Lesson 3

Fat Substitutes & Sweeteners

(Sugar substitutes)-

Sensory Perception of Foods

Lesson 3: Fat replacers & Alternative sweeteners-

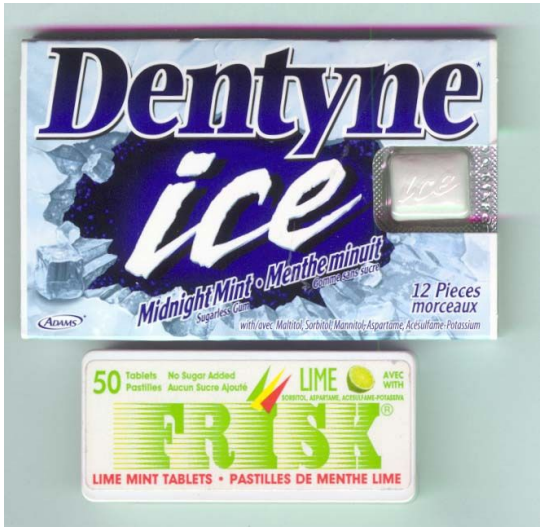
Kroger, M, Meister, K. and Kava, R. 2006. Low-calorie sweeteners and other sugar substitutes: A review of the safety issues. Comprehensive Reviews in Food Science and Food Safety 5: 35-47.

Réjeanne Gougeon, Mark Spidel, Kristy Lee, Catherine J. Field. 2004. Canadian Diabetes Association National Nutrition Committee technical review: Non-nutritive. Canadian J. Diabetes, 28(4):385-399.

Canadian Diabetes Association. Sweeteners that don't increase blood glucose levels


Original
fat free
PRINGLES
POTATO CRISPS
NET WT 6 1/2 OZ (184g)


Sugar Free
NOT FOR WEIGHT CONTROL
SnackWell's
Shortbread
Cookies
NET WT 7 OZ (198g)
3493R-V1
1297


Dentyne
ice
Midnight Mint • Menthe minuit
12 Pieces
morceaux
50 Tablets Pastilles
No Sugar Added
Aucun Sucre Ajouté
LIME
AVEC WITH
TRISK
LIME MINT TABLETS • PASTILLES DE MENTHE LIME


Diet Coke
WITH ASPARTAME
355 mL
Diet Sprite
WITH/AVEC ASPARTAME AND/ET

Why use fat substitutes?

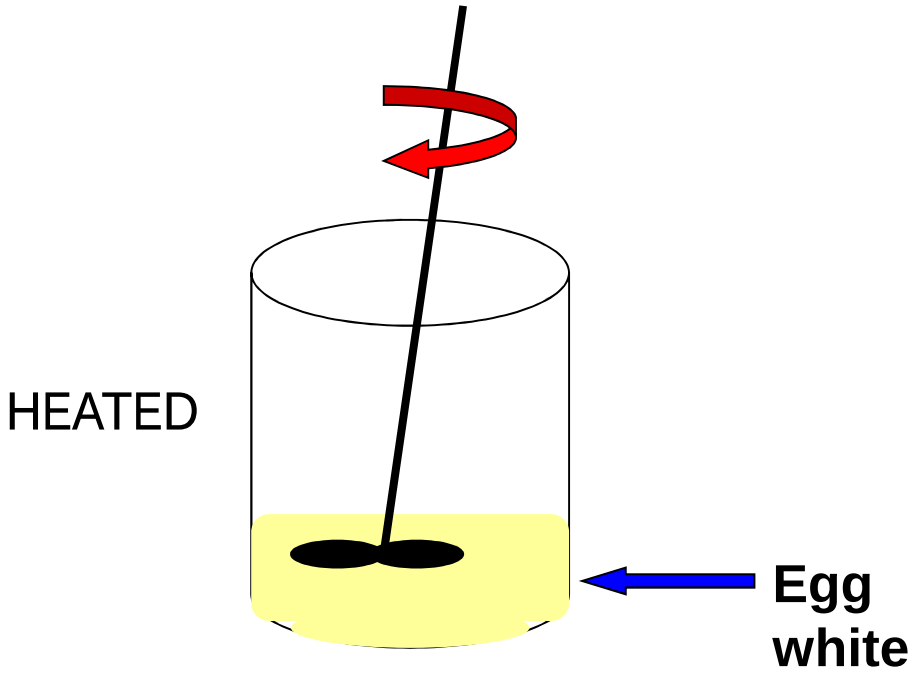
- *Lesson 1…*
- Consumer trends - demand foods with less fat, overall healthier.
  - health problems- over eating & obesity, sedentary lifestyle
  - developed countries

TYPES OF FAT SUBSTITUTES

1. Protein based
2. Carbohydrate based
3. Fat based

Protein based –Simplesse®

- Protein is partially coagulated by heat
- create a micro-dispersion: microparticulation
- spheres of protein & water are very small (0.1-0.2 microns)



- **Ice cream, yogurt, cheese spread, salad dressings, margarine, mayonnaise, coffee creamer, soups and sauces.**

Fat substitute:
Protein based – e.g. Simplesse®

- soy, milk (whey) or egg white protein
- dispersion perceived as a fluid w/creaminess & richness of fat
  - tiny particles are below the size limit that we can feel with our tongue
  - 1.3 Cal/g

Question: What is an acceptable common name for "Simplesse" when it is used as an ingredient of a food?

