar was not included in these criteria.

During the NLEA deliberation, the FDA expressed concern that more information about sugar would confuse consumers because healthy food can contain naturally occurring sugar.<sup>15</sup> The FDA found a lack of consensus to develop an appropriate daily reference value for total sugar<sup>17</sup> and noted that sugar is generally recognized as safe<sup>19</sup>; but the FDA did state that “there could be safety concerns” if sugar intake increased significantly over the levels at that time, approximately 50 grams or 10% of total calories.<sup>17</sup> Finally, the agency rejected public health concerns about added sugar and found that there was no analytical method to distinguish between added and naturally occurring sugars in food, so the agency could not evaluate the accuracy of a disclosure anyway.<sup>17</sup>



In 2007, the FDA considered revised reference values and whether certain nutrients should be added to the nutrition facts panel but declined the opportunity to augment its previous standards on sugar.<sup>20</sup> The FDA noted that the IOM recommended against setting a daily recommended limit for sugar “because it could be misrepresented as a desirable intake level.”<sup>20(p621–664)</sup>

In 2009, the FDA announced the creation of a uniform front-of-package symbol, and Congress requested that the IOM conduct a study to offer recommendations on the topic.<sup>21</sup> In its first phase report, the IOM found that Americans consume too much added sugar.<sup>21</sup> However, after evaluating the evidence, the IOM initially recommended excluding sugar and added sugar from the front-of-package system for the same reason the FDA rejected sugar labeling during the NLEA proceedings: there was a lack of scientific consensus on daily recommended sugar consumption, deficient evidence that added sugar has adverse health effects, and a lack of an adequate analytical testing method.<sup>21</sup> The IOM further noted concerns over micronutrient dilution if consumers followed a recommendation to limit total sugar, as sugar is added to food it considers healthy (e.g., dairy products and ready-to-eat cereal) and front-of-package labeling for added sugar would be inconsistent with the nutrition facts panel.<sup>21</sup>

In January 2011 the food industry launched a voluntary front-of-package symbol that discloses calories, nutrients to limit

(including total sugar), and nutrients to encourage.<sup>13,22</sup> The Grocery Manufacturers Association reported that manufacturers have adopted the system and that continued growth is expected through 2012.<sup>23</sup>

In October 2011, the IOM issued the final phase of its front-of-package analysis. The IOM reconsidered its conclusions about sugar in light of the United States Department of Agriculture’s (USDA’s) release of the 2010 Dietary Guidelines for Americans, which provided clear recommendations for added sugar consumption and an approach to evaluate added sugar content in foods.<sup>11</sup> The IOM recommended a single standardized front-of-package system to encourage healthier choices, and added sugar is a main component of the nutritional criteria.<sup>11</sup> The IOM’s final recommendation was that the FDA consider including added sugar in its front-of-package system.

In 2011, the European Parliament adopted regulations requiring that manufacturers disclose nutrition information, including total but not added sugar, on a fact panel.<sup>24</sup> In the United Kingdom, research indicated consumers wanted to be able to distinguish between products with added and naturally occurring sugars.<sup>25</sup> As a result, when the UK Food Standards Agency launched a voluntary front-of-package symbol in 2007, the nutrition criteria included these considerations.<sup>25</sup> Products high in added sugar receive a red traffic light; products containing a high percentage of naturally occurring sugar receive an amber light with

a disclosure stating this fact.<sup>25</sup> Some manufacturers have adopted the traffic light system, but the current UK administration has not encouraged its use.

### US ADDED SUGAR CONSUMPTION

Added sugar consumption in the United States reached its peak in 2000, representing 17.9% of total energy intake (98.6 g) for the entire population.<sup>26</sup> The most recent analysis using National Health and Nutrition Examination Survey data for 2007–2008 indicates that the average added sugar intake decreased to 14.5% of total energy for the entire population but that it remains high for certain age groups.<sup>26</sup> Americans aged 6 to 54 years consume 83.6 to 92.3 grams of added sugar daily, and added sugar represents approximately 17.0% of total energy intake for those aged 6 to 17 years and 16.3% for those aged 18 to 34 years.<sup>26</sup> The total population’s intake of added sugar is significantly higher than it was when the FDA made its initial determinations regarding sugar labeling in 1993, which was 10.0% of calories and 50 grams.<sup>17</sup>

