

Chewing/Bubble Gum

Gwendolyn Graff

Tech Principle – Wm. Wrigley Jr. Co

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Course in
Confectionery
Technology**



Gum History

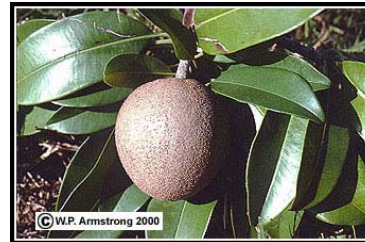


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GUM HISTORY

Time

- 50 A.D.: The ancient Greeks chewed tree resin – Mastiche
(the term “masticate” comes from this)
- 200 A.D.: The Maya Indians chewed chicle
- 1800's: American Indians chewed sap from trees



GUM HISTORY

- Time** ↓
- **1848:** The first commercial chewing gums were manufactured - John B. Curtis manufactured State of Maine Pure Spruce Gum
 - **1869:** William Finley Semple obtained the first chewing gum patent on December 28, 1869
 - **1869:** Mexican General, Antonio Lopez de Santa Anna showed Chicle to Thomas Adams

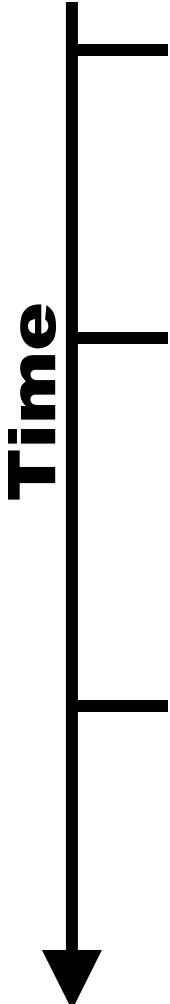
GUM HISTORY

Time
↓

- **1880:** When William J. White added corn syrup, sugar and peppermint oil he called the new gum Yucatan
- **1899:** The merger of six manufacturers to form the Chewing Gum Trust, later known as the American Chicle Co.
 - William Wrigley Jr. was asked to join in the merger but refused
- **1899:** Frank E. Barbour son-in-law of the president of Beech-Nut Packing started Beechnut Gum



GUM HISTORY

- 
- **1906:** Frank Fler invented a form of bubble gum known as Blibber-Blubber Gum,
 - **1917:** Chewing gum was included in soldier's ration. The American Red Cross distributed over 4 ½ million packs
 - **1927:** Holger Sorenson [Dandy's founder] noticed chewing gum at a London exhibition; 1st Danish chewing gum produced; Vejle Tyggegummi

GUM HISTORY

Time

- 1937: White Laboratories introduce
 - Aspergum; an analgesic gum containing aspirin
 - Pheenamint; a laxative gum containing phenylthaline
 - Chooz; an antacid gum containing calcium carbonate
- 1946: The Mexican government nationalized the chicle industry



GUM HISTORY

Time



- **Claude E. Parfet** [formerly the European general agent for the Beech-Nut Co] **formed Krema-Hollywood Chewing Gum in France**
- **1948: Bruno Petrulis' company, Amurol Products Company** {Naperville, IL} **manufactures a SF gum**
- **Vincent Ciccone** [production manager of Charms] **conceived the idea of inserting a bubble gum filling in a lollipop**



GUM HISTORY

- Time**
- **1964:** After test marketing for two years, American Chicle Co. introduced their first sugar-free gum; Trident
 - **1990's:** Functional chewing gums, lead by Pharmacia's Nicorette Gum, became an industry growth segment
 - **1996:** Hershey Foods acquires Leaf North America Confectionery
 - **1998:** Concord Confections Inc. acquires Fleer Corporation



GUM HISTORY



GUM HISTORY

- 
- **2003:** Concord Confections Inc. acquires Philadelphia Chewing Gum
 - **2004:** Wm. Wrigley Jr. Company acquires Joyco Group and Cafosa Gum
 - **2004:** Tootsie Roll Industries acquires Concord Confections
 - **2007:** Cadbury buys Intergum [Turkey]
 - **2008:** MARS purchases Wrigley

Gum Base



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What is Gum Base?

