Lesson 3

Fat Substitutes & Sweeteners (Sugar substitutes)- **Sensory Perception of Foods**

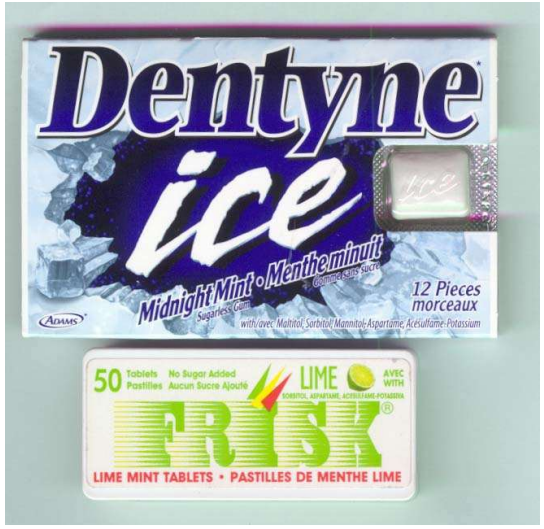
Lesson objectives

compare and contrast the different types of fat replacers and alternative sweeteners used in foods.

discuss the role that sensory parameters play in our selection and perceptions of food


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
Sugar Free
NOT FOR WEIGHT CONTROL
SnackWell's
Shortbread
Cookies
Sugar Free
SnackWell's
Shortbread
Cookies
Sugar Free
SnackWell's
Shortbread
Cookies
Diet


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

Why use fat substitutes?

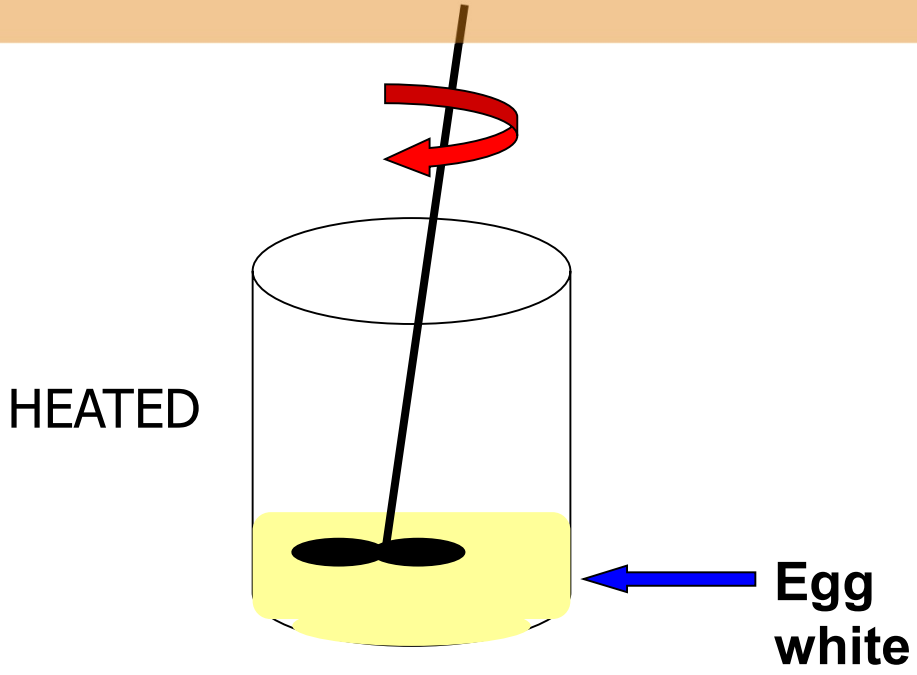
- *Lesson 1…*
- Consumer trends - demand foods with less fat, less calories and overall healthier.
  - health problems- over eating & obesity, sedentary lifestyle
  - developed countries

