**BACKGROUND:** It is unclear whether energy-containing drinks, especially those sweetened with high-fructose corn syrup (HFCS), promote positive energy balance and thereby play a role in the development of obesity.

**OBJECTIVE:** The objective was to examine the satiating effects of HFCS and sucrose in comparison with milk and a diet drink.

**DESIGN:** The effects of four 800-ml drinks containing no energy or 1.5 MJ from sucrose, HFCS, or milk on satiety were assessed, first in 15 men and 15 women with a mean (±SD) body mass index (BMI; in kg/m²) of 22.1 ± 1.9 according to visual analogue scales (VAS) and blood variables and second in 20 men and 20 women (BMI: 22.4 ± 2.1) according to ingestion of a standardized ad libitum meal (granola cereal + yogurt, 10.1 kJ/g).

**RESULTS:** Fifty minutes after consumption of the 1.5-MJ preload drinks containing sucrose, HFCS, or milk, 170%-mm VAS changes in satiety were observed. Glucagon-like peptide 1 (GLP-1) (P < 0.001) and ghrelin (P < 0.05) concentrations changed accordingly. Compensatory energy intake did not differ significantly after the 3 preload and ranged from 30% to 45%. Energy intake compensations were related to satiety (r = 0.35, P < 0.05). No differences were observed between the effects of the sucrose- and HFCS-containing drinks on changes in VAS and on insulin, glucose, GLP-1, and ghrelin concentrations. Changes in appetite VAS ratings were a function of changes in GLP-1, ghrelin, insulin, and glucose concentrations.

**CONCLUSION:** Energy balance consequences of HFCS-sweetened soft drinks are not different from those of other isoenergetic drinks, eg, a sucrose-drink or milk.

*American Journal of Clinical Nutrition, Vol. 86, No. 6, 1586-1594, December 2007*

---

**BACKGROUND:** The greater prevalence of obesity and the metabolic syndrome in the past 35 y has been attributed to the replacement of sucrose in the food supply with high-fructose corn syrup (HFCS).

**OBJECTIVE:** Two experiments were conducted to determine the effect of solutions containing sucrose, HFCS, or various ratios of glucose to fructose (G:F) on food intake (FI), average appetite (AA), blood glucose (BG), plasma insulin, ghrelin, and uric acid (UA) in men.

**DESIGN:** Sugar solutions (300 kcal/300 mL) were (in %) G20:F80, HFCS 55 (G45:F55), sucrose, and G80:F20 (experiment 1, n = 12) and G20:F80, G35:F65, G50:F50, sucrose, and G80:F20 (experiment 2, n = 19). The controls were a sweet energy-free control (experiment 1) and water (both experiments). Solutions were provided in a repeated-measures design. AA, BG, and FI were measured in all subjects. Hormonal responses and UA were measured in 7 subjects in experiment 2. Measurements were taken from baseline to 75 min. FI was measured at 80 min.

**RESULTS:** Sucrose and HFCS (experiment 1) and sucrose and G50:F50 (experiment 2) had similar effects on all dependent measures. All sugar solutions similarly reduced the AA area under the curve (AUC). FI and plasma UA concentrations were significantly (P < 0.05) lower after high-glucose solutions than after low-glucose solutions. The lower FI was associated with greater BG AUC (P < 0.05) and smaller AA and ghrelin AUCs (P < 0.01). Insulin and BG AUCs were positively associated (P < 0.001).

**CONCLUSION:** Sucrose, HFCS, and G50:F50 solutions do not differ significantly in their short-term effects on subjective and physiologic measures of satiety, UA, and FI at a subsequent meal.


---

**BACKGROUND:** Widespread use of high-fructose corn syrup (HFCS) in beverages has been linked to rising obesity rates. One hypothesis is that HFCS in beverages has little satiating power.

**OBJECTIVE:** The objective of the study was to compare the relative effect of commercial beverages containing sucrose or HFCS on hunger, satiety, and energy intakes at the next meal with the use of a within-subject design.