The major source of added sugar in the American diet is derived from commercially sweetened products, including calorically sweetened beverages, grain-based desserts, dairy desserts, syrups, and candy as well as ready-to-eat cereals for children.<sup>26,27</sup> For all age groups, sweetened beverages (regular soda and energy, sports, and fruit drinks) are consistently the largest contributor of added sugar to the

diet. The 2005–2006 data show sweetened beverage consumption as 46.2% of all added sugar in the American diet,<sup>27</sup> and the 2007–2008 data revealed that this number declined to 39.6%.<sup>26</sup> The decrease resulted primarily from a decrease in regular soda consumption.<sup>26</sup> Industry likewise noted consumers’ move away from “sodas loaded with sugar”<sup>28</sup> and reported reformulating products accordingly.<sup>29</sup> However, it is noteworthy that including other sweetened beverages, such as sweetened tea, coffee, and milk drinks, in this category brings the percentage of added sugar from sweetened beverages in the American diet to 47.1%.<sup>26</sup>

### SUGAR AND HEALTH

In its first phase report, the IOM found there was a lack of scientific consensus regarding the role added sugar plays on adverse health outcomes except for its contribution to excess calories.<sup>21</sup> Studies supporting this conclusion have found a lack of evidence that diets high in caloric sweeteners cause an increase in obesity rates or other chronic conditions.<sup>30,31</sup>

Recent studies and reviews by independent scientific bodies support the conclusion that a high intake of added sugar has a negative impact on health and overall diet quality. In its 2009 Scientific Statement, the American Heart Association reviewed the evidence and concluded that weight gain over the past 30 years in the United States “must be related in part to increased intake of added sugars,”<sup>6(p1016)</sup> which also “appears to be associated with increased



triglyceride levels, a known risk factor for coronary heart disease.<sup>6(p1014)</sup> Since then, and since the IOM's first phase report, 2 studies using National Health and Nutrition Examination Survey data have confirmed these findings. The first, on adults, found high added sugar intake was positively correlated with weight gain, lower high-density lipoprotein cholesterol, higher triglycerides, and higher ratios of triglycerides to high-density lipoprotein cholesterol.<sup>32</sup> The most recent study found that high added sugar intake in adolescents was positively associated with increased dyslipidemia (lower high-density lipoprotein, higher low-density lipoprotein, and higher triglycerides) for all adolescents and increased insulin resistance among overweight adolescents, a known risk factor for cardiovascular disease.<sup>33</sup>

Research also indicates that people with the highest sugar intake have the lowest micronutrient intake.<sup>6,34</sup> At moderate levels of added sugar consumption, micronutrient dilution is determined by the specific foods in the diet.<sup>6</sup> The FDA's and IOM's original hesitancy to address sugar stems in part from the fact that sugar is added to dairy products, which provides calcium, and to fortified cereals, which have added vitamins and minerals.<sup>17,21</sup> Studies do confirm that sweetened dairy and fortified cereals have a positive impact on diet; however, sweetened beverages, sweets, and sweetened grains have been found to have a negative impact.<sup>27</sup> The consumption of sweetened beverages in particular is associated with dental caries, weight gain,

overweight, obesity, and an independent risk factor for diabetes and heart disease.<sup>26,35-39</sup>

The FDA (in 1990) and the American Dietetic Association (in 2004) stated that there is no evidence that the body makes any physiological distinction between added and naturally occurring sugar in food.<sup>15,30</sup> However, science is emerging that may refute this statement and support the position that not all added sugar is metabolized the same: added fructose has been singled out as a possible culprit in the obesity epidemic, and increased consumption is associated with metabolic changes.<sup>8,40,41</sup> It is not necessary to have conclusive evidence on this issue because there is agreement that the US diet contains too much added sugar.<sup>21,26</sup> Current regulations do not adequately address this.

### CONSUMPTION RECOMMENDATIONS

The American Heart Association has recommended limiting daily intake of added sugar to approximately 4.5% to 6.5% of total calories, which for most women equals 100 calories a day and for most men, 150 calories a day.<sup>6</sup>

The USDA has historically provided qualitative recommendations, such as "avoid too much sugar,"<sup>42</sup> but the appendix to the 2010 Dietary Guidelines included a quantitative recommendation for discretionary calories. The USDA advised that added sugar and solid fat *together* should provide no more than 13% of the total calories of an average person requiring a 2000-calorie diet.<sup>43</sup>

This swayed the IOM during its second phase analysis and bolsters support for increased FDA regulation.

