Welcome to the COPE Webinar Series for Health Professionals!

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Low Calorie Sweeteners and Healthy Lifestyle: Do They Fit Together?

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Handouts of the slides are posted at: www.villanova.edu/COPE
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MacDonald Center for Obesity Prevention and Education (COPE)
Goals

- Provide Continuing Education
- Participate in Research
- Enhance Education
- Partner with agencies and organizations

Low Calorie Sweeteners and Healthy Lifestyle: Do They Fit Together?

Objectives:
1. Examine recent controversies involving the use of low calorie sweeteners.
2. Understand the science regarding the impact of no and low calorie sweeteners on hunger, appetite and diet quality.
3. Describe the safety evaluation process and determination of the Acceptable Daily Intake (ADI) for a low calorie sweetener.
Notice:

- Villanova University College of Nursing is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center Commission on Accreditation
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- The American College of Sports Medicine's Professional Education Committee certifies that Villanova University College of Nursing Continuing Education, Center for Obesity Prevention and Education (COPE) meets the criteria for official ACSM Approved Provider status (2015-December, 2018). Providership #588649

Credits:

- This webinar awards 1 contact hour for nurses and 1 CPEU for dietitians
- Suggested CDR Learning Need Codes: 2000, 2030, 4000, 5370, Level 2

Low Calorie Sweeteners and Healthy Lifestyle: Do They Fit Together?

Berna Magnuson PhD, ATS
Vice-President
Health Science Consultants
Low Calorie Sweeteners and Healthy Lifestyle: Do they fit together?

Berna Magnuson, PhD, ATS Fellow
HEALTH SCIENCE CONSULTANTS

2015-2020 Dietary Guidelines for Americans

- Recommended reduction in intake of added sugars to <10% total daily calories.
- Noted that available scientific evidence demonstrates that FDA-approved no calorie sweeteners are safe for the general population.
Do they fit into a “healthy” lifestyle?

- yes
- no
- maybe

Objectives:

- Identify & examine recent controversies.
- Understand science regarding impact of no and low calorie sweeteners (LCS) on hunger, appetite & diet quality.
- Describe the safety evaluation process & determination of the ADI for a LCS.
**Let’s start with safety…**

Safety = absence of risk

Risk = Hazard (Potential to cause harm) × Exposure

http://toxedfoundation.org/hazard-vs-risk/
Can have acceptable Risk with High hazard – Low Exposure

If low hazard, can have higher exposure –

*Drinking Too Much Water Can Kill: People can and do drink themselves to death.*

6L FOR 165lbs PERSON
IMPORTANT:
For ALL chemicals -
natural and man-made

There is a dose:
• that can cause toxicity,
And-
• that is safe - does not cause an adverse effect.

Hazard evaluation of LCS
• A extensive number of toxicology tests required
• What happens to the compound when we consume it?
• Toxicity following long-term consumption?
• Any effect on mutations or cancer development?
• Reproductive toxicity?
  • before and during pregnancy
• Teratogenicity – effect on development?
• Also human clinical studies
  • effect on blood sugar or insulin?

FDA Redbook, Recommended Toxicology Studies, 2007

Acceptable Daily Intake (ADI)
Established by Regulatory Agencies
• Results from safety studies used to establish the No Observed Adverse Effect Level (NOAEL)
• amount consumed every day without adverse effect
• Divide by “safety factors” to account for
  • differences between individuals
  • differences between humans and animals

NOAEL/safety factors = ADI
(amount/kg body weight/day)

www.efsa.europa.eu/sites/default/files/scientific_output/.../1150.pdf
Human studies
Clinical studies conducted for all LCS
- submitted to regulatory agencies confirming safety of long term LCS consumption at = or > ADI.
Diabetics specifically studied –
- no effect on blood sugar or insulin.
Also epidemiology studies have confirmed safety of use.

See reviews: Magnuson et al., 2007; Grotz and Munro 2009; Arnold et al., 1983; Carakostas et al., 2008
Are LCS Safe for pregnant women? Children? Yes, for approved sweeteners!

This question MUST be answered in safety testing before sweetener is approved for use in foods and beverages! ADI applies to entire population.

Safety = absence of risk

Risk = Hazard (Potential to cause harm) × Exposure

Must also consider exposure

- Using food intake surveys, regulatory agency estimate possible intakes.
- Agencies set Maximum Permissible Levels (MPL) in foods & beverages.

