Engineering the Perfect Diet: The Problem with Sugar and Artificial Sweeteners

Brian R. Hoffmann, PhD
Assistant Professor
Department of Biomedical Engineering
Max McGee National Research Center
Center for Advancing Population Science
Cardiovascular Center
Medical College of Wisconsin
Marquette University

Outline

• Diabetes Overview
• Implications of Chronic Sugar and Artificial Sweetener Consumption
• Forward Thinking: What can we do?

Global Prevalence of Diabetes

Rapid Rise in Diabetes
Diabetes Complications

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Blood Glucose Regulation

Hyperglycemia (High Blood Glucose)

https://www.umassmed.edu/dcoe/diabetes-education/complications/

http://www.healthy-diet-healthy-you.com/Low_Glycemic_Foods.html

Hyperglycemia (High Blood Glucose)

Diabetes Blood Glucose Levels

- Normal: <120 mg/dl
- Prediabetes: 126-199 mg/dl
- Diabetes: ≥200 mg/dl

Spontaneous Sugar Modifications (Similar to Marinating Steak)

Endothelial Cell Tube Formation Assay:

Endothelial Cell Groups:
1. Normal Glucose (NG)
2. High Glucose (HG)
3. NG plus PNGaseF (NG-PF)
4. HG plus PNGaseF (HG-PF)

PNGaseF (PF): Removes specific sugar modifications

Dhanush Haspula (Postdoctoral Fellow)

High Glucose Cardiovascular Impairment

Endothelial Cell Tube Formation Assay:

Endothelial Cell Groups:
1. Normal Glucose (NG)
2. High Glucose (HG)
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4. HG plus PNGaseF (HG-PF)

Identify Sugar Modified Proteins in Cells

No Treatment

Treatment

High Glucose

Identify Sugar Modified Proteins
Sugar Modified Proteins

Sugar Modification (Red)

What About Artificial Sweeteners?

FDA Approved Major Artificial Sweeteners

Sweetener Biochemical Variation

Sweetener Induced Changes

Measure Blood Glucose Over Time

Added to Water
**Sweetener Induced Changes**

- Aspartame
- Acesulfame K
- Saccharin
- Stevioside

**Impact on Cardiovascular Function**

- Acesulfame K
- Aspartame
- Stevioside
- Sucralose

*Significantly different (p<0.05, N=6); Diets started at weaning (21 days of age); BB-DR is a T1D Susceptible Rat

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Targeted Therapeutics

1) Mutate Site of Modification

Increased glycosylation prevents function and an autoimmune response occurs

2) Nano Delivery Systems

Nano vesicle = Nano vehicle

Treatment Molecule

Blood Vessel Cell Lining

Tissue Regeneration – Adult Stem Cells

EC = Endothelial Cell

EPC = Endothelial Progenitor Cell


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CHALLENGE: Adult stem cells are often dysfunctional during states of diabetes

Transform Sweetener Studies to Patients

Study Visit

Plasma Collection

Increased consumption of sweeteners and metabolic control

Measure Body Composition

Be Aware of Your Consumption

BRAN MUFFIN

Calories = 269
Protein = 4 grams
Fat = 15 grams
Fiber = 1 gram
Sugar = 15 grams
Sodium = 202 mg
Cholesterol = 19 mg
Vitamin K = 8.2% of Daily Value

REGULAR SODA

Calories = 170
Protein = 0 grams
Fat = 0 grams
Fiber = 0 grams
Sugar = 46 grams
Sodium = 45 mg

DIET SODA

Calories = 0
Protein = 0 grams
Fat = 0 grams
Fiber = 0 grams
Sugar = 0 grams
Sodium = 30 mg

NOTE: Contains sucralose, acesulfame potassium, aspartame

SUGI’S YOGURT

Calories = 424
Protein = 5 grams
Fat = 18 grams
Fiber = 1 gram
Sugar = 39 grams
Sodium = 380 mg
Cholesterol = 34 mg
Vitamin K = 49% of Daily Value

LIGHT & FIT YOGURT

Calories = 120
Protein = 16 grams
Fat = 0 grams
Fiber = 0 grams
Sugar = 9 grams
Sodium = 60 mg
Calcium = 15% of Daily Value

DANNON FRUIT YOGURT

Calories = 150
Protein = 6 grams
Fat = 1.5 grams
Fiber = 0 grams
Sugar = 26 grams
Sodium = 105 mg
Calcium = 20% of Daily Value

NOTE: Contains sucralose, and acesulfame potassium

Calories = 80
Protein = 12 grams
Fat = 0 grams
Fiber = 0 grams
Sugar = 7 grams
Sodium = 45 mg
Calcium = 15% of Daily Value
Be Mindful of Reporting

Nutritional Balance

IN OUT

METABOLISM
cjlearning.wordpress.com
http://mitrafarmand.com/comic/elephant-in-the-room/

Nutritional Balance

IN OUT

METABOLISM

Nutritional Balance

IN OUT

Metabolic Syndrome and Diabetes