The ingredient that separates gum from other confections

n.: thermoplastic material that remains in the mouth; indigestible

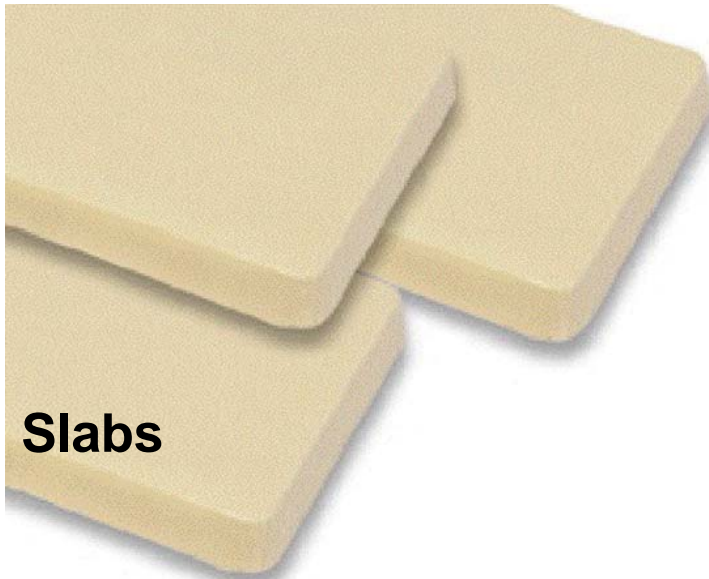
Chewing gum base is an insoluble, semi-crystalline, non-nutritive, masticatory substance formulated to provide a pleasant chewing experience and gradual release of flavors and sweeteners

What is Gum Base?

Chewing Gum Base

US FDA 21CFR172.615

A food additive consisting of one or more of the following substances that meet the specifications and limitations prescribed in the paragraph and used in amounts not to exceed those required to produce the intended physical or other technical effect.



Slabs



Sheets



Pellets

(various shapes)

Components



Purified Elastomeric Polymers

Resins

Texturizers

Micro Waxes

Paraffins

Emulsifiers

Hydrogenated Oils

Antioxidants

<u>Substances</u>	<u>Specifications</u>
Butadiene-Styrene Rubber	Base Polymer
Isobutylene Isoprene copolymer (Butyl Rubber)	Base polymer
Petroleum wax	Complying with Sec. 172.886.
Synthetic petroleum	Complying with Sec. 172.888.
Polyethylene	Molecular weight 2,000-21,000.
Polyisobutylene	Minimum molecular weight 37,000 (Flory).
Polyvinyl acetate	Molecular weight, minimum 2,000
Synthetic paraffin wax	Synthesized by Fischer-Tropsch process from carbon monoxide and hydrogen which are catalytically converted to a mixture of paraffin hydrocarbon. Lower molecular weight fractions are removed by distillation. The residue is hydrogenated and further treated

<u>Substance</u>	<u>Specifications</u>
Lanolin	
Rice bran wax	Complying with Sec. 172.890
Stearic acid	Complying with Sec. 172.860.
Sodium and potassium stearates	Complying with Sec. 172.863.

<u>Substance</u>	<u>Specifications</u>
Glycerol ester of partially dimerized rosin	Having an acid number of 3-8, a drop-softening point of 109° C-119° C, and a color of M or paler.
Glycerol ester of partially hydrogenated gum or wood rosin.	Having an acid number of 3-10, a drop-softening point of 79°C-88°C, and a color of N or paler.
Glycerol ester of polymerized rosin	Having an acid number of 3-12, a melting-point range 80°C-126°C, and a color of M or paler.

<u>Substance</u>	<u>Specifications</u>
Glycerol ester of gum rosin	Having an acid number of 5-9, a drop-softening point of 88°C-96°C, and a color of N or paler. The ester is purified by steam stripping.
Glycerol ester of tall oil rosin	Having an acid number of 2-12, a softening point (ring and ball) of 80°C-88°C, and a color of N or paler. The ester is purified by steam stripping.
Glycerol ester of wood rosin	Having an acid number of 3-9, a drop-softening point of 88°C-96°C, and a color of N or paler. The ester is purified by steam stripping.

<u>Substance</u>	<u>Specifications</u>
Methyl ester of rosin, partially hydrogenated	Having an acid number of 4-8, a refractive index of 1.5170-1.5205 at 20°C, and a viscosity of 23-66 poises at 25°C. The ester is purified by steam stripping.
Pentaerythritol ester of partially hydrogenated gum or wood resin	Having an acid number of 7-18, a drop-softening point of 102°C-110° C, and a color of K or paler.
Pentaerythritol ester of gum or wood rosin.	Having an acid number of 6-16, a drop-softening point of 109°C-116°C, and a color of M or paler.

<u>Substance</u>	<u>Specifications</u>
Synthetic Terpene Resin	Consisting of polymers of α -pinene, β -pinene, and/or dipentene; acid value less than 5, saponification number less than 5, and color less than 4 on the Gardner scale as measured in 50 percent mineral spirit solution.
Natural Terpene Resin	Consisting of polymers of α -pinene; softening point minimum 155°C, determined by U.S.P. closed- capillary method, United States Pharmacopeia XX (1980) (page 961).