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

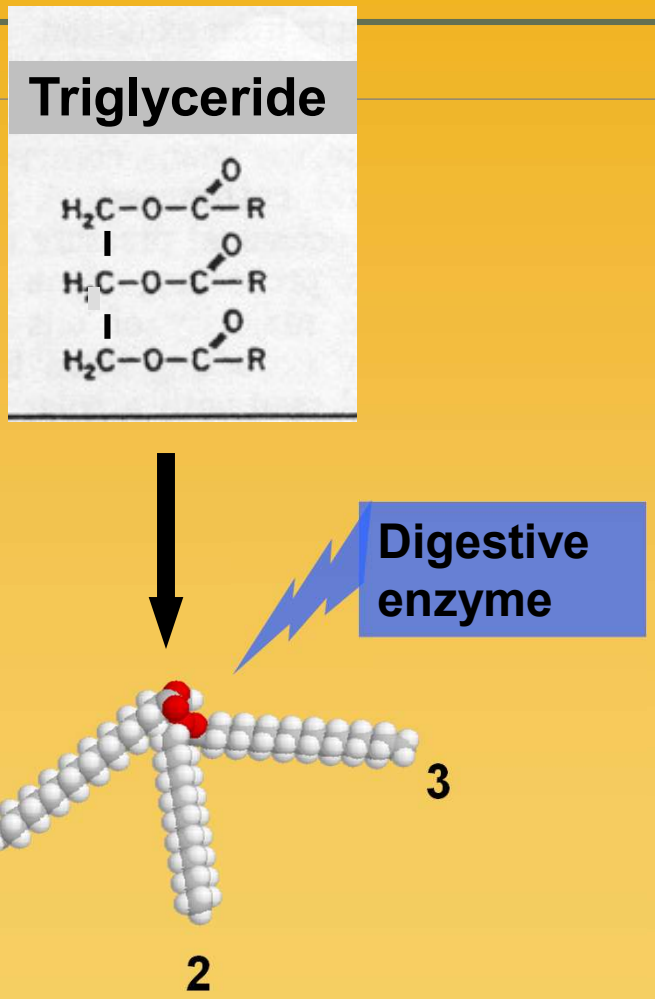
WHY?

- **made primarily from fat**

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

Lesson 2:

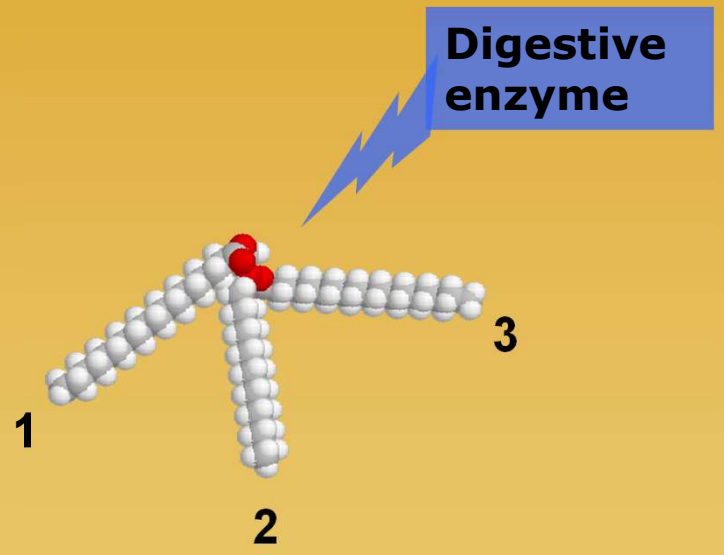
Fat is made of **triglycerides** (3 FA + glycerol…)



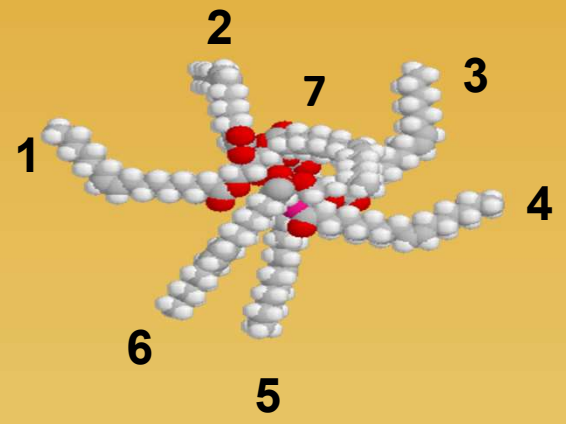
Olestra:

- **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

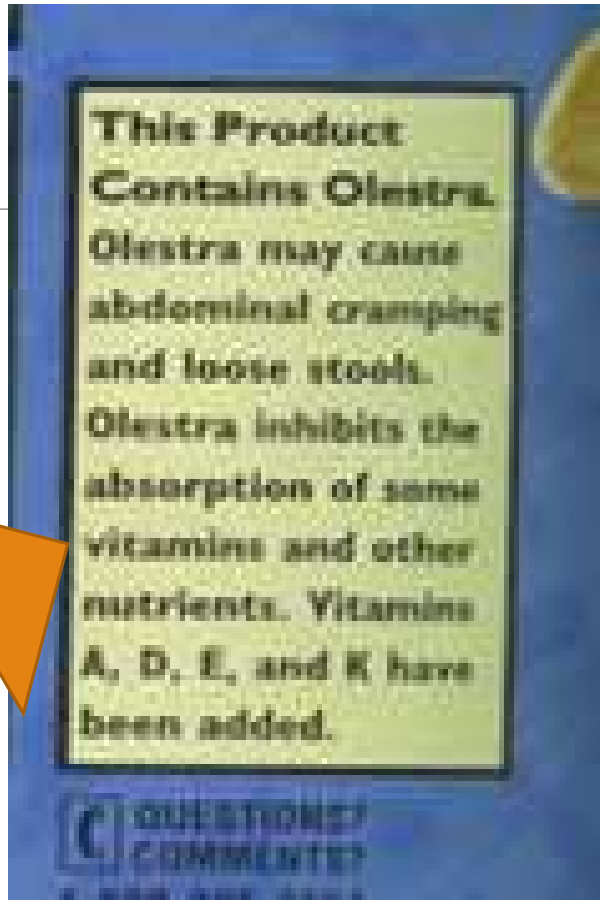
Fat based – e.g. Olean® / Olestra

"…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/fdcc/?set=GRASNotices&sort=GRN_No&order=DESC&startrow=1&type=basic&search=olestra

Warning requirement lifted in 2003

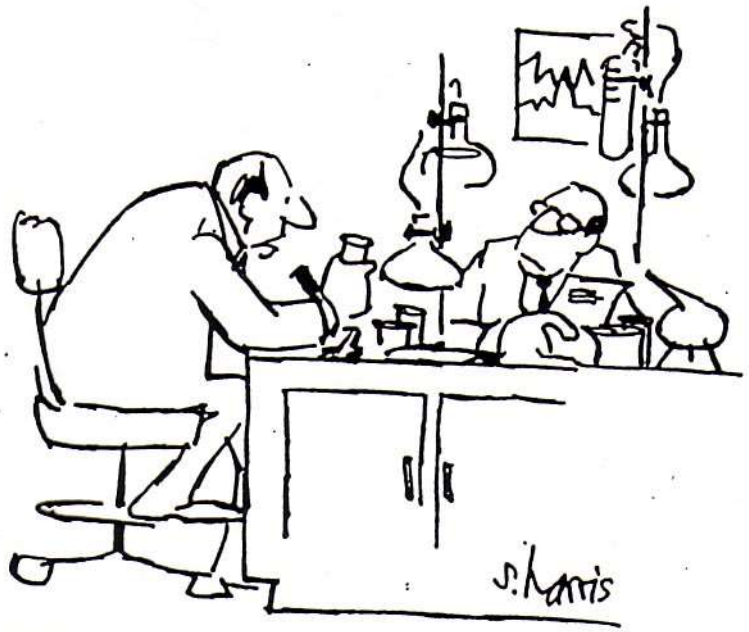
Lost popularity



Discussion: New kid on the block

Esterified Propoxylated Glycerol (EPG)

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:

"**sweetener**" " means a food additive that is used to impart a sweet taste to food [Ref: Marketing Authorization for Food Additives that May Be Used as Sweeteners]. Examples of food additives that may be used as sweeteners include aspartame, maltitol and sorbitol.

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

http://www.inspection.gc.ca/food/labelling/food-labelling-for-industry/sweeteners/eng/1387749708758/1387750396304?chap=1

Why do we use Sweeteners?

