Appetite

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November 2007

Effects of Glucose-to-Fructose Ratios in Solutions on Subjective Satiety, Food Intake, and Satiety Hormones in Young Men

A study to determine the effect of solutions containing sucrose, HFCS, or various ratios of glucose to fructose (G:F) on food intake, average appetite, blood glucose, plasma insulin, ghrelin and uric acid. The study consisted of two experiments: in the first, sugar solutions (300kcal/300ml) were provided to 12 men in the following forms (in %); G20:F80, HFCS 55 (G45:F55), sucrose, and G80:F20. In the second experiment, 19 men received the solutions as G20:F80, G35:F65, G50:F50, sucrose, and G80:F20. Controls were water (both experiments) and a sweet energy-free solution (experiment 1). Solutions were provided in a repeated-measures design. Average appetite, blood glucose and food intake were measured in all subjects. Hormonal responses and uric acid were measured in the second experiment. Average appetite AUC was similarly reduced by all sugar solutions. High G:F solutions resulted in higher blood glucose and insulin concentrations and lower uric acid concentrations and food intakes than did low G:F solutions. Solutions of HFCS, F50:G50 and sucrose were similar in their effects on satiety, uric acid concentrations and food intake.

Akhavan T & Anderson H

American Journal of Clinical Nutrition 2007; 86: 1354-1363

August 2007

Enhanced Food Intake Regulatory Responses after a Glucose Drink in Hyperinsulinemic Men

A study to determine the effect of hyperinsulinaemia on food intake and plasma concentrations of glucose and regulatory hormones after a glucose drink. Thirty-three normoinsulinaemic (NI) men and 32 hyperinsulinaemic (HI) men were recruited for this study. Subjects consumed either a non-caloric sweetened drink or a glucose-containing drink (75g/300ml) in random order on two occasions. Food intake was measured at a subsequent meal. Food intake was reduced by the glucose preload and by hyperinsulinaemia. Mean food intake reduction in response to the glucose drink was greatest in the HI men. Plasma insulin and CCK concentrations increased more and had a higher AUC in the HI group, compared to the NI group. Ghrelin decreased over time and was lower in the HI group. Plasma leptin and adiponectin levels did not change in response to the glucose preload, but leptin was higher and adiponectin lower in the HI men, compared to the NI men. Food intake correlated positively with ghrelin in pooled data and within the NI group, but not the HI group. Food intake was not correlated with insulin, CCK, leptin or adiponectin.

Abou Samra R et al.

International Journal of Obesity 2007 (Aug); 31: 1222-1231

July 2007

Sugars and Satiety: Does the Type of Sweetener Make a Difference?

This study compared the relative effect of commercial beverages containing either sucrose or HFCS on hunger, satiety and energy intakes. Subjects were 37 adults (BMI 23.4 ± 1.8 for men and 21.9 ± 2.7 for women). Subjects consumed isocaloric cola beverages (215 kcal) containing sucrose, HFCS 42, or HFCS 55. Diet cola (2kcal), 1%-fat milk (215 kcal) and no beverage were the control conditions. All beverages were consumed 2hr after a standardised breakfast. There were no significant differences in hunger, fullness or desire-to-eat ratings between the 3 caloric cola beverages. All beverage conditions led to lower hunger and desire-to-eat ratings, and higher fullness ratings, compared to the no-beverage control. Hunger ratings were similar between the diet cola and milk conditions for the first 60 mins, but then rose more rapidly in the diet cola condition. Diet cola was associated with significantly lower fullness ratings than milk. The four caloric beverages partially suppressed energy intakes at subsequent lunch, compared to the no-beverage condition, but this was only significant for milk. Energy intakes in the diet and no-beverage condition did not differ significantly. Combining the energy intake at lunch and the energy content of the preload showed that all four caloric beverages differed significantly from diet cola and the no-beverage condition, but not from each other: the combined energy intakes were significantly higher in the caloric beverage conditions. In conclusion, there was no evidence that HFCS has a significantly different effect from sucrose on hunger, satiety or short-term energy intakes.