In 2002 and again in 2005, the IOM issued the most lenient recommendation for added sugar: that it account for less than 25% of total calories.<sup>44,45</sup> The food industry and trade groups have embraced the IOM's added sugar recommendations and use it for promotional materials and self-regulatory pledges not to advertise unhealthy food to young children.<sup>46-49</sup>

The World Health Organization recommends that less than 10% of total calories be consumed as added sugar.<sup>50</sup> The Nordic Nutrition Recommendations follow this standard<sup>51</sup>; and, although the United Kingdom has not issued official guidelines, the Food Safety Authority used the 10% (50 g) added sugar recommendation as the benchmark for the traffic light system.<sup>52</sup>

In 2010, a European Food Safety Authority panel on dietary reference values determined that the evidence was insufficient to establish an upper level of added sugar intake.<sup>51</sup> The authority suggested that each member country establish its own dietary guideline<sup>53</sup> and noted that the European food industry uses 90 grams as its daily consumption guideline for total sugar labeling.<sup>54</sup>

### REVISING FOOD AND DRUG ADMINISTRATION REGULATIONS

Based on the most recent science, Congress or the FDA may determine that more information about sugar on food packages

would benefit the public. The FDA's procedure for rulemaking includes a notice and comment period, during which it will gain insight into various perspectives to assist it in developing appropriate recommendations.<sup>55</sup>

In the United States, it is illegal to introduce misbranded food into the marketplace. The FDA is responsible for enforcing this regulation.<sup>56</sup> The FDA assigns the responsibility for ensuring the validity of a product label's stated nutrient values to the manufacturer, which determines how to calculate nutrition values required by the NLEA.<sup>57</sup> The FDA enforces labeling requirements by random sampling laboratory analysis and requires values to be accurate within a preestablished percentage.<sup>57</sup> Requiring such precision for added sugar labels is increasingly possible based on the science of added sugar detection, but it is not necessary, as evidenced by the FDA's regulatory mechanisms in other contexts.

Congress enacted the Food Allergen Labeling and Consumer Protection Act of 2004, which requires that the 8 most common food allergens be disclosed on the labels of food regulated by the FDA.<sup>58</sup> In 2006, the FDA released a report summarizing the scientific knowledge regarding food allergens and admitted there are "no validated detection methods or commercially available kits for most food allergens or allergenic proteins"<sup>59(p28)</sup> but noted that it "is likely that there will be significant scientific advances in the near future"<sup>59(p2)</sup> to address such limitations. The FDA was aware of the absence of a



standardized method to detect food allergens years prior to enactment of the act but acted to protect public health nonetheless.<sup>60</sup> The FDA does not have a commercially available method to substantiate the exact amount of sugar added to food in grams, and this should likewise not hinder appropriate labeling requirements.

Manufacturers know how much sugar is added to their products. The FDA can require manufacturers to confidentially submit the food recipe to the agency for verification without invoking concerns over proprietary information, as is done for tobacco products.<sup>61</sup> The FDA currently requires tobacco companies to submit ingredient information, including nonpublic trade secret and confidential commercial information for verification.<sup>61</sup> The confidentiality of this information is protected under several laws, and the same method could be used for food ingredient lists to verify added sugar.<sup>61</sup> This, coupled with random sampling laboratory analysis, provides a solid basis to enforce an added sugar disclosure requirement.