MPLs in different foods and beverages ensure low probability of exceeding ADI.

http://www.fda.gov/Food/IngredientsPackagingLabeling/FoodAdditivesIngredients/ucm094211.htm
Sweetness Intensity Means Low Intake

<table>
<thead>
<tr>
<th>Sweetener</th>
<th>Sweetness Intensity*</th>
<th>To replace 25 g of sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acesulfame K</td>
<td>~ 200 x</td>
<td>125 mg</td>
</tr>
<tr>
<td>Aspartame</td>
<td>~ 200 x</td>
<td>125 mg</td>
</tr>
<tr>
<td>Saccharin</td>
<td>~ 300 x</td>
<td>80 mg</td>
</tr>
<tr>
<td>Steviol glycosides</td>
<td>200 - 300 x</td>
<td>80-125 mg</td>
</tr>
<tr>
<td>Sucralose</td>
<td>~ 600 x</td>
<td>40 mg</td>
</tr>
</tbody>
</table>

* compared to sugar

ADI expressed as servings for adult (70 kg) each day

<table>
<thead>
<tr>
<th>Sweetener</th>
<th>Ace K</th>
<th>Aspartame</th>
<th>Sucralose</th>
<th>Stevia Glycosides</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADI mg/kg body wt</td>
<td>0-15</td>
<td>0-50</td>
<td>0-5</td>
<td>0-4 as steviol</td>
</tr>
<tr>
<td>Servings of packets/day</td>
<td>23</td>
<td>75</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>Servings of sodas/day</td>
<td>25</td>
<td>18</td>
<td>15</td>
<td>16</td>
</tr>
</tbody>
</table>

Based on 12 oz or 350 ml;
http://www.fda.gov/Food/IngredientsPackagingLabeling/FoodAdditivesingredients/ucm387726.htm

NOEL vs ADI vs Consumer Consumption of Aspartame

![Graph showing NOEL vs ADI vs Consumer Consumption of Aspartame](image)

- No observed effect level in lifetime studies
- High level of safety
- Key risk

Magnuson et al., 2007
So if these sweeteners are safe, why is there so much controversy?

In many cases, controversy because:

- Inappropriate extrapolations;
- Experimental protocol not physiologically relevant;
- Associations in observational studies interpreted as causation;
- Controversies make good news stories.

Source of Controversy:
- Inappropriate extrapolations
  - Example: Study on artificial sweeteners and gut microbiota
  - Sweeteners tested in mouse study:
    - aspartame, saccharin, sucralose,
    - very high doses used,
    - microflora actually not evaluated.
  - Remaining experiments only use saccharin - extrapolate results to all “artificial sweeteners”.

Suez et al., 2014
**Saccharin**

- Small molecule;
- Majority absorbed, excreted in urine;
- With high doses, some to colon; excreted in feces.
- Effect of high doses on gut microflora reported in '80s, extensive investigation followed.
  - Daly, K. et al. (2014). Dietary supplementation with lactose or artificial sweetener enhances swine gut Lactobacillus population abundance. Br J Nutr 111: S30-5.
  - Many others: none mentioned in Nature paper.

**Sucralose**

- Structure similar to sugar, disaccharide with 3 Cl
- Cannot be digested into monosaccharides – no impact on blood glucose.
- Extensive studies conducted; gut microflora unable to hydrolyse sucralose.

Grice and Goldsmith, 2000
Aspartame

2 amino acids & methyl group
• Aspartic acid (aspartate)
• Phenylalanine

Not absorbed intact.

Completely digested into these components which are all commonly found in foods!

Magnuson et al., 2007
Steviol glycosides
Many different glycosides; Varying glucose number & position
• Reb A – sweetest; 4 glucose units
• Stevioside – 2 glucose units

• Extensive metabolism by colonic gut microflora, to common metabolite, steviol.
• Is why ADI expressed as “steviol equivalents”.

Carakostas et al., 2008

Source of Controversy:
- Experimental design

Example: Same study on gut microbiota
• Ignored the fact that the LCS dosing protocol resulted in significant changes in total diet intake and diet composition.
• Difference in intake of other nutrients known to affect microflora!

LCS added to drinking water, increased liquid intake, and significant reduction in food: >50% in saccharin group!
Results in significant changes in diet, not just LCS!
Not physiologically relevant to human consumption
Note: liquid & food intake only for 4/20 mice/group and 72 hr of 11 weeks.

Suez et al., Nature, 2014

Take Home Messages:
Observations with one LCS not applicable to all.
Must consider if experimental protocol valid – where other variables controlled?