Monsivais P et al.

American Journal of Clinical Nutrition 2007 (Jul); 86: 116-123

May 2007

Adolescent Screen-Viewing Behaviour is Associated with Consumption of Sugar-Sweetened Beverages: The Role of Habit Strength and Perceived Parental Norms

A Dutch sample of adolescents (n=383) were studied in an investigation of the association between screen-viewing behaviour and consumption of sugar-sweetened beverages (SSB). A self-administered questionnaire was used to collect data. There was a medium effect size correlation between screen-viewing behaviour and SSB consumption (r=0.32). Habit strength of screen-viewing was the strongest correlate of habitual SSB consumption in the final model (r=0.50). Consumption of SSB was also significantly correlated with perceived parental norms regarding both screen viewing and SSB consumption.

Kremers SPJ et al.

Appetite 2007 (May); 48: 345-350

November 2006

Selective Carbohydrate or Protein Restriction: Effects on Subsequent Food Intake and Cravings

Participants in this study were 89 females aged 17-24 years. Participants were randomly assigned to one of three conditions: carbohydrate-restriction, protein-restriction, or control (no restriction). Those in the restriction conditions were asked to restrict their intake of either complex carbohydrates or animal proteins for three days. Subjects then attended the laboratory for an experimental session, during which their food intake and cravings were measured. The results of the experimental session showed that those restricting carbohydrates reported more CHO cravings over the study period than did protein-restrictors or controls. Similarly, protein-restrictors reported more cravings for high-protein foods, compared to CHO-restrictors and controls. Subjects in the CHO-restriction group consumed significantly more of the carbohydrate test food during the experimental session than did those restricting protein or control subjects. However, there were no differences in consumption of the protein test food between groups. CHO-restrictors also had higher ratings of depression than controls, but did not have higher ratings than protein-restrictors.

Coelho JS et al.

Appetite 2006 (Nov); 47: 352-360

February 2006

Effect of a High-Protein Breakfast on the Postprandial Ghrelin Response

A single-blind cross-over study of 15 subjects, to investigate whether a high-protein breakfast (HP), is more satiating than a high-carbohydrate breakfast (HC), through suppression of postprandial ghrelin concentrations, or through other physiologic processes. The HP (58.1% energy from protein, 14.1% energy from CHO) and HC (19.3% energy from protein, 47.3% energy from CHO) breakfasts were isocaloric. Gastric emptying was slower and total ghrelin was suppressed more after the HP, compared to HC breakfast. Total ghrelin concentrations were correlated with glucose-dependent insulinotropic polypeptide and glucagon, suggesting that stimulation of these peptides may mediate postprandial ghrelin response. Glucagon and cholecystokinin were significantly increased by the HP breakfast. Increased secretion of cholecystokinin and glucagons-like peptide 1 may be responsible for the reduced gastric emptying. Glucose response and AUC was significantly higher after HC, compared to HP: insulin response, (but not AUC) showed a significant difference between treatments. and subsequent ad libitum energy consumption was not significantly different between groups.

Blom WAM et al.

American Journal of Clinical Nutrition 2006 (Feb); 83: 211-220

January 2006

Macronutrient and Dietary Energy Density Influences on the Intake of Free-Living Humans

An analysis of 7-day food diaries from 669 free-living adults. There were weak relationships between macronutrients and intake, such that carbohydrate intake in the morning suppressed carbohydrate intake over the rest of the day, while protein suppressed protein intake and fat suppressed fat intake. Energy density (ED) analysis results suggest that it is the overall ED of the meal, not the ED of any particular macronutrient in that meal, that is the important factor in energy intake. However, ED of reported diets was not related to body size of the participants. Carbohydrate, protein and fat have macronutrient-specific relationships with subsequent intake in the short-term, but only account for a small amount of the variance in intake. ED has a stronger relationship with short-term energy intake, but there is no evidence of a long-term effect. This supports the view that short-term intake is controlled by weight and volume, not energy or macronutrient content.