<u>Substance</u>	<u>Specifications</u>
Butylated hydroxyanisole	Not to exceed antioxidant content of 0.1% when used alone or in any combination.
Butylated hydroxytoluene	Not to exceed antioxidant content of 0.1% when used alone or in any combination.

In addition to the substances listed, chewing gum base may also include substances generally recognized as safe in food, such as hydrogenated or partially hydrogenated oils, lecithin, mono & di-glycerides, etc.

Gum Base FAQ's

What makes bubble gum bases different than chewing gum bases?

- *ability to make bubbles,*
- *higher levels of rubbers or polymers and/or,*
- *higher molecular weight polymers,*
- *lower base levels than in chewing gums.*

What makes a gum base regular or acid compatible?

- *mineral adjuncts*
 - *Calcium Carbonate,*
 - *Food Grade Talc,*
 - *Dicalcium Phosphate*
- *These modify the mouth feel & facilitate the processing of gum bases*

Gum Base FAQ's

How do Gum Bases vary in quality?

- *Texturizers are lower cost than the other components used in gum base. Higher texturizer levels effect:*
 - *Price*
 - *Chewing character & mouth feel*
 - *Bubble character & size*
 - *Processing*

Chewing gum base

- *high quality chewing gum base,*
 - *texturizer levels 5-20%,*
- *economical chewing gum base,*
 - *Levels can be as high as 45-55%.*

Bubble gum base

- *Texturizers from 20% to 65%,*
 - *higher levels being the more economical grade*
 - *higher levels of texturizer reduce stretch*
 - *higher levels of texturizers reduce bolus (cud) size*

Gum Base FAQ's

What is a “non-sticking” gum base?

- *Chewing gums that have no tack to dental work*
- *Bubble Gums that have no tack to lips & face*

Why are Antioxidants used in gum bases?

- *Antioxidants, such as BHT, BHA or Tocopherols [Vit E] are necessary to protect the components of the gum base from oxidation*
- *Gum bases can be made without antioxidants, but special stable components are used*

Gum Base FAQ's

What are the different Gum Base types?

- *Because chewing gums and bubble gums are sold in different formats gum bases need to be different:*
- ***Sticks & Tabs***
 - *Dragées (Pellets)*
 - *Hollow balls*
 - *Cut & wrap*
 - *Tubes*
 - *Etc.*



Gum Ingredients



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Gum Ingredients – Gum Base

Gum Base – {Insoluble} [~17-30% of formula]

Function in gum:

- *to provide a pleasant chewing experience and gradual release of flavors and sweeteners.*
- *Binds ingredients together to form cohesive cud*

- ❖ Different types can affect flavor release, processing, bubble blowing etc.
- ❖ Interactions with Flavors in the formula cause base to plasticize (soften)
- ❖ Can also have interactions with acid – resulting in processing problems, as well as stability issues

Gum Ingredients – Fillers/Texturizers

Mineral Fillers – {Insoluble} [if at all, <10% of gum formula]

Examples:

- Talc –Inert
- CaCO_3 – Reacts with acid

Function in gum:

- *Primarily a base ingredient - used in gum formulas to:*
 - *Reduce cost*
 - *Add bulk to cud*
- ❖ Can affect chew characteristics – generally, it firms up the chew, and dries out the gum; too much could cause gum to dissolve
- ❖ Important to know which filler used [whether in base or gum formula]
 - Filler determines acid compatability

Gum Ingredients – Flavors

Flavors — [~0.75-3 % of gum formula]

Function in gum:

- *Provides taste to gum*
- *Can affect texture thru plasticization of base*

- ❖ The flavor to base ratio is often used as a tool in formulation. This ratio is critical to give the desired flavor release and chewing characteristics
- ❖ The carrier/solvent the flavor is in is important – as different types can plasticize the gum differently
- ❖ Gum flavors are much more concentrated than candy flavors
- ❖ Significant amounts of certain flavors will dissolve in base and never release
- ❖ Some flavors are very volatile and release quickly from base depending on the composition of the base and flavor. Processing temperatures need to be held in check
- ❖ Encapsulated versions are used to protect flavor and provide either quick release or delayed release

Gum Ingredients – Flavors (cont.)