Added sugar detection has a rich scientific history that has evolved in the area of juice adulteration.<sup>62</sup> In recent litigation, POM Wonderful sued another beverage company for selling adulterated pomegranate juice.<sup>63</sup> The parties submitted samples of their juice to independent laboratories, which were able to detect added sugar, showing that the competitor's 100% juice claim on its label was false.<sup>63</sup> The leading laboratory in this case is able to detect sugar added to all major juice

products (38 in total) available in the marketplace.<sup>64</sup>

Scientists have confirmed that techniques exist to measure and differentiate among the carbon isotope profile of corn-, beet-, and cane-sweetened food.<sup>62</sup> This is based on the fact that different types of plant photosynthesis lead to different sugar isotopes.<sup>65</sup> Corn and sugar cane have a C4 carbon isotope signature, whereas beets, maple, fruit, and vegetables have a C3 signature.<sup>66</sup> This has enabled scientists to determine which type of sugar was added to foods such as sweetened beverages, candy, and ready-to-eat cereals.<sup>66</sup>

The discovery of the C4 photosynthetic pathway developed into a practical method for detecting added sugar in juice (Dana Krueger, personal communication, May 21, 2011). Because food laboratories' primary work is to detect adulteration and assist manufacturers with accurate food labels based on required disclosures, quantifying the amount of added sugar in grams has not been a goal. Increased labeling requirements would encourage laboratories to develop methods for added sugar detection in grams, and the FDA can independently support this. Currently, food laboratories can distinguish between naturally occurring components of food and have already assessed the normal distribution of naturally occurring sugars in food. Each product type requires unique analysis. For example, sugar added to milk can be distinguished through liquid chromatography that separates lactose from the other sugars.

The amount of sugar added to the product can be calculated through subtraction.

Until the science is fully engineered to specifically determine added sugar for all products in grams, the FDA can choose to give manufacturers slightly more leeway on an added sugar requirement, such that the number may not be within the same percentage as other nutrient disclosures required by the NLEA.<sup>57</sup> The lack of a perfect scientific method for determining added sugar is no different from that in the food allergen area. The science is similarly evolving, and the current methods are strong enough that the FDA's original concern should not be used to impede progress on nutritional labels.

The USDA has determined the amount of added sugar in more than 8000 food products, and the results are available online.<sup>67,68</sup> The IOM found the USDA's method to evaluate added sugar was sufficient to address its original concerns about enforcement for front-of-package purposes, and this can be used by the FDA for all labeling requirements.

Increased labeling in the context of sugar is warranted. The literature points primarily to added sugar as an issue of concern for the American diet. The FDA might find that addressing added sugar is feasible without impinging on the concern that total sugar labeling inappropriately captures sweetened food it considers healthy.

To address added sugar, the FDA could first require its disclosure on the nutrition facts panel. This could take the form of requiring manufacturers to

disclose added sugar or additionally list naturally occurring sugar. Under total sugar, there could be a subcategory for 1 or both. A consumer survey would help determine which method has the most information value. Once added sugar is disclosed, the FDA could create a daily reference value for added sugar based on recommendations issued by the USDA, the American Heart Association, and the World Health Organization. A daily reference value for added sugar would go a long way in providing guidance to consumers.

As suggested by the IOM, the FDA could include added sugar considerations in its front-of-package system whether or not it revises the nutrition facts panel.<sup>11</sup> Added sugar could be considered in the nutrition criteria or disclosed as a front-of-package symbol.

Under current regulations and without forging a new path, the FDA can require increased standards for total sugar to better match current science. Significantly, the FDA should revise requirements for health claims. A disqualifying level of sugar would likely benefit consumers, so foods high in sugar can no longer bear health claims. This is especially prevalent for food marketed to children in which a character adorns a high-sugar product and a health claim appeases a parent who might otherwise be hesitant to purchase the product.<sup>69</sup>

If the FDA rejects the IOM's recommendation to focus on added sugars for its front-of-package system, the FDA could require total sugar disclosures or consider total sugar in its development of a nutrition criterion.





A daily reference value for total sugars could also be devised if the agency rejects a daily reference value for added sugar. During the NLEA proceedings, the FDA posited that 10% of calories came from naturally occurring sugar and 10% came from added sugar.<sup>17</sup> Studies can confirm current levels and determine which levels should be recommended to foster positive health outcomes. This recommendation might prove to be the most controversial for the agency because of its concern that consumers will not be able to distinguish between healthy food with naturally occurring or added sugar and unhealthy food with added sugar.<sup>15</sup> If this proves to be the case, it would be an unintended consequence of creating a daily reference value for total sugar. However, healthy products with naturally occurring or low levels of added sugar could still be permitted to make health claims, so this could help manufacturers communicate the positive values of the product. Consumer research could determine whether additional information disclosures would address the FDA's concerns so that a daily reference value for total sugar is ultimately useful.