- *Answer:* The common name of Simplesse for use in the list of ingredients of a food depends on the form of Simplesse used in the final product. If the Simplesse is made from **egg white** and milk protein, then the common name must appear in the list of ingredients as **"egg and milk protein".** The trade name "Simplesse" may appear in brackets following "egg and milk protein". (An earlier suggested common name "microparticulated protein" is no longer required and there is no triggering of nutrition labelling.)
- If Simplesse is actually "**whey protein concentrate**", it may be described as either "**whey protein concentrate**" or "**modified milk ingredient**" (section B.01.010 (3) (b) item 7.1, of the *Food and Drug Regulations*) in the list of ingredients. In either case, the trade name "Simplesse" may appear in brackets following it. (09/MA/90; 20/MR/92; 06/NO/92; MA 25/94.)"

Fat substitute :
Carbohydrate based – e.g. Maltrin®

- carbohydrate sources: corn, potato, wheat & tapioca
  - cellulose, starch, gums, maltodextrins and fibre
- smooth mouthfeel and bland flavour
- Maltrin is fully digestible: 4 Cal/g (fat = 9 Cal/g)
- Other carbohydrate-based fat replacers available range from non-digestible to partially digestible (0-2 Cal/g)
  - eg. Avicel, Betatrim

- Margarine, salad dressings, frozen desserts, frostings, processed meat.

Fat substitute

Fat based – Sucrose Polyester, e.g. Olean®

- Also known as Olestra
- Approved in USA in 1996

  Not Approved in Canada!
- Olestra can withstand high temperatures (e.g. frying)
- Rich taste and creamy texture of ordinary fat

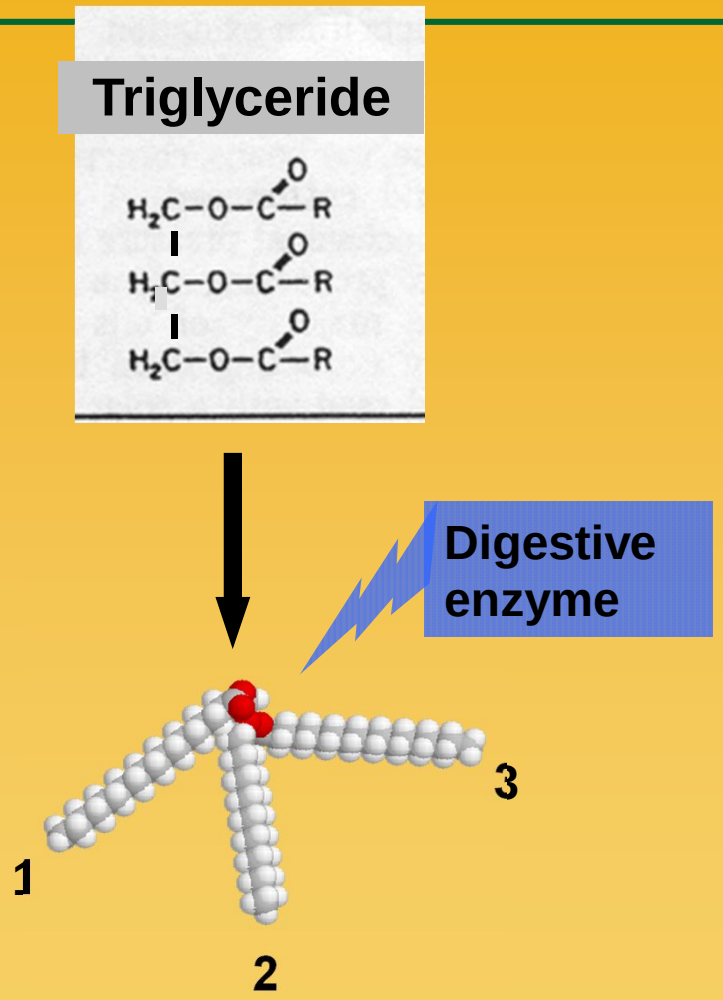
WHY?

- made primarily from fat

- **Triglycerides are broken down in the body by specific digestive enzymes (*lipases*)**

Lesson 2:

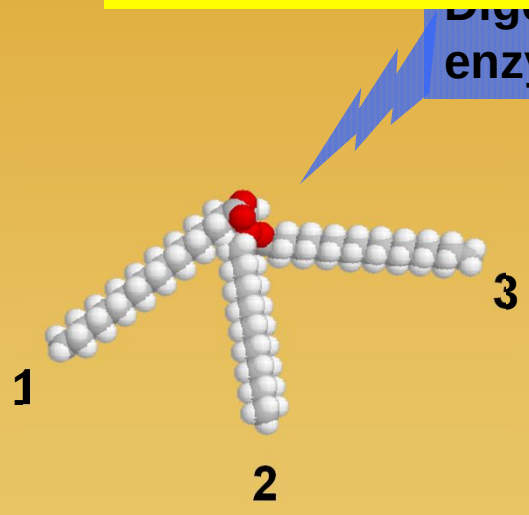
Fat is made of triglycerides (3 FA + glycerol...)