Triacetin & Oil

Function in Gum:

- *Gumbase softeners*
 - *Provide additional plasticizing to gum*
 - *Used to supplement flavor plasticizing to achieve a desired chew character*
-
- ❖ Too high of levels can result in processing issues or gum dissolving when chewed
 - ❖ If in formula, and too little was added – gum could exhibit processing problems, or firm chew texture

Gum Ingredients – Bulking Agents

Bulking Agents – [~70-85% of gum formula]

Examples:

- Carbohydrates (Sugar)
 - Sugar
 - Dextrose
 - Corn Syrup
- Polyols (Sugar-free)
 - Sorbitol
 - Maltitol
 - Mannitol
 - Xylitol
 - Maltitol Syrup
 - Hydrogenated Starch Hydrolysates

Gum Ingredients – Bulking Agents (cont.)

Function in gum:

- *Provide body, sweetness, cooling (in the case of Xylitol)*
- *Effect flavor release, shelf life, & processing*
- *Crystal morphology, % solids and DE in syrups can affect all aspects of chewing gum*
- *Potentiate flavor.*
- ❖ Syrups often aid in mixing, but can cause mixing problems that result in longer mixing times:
 - If added too early – can prevent base from schmearing
 - If added too late – mix will be crumbly
- ❖ The particle size of dry bulking agents is usually specified – the p.s. is critical to both the processing as well as the final products' sensory profile
 - If too large – may make gum gritty or mix more soupy
 - If too fine – may cause clumping, dry out gum or cause sensory changes (shorter sweetness duration)

Gum Ingredients - Softeners

Softeners/Emulsifiers — [~1-6 % of gum formula]

Examples:

- Glycerin
- Lecithin
- Glycerol monostearate

Function in gum formula:

- *Used to soften initial chew*
- *Serve as a humectant (glycerin) to regulate loss and gain of H₂O*
- *Serve as emulsifiers - allow hygroscopic and hydrophobic ingredients to be miscible in one another*
- *Assist in mixing – make gum easier to work with*
- *Extend softness of gum during storage, distribution and sales*
- ❖ Can affect processing
 - Some of them lubricate and can help to achieve cleaner scoring
- ❖ Can affect shelf life
 - Help maintain softer initial chew texture
- ❖ Can affect tack and flavor release

Gum Ingredients - Acids

Acids — [0-2 % of gum formula]

Examples:

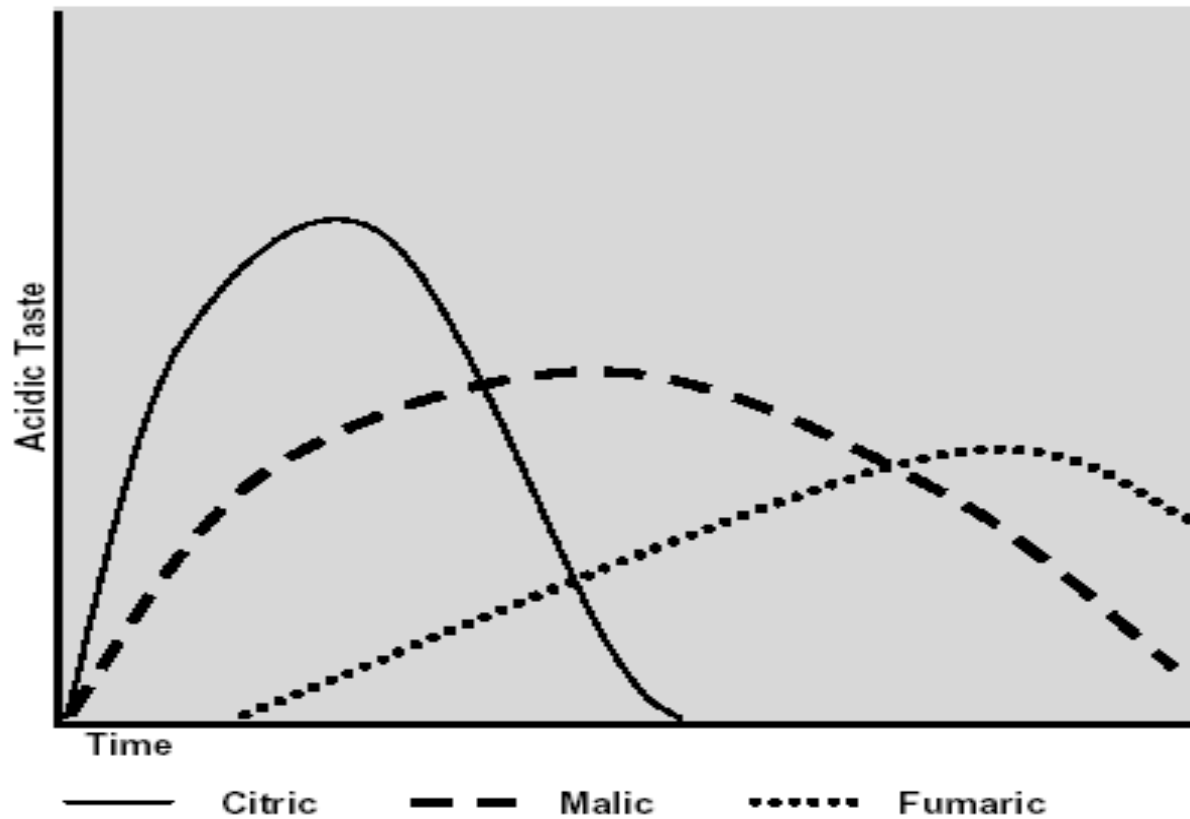
- Citric Acid
 - Tart, early high impact, brightens up flavor
- Fumaric Acid
 - “Clean” tartness
- Malic Acid
 - Smooth tart taste that builds up & diminishes without a burst