Increased labeling may result in increased costs. However, the FDA and USDA Economic Research Service undertook evaluations of the costs and benefits of mandatory nutrition labeling under the NLEA, and their rationale applies in the context of increased sugar disclosures. The FDA considered its administration and laboratory testing costs and manufacturers' printing and lost inventory (preprinted labels) costs.<sup>70</sup>

The FDA considered the benefits for those who read the label to be improved health and reduction of illness and death.<sup>70</sup> The USDA identified additional benefits in that labels foster informed choice and result in improved health for the wider population if positive reformulation results.<sup>70</sup> The result of these analyses was the comprehensive labeling system in effect today. The addition of sugar information would enhance the information value and efficacy and likely lead to positive reformulation and health outcomes.<sup>29</sup>

### EMERGING SCIENCE AND DIRECTIONS FOR THE FUTURE

If the government made strong labeling requirements, manufacturer reformulation is a likely positive outcome that could increase competition among companies to create and advertise products with less added sugar. Two seemingly identical baby food products are illustrative: in a peach yogurt, 77% of the 6.6 grams of sugar is added, whereas only 7% of the 3.9 grams of sugar in the banana yogurt is added.<sup>71</sup> Absent reformulation, the FDA could seek voluntary reductions or directly regulate the amount of added sugar in products of specific concern,<sup>72</sup> such as energy and juice drinks.<sup>73</sup>

Science is emerging to suggest that sugar can be addictive.<sup>74</sup> If a food additive is unsafe or added to induce addiction, the Secretary of Health can declare it unsafe and directly regulate food products produced with it.<sup>75</sup> Assuming sugar would not lose its generally recognized as safe status, if sugar

is confirmed to be addictive the FDA could determine a safe limit of sugar to be added to food and regulate accordingly.<sup>72</sup>

Researchers have noted the limitation on self-reported dietary intake measures, especially in the area of sugar consumption because added sugar is not labeled and is often added to food without consumers' knowledge. Thus, scientists are developing a noninvasive finger-stick test to identify biomarkers of added sugars in the blood.<sup>76</sup> The goal is to give people who seek the information a tool similar to current tests for dietary cholesterol to learn their own consumption of added sugar.

The need for more information relevant to sugar on food labels is long overdue. The government can currently require more information pertinent to total sugar consistent with the public health literature and scientific methods necessary for enforcement. The time has come that added sugar labeling can also be enforced and should seriously be considered by the government to protect and inform consumers. Increased labeling requirements also lead to innovation and positive reformulation. The American Heart Association, the USDA, and the World Health Organization have issued strong standards that can guide the government. There are no longer any viable reasons to maintain outdated nutrition labeling standards for sugar. ■

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#### References

- Herbst S. *Food Lover's Companion*. New York: Barron's Educational Series; 2001.
- Kilman S, Tomson B. Modified beet gets new life. *Wall Street Journal*. February 5, 2011.
- Murano P. *Understanding Food Science and Technology*. Belmont, CA: Thompson Wadsworth; 2003.
- Western Sugar Cooperative v. Archer-Daniels-Midland Co.*, Complaint CV11-3473 (C.D. Cal. April 22, 2011).
- Vacek-Aranda A. Sugar wars: dispute settlement under NAFTA and the WTO as seen through the lens of the HFCS case and its effects on US-Mexican relations. *Tex. Hosp. J.L. & Pol'y*. 2006;12(1):121-160.
- Johnson RK, Appel LJ, Brands M, et al. Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association. *Circulation*. 2009;120(11):1011-1020.
- Taubes G. Is sugar toxic? *New York Times*. April 17, 2011.
- Havel PJ. Dietary fructose: implications for dysregulation of energy homeostasis and lipid/carbohydrate metabolism. *Nutr Rev*. 2005;63(5):133-157.
- US General Accounting Office. *Sugar Program: Supporting Sugar Prices Has Increased Users' Costs While Benefiting Producers*; June 2000. Available at: <http://www.gao.gov/new.items/rc00126.pdf>. Accessed August 30, 2011.
- Brownell KD, Koplan JP. Front-of-package nutrition labeling—an abuse of trust by the food industry? *N Engl J Med*. 2011;364(25):2373-2375.
- Institute of Medicine. *Front-of-Package Nutrition Rating Systems and Symbols: Promoting Healthier Choices*. Washington, DC: National Academies Press; 2012.