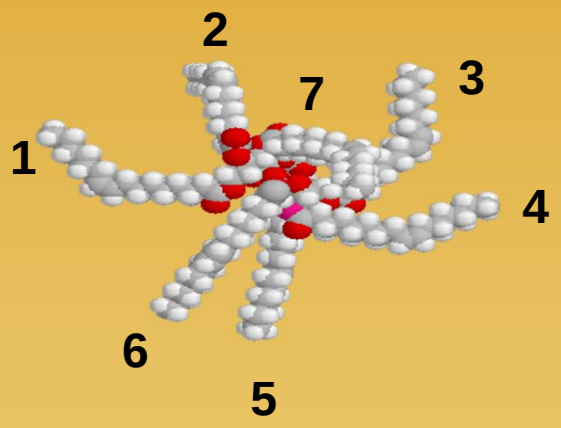
Olestra:

- **Instead of 3 FA chains attached to glycerol, there are 6-8 Fatty Acid chains attached to a SUCROSE molecule: sucrose polyester**

Not metabolized & not absorbed by the body: contributes 0 Cal / g



Triglyceride



Olestra: sucrose + FA

Sucrose polyester

Fat based – e.g. Olean® / Olestra

- Large portions of olestra snacks:
  - Abdominal cramping or changes in stool consistency (similar to consumption of high-fiber diets)
- Not digested/absorbed – thus fat-soluble vitamins consumed at the same time are also not absorbed
  - Must mention that vitamins A, D, E and K have been added

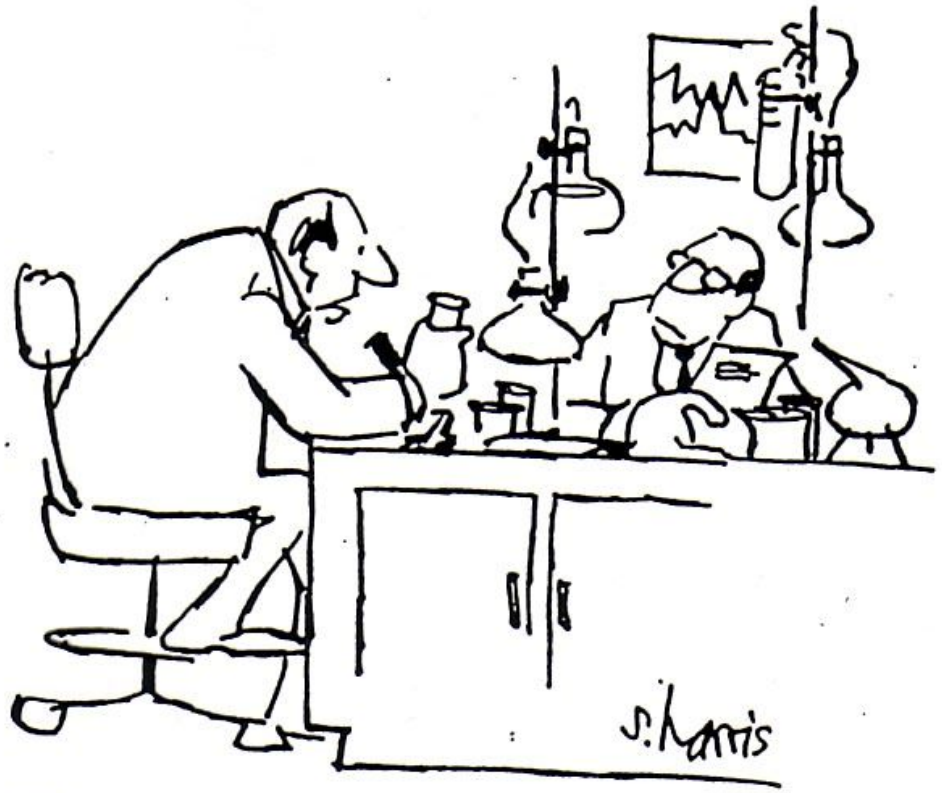
Fat based – e.g. Olean® / Olestra

- "...because of olestra's physical properties, fat- soluble nutrients present in olestra-containing foods or other foods in the GI tract at the same time as olestra can partition into olestra and pass through the GI tract without being absorbed by the body. Therefore, FDA required the addition of fat-soluble vitamins A, D, E, and K, to savory snacks containing olestra to compensate for any inhibition of absorption by olestra..."