For critical review of Nature study See: Calorie Control Council webpage
http://www.caloriecontrol.org/pressrelease/council-spokesperson-berna-magnuson-reviews-nature-study-on-low-calorie-sweeteners-0

Controversy: LCS and weight
Based on observations of positive correlations between LCS consumption and body weight and/or BMI.
Cause or result?
Association does not establish CAUSE!

See review: Pereira, Nutr Rev 2013
Meta-Analysis: Randomized Controlled Trials (RCT) and Prospective Cohort Studies on LCS and Body Weight

15 RCTs and 9 prospective trials analyzed
- **RCTs**: LCS associated with reduced body weight, BMI, fat mass and waist circumference.
- **Prospective**: mixed, modest or no association with increase.

**Conclusion**: RCT demonstrate that substituting LCS for sugar modestly reduces body weight, BMI, fat mass, and waist circumference.

Miller and Perez AJCN 2014

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**RCT Weight Loss and weight maintenance**: Greater success with diet beverages (DB) compared to water

- 303 overweight and obese M&F
- 12-week weight loss, 9 mo maintain
- Diet Bev (DB) or Water (W) only
  - Weight loss greater with DB:
    - DB 6 kg, W 4 kg,
    - Lost >5% body wt greater with DB;
    - DB 64%, W 43%
  - Weight loss maintenance improved in DB.

Peters et al., Obesity, 2014
Peters et al., Obesity, 2016

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**Controversy: LCS and Appetite or Hunger**

- Most studies and reviews conclude that LCS do not affect appetite or hunger or desire for sweetness.
- RCTs that measured hunger and food choices demonstrate either no or possible beneficial effect.

Anderson et al. 1989; Drewnowski et al., 1994; Rogers et al. 1995; Blackburn et al., 1997; Mattes et al. 2006; Anderson et al., 2012; Gardner et al., 2012; Piernas et al., 2013, Peters et al., 2016.
LCS use in successful weight loss maintainers

Surveyed 434 National Weight Control Registry members: (lost >13.6 kg and maintained weight loss for >1 yr).

• 53% regularly consume LCS beverages,
• 78% say diet beverages help them control total calories,
• Changing patterns of beverage consumption very important for many for:
  • weight loss (42%)
  • maintenance (40%).

Catenacci et al., 2014, Obesity.

Controversy: LCS and Diet Quality

Concern: “Use of sweet, yet non-caloric LCS, might confuse the body, provoke increased appetite for sweet foods, reduce overall diet quality and contribute to weight gain.”

Addressed in study by Drewnowski and Rehm

Food intakes:
• 22,231 adults from 5 cycles NHANES (1999-2008),
• Single 24-hour recall,
• Compared overall diet quality of LCS consumers and nonconsumers
  • LCS beverages & foods and tabletop sweeteners,
  • Diet quality = Healthy Eating Index 2005 (HEI 2005)*
• Other health behaviors assessed
  • physical activity, smoking and alcohol use


LCS consumers have better diets

Drewnowski and Rehm, 2014 Nutrients
Conclusions

- Hundreds of studies carefully reviewed by regulatory agency experts worldwide confirm LCS safety at approved use levels.
- Journal reports, not subject to same rigor, have lead to controversies.
- Understanding of safety assessments, chemistry and metabolism of LCS facilitates ability to address controversies.

Conclusion: Do LCS fit into a “healthy” lifestyle?

✔ yes
☐ no
☐ maybe

WHAT DOES THIS ALL MEAN?

When combined with a healthy diet, being physically active, and adopting other healthy behaviors, using low-calorie sweeteners to reduce calories is a winning strategy for improved weight management and better health.

Center for Public Health Nutrition, University of Washington
Thank you!

Questions?
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Evaluations and CE Certificates

- Those completing the webinar will be emailed a link to the evaluation.
- The email will be sent to the email address that you used to register for the webinar.
- Complete the evaluation soon after you receive the email. The evaluation does expire after 3 weeks. Once expired, you cannot obtain a certificate.
- Once the evaluation is completed, the CE certificate will be emailed separately within 2 or 3 business days.

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Paul J. Arciero FACSM, FTOS
Professor, Health and Sciences Department
Director, Human Nutrition and Metabolism Laboratory
Skidmore College
Owner, PRISE LLC and GenioFit™

The PRISE Protocol for Optimal Health and Performance
Date: Wednesday, November 9, 2016
Time: 12:00PM - 1:00PM EST
CE Credit: 1.0 contact hour, 1.0 CPEU
To register: villanova.edu/cope
Questions and Answers

Moderator: Lisa K. Diewald MS, RD, LDN
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Thank you to SPLENDA® Sweeteners for their support of this webinar.