12. Grocery Manufacturers Association. *Grocery Manufacturers Association Statement in Response to the Institute of Medicine's Committee on Examination of Front-of-Package Nutrition Rating Systems and Symbols Report*; October 20, 2011. Available at: <http://www.gmaonline.org/news-events/newsroom/gma-statement-in-response-to-the-iom-front-of-package-nutrition-rating-syst>. Accessed January 25, 2012.
13. Facts Up Front. *About the Icons*. Grocery Manufacturers Association. Available at: <http://www.factsupfront.org/aboutTheIcons.html>. Accessed January 26, 2012.
14. Nutrition Labeling and Education Act of 1990, Pub L No. 101-535, 104 Stat. 2353, 21 USC 343.
15. 55 *Federal Register* 29487 (1990).
16. 56 *Federal Register* 60366 (1991).
17. 58 *Federal Register* 2206 (1993).
18. 21 CFR §101.14(a)(4).
19. The Federal Food, Drug, and Cosmetic Act §§ 201(s), 409.
20. 72 FR 62149 (2007).
21. Institute of Medicine. *Examination of Front-of-Package Nutrition Rating Systems and Symbols: Phase I Report*. Washington, DC: National Academies Press; 2010.
22. Grocery Manufacturers Association. *Food and Beverage Industry Launches Nutrition Keys Front-of-Pack Nutrition Labeling Initiative to Inform Consumers and Combat Obesity*, January 24, 2011. Available at: <http://www.gmaonline.org/news-events/newsroom/food-and-beverage-industry-launches-nutrition-keys-front-of-pack-nutrition>. Accessed August 30, 2011.
23. Grocery Manufacturers Association. *GMA and FMI Announce "Facts up Front" as Theme for Front-of-Pack Labeling Program Consumer Education Campaign*; September 22, 2011. Available at: <http://www.gmaonline.org/news-events/newsroom/gma-and-fmi-announce-facts-up-front-as-theme-for-labeling-program-consumer>. Accessed January 25, 2012.
24. European Parliament. *Press Release. Food Labels: Clearer Information for Consumers: Parliament Adopts Proposal at Second Reading*; July 6, 2011. Available at: <http://www.reading.ac.uk/foodlaw/news/eu-11058.htm>. Accessed August 30, 2011.
25. Food Standards Agency. *Front-of-pack traffic light signpost labelling. Technical Guidance*. 2007;2:1-16.
26. Welsh JA, Sharma AJ, Grellinger L, Vos MB. Consumption of added sugars is decreasing in the United States. *Am J Clin Nutr*. 2011;94(3):726-734.
27. Van Horn L, Johnson RK, Flickinger BD, Vafiadis DK, Yin-Piazza S. Translation and implementation of added sugars consumption recommendations: a conference report from the American Heart Association Added Sugars Conference 2010. *Circulation*. 2010;122(23):2470-2490.
28. James M. Pepsi hopes Cowell can put fizz into sales. *Los Angeles Times*. March 17, 2011.
29. Neuman W. US seeks new limits on food ads for children. *The New York Times*. April 28, 2011.
30. Position of the American Dietetic Association. Use of nutritive and non-nutritive sweeteners. *J Am Diet Assoc*. 2004;104(2):255-275.
31. Ruxton CH, Gardner EJ, McNulty HM. Is sugar consumption detrimental to health? A review of the evidence 1995-2006. *Crit Rev Food Sci Nutr*. 2010;50(1):1-19.
32. Welsh JA, Sharma A, Abramson JL, Vaccaro V, Gillespie C, Vos MB. Caloric sweetener consumption and dyslipidemia among US adults. *JAMA*. 2010;303(15):1490-1497.
33. Welsh JA, Sharma A, Cunningham SA, Vos MB. Consumption of added sugars and indicators of cardiovascular disease risk among US adolescents. *Circulation*. 2011;123(3):249-257.
34. Steyn NP, Myburgh NG, Nel JH. Evidence to support a food-based dietary guideline on sugar consumption in South Africa. *Bull World Health Organ*. 2003;81(8):599-608.
35. Heller KE, Burt BA, Eklund SA. Sugared soda consumption and dental caries in the United States. *J Dent Res*. 2001;80(10):1949-1953.
36. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr*. 2006;84(2):274-288.
37. Malik VS, Popkin BM, Bray GA, Despres JP, Hu FB. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. *Circulation*. 2010;121(11):1356-1364.
38. Hu FB, Malik VS. Sugar-sweetened beverages and risk of obesity and type 2 diabetes: epidemiologic evidence. *Physiol Behav*. 2010;100(1):47-54.
39. Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet*. 2001;357(9255):505-508.
40. Nguyen S, Lustig RH. Just a spoonful of sugar helps the blood pressure go up. *Expert Rev Cardiovasc Ther*. 2010;8(11):1497-1499.