http://www.accessdata.fda.gov/scripts/fcn/gras_notices/707728A.PDF


fat free
PRINGLES
LOOK FOR THE FLAVOR SEAL
fatfree.pringles.com
Nutrition Facts
Serving Size 1 Ounce
(28g/about 15 crisps)
Servings Per Container About
Amount Per Serving
Calories 70 Calories from Fat 0
% Daily Value*
Total Fat 0g 0%
Saturated Fat 0g 0%
Cholesterol 0mg 0%
Sodium 160mg 7%
Total Carbohydrate 15g 5%
Dietary Fiber 2g 8%
Protein 2g
Vitamin C 10%
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:
Calories: 2,000 2,500
Less than 65g 80g
Less than 20g 25g
Less than 300mg 300mg
Less than 2,400mg 2,400mg
300g 375g
25g 30g
INGREDIENTS: DRIED POTATOES, OLESTRA (OLEAN BRAND), MODIFIED CORNSTARCH, MALTODEXTRIN (FROM CORN), CONTAINS 2% OR LESS OF: SALT, DEXTROSE (FROM CORN), POLYGLYCEROL ESTERS OF MONO- AND DIGLYCERIDES*, DL-ALPHA-TOCOPHEROL ACETATE (VITAMIN E), TOCOPHEROLS (TO PROTECT FLAVOR), VITAMIN A PALMITATE, ASCORBIC ACID (VITAMIN C), VITAMIN K, AND VITAMIN D.
*Adds a trivial amount of fat.
MADE WITH Olean® BRAND FAT-FREE COOKING OIL
While many factors affect heart disease and cancer, diets low in saturated fat and cholesterol may reduce the risk of heart disease, and diets low in total fat may reduce the risk of some cancers. When eating salty snacks, olestra provides one option to reduce dietary fat.
This Product Contains Olestra. Olestra may cause abdominal cramping and loose stools. Olestra inhibits the absorption of some vitamins and other nutrients. Vitamins A, D, E, and K have been added.
37000 31175 1
QUESTIONS? COMMENTS?
1-800-395-8654
Canister contains at least 50% recycled material: 15% post-consumer content.
© P&G

SWEETENERS
(Sugar substitutes)



'This sugar substitute is perfect except for one thing. It's salty.'

Sweeteners and Sweetening agents

Food and drug regulation (FDR)defines:

http://www.inspection.gc.ca/english/fssa/labeti/guide/ch9e.shtml#9.2

“sweetener" as any food additive listed as a sweetener in Table IX to B.16.100. Examples of sweeteners are aspartame, sorbitol, and maltitol.

"**Sweetening agent**" includes any food for which a standard is provided in Division 18 of the *FDR*, but does not include those food additives listed in the table to Division 16 [B.01.001]. Examples of sweetening agents are sugar, honey and molasses.

Why do we use Sweeteners?

- Sweeteners (Sugar substitutes) –
  - those with diabetes
  - individuals concerned with high caloric intake
  - reducing risk of tooth decay (cavities)

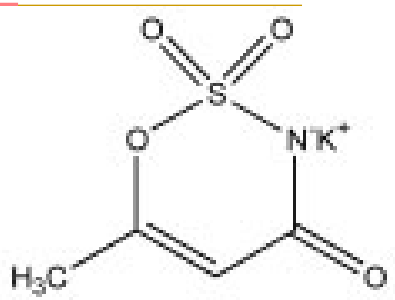
SWEETENERS
(Sugar substitutes)

- non-caloric
  (not metabolized by the body: 0 Cal / g)
  e.g. Acesulfame potassium (K), sucralose

or

- "*non-nutritive*" or low-calorie
  contribute $\leq$ 4 Cal / g but due to high sweetness → trace amount used
  e.g. Aspartame

Non-caloric sweeteners
e.g. **Acesulfame Potassium (K)**

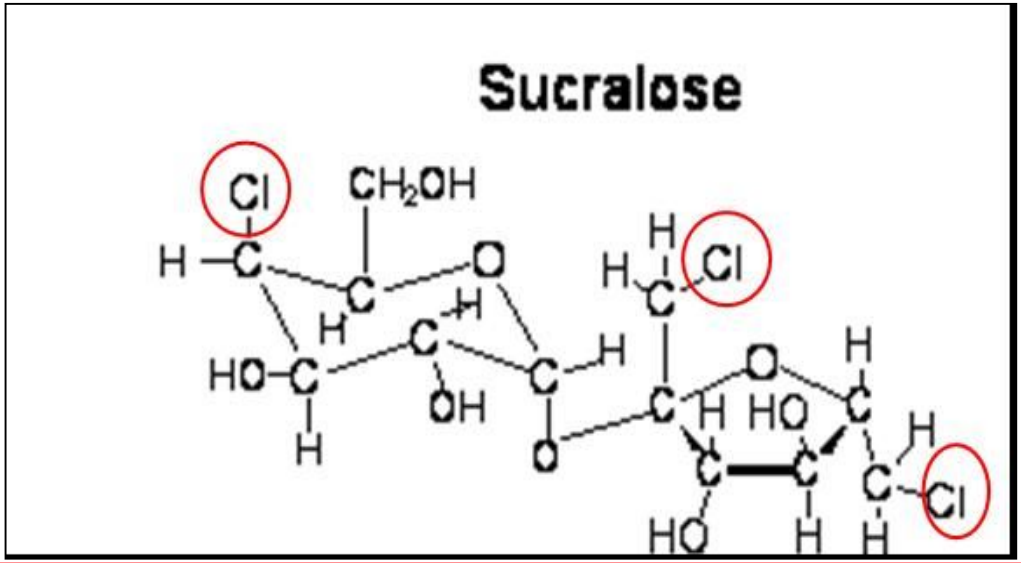


- Discovered in 1967: Sunett®, Sweetone®
- 200 times sweeter than sucrose
- Heat stable
- No contribution to cavities
- Not metabolized by the body (0 Cal/g)
- ADI of 15 mg/kg of body weight.