de Castro JM

2006 (Jan); 46: 1-5

September 2005

Influence of Glycemic Index/Load on Glycemic Response, , and Food Intake in Healthy Humans

A study of the effects of consuming high and low GI meals on , food intake and insulin and glucose responses. Thirty-nine adults consumed only low or high GI foods ad libitum in a laboratory for eight days in either high (three foods per meal) or low (one food per meal) variety conditions. Glucose and insulin concentrations and were measured before and two hours after breakfast and lunch on days 1 and 8. There were no differences between groups for glycaemic and insulinaemic responses, or total energy and macronutrient intake. The results indicate that responses observed when a food is tested in isolation, are not preserved when tested under chronic ad libitum consumption of mixed meals.

Alfenas RCG & Mattes RD

Diabetes Care 2005 (Sep); 28: 2123-2129

August 2005

Energy Intake of Children after Preloads: Adjustment, not Compensation

A study testing the hypothesis that accurate energy compensation varies by age, BMI and other individual characteristics. Seventy-four children (aged 6-9 years) consumed a preload snack of either no-energy (NE: 250ml water); low-energy (LE: 56g muffin and 250ml orange drink - 783kJ); or high-energy (HE: 56g muffin and 250ml orange drink - 1628 kJ). After 90 mins, energy intake from a test meal was measured. Children ate significantly less after the HE preload than after the LE preload, and less after both of these than the NE preload. However, total energy intake was higher after the HE preload, compared to the LE and NE preloads, suggesting that compensation was not accurate. The adjustment for preload was more effective in younger children than older children. Macronutrient intake at lunch varied according the preload - children consumed significantly less energy as fat and more as carbohydrate after HE compared to NE. Parental concerns of child overweight were also associated with an inability to compensate accurately.

Cecil JE et al.

American Journal of Clinical Nutrition 2005 (Aug); 82: 302

July 2005

A High-Protein Diet Induces Sustained Reductions in , Ad Libitum Caloric Intake, and Body Weight Despite Compensatory Changes in Diurnal Plasma Leptin and Ghrelin Concentrations

This study investigates whether increasing the protein content, while maintaining the carbohydrate content of a low-carbohydrate diet, lowers body weight by decreasing and spontaneous caloric intake. Nineteen subjects (mean BMI 26.2 ± 2.1 SD) were placed on three diets in the following order: a weight-maintaining diet (15% pro, 35% fat, 50% CHO) for two weeks; an isocaloric diet (30% pro, 20% fat, 50% CHO) for two weeks; and an ad libitum diet (30% pro, 20% fat, 50% CHO) for 12 weeks. In weeks 3 and 4, subjects reported a decrease in hunger and an increase in fullness, which was confirmed by a reduction in spontaneous caloric intake of 494 ± 74 kcal/d within 24hr of starting the ad libitum phase. Hunger and fullness scores returned to normal soon after this, but a significant reduction in calorie intake was maintained to the end of the study. Mean weight loss was 4.9 kg, 76% of which was fat mass loss. Leptin had decreased significantly at the end of the study. Decreased ad libitum caloric intake may be mediated by increased leptin sensitivity.

Weigle DS et al.

American Journal of Clinical Nutrition 2005 (Jul); 82: 41-48

April 2005

Does the Consumption of Caloric and Non-Caloric Beverages with a Meal Affect Energy Intake?

