

Role of Sugar and Substitutes in Healthy Life

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Why sugar is added to food



- Taste
- Availability



- **Functions:**
 - ❖ Source of glucose to the body
 - ❖ Sweetness and flavour
 - ❖ Preservative
 - ❖ Colour
 - ❖ Viscosity
 - ❖ Bulking agent
 - ❖ Fermentation

SUGAR CONSUMPTION






There is no RDA for sugar intake

The AHA recommendations

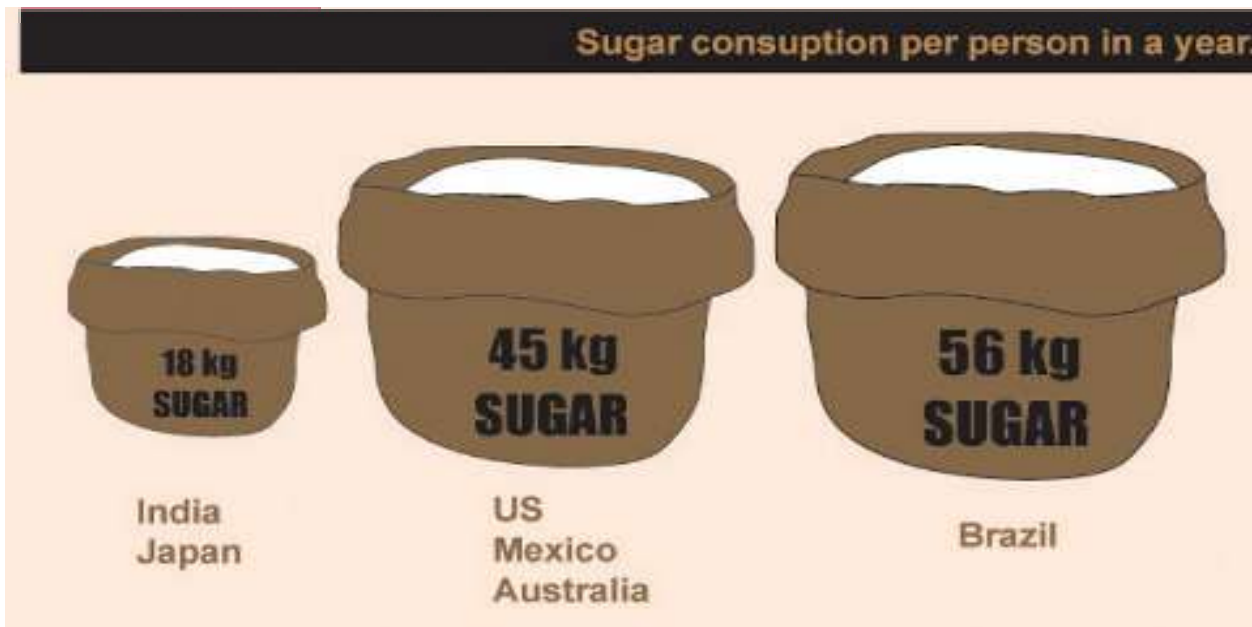
- focus on all added sugars, without singling out any particular types such as high-fructose corn syrup.
- no more than 100 calories per day, or about 6 teaspoons of sugar for women. For men, it's 150 calories per day, or about 9 teaspoons

How sugar affects our body

- Too much glucose $>$  insulin $>$ sugar is stored as fat  cells become resistant to insulin  diabetes/obesity
- Obesity leads to heart disease, joint problems, high blood pressure
- Sucrose also contains 50% fructose which is metabolized in liver to glucose and later fat

Need for sugar substitute

- Energy or calorific value - obesity
- Health effects: Diabetes
- Dental caries
- Hyperactivity in children