http://www.diabetes.ca/files/en_sweeteners_final.pdf

Non-caloric sweeteners
e.g. **Sucralose or Splenda®**

- a chlorinated molecule
  - 3 hydroxyl groups (OH) of the sucrose molecule are replaced by chlorine (Cl)
- 600x sweeter than sucrose



Non-caloric sweeteners

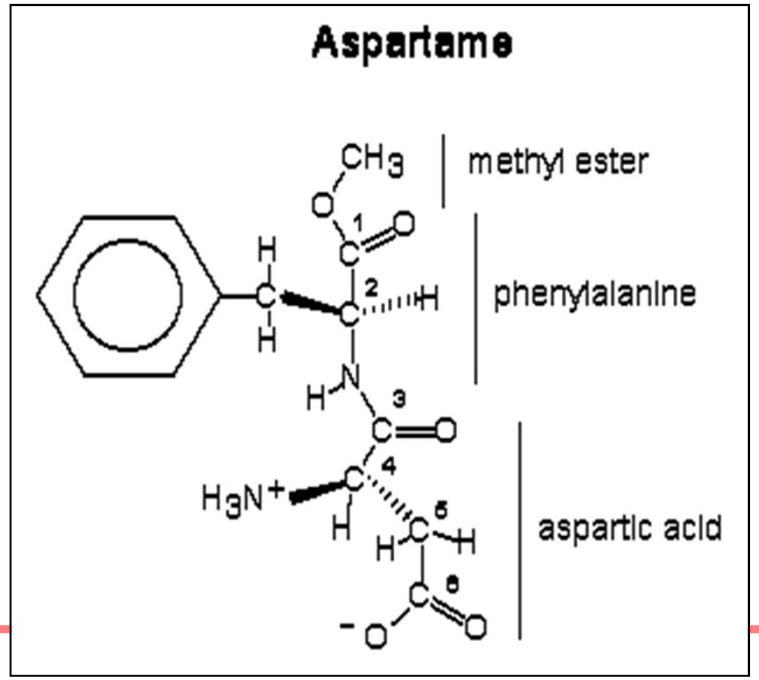
e.g. **Sucralose or Splenda®**

- Heat stable
- Not metabolized by the human body (0 Cal/g)
- ADI: 9 mg/kg body weight per day
- no effect in carbohydrate metabolism
  - No increase -blood glucose or insulin levels

Low-calorie sweeteners

e.g. **Aspartame**

- Discovered by accident in 1965 (James Schlatter)
- 2 amino acids:
  - phenylalanine & aspartic acid
- 180-220x sweeter than sucrose



Low-calorie sweeteners

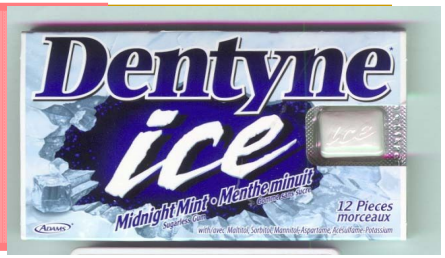
e.g. **Aspartame**

- 4 Cal/g

(due to high Sweetness only use small amount required)

- No increase in blood glucose or insulin levels
- ADI: 40 mg/kg body weight per day
- Phenylketonuria (PKU)
- Degrades at high temperatures & overtime
  - can not be used on baked goods
  - DKP
    - best before date necessary on products

Low-calorie sweeteners
e.g. **sugar alcohols**



- Sorbitol, mannitol, xylitol...
- naturally in many fruits
  - less sweet than sucrose
- Cooling sensation
- Do not promote dental caries
- No major increase - blood glucose or insulin levels
  - slow absorption... laxative effect (threshold 20-40 g/day)
- Partially digested= 1.5 -3 Cal/g

Sugar alcohols Chemical Structure

- Sugars
  - $CH_2OH\text{-}CO\text{-}(CHOH)_n\text{-}CH_2OH$
  - $CHO\text{-}(CHOH)_n\text{-}CH2OH$
- Sugar alcohol
  - $CH_2OH\text{-}(CHOH)_n\text{-}CH_2OH$

table-top sweeteners

Allowed in Canada

aspartame,
acesulfame-K,
sucralose

Neotame?