A study of 44 women, to assess the effect of consumption of different beverages, (with a meal), on energy intake. The subjects ate lunch (ad libitum) in a laboratory once a week for six weeks. Lunch was served with 360g of either water, diet cola, regular cola, orange juice, 1% milk or no beverage. Beverages were consumed in full. Beverage type significantly affected energy intake at lunch ($P<0.0001$). When a caloric beverage was consumed with lunch, total energy intake for the meal increased by a mean of 104 kcal, compared to when a non-caloric beverage or no beverage was consumed. Food intake was not reduced to compensate for the energy content of the beverages. After lunch, the no-beverage condition produced lower ratings of fullness and higher ratings of hunger (with the exception of milk) and prospective consumption than any of the beverage conditions.

Della Valle DM, Roe LS & Rolls BJ

2005 (Apr); 44: 187-193

March 2005

Decreases in Fasting Leptin and Insulin Concentrations after Acute Energy Restriction and Subsequent Compensation in Food Intake

A study to assess the effect of acute decreases in fasting leptin concentrations (induced by energy restriction) on subsequent energy intake compensation. Thirty-four men, (mean age 23 yrs, mean BMI 22.3) participated in this semi-controlled intervention study. Days 1 and 2 were energy restricted, providing approximately 1/3 of daily energy requirements. On days 3 and 4, food intake was not controlled. Fasting leptin and insulin concentrations decreased by 27.2% (95% CI -34.4 to -19.9) and 30.7% (95% CI -41.0 to -20.4) respectively during the energy restriction phase. Reductions in fasting leptin concentration were not associated with changes in body weight or insulin concentrations, but were associated with baseline fasting leptin concentrations, the proportion of energy restriction and baseline BMI. On days 3 and 4, approximately 143% and 124% of estimated daily energy needs were consumed. There were no significant correlations between decreases in fasting leptin or insulin concentration and subsequent ad libitum energy intake. However, decreases in insulin concentration were correlated with an increase in later carbohydrate intake.

Mars M et al.

American Journal of Clinical Nutrition 2005(Mar); 81: 570-577

February 2005

Ghrelin Response to Carbohydrate-Enriched Breakfast is Related to Insulin

This was a double-blind, randomised, crossover design study to examine the effects of amount and type of carbohydrate on ghrelin concentrations. Twenty non-obese males (BMI 19.9-25.4) were provided with liquid breakfast meals – water, low-calorie meal (LC), high-calorie simple carbohydrate (HC-SC) and high-calorie complex carbohydrate (HC-CC). Subjective measures of and concentrations of ghrelin, glucose, insulin and leptin were measured at intervals for four hours after the test meal. Hunger, desire to eat and prospective food consumption were positively associated with ghrelin, while fullness was negatively associated. Ghrelin concentrations decreased after the LC, HC-SC, HC-CC and water meals by 24%, 41%, 33% and 2% respectively. No significant differences in ghrelin concentration were observed between the three breakfasts until 120 minutes: ghrelin concentrations returned to baseline values after 90-120 minutes for the LC meal, but remained lower than baseline until 240 minutes for both the HC meals. The percentage decrease in ghrelin concentrations between 0 and 30 minutes correlated with the increase in insulin and glucose, but not with the decrease in leptin. Between 30 and 180 minutes, the percentage decrease in ghrelin correlated with the decreases in insulin and leptin concentrations, but not glucose. Only insulin concentration was correlated with ghrelin concentration for 0 to 180 minutes. The authors suggest that ghrelin may be regulated through insulin.

Blom W et al.

American Journal of Clinical Nutrition 2005 (Feb); 81: 367-375

November 2004

Atypically High Insulin Responses to Some Foods Relate to Sugars and Satiety

An examination of the differences between the observed insulinaemic response (or index [II]), of 32 common foods and the GI-based estimates of the expected II (IIGI). The aim of the study was to explore the concept that II values consist of a GI-predicted component and a second component that is due to the properties of the food other than GI. The insulin discrepancy was calculated as II-IIGI. GI was not significantly correlated (P >0.05) with any of the seven food characteristics studied: these were sugars, protein, fibre (g/kg CHO), fat (log [1+g fat/kg CHO]), satiety index, energy density (KJ/g) or meal size (g). II correlated positively with fat content and energy density and negatively with satiety index and meal size. Insulin discrepancy correlated positively with sugar content (P<0.001) and fat content (P<0.05), but negatively with satiety index. Measuring the relation between GI and II may be useful in investigating how foods affect hunger and satiety.