High Gi
70 & Above

High GL
20 & Above

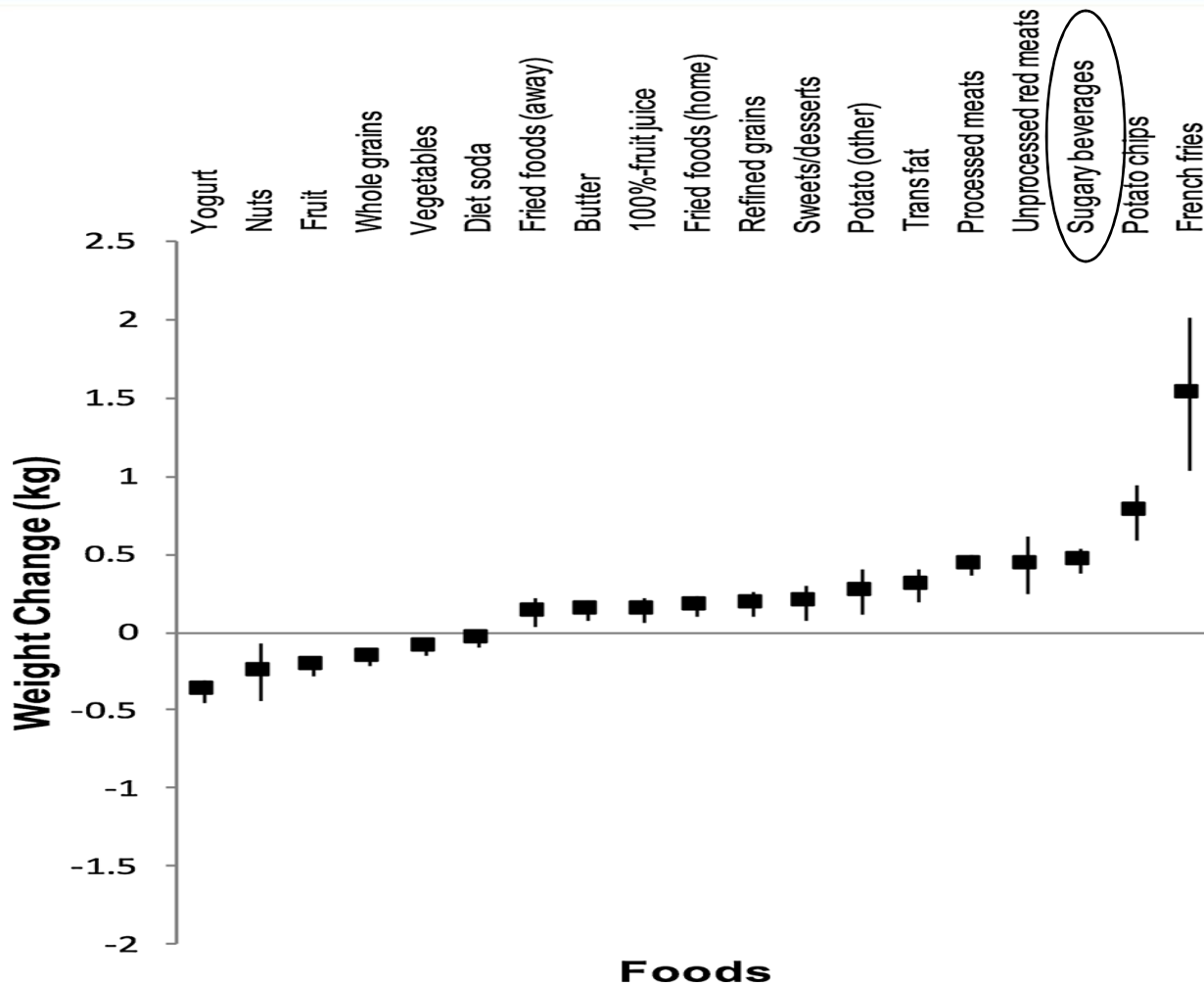
Medium Gi
56 - 69

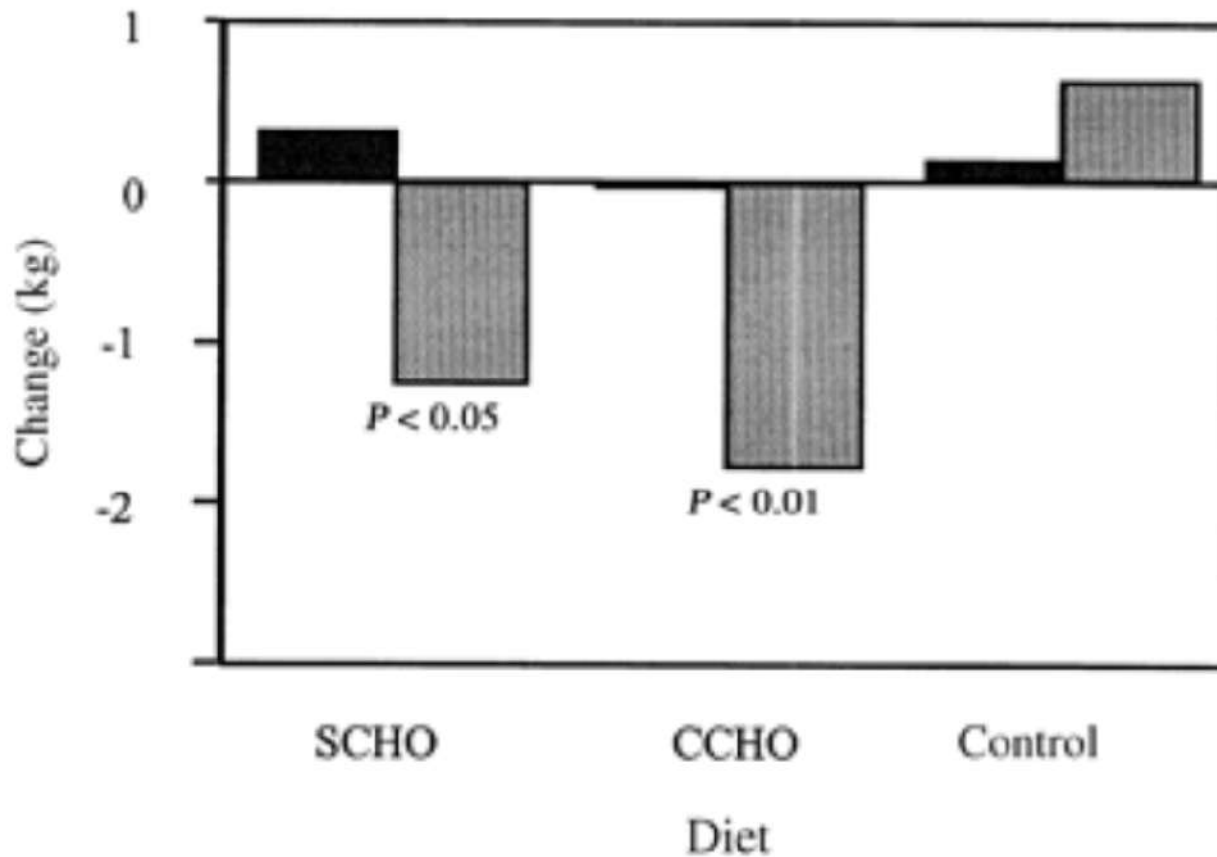
Medium GL
11 - 19

Low Gi
55 & Below

Low GL
10 & Below

Effect of food products on weight





SCHO: Low fat, High sugar diet

CCHO: Low fat, High Oligosaccharide, high starch diet

Control: Normal fat, Normal CHO, conventional diet

From: Sugars, energy metabolism, and body weight control

Am J Clin Nutr. 2003;78(4):850S-857S. doi:10.1093/ajcn/78.4.850S

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Challenges of sugar substitution

- Replace sweetness of sugar
- Bulking
- Viscosity
- Heat stability
- Stability in acidic environment
- After taste/cooling



Sugar substitutes

- High intensity sweeteners: used in small quantities
 - Saccharin
 - Sucralose
 - Aspartame
 - Acesulfame K
 - Stevia
- Bulking agents
 - Maltodextrin
 - Maltitol
 - Erythritol
 - Xylitol
 - Lactose



High intensity sweeteners



Saccharin

- 300-700 x as sweet as sugar
- Used in soft drinks and as a tabletop sweetener (coffee, on cereal) (Sweet&Low)
- Rapidly excreted in the urine; does not accumulate in the body
- **Challenge:** bitter or metallic aftertaste, especially at high concentrations
- Saccharin is unstable when heated
- Bladder tumour formation in mice

Sucralose

- Derivative of sucrose – replaced 3 hydroxyl groups of sucrose with chlorine atom \Rightarrow not recognized as CHO so it passes through GI tract unabsorbed
- 600 x as sweet as sugar: can be used in baking, table top sweetener, dairy products, soft drinks (Splenda)
- **Challenge:** recent reports indicate increase in blood glucose levels, negative impact on gut flora



High intensity sweeteners



Aspartame

- made up of 2 amino acids and a methyl group so has 4kcal/g like protein, but since so little is used **no caloric effect**
- 200 x as sweet as sugar
- used as a tabletop sweetener (Equal)
- Challenge:** dangerous for people with PKU – phenylketonuria since it contains phenylalanine which people with PKU cannot metabolize accumulation causes mental retardation

Acesulfame K

- Dihydrooxathiazinone dioxide
- 200 x as sweet as sugar
- Used in chewing gum, dry beverage mixes, breath mints, cough drops
- **Challenge:** contains methylene chloride; Long-term exposure to methylene chloride can cause headaches, depression, nausea, mental confusion, liver effects, kidney effects, visual disturbances and cancer in humans