**DESIGN:** Thirty-seven volunteers (19 men, 18 women) aged 20–29 y consumed isocaloric cola beverages (215 kcal) sweetened with sucrose, HFCS 42, or HFCS 55. HFCS 42 contains 42% fructose, and HFCS 55 contains 55% fructose. Diet cola (2 kcal), 1%-fat milk (215 kcal), and no beverage were the control conditions. The 5 beverages were consumed at 1010 (2 h after a standard breakfast). Participants rated hunger, thirst, and satiety at baseline and at 20-min intervals after ingestion. A tray lunch (1708 kcal) was served at 1230, and energy intakes were measured. The free sugars content of sucrose-sweetened cola was assayed at the time of the study.

**RESULTS:** We found no differences between sucrose- and HFCS-sweetened colas in perceived sweetness, hunger and satiety profiles, or energy intakes at lunch. The 4 caloric beverages tended to partially suppress energy intakes at lunch, whereas the no-beverage and diet beverage conditions did not; the effect was significant (P < 0.05) only for 1%-fat milk. Energy intakes in the diet cola and the no-beverage conditions did not differ significantly.

**CONCLUSION:** There was no evidence that commercial cola beverages sweetened with either sucrose or HFCS have significantly different effects on hunger, satiety, or short-term energy intakes.

**Nutrition™ The International Journal of Applied and Basic Nutritional Sciences**

**Effects of high-fructose corn syrup and sucrose consumption on circulating glucose, insulin, leptin, and ghrelin and on appetite in normal-weight women**

Kathleen J. Melanson Ph.D., R.D., L.D.1, Linda Zukley M.A., R.N.2, Joshua Lowndes M.A.3, Von Nguyen M.S., R.D.2, Theodore J. Angelopulos Ph.D., M.P.H.1,2,3, and James M. Rippe M.D.2 1Department of Nutrition and Food Sciences, University of Rhode Island, Kingston, RI 2Rippe Lifestyle Institute, Shrewsbury, MA, and Celebration Health, Celebration, FL 3Center for Lifestyle Medicine and Department of Health Professions, University of Central Florida, Orlando, FL

**Objective:** Fructose has been implicated in obesity, partly due to lack of insulin-mediated leptin stimulation and ghrelin suppression. Most work has examined effects of pure fructose, rather than high-fructose corn syrup (HFCS), the most commonly consumed form of fructose. This study examined effects of beverages sweetened with HFCS or sucrose, when consumed with mixed meals, on blood glucose, insulin, leptin, ghrelin, and appetite.

**Methods:** Thirty lean women were studied on two randomized 2-d visits during which HFCS- and Sucrose-sweetened beverages were consumed as 30% of energy on isocaloric diets during day 1 while blood was sampled. On day 2, food was eaten ad libitum. Subjects rated appetite at designated times throughout visits.

**Results:** No significant differences between the two sweeteners were seen in fasting plasma glucose, insulin, leptin, and ghrelin (P > 0.05). The within-day variation in all four items was not different between the two visits (P > 0.05). Net areas under the curve were similar for glucose, insulin, and leptin (P > 0.05). There were no differences in energy or macronutrient intake on day 2. The only appetite variable that differed between sweeteners was desire to eat, which had a higher area under the curve the day after Sucrose compared to HFCS.

**Conclusion:** These short-term results suggest that, when fructose is consumed in the form of HFCS, the measured metabolic responses do not differ from Sucrose in lean women. Further research is required to examine appetite responses and to determine if these findings hold true for obese individuals, males, or longer periods.

**Nutrition, Volume 23, Issue 2, 103-112, February 2007**

---

**ENDO 2007 Annual Meeting of The Endocrine Society**

**The Effect of High Fructose Corn Syrup on Post-Prandial Lipemia in Normal Weight Females**

Linda M. Zukley1, Joshua Lowndes1, Kathleen J. Melanson2, Von Nguyen1, Theodore J. Angelopulos1, James M. Rippe1. 1Rippe Lifestyle Institute, Celebration, FL. 2Nutrition & Food Science, University of Rhode Island, Kingston, RI.