Function in gum:

- *Provides tartness*
- *Usually used to enhance fruit flavors*

Raw Materials – Acids (cont.)

Taste Retention of Acids



Raw Materials – Acids (cont.)

- ❖ Acids can interact with other ingredients (such as sweeteners and flavors) to enhance or degrade sensorial properties of gum.
- ❖ Acids must be stored properly to keep them from blocking / bridging
- ❖ Acids may fade or bleach some colors (most prevalent in red colors)
- ❖ When a formula contains acid, it should be made with a gum base that only contains talc as its filler - **Gum bases containing Calcium Carbonate as a filler should not be used.** Thorough clean-outs need to be conducted of products that contained any CaCO_3 gum base before the gum is made

Care must be taken to avoid cross contamination of acid with alkaline ingredients – such as CaCO_3 . This filler will react with the acid if mixed. As a result:

- The acid is consumed as it reacts with the Calcium Carbonate
- The base is compromised and the resultant gum tends to be tacky, or can fall apart when chewed

Raw Materials - HIS

High Intensity Sweeteners (\$\$\$) - [~0.005 - 1 % of gum formula]

Examples:

- **Aspartame**
- **Neotame**
- **Ace-K**
- **Sucralose**
- **Saccharin & Salts**
- **Alitame**
- **NHDC**
- **Glycyrrizin**
- **Thaumatococin**
- **Stevioside**

Function in gum:

- *Provide increased sweetness over a broad interval of time*
- *Several encapsulated versions are used to extend sweetness delivery*
- ❖ Expensive, but used in small amounts they deliver on cost efficiency and quality
- ❖ Encapsulation also protects the ingredient from degrading or reacting with surrounding ingredients
- ❖ Types and levels may have regulatory restrictions
- ❖ Even small changes in level will have large impact

Raw Materials - Colors

Colors – [~0.03 % of gum formula]

Examples:

- Natural Colors
- Certified Colors
 - 2 Types
 - Lakes
 - Not water soluble
 - Function by dispersion
 - *Generally, these are used in gum formula because won't chew out of gum
 - Dyes
 - Water soluble
 - Function by dissolution