Natural High Intensity sweeteners



- **Stevia:** Steviol glycosides extracted from leaves of the plant *Stevia rebaudiana*; 200-300x sweeter than sucrose
- **Thaumatococin:** protein extracted from Ketemfe fruit; 1600-3000x sweeter than sucrose
- **Mogrosides:** Monk fruit extract 250-400x sweeter than sucrose
- Obtained from microorganisms
- Monellin



Stevia



- Stevioside is a stable molecule at 100°C when maintained in solution in the pH range 3–9
- 300 times as sweet as sucrose
- Rebaudioside A, the second most abundant ent-kaurene glycoside sweeter than other Steviosides
- **Challenge:** bitterness and an undesirable lingering aftertaste



BULKING AGENTS: MALTODEXTRINS

- Product of partial hydrolysis of starch
- Digestible
- Resistant



- Classified by DE (dextrose equivalents) - reducing sugars
- High GI – 85-105
- Not suitable for diabetics

- Either present naturally
- Starch treated to modify digestibility
- Characteristics similar to dietary fiber
- Cost is a challenge
- May cause bloating on excess consumption

Polyols (sugar alcohols)

- Monosaccharide-derived : Sorbitol, mannitol, xylitol, erythritol
- Disaccharide-derived: Isomalt, Lactitol, Maltitol
- Foods containing polyols can be labeled as sugar-free
- Contain less calorific value than sugars
- Reduced glycemic response,
- Decreased caries risk
- Prebiotic effects

Characteristics of Sugar Alcohols



Name	Sweetness (sucrose = 1.0)	Caloric content (kcal / g)	Challenges in use as bulking agent
Erythritol	0.7	0.2	Cooling effect on tongue
Glycerol	0.6	4.3	Viscous, calorific value high
Isomalt	0.5	2.0	crystallization
Lactitol	0.4	2.0	Laxative effect
Maltitol	0.9	2.1	Laxative effect at high concentration
Mannitol	0.5	1.6	Diuretic effect
Sorbitol	0.6	2.6	Cooling effect, Digested to give small amounts of glucose in small intestine
Xylitol	1.0	2.4	Cooling effect on tongue
<i>Sucrose</i>	1	4	-



Lactose as Bulking agent



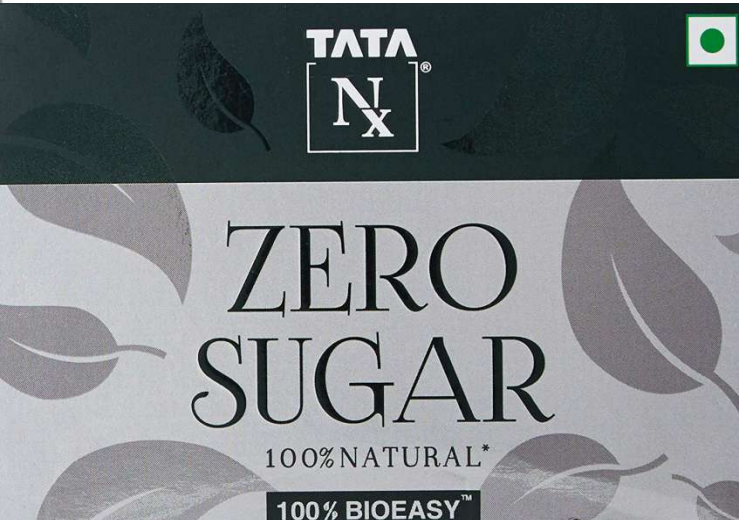
- Lactose $\xrightarrow{\text{Lactase}}$ Glucose + Galactose
- Lactase -brush border of epicytes
- Undigested Lactose \longrightarrow Gut $\xrightarrow{\text{Lab}}$ Prebiotic
- Suitable as bulking agent for high intensity sweeteners
- Natural carbohydrate, neutral taste, lower glycemic index than sucrose



Sugar replacers-Small serving sizes – 1 gram or lower



TATA Nx ZERO SUGAR



- Stevia :High intensity sweetener
- Bulking agent- lactose
- Sweetness intensity
- ❖ 1g = 1 spoon sugar
- Can be used as sugar replacer for all products
- Convenient Sachets for 1 serving



SUMMARY



- Sugar plays a major role in health as well as an ingredient
- Replacement of sugar as sweetener is a challenge

THANK YOU