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

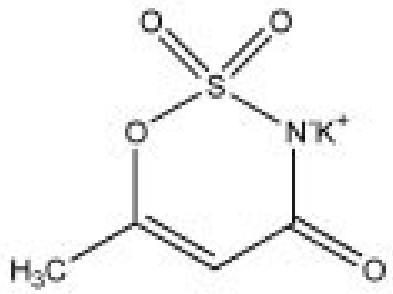
SWEETENERS
(Sugar substitutes)

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

or

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

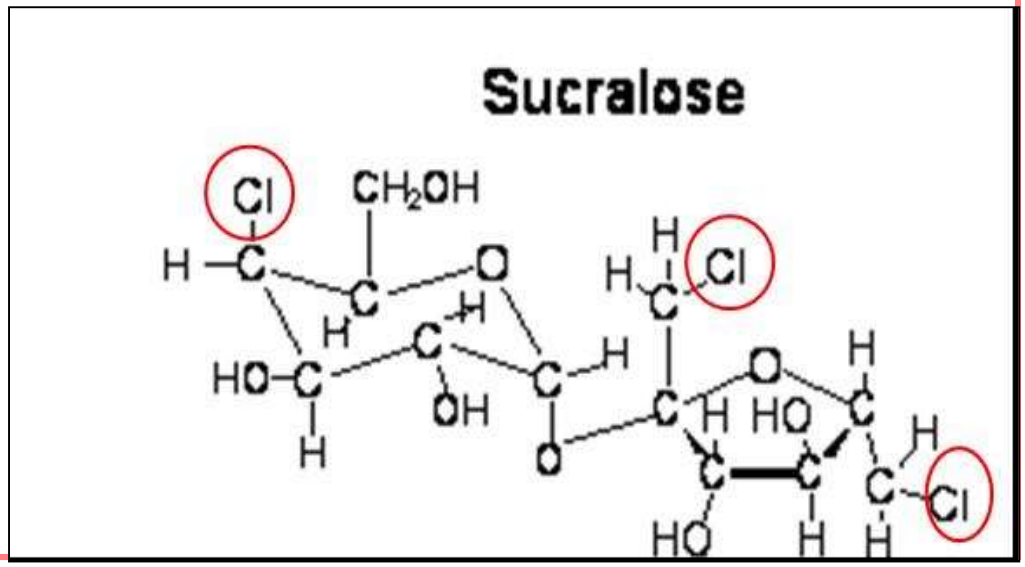
Non-caloric sweeteners
e.g. **Acesulfame Potassium (K)**



- 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.