Trout DL, Hallfrisch J & Behall KM

International Journal of Food Sciences & Nutrition 2004 (Nov); 55: 577-588

October 2004

Effects of a Nonsweet Lunch on Short-Term : Differences in Female High and Low Consumers of Sweet/Low-Energy Beverages

A study of the effect of sweet tasting foods on in habitual high (n = 8), and low (n = 16), consumers of sweet, low-energy beverages. Two test lunches were provided (one sweet and one non-sweet); all participants consumed both lunches, each on a separate day, approximately one week apart: subsequent was then measured. The high consumers reported an increase in for something sweet following the non-sweet lunch and a decrease in for something sweet following the sweet lunch. The low consumers reported a decrease in for sweet foods following both lunches. These results suggest that short-term control of varies according to the habitual pattern of dietary intake.

Appleton KM, Rogers PJ & Blundell JE

Journal of Human Nutrition and Dietetics 2004 (Oct); 17: 425-434

March 2004

Metabolic and Cognitive Coefficients in the Development of Hunger Sensations after Pure Macronutrient Ingestion in the Morning

Fifteen healthy male students were studied for the effect of pure carbohydrate, protein and fat ingestion on short-term satiety and their relation to metabolic and cognitive performance indices. Subjects fasted overnight. Measurements were made before and hourly for three hours after macronutrient ingestion. Preloads were isoenergetic (1670 KJ) with similar sensory properties. Hunger ratings ('desire to eat' and 'gastric emptiness') were generally higher after fat and carbohydrate compared with protein. Carbohydrate suppressed hunger in a similar way to protein in the first hour and was related to changes in β-hydroxybutyrate and insulin concentrations. In the third hour, the satiating properties of carbohydrate were similar to that of fat, and were related to diet-induced thermogenesis. Objective cognitive performance was positively related to feelings of hunger.

Fischer K, Colombani PC & Wenk C

2004 (Mar); 42: 49-61

December 2003

Moderate Physical Activity Permits Acute Coupling Between Serum Leptin and -Satiety Measures in Obese Women

This study used three trials to investigate the effect of physical activity and snack intake on , these were moderate physical activity (20 min brisk walking), snack (58.5g chocolate-based) and control (sitting, TV watching). The participants (10 obese women) were subjected to the trials in a random order. The measurements made were , satiety, serum leptin, blood glucose and plasma free fatty acids. Lower and higher satiety perceptions were produced after the snack and the physical activity, compared to control. Serum leptin concentration did not differ between trials and was not associated with or satiety during either the control or snack trials. However, after the physical activity, serum leptin was correlated to both and satiety. The authors suggest the possibility that leptin is involved in short-term regulation in response to physical activity-induced factors.

Tsofliou F et al.

International Journal of Obesity 2003; 27:1332-1339

September 2002

Snacks consumed in a nonhungry state have poor satiating efficiency: influence of snack composition on substrate utilization and hunger.

Consuming a high protein snack 3 hours 35 mins after lunch delayed the latency of dinner request by ~ 40 minutes, whereas a high carbohydrate snack did not notably delay the request. Ad libitum energy intakes at the dinner did not differ according to snack composition.

Marmonier et al.

American Journal of Clinical Nutrition; 76 (3), September 2002. Pp518-528.

June 2002

Carbohydrate and Satiety

The effect of carbohydrate on food intake is potentially dependent on the rate of gastric emptying, small intestinal transit, small intestinal digestion and absorption, and gut hormone release. Monosaccharides, excluding glucose, are poorly absorbed from the small intestine and therefore use of these sugars as sweeteners in food systems could help to reduce food intake.

Feinle et al.