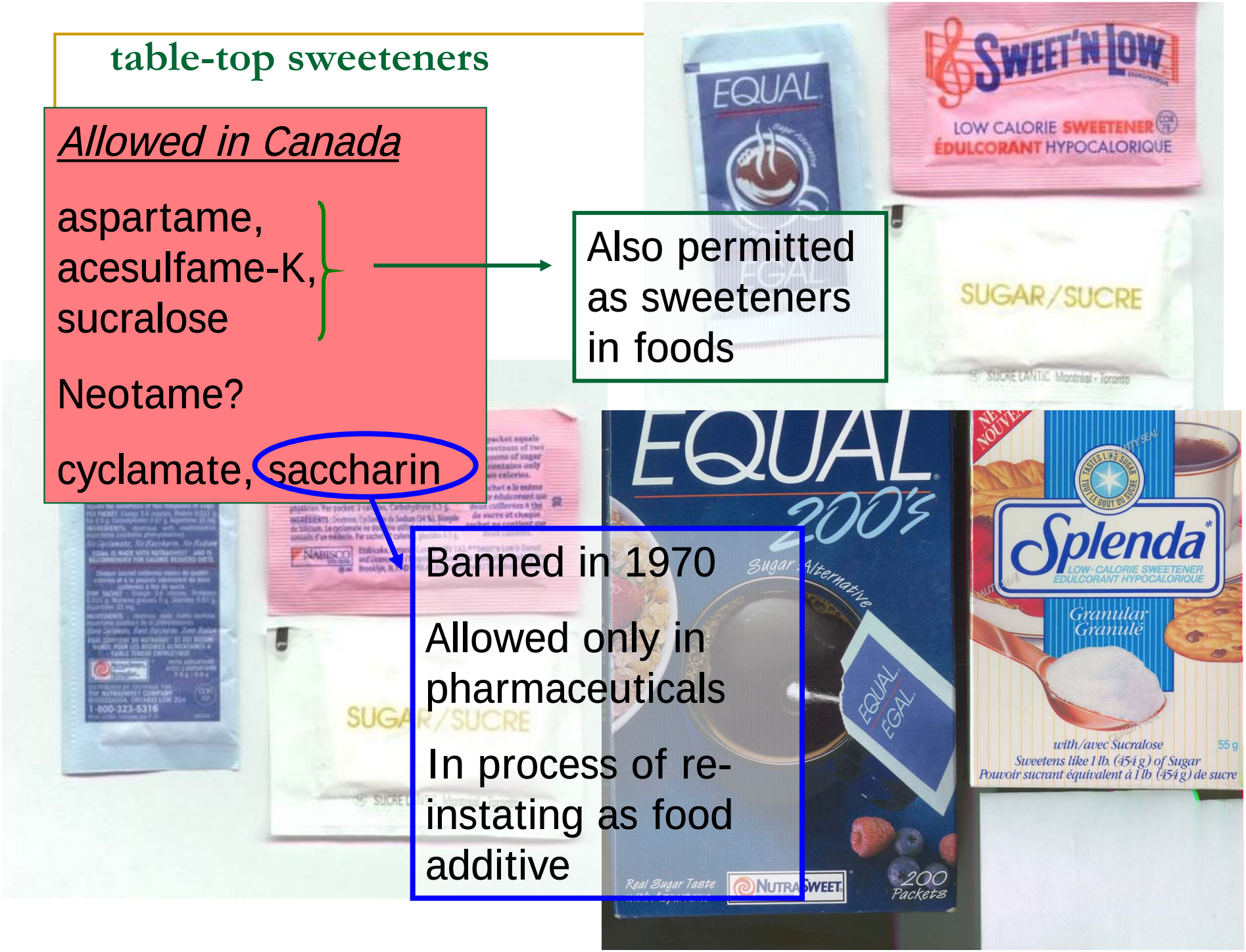
cyclamate, saccharin

Also permitted as sweeteners in foods

Banned in 1970

Allowed only in pharmaceuticals

In process of re-instating as food additive



Neotame

- Is it considered nutritive or non-nutritive sweetener?
- Is it allowed in Canada?
- What is its sweetness compared to Sucrose?

Stevia

http://www.hc-sc.gc.ca/fn-an/securit/addit/sweeten-edulcor/index-eng.php

Go to the above link and answer these questions:

- What is Stevia
- What is the status of using Stevia in Canada

Terms to remember-Fat and Sugar Substitute

Simplesse

microparticulation

Maltrin

Olean/Olestra

- **sucrose polyester**

sweetener vs. **sweetening agent**

Alternative sweeteners (eg Aspartame,…)

PKU and DKP

Sugar alcohols (e.g. Sorbitol,….)

SENSORY PERCEPTION OF FOODS

SENSORY PERCEPTION OF FOODS

- Food quality detectable by our senses:
  1. **Appearance factors**
  2. **Textural factors**
  3. **Flavour factors**

SENSORY PERCEPTION OF FOODS

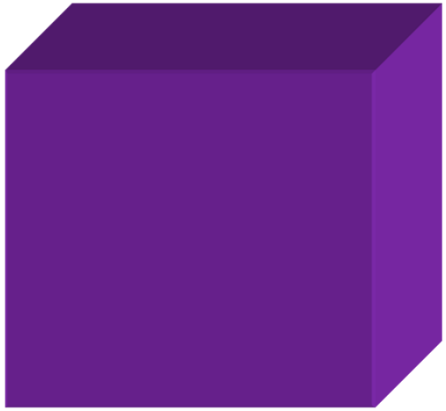
(1) Appearance

- Colour,
- Size,
- Shape,
- Gloss,
- Consistency,
- Presence of defects

SENSORY PERCEPTION OF FOODS

(1) Appearance

- Purple coloured jello cube
- What flavour would you expect to taste?