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

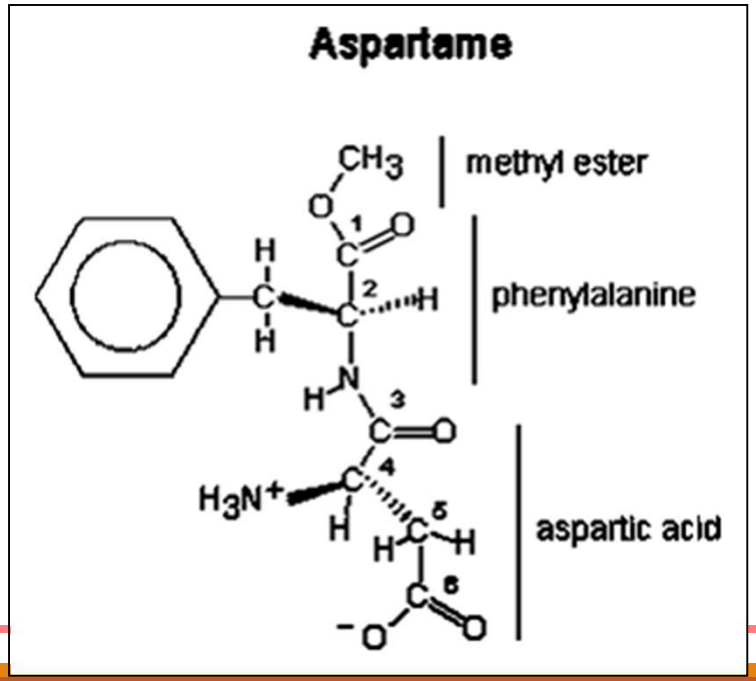


Non-caloric sweeteners
e.g. **Sucralose or Splenda®**

- 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

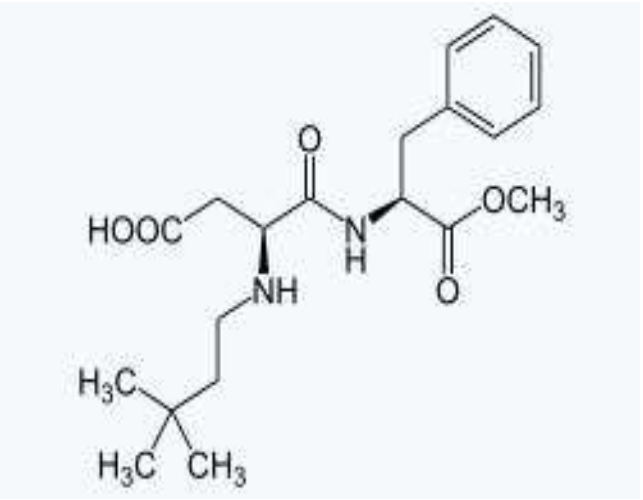
e.g. **Aspartame**

- **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. **Neotame**

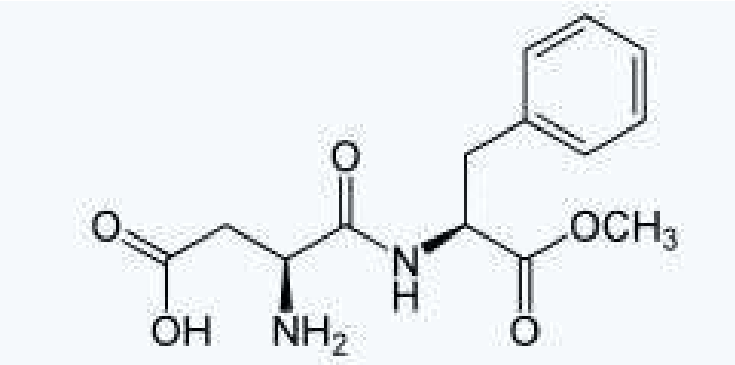
- **Made of 2 amino acids:**
  - phenylalanine & aspartic acid
- **7000 sweeter** than sucrose



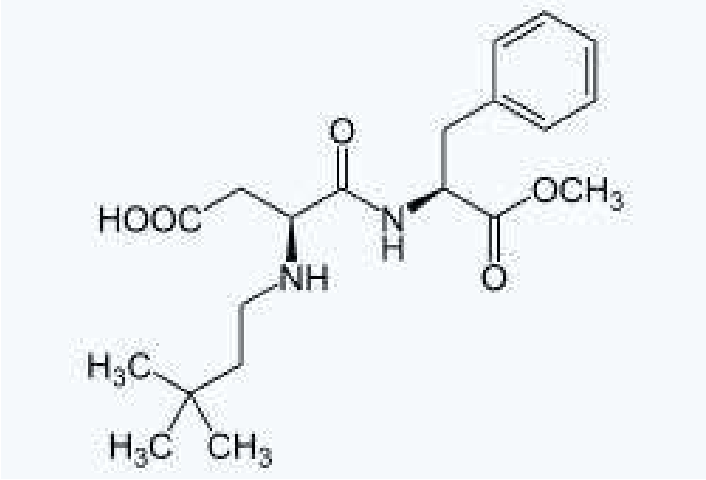
Low-calorie sweeteners
e.g. **Neotame**

- **4 Cal/g**
- **(**due to high Sweetness only use small amount required**)**
- No increase in blood glucose or insulin levels
- ADI: **2 mg/kg** body weight per day (18 mg/day in US)
- Relatively heat stable
- No problem for people with Phenylketonuria (PKU)

Do you see any thing interesting from comparing the structure?