Nutrition Reviews, 60 (6), June 2002. Pp155-169.

May 2002

The ability of habitual exercise to influence and food intake in response to high- and low-energy preloads in man.

No difference in ad libitum energy intakes was observed in non-exercising subjects following the high- and low-energy preloads. In contrast exercising subjects reduced their energy intakes following the high-energy preload compared with the low-energy preload. The ratios of macronutrients selected by the subjects did not differ between exercisers and non-exercisers.

Long et al.

British Journal of Nutrition; 87 (5); May 2002. Pp517-523.

March 2002

An investigation of the role of oro-sensory stimulation in sugar satiety.

Chewing sucrose-containing pastilles, over a 10-minute period, reduced energy intake during a subsequent test meal more than when water or an equicaloric sucrose-containing drink, consumed over 2-minutes. Energy intake in the test meal was higher after consuming the sucrose-containing drink compared to after consuming the water. Study supports the hypothesis that enhanced oro-sensory stimulation plays a role in the suppression of .

Lavin et al.

International Journal of Obesity, 26 (3) March 2002. Pp384-388

February 2002

Stimulus satiation: effects of repeated exposure to foods on pleasantness and intake.

Subjects rated pleasantness and desire to eat that food each day. Over the 22day study period the desire to eat and the pleasantness of eating chocolate declined, however, intake did not decrease. Pleasantness or desire to eat did not decline in those consuming bread and butter. Subsequent experiments found that when given increasing amounts of chocolate, pleasantness and desire to eat declined over time, but intake did not decrease.

Hetherington M et al.

, 38 (1), February 2002. Pp19-28.

January 2002

sensations and eating behaviours to complete fasting in obese and non-obese individuals.

Using a Visual Analogue Scale (VAS) perceptions of hunger, desire to eat, prospective consumption and fullness were measured in both obese and non-obese individuals over a 9 day fasting period. Distinct differences in response were observed between groups; the measures for hunger, desire to eat, and prospective consumption VAS progressively decreased in the non-obese while they increased in the obese. No group difference was evident prior to fasting.

Oh, S-Y., Kim, B.S. and Choue, R.

European Journal of Clinical Nutrition. Vol. 56 (1) January 2002. Pp86-89.

2002

Comparison of oral and gastric administration of sucrose and maltose on gastric emptying rate and .

Gastric emptying rate of maltose was markedly slower than that of sucrose both when administered orally and directly into the stomach. In comparison, suppression of differed depending on the administration of the sugars. Sucrose induced a greater suppression of prospective consumption and enhanced feeling of fullness than maltose only when given orally.

Lavin, J.H., French, S.J. and Read, N.W.

International Journal of Obesity, 2002, Vol 26. Pp80-86

December 2001

Effect of sucrose and safflower oil preloads on short-term and food intake of young men.

The effects of sucrose (CHO) and safflower oil (fat) on were investigated and compared at varying levels of intake. Sucrose consumption resulted in a dose dependent reduction in and food intake that was greater than the reduction produced by safflower oil. Previous studies however, suggest the effects of fat on satiety may take longer than those of CHO to become evident (1 hour interval studied in this case).

Woodend, D.M. and Anderson, G.H.

: Eating and Drinking. Vol 37 (3) December 2001. Pp185-195.

November 2001

Substrate oxidation and control of food intake in men after a fat-substitute meal compared with meals supplemented with an iso-energetic load of carbohydrate, long-chain triacylglycerols or medium-chain triacylglycerols.

Evidence indicates that the post meal interval is related to the energy intake from a meal and the rate of glucose oxidation. The CHO supplemented lunch was shown to have a more pronounced effect on satiety than the fat supplemented lunch. Medium-chain TAGs however, may play an active role in controlling food intake, particularly in satiation at the next meal.

Wymelbeke, V.V. et al.

The American Journal of Clinical Nutrition, November 2001, Volume 74, No 5. Pp620-630.