41. Lim JS, Mietus-Snyder M, Valente A, Schwarz JM, Lustig RH. The role of fructose in the pathogenesis of NAFLD and the metabolic syndrome. *Nat Rev Gastroenterol Hepatol*. 2010;7(5):251-264.
42. Murphy SP, Johnson RK. The scientific basis of recent US guidance on sugars intake. *Am J Clin Nutr*. 2003;78(4):827S-833S.
43. US Department of Agriculture. *Dietary Guidelines for Americans 2010. Appendix 7*. Available at: <http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/PolicyDoc/Appendices.pdf>. Accessed May 20, 2011.
44. Institute of Medicine. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids*. Washington, DC: National Academies Press; 2002.
45. Institute of Medicine. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids*. Washington, DC: National Academies Press; 2005.
46. Sibbald B. Sugar industry sour on WHO report. *CMAJ*. 2003;168(12):1585.
47. National Dairy Council. *Sugars & Health*. Dairy Council Digest Archives. Available at: <http://www.nationaldairyCouncil.org/Research/DairyCouncilDigestArchives/Pages/dcd78-4Page5.aspx>. Accessed May 20, 2011.
48. PepsiCo. *CFBAI Pledge Exempt Food*. Yale Rudd Center; 2011. Available at: [http://www.yaleruddcenter.org/marketingpledges/company.aspx?id=49&pledge\\_id=9](http://www.yaleruddcenter.org/marketingpledges/company.aspx?id=49&pledge_id=9). Accessed May 19, 2011.
49. Campbell's Soup Company. *Commitment Concerning Advertising to Children (US)*. Available at: [http://www.campbellsoupcompany.com/governance\\_children\\_commitment.asp](http://www.campbellsoupcompany.com/governance_children_commitment.asp). Accessed May 20, 2011.
50. Nishida C, Uauy R, Kumanyika S, Shetty P. The joint WHO/FAO expert consultation on diet, nutrition and the prevention of chronic diseases: process, product and policy implications. *Public Health Nutr*. 2004;7(1A):245-250.
51. European Food Safety Authority. Scientific opinion on dietary reference values for carbohydrates and dietary fibre. *EFSA Journal*. 2010;8(3):1462. Available at: <http://www.efsa.europa.eu/en/efsajournal/pub/1462.htm>. Accessed May 18, 2011.
52. Food Standards Agency. *Rationale and discussion of the 15 g high sugars criterion within the FSA signposting scheme*. Available at: <http://www.food.gov.uk/multimedia/pdfs/paperexpert.pdf>. Accessed September 11, 2011.
53. European Food Standards Agency. Scientific opinion on establishing food-based dietary guidelines. *EFSA Journal*. 2010;8(3):1460. Available at: <http://www.efsa.europa.eu/en/efsajournal/doc/1460.pdf>. Accessed May 18, 2011.
54. European Food Standards Agency. Scientific opinion of the panel on dietetic products, nutrition and allergies on a request from European Commission on the review of labelling reference intake values for selected nutritional elements. *The EFSA Journal*. 2009;1008:1-14. Available at: <http://www.efsa.europa.eu/en/efsajournal/doc/1008.pdf>. Accessed April 25, 2012.
55. Center for Science in the Public Interest. *Petition to the FDA to Require Better Sugar Labeling on Foods*; 1999. Available at: [www.cspinet.org/reports/sugar/sugarpet1.pdf](http://www.cspinet.org/reports/sugar/sugarpet1.pdf). Accessed May 20, 2011.
56. 21 US Code § 331(a).
57. US Food and Drug Administration. *Guidance for Industry: Nutrition Labeling Manual*. Available at: <http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/FoodLabelingNutrition/ucm063113.htm>. Accessed May 24, 2011.
58. Pub L No. 108-282, 118 Stat. 905 (2004).
59. US Food and Drug Administration, Threshold Working Group. *Approaches to Establish Thresholds for Major Food Allergens and for Gluten in Food*; March 2006. Available at: <http://www.fda.gov/downloads/Food/Labeling/Nutrition/FoodAllergensLabeling/GuidanceComplianceRegulatoryInformation/UCM192048.pdf>. Accessed May 10, 2011.
60. US Food and Drug Administration. *Guidance on Inspections of Firms Producing Food Products Susceptible to Contamination With Allergenic Ingredients*; 2001. Available at: <http://www.fda.gov/ICECI/Inspections/InspectionGuides/ucm074944.htm>. Accessed May 15, 2011.
61. US Food and Drug Administration. *Final Guidance for Industry: Listing of Ingredients in Tobacco Products*;