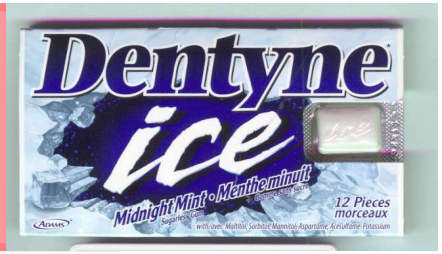


Aspartame



Neotame

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

→ Also permitted as sweeteners in foods

cyclamate, saccharin

→ Banned in 1970

Allowed only in pharmaceuticals

Reinstated in 2014 as approved sweetener

Advantame

http://www.hc-sc.gc.ca/fn-an/securit/addit/list/9-sweetener-edulcorant-eng.php

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https://www.canada.ca/en/health-canada/services/food-nutrition/public-involvement-partnerships/proposal-use-new-food-additive-advantame-sweetener-certain-unstandardized-foods-including-certain-beverages/document.html

- Is it considered a 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?

WHO report on sweeteners (2023)

April 12

Health effects of the use of non-sugar sweeteners: a systematic review and meta-analysis

May 15

WHO advises not to use non-sugar sweeteners for weight control in newly released guideline

May 15

Use of non-sugar sweeteners: WHO guideline

July 14

Aspartame hazard and risk assessment results released

Terms to remember-
Fat and Sugar Substitute

Simplesse

microparticulation

Maltrin

Olean/Olestra

sucrose polyester

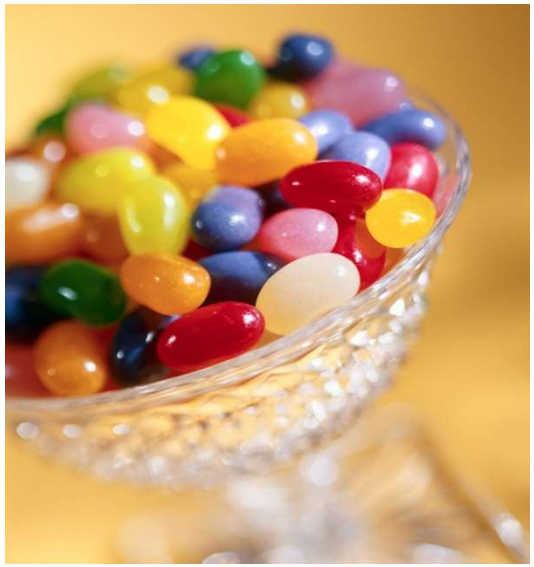
sweetener vs. **sweetening agent**

Alternative sweeteners (eg Aspartame,…)

PKU and DKP

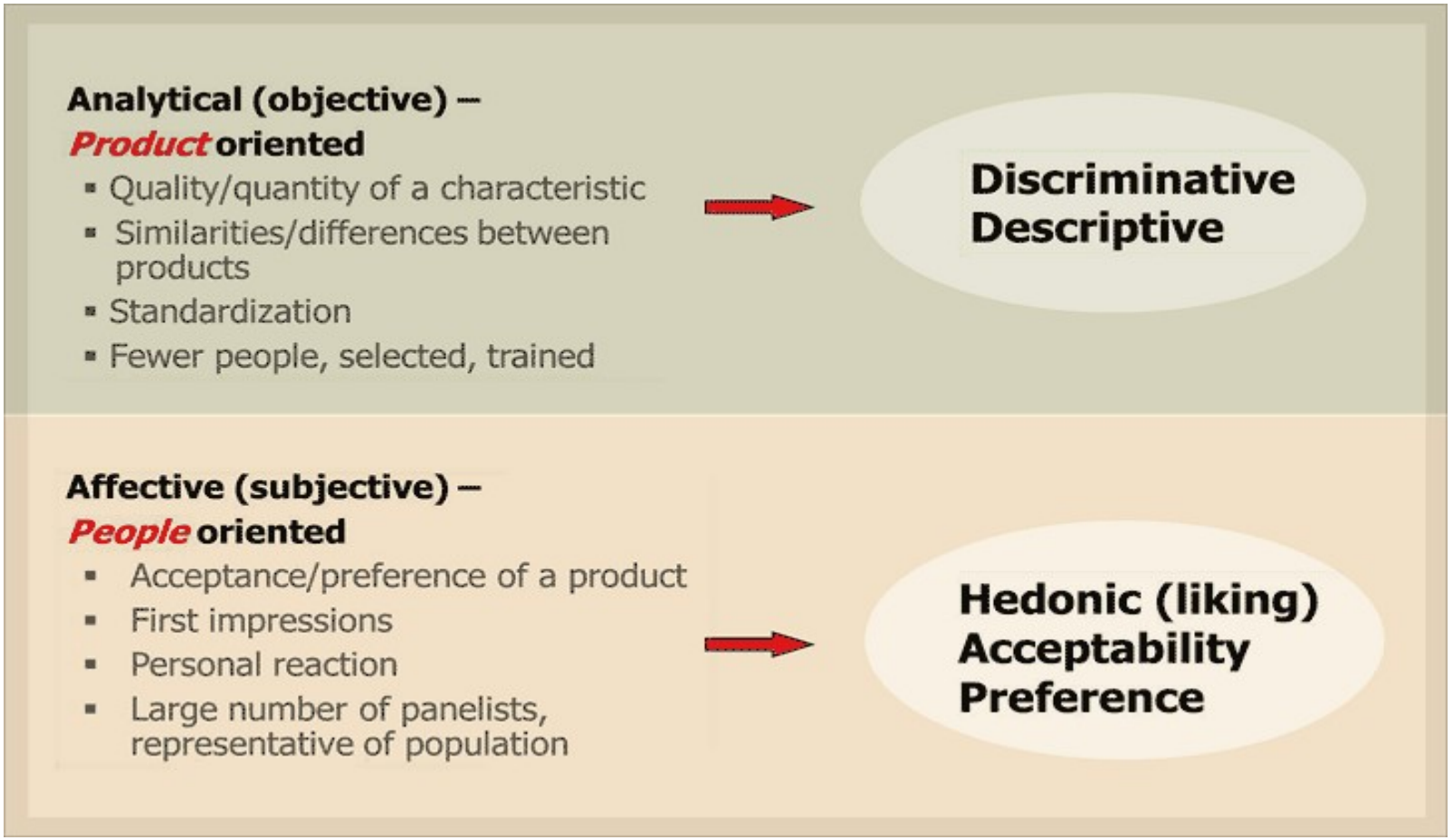
Sugar alcohols (e.g. Sorbitol,….)