**Introduction:** Fructose has been implicated in potentially promoting obesity, due in part to its lipogenic effect. Most work has examined the effects of pure fructose rather than high-fructose corn syrup (HFCS), the commonly-consumed form of fructose. A further concern is that postprandial lipemia, a risk factor for cardiovascular disease, may be greater after fructose consumption likely due to hepatic lipogenesis. In the past thirty years HFCS has largely replaced sucrose as the sweetener used in carbonated soft drinks in the USA. The purpose of this study was to compare the effect of HFCS versus sucrose sweetened soft drinks as part of a normal diet on triglycerides in normal weight females.

**Methods:** Thirty normal weight women (mean age 33.0 10.6 years, mean BMI 22.42 1.65) were studied on two randomized 2-day experimental visits to our metabolic unit during which HFCS and sucrose sweetened beverages were consumed with isocaloric diets on day 1 while blood was sampled. On day 2 of these visits, food was eaten ad libitum. Blood was sampled every 30 minutes for the first 16 hours and then every 60 minutes thereafter. Net area under the curve was calculated using the trapezoidal method after subtracting each value from the baseline value.

**Results:** No significant differences between the two experimental visits were seen in fasting values of triglycerides (p=NS). The within day variation was not different between the two experimental visits. Net areas under the curve were also similar (p=NS). There were no differences in energy or macronutrient intake on day 2 (ad-libitum feeding).

**Discussion:** These short-term results suggest that when fructose is consumed in the form of HFCS, there are no differences in the metabolic effects in lean women compared to sucrose. Further research is required to determine if the current findings hold true for obese individuals, or in individuals at risk for the metabolic syndrome.

**Program Abstract # P2-46 presented at the annual meeting of The Endocrine Society June 2-5, 2007**

---

**ENDO 2007 Annual Meeting of The Endocrine Society**

**The Effect of High-Fructose Corn Syrup on Uric Acid Levels in Normal Weight Women**


**Introduction:** Over the past 3 decades dietary fructose consumption has increased greatly, a trend coinciding with the emergence of the obesity epidemic. As such, excess fructose consumption has been investigated for its potential causative role. Recent evidence also suggests a potential link between fructose consumption and the development of the metabolic syndrome, independent of weight gain, as a result of uric acid mediated endothelial dysfunction. Over the past 30 years HFCS has largely replaced sucrose as the sweetener in carbonated soft drinks (CSD) in the USA. The HFCS in CSD represents a major source of fructose in the USA diet. Therefore the purpose of this study was to compare the effects of HFCS when consumed as part of mixed meal, on uric acid levels compared to sucrose consumption.

**Methods:** Thirty normal weight women (mean age 33.0 10.6 years, mean BMI 22.42 1.65) were studied on two randomized 2-day experimental visits to our metabolic unit during which HFCS and sucrose sweetened beverages were consumed with isocaloric diets on day 1 while blood was sampled. On day 2 of these visits, food was eaten ad libitum. Blood was sampled upon entering the metabolic unit at 9am, and two hours subsequently until 7am the following morning.

**Results:** No significant differences between the two experimental visits were seen in fasting values of uric acid (p=NS) all of which were within normal limits. The within day variation was not different between the two experimental conditions (HFCS/sucrose). A post-prandial increase in uric acid concentration was only observed after dinner (p=0.013), but this was comparable between the two trials. There were no differences in energy or macronutrient intake on day 2 (ad-libitum feeding).

**Discussion:** These short-term results suggest that when fructose is consumed in the form of HFCS, there are no differences in the metabolic effects in lean women compared to sucrose. Further research is required to determine if the current findings hold true for obese individuals and males.

**Program Abstract # P2-45 presented at the annual meeting of The Endocrine Society June 2-5, 2007**

**Links to full studies are available at www.HFCSfacts.com/Related_Links.html**