non-biased perception of flavour

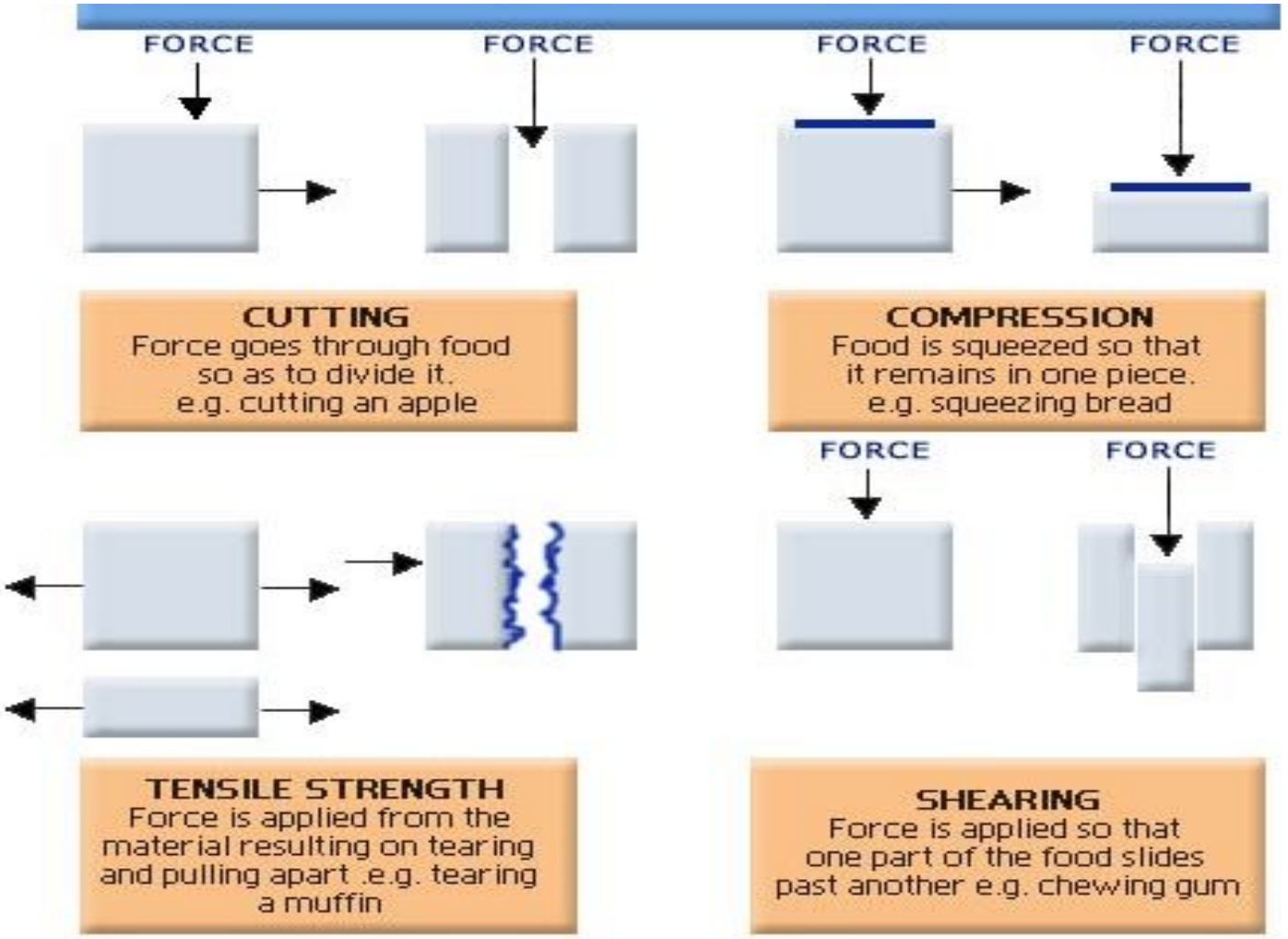
- blindfolds

Or

- sensory testing facilities with special lighting (red light)

SENSORY PERCEPTION OF FOODS

(2) Texture



SENSORY PERCEPTION OF FOODS

(3) Flavour

- Flavour – comprises both taste and smell

-water-soluble substances

-interact with sensory receptors on the tongue

- Detected in the mouth-tongue

fat-soluble & volatile aroma compounds

• interact w/receptors in the nose

receptors in the olfactory region

why food seems bland when we have a cold?