SENSORY PERCEPTION OF FOODS



Let’s go shopping

Sensory testing



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

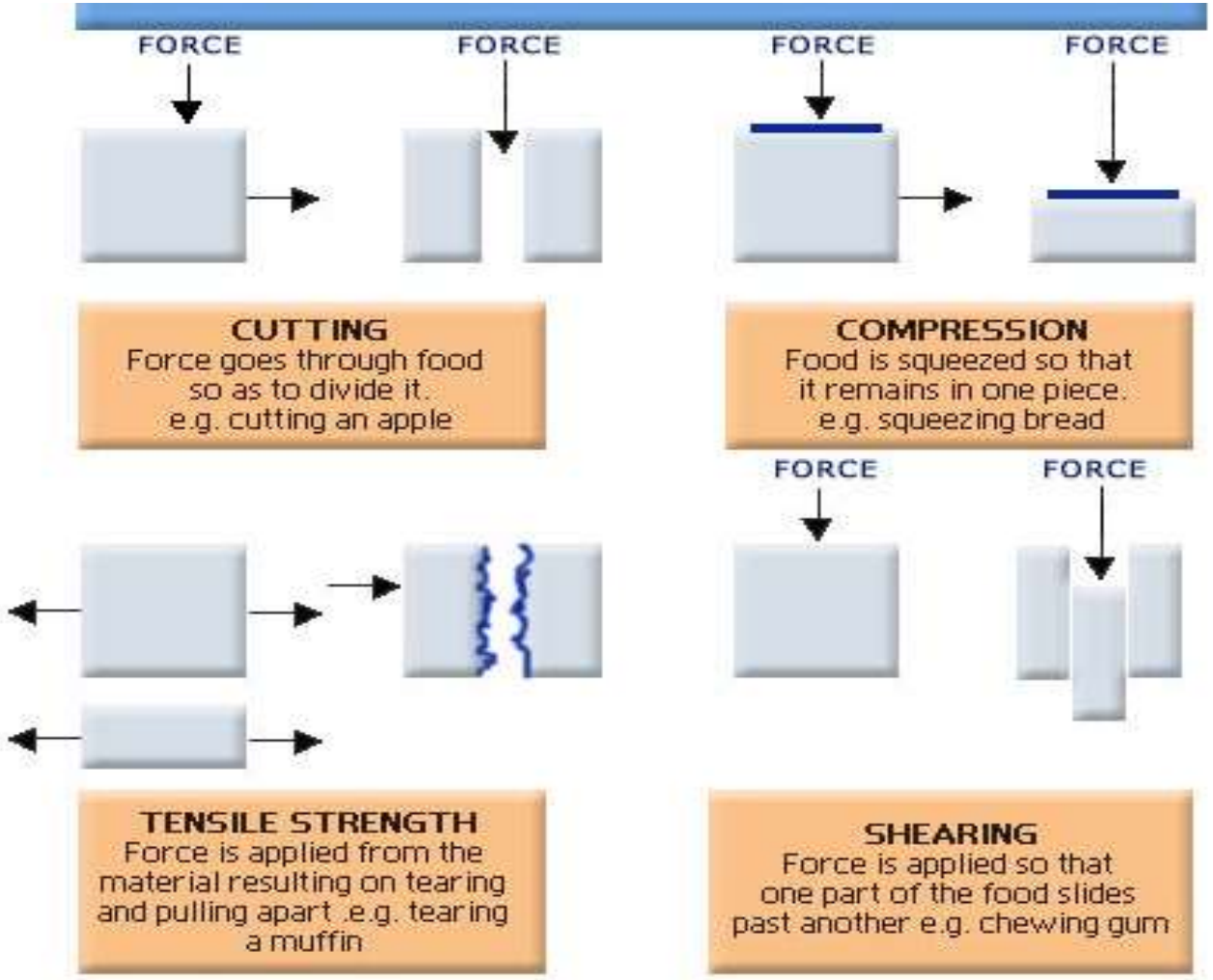
- sensory testing facilities with special lighting (red light)