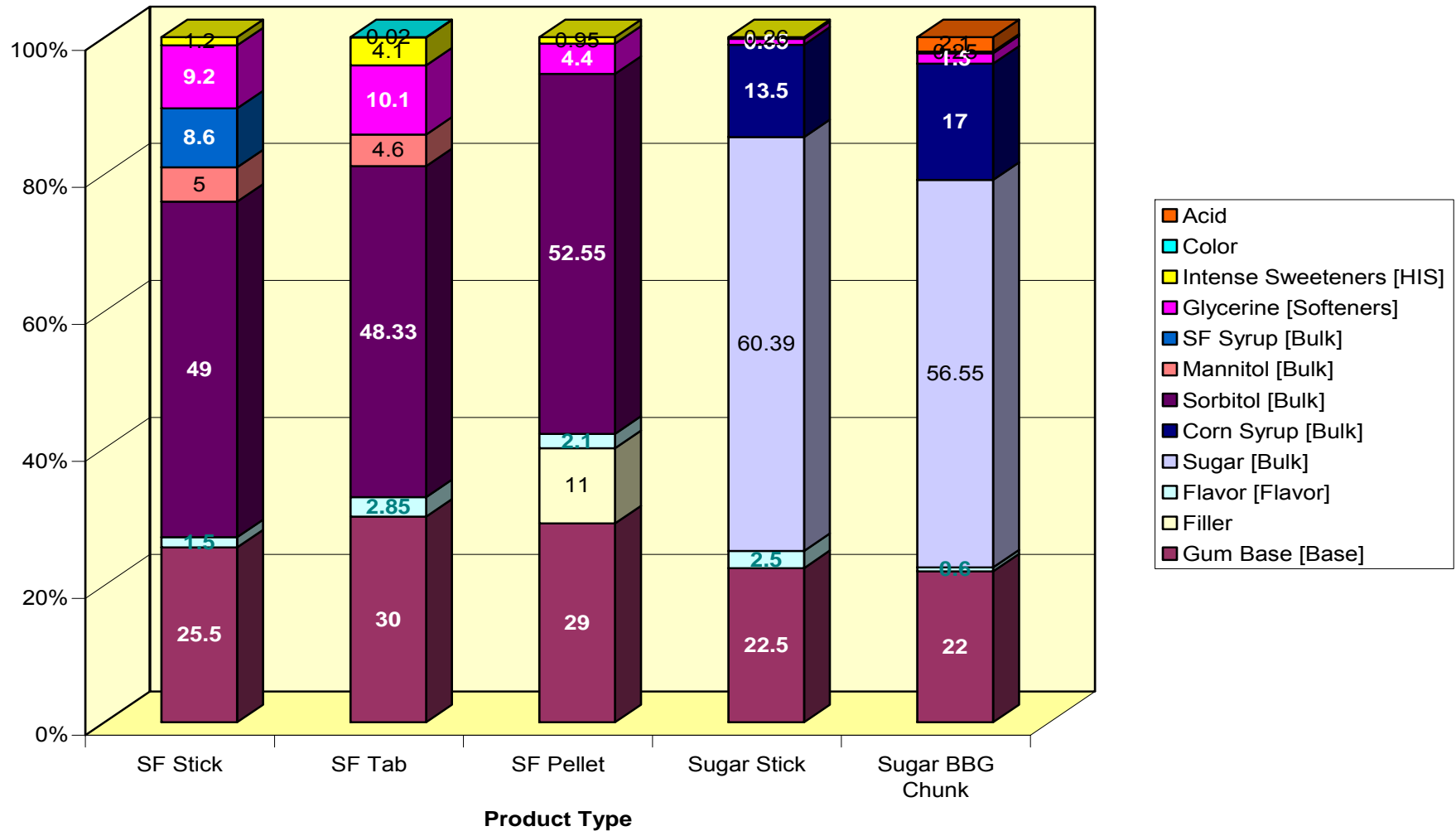


Function in gum:

- *used to color gum*
- *Can also act as a homogeneity test*

Formulation Differences

Comparison of Formulas



Formulation Differences

- These are sample formulas to compare trends – formulas differ, as there are different ways to soften/balance out ingredients
- Look for Base : Flavor to remain balanced
- Tab gums tend to have higher base content to produce a larger cud due to decreased piece size (2g) vs. stick (3.7g)
- Look at Syrups and Softeners collectively to soften gum; mannitol also tends to soften – so group these 3 together to compare
- Filler used more commonly in pellet to firm up center so it can withstand the forces involved in panning and bulk handling
- Higher levels of softeners in stick and tab
- Note pellet formula – most of filler will remain in cud; collective cud contribution is high, but keep in mind that this formula only contributes to ~2/3 of the formula – additional bulking agent and flavor will be added in the coating
- Keep in mind that some of the flavors and HIS's are encapsulated – therefore, not a neat comparison in these charts
- For lower level ingredients - even small fluctuations can make large differences in the final product; generally, these are more potent ingredients

Appendix A

BULKING AGENTS

More Specific Information on:

- **Types**
- **Structures**
- **Characteristics**
- **Guidelines in Gum**

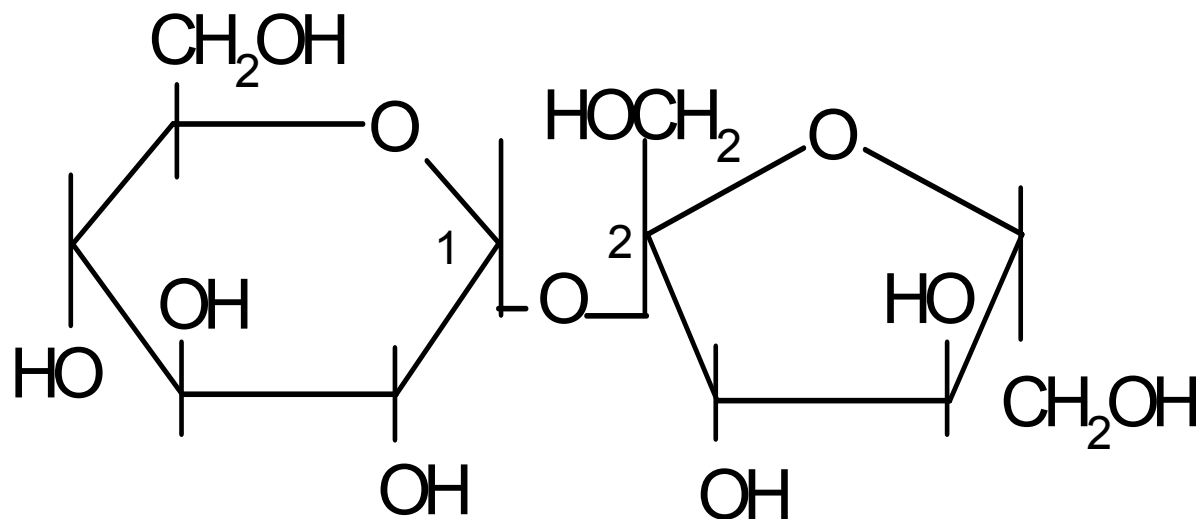
BULK SWEETENERS



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SUCROSE

- **Sucrose is disaccharide manufactured either from cane or beets. For Gum it should be fully refined to remove impurities and to have a very low moisture and invert sugar content.**



Sacarose Molecule
 α - D-Glucopyranosyl- β - D - Fructofuranoside

SUCROSE

For Chewing Gum, sucrose must be ground to a very fine powder. The usual particle size for ground Sugar used in Gums is 4% retained on a 200 mesh screen, or 96% of the Sugar passing through the screen. If the Sugar is coarser then the final Gum will have a gritty texture during the intermediate chewing stages.

SUCROSE

- Sometime this coarse chewing texture is desired and un-ground Sugar is put into the Gum. This is rare and most manufactures use only a fine pulverized Sugar.

SUCROSE

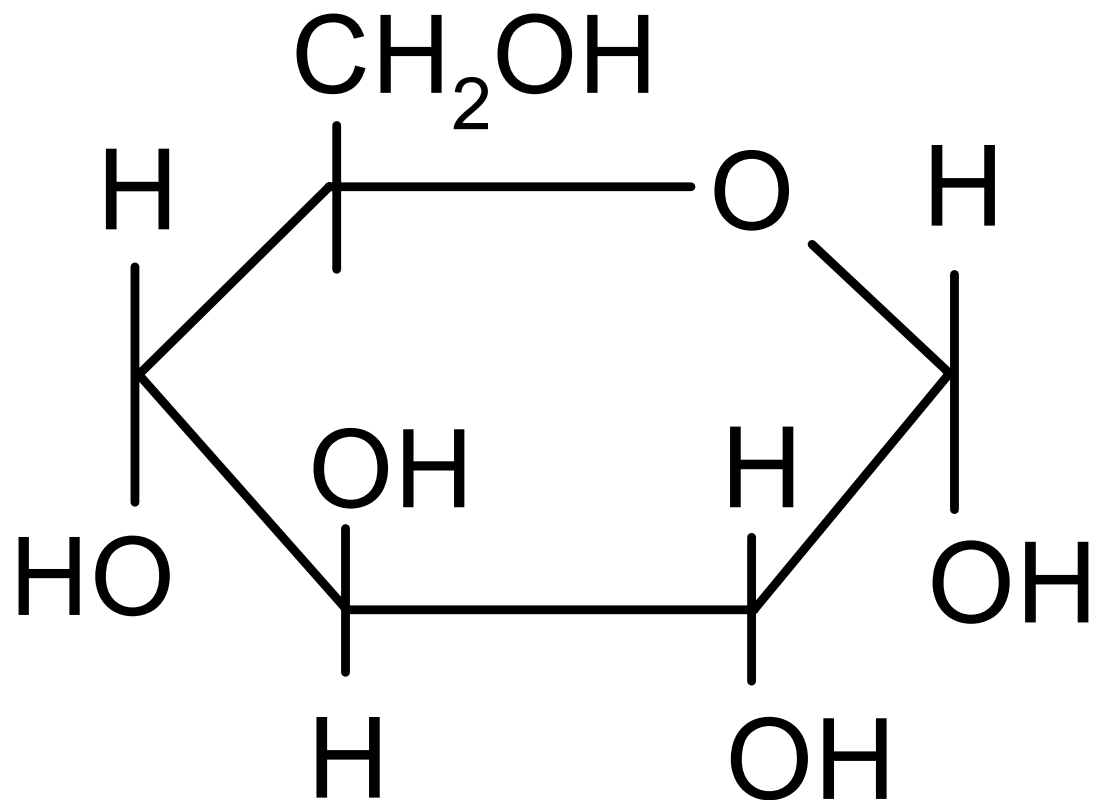
- **The particle size of the Sugar is a very important control point to the processing of Gums. The grain size of the Sugar determines the firmness of the Gum. As Gum is a mixture of Corn Syrup, Gum Base, and Sugar, it is easy to see that the finer the Sugar powder, the firmer the Gum.**