November 2009. Available at: <http://www.fda.gov/TobaccoProducts/GuidanceComplianceRegulatoryInformation/ucm191982.htm>. Accessed May 19, 2011.

62. Krueger D. Detection of added sugar to fruit juices using carbon and hydrogen stable isotope ratio analysis. In: Nagy S, Wade RL, eds. *Methods to Detect Adulteration of Fruit Juice Beverages*. Auburndale, FL: Agscience, Inc.; 1995.

63. *POM Wonderful LLC v. Purely Juice, Inc.*, No. 07-02633, 2008 WL 4222045 (C.D. Cal. July 17, 2008).

64. Krueger Food Laboratories. *Fruit Juice Authenticity Analysis*. Available at: <http://kfl.com/sas.html>. Accessed May 19, 2011.

65. Krueger HW, Reesman RH. Carbon isotope analysis in food technology. *Mass Spectrom Rev*. 1982;1(3):205–236.

66. Jahren AH, Saudek C, Yeung EH, Kao WH, Kraft RA, Caballero B. An isotopic method for quantifying sweeteners derived from corn and sugar cane. *Am J Clin Nutr*. 2006;84(6):1380–1384.

67. US Department of Agriculture. *SuperTracker. Food-A-Pedia*. Available at: <https://www.choosemyplate.gov/SuperTracker/default.aspx>. Accessed January 25, 2012.

68. US Department of Agriculture. *USDA Launches New Online Nutrition SuperTracker in Time for Those Healthy New Year Resolutions*; December 22, 2011. Available at: <http://www.usda.gov/wps/portal/usda/usdahome?contentid=2011/12/0518.xml>. Accessed January 25, 2012.

69. Harris JL, Thompson JM, Schwartz MB, Brownell KD. Nutrition-related claims on children's cereals: what do they mean to parents and do they influence willingness to buy? *Public Health Nutr*. 2011;Aug 2:1–6. [Epub ahead of print].

70. Golan E, Kuchler F, Mitchell L, Greene C, Jessup A. *Economics of Food Labeling Economic Research Service, U.S. Department of Agriculture*. Washington, DC: US Department of Agriculture; January 2001. Agricultural Economic Report No. 793.

71. US Department of Agriculture. *Database for the Added Sugars Content of Selected Foods*; February 2006. Available at: [http://www.ars.usda.gov/SP2UserFiles/Place/12354500/Data/Add\\_Sug/addsug01.pdf](http://www.ars.usda.gov/SP2UserFiles/Place/12354500/Data/Add_Sug/addsug01.pdf). Accessed May 15, 2011.

72. *Rubin v. Coors Brewing Co.*, 514 US 476, 490-491 (1995).

73. Pomeranz JL. Advanced policy options to regulate sugar-sweetened beverages to support public health. *J Public Health Policy*. 2012;33(1):75–88.

74. Gosnell BA, Levine AS. Reward systems and food intake: role of opioids. *Int J Obes (Lond)*. 2009;33(suppl 2):S54–S58.

75. 21 USC §342.

76. Davy BM, Jahren AH, Hedrick VE, Comber DL. Association of delta(1)(3)C in fingerstick blood with added-sugar and sugar-sweetened beverage intake. *J Am Diet Assoc*. 2011;111(6):874–878.