Texture testing

How do you test for texture?

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

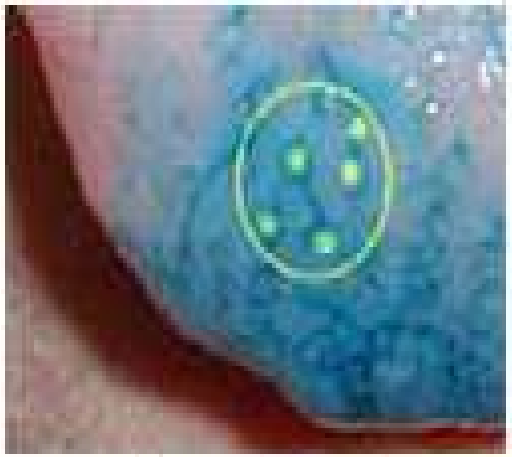
- typically alkaloids e.g. caffeine in coffee & tea or *theobromine* in chocolate

some salts (Na- sulphate, Ca- chloride)

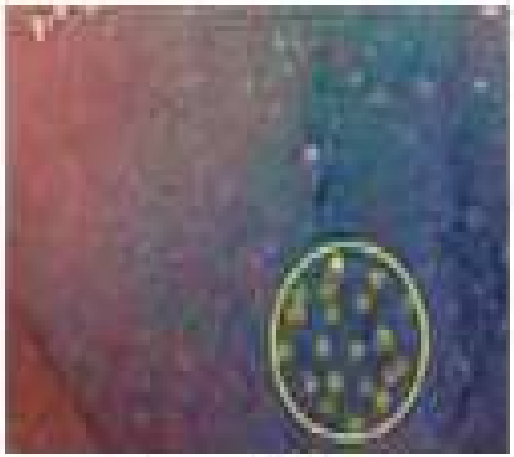
amino acids and peptides (eg. sharpness, bitterness of aged Cheddar cheese).

Individual Differences in Taste Bud Density

(Source: www.bbc.co.uk/science)



HypoTaster



Normal Taster

SuperTaster

the fifth taste – Umami (Savoury)

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

Savoury

Some flavour enhancers or potentiators → **umami**

MSG (monosodium glutamate)– **meaty & vegetable** flavours

5'-nucleotides– **meaty** flavours

Torula yeast, autolyzed yeast extract, hydrolyzed protein, yeast extract

Flavour Enhancers/Potentiators/Modifiers

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.
- e.g miracle fruit

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