SUCROSE

- **Changes in the particle size distribution of the Sugar can also affect the texture and the processing of the Gum. One important aspect is that the Sugar must be consistent from batch to batch and day to day.**

DEXTROSE

- **Dextrose is used in Chewing Gums because it is lower in cost in some countries. In general, Dextrose has a negative effect on the chewing character of the Gum and can also have a negative effect in processing.**



Dextrose Molecule
 α -D-glucopyranose

DEXTROSE

- **Dextrose is recommended at about a 10% level to give some cooling effect to the gum, or to reduce the cost of the gum. The levels in the formula should be as low as possible. Dextrose is used in the particle size as purchased. There is no need to grind it.**

CORN SYRUP OR GLUCOSE

- The usual range on the D.E. specification on Corn Syrup is from 38 to 44 D.E. For Gum a D.E. of 38 is more desirable because it reduces the tack of the Gum to machines, paper, etc. If the D.E. is 44 or higher the Gum becomes soft and has more tack.

CORN SYRUP OR GLUCOSE

- It is very important that the Dextrose Equivalent of the Corn Syrup used in Gum manufacture be consistent. This avoids variation in the Gum texture which lowers Gum productivity levels. The variation in D.E. range from shipment to shipment should be ± 2.0 units, that is 38-42 or 39-43 etc.

CORN SYRUP OR GLUCOSE

- If the variation is greater than ± 2.0 , then the Gum formula and process conditions will need to be discovered again each time a new order of Corn Syrup is received.
- The Baumé is a density measurement that is used to measure the water content of the Corn Syrup.

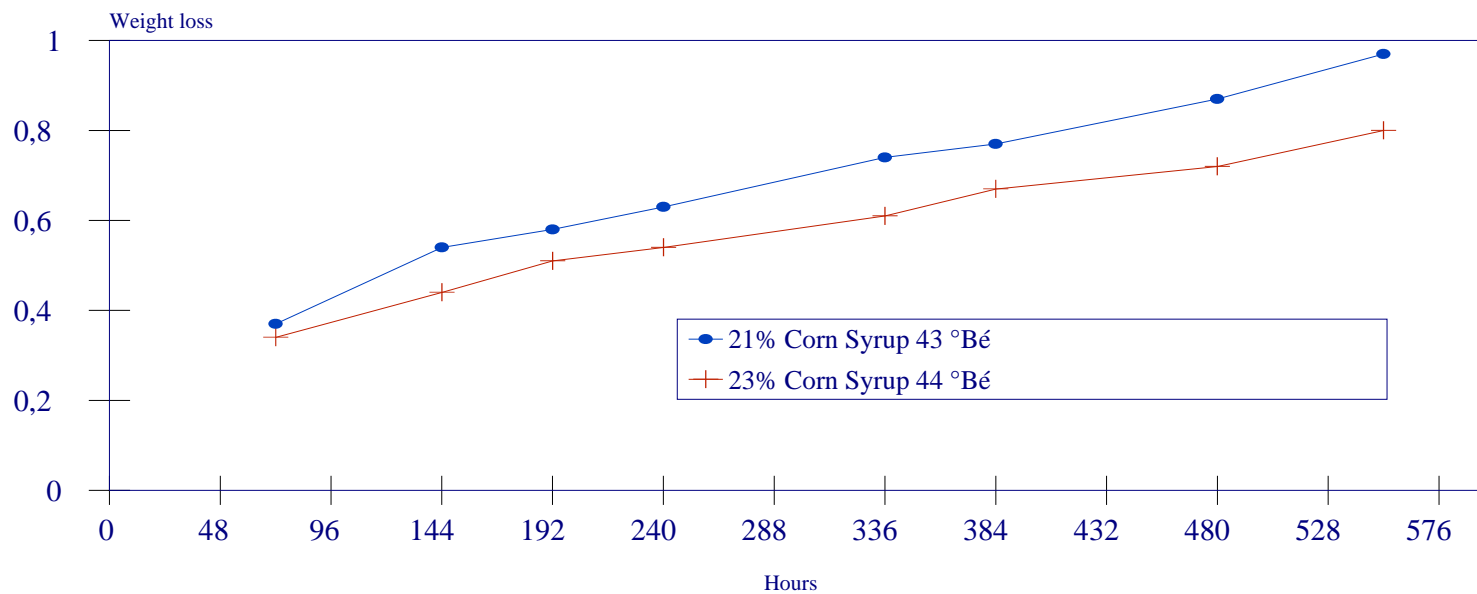
CORN SYRUP OR GLUCOSE

- The water content of Corn