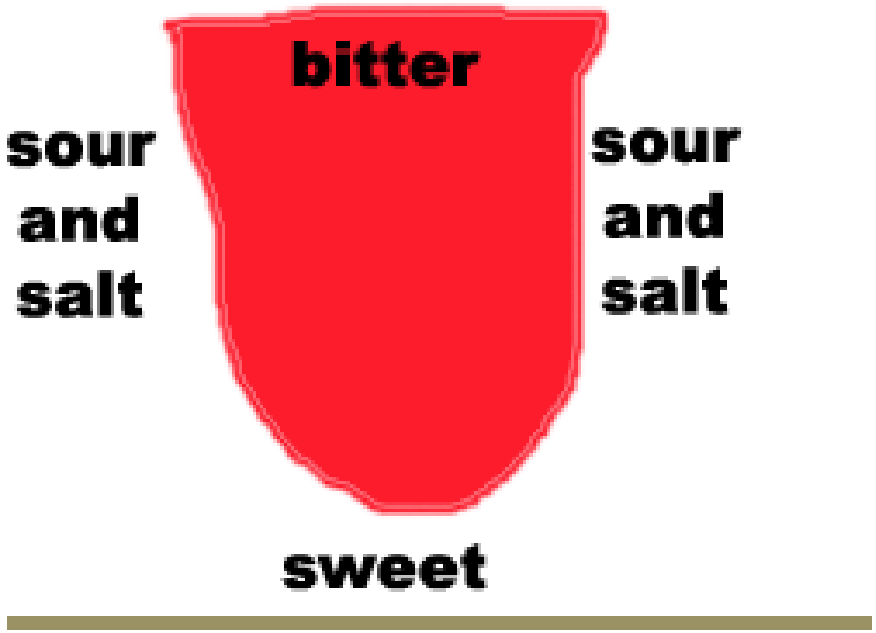
Why does food seem bland when we have a cold?

- "flavour test"
  - taste food with/without aroma
- do a "taste test"
  - compare the sweetness of sugar placed near the tip vs sides of your tongue
  - or try to note the location of your tongue that sense the bitterness of coffee or beer

The Basic Taste Sensations

- Basic tastes – **sweet, salty, sour, bitter**
- A **5th** sensation – **umami**

Old and controversial tongue map



Sweet Taste

- mono & disaccharides
- some amino acids, peptides eg. aspartame
- synthetic sweeteners eg. saccharin, cyclamate

others – chloroform, lead acetate!

Salty Taste

only sodium chloride = true salty taste

- K-chloride (used as a salt substitute) gives a bitter as well as salty taste
- Na- sulphate – bitter, only slightly salty
- Ca- chloride – very bitter
- cesium chloride – sweet!

Sour Taste

protonated (H^+), organic & inorganic acids

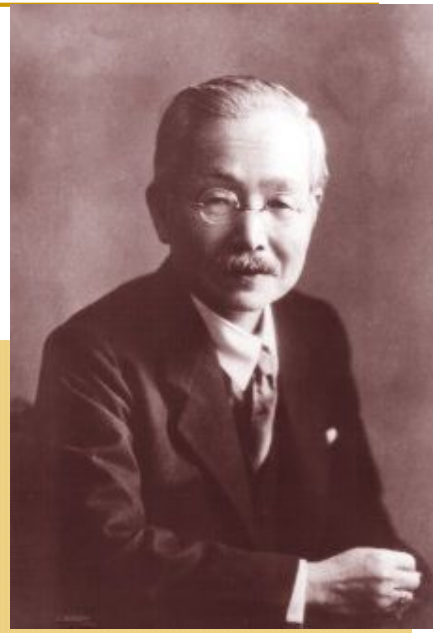
- e.g. vinegar (acetic acid)
- others –citric, tartaric, malic, lactic, fumaric and phosphoric acids.

Bitter Taste

- typically alkaloids e.g. caffeine in coffee & tea or *theobromine* in chocolate

- some salts (Na- sulphate, Ca- chloride)
- amino acids and peptides (eg. sharpness, bitterness of aged Cheddar cheese).

the fifth taste – Umami



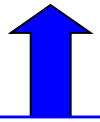
- In 1908, Professor K. Ikeda
- working with Kombu seaweed,
  - found a "*new taste*" to be present
- Extracted crystals of Glutamic Acid- *Glutamate*
- Glutamate- distinctive taste,
  - different from Sweet, Sour, Bitter and Salty:
  - "umami"

Glutamate Content of Foods

	Free glutamate (mg/100 g)
Human milk	22
Beef	33
Chicken	44
Potatoes	102
Tomatoes	140
Broccoli	176
Soy sauce	1090
Parmesan cheese	1200
Roquefort cheese	1280

the fifth taste – Umami

- Savory
- Some flavour enhancers or potentiators → umami



MSG (monosodium glutamate)–
meaty & vegetable flavours

5'-nucleotides– meaty flavours

Flavour Enhancers/Potentiators

- modify or enhance intensity or quality of taste of another substance

- eg. MSG, 5'-nucleotides...- *umami*
- eg. maltol – modifies flavours of high carbohydrate foods, beverages.

Other mouth/tongue sensations

- **Astringency**
  - More of a "physical" sensation described as puckering in the mouth; attributed to **tannins** or **polyphenols** of high molecular weight. (e.g. black tea)
- **Pungency**
  - Sensation of "spicy heat" in the oral cavity. chili peppers.
- **Coolness**
  - Various **sugar alcohols** such as xylitol and sorbitol or compounds such as **menthol (e.g chewing gum)**

Terms to remember-Sensory

- **appearance**
- **flavour**
- **aroma**
- **volatile**
- **taste receptors**
- **shearing**
- **tensile strength**
- **compression**
- **cutting**
- **umami**
- **monosodium glutamate (MSG)**
- **astringency**
- **pungency**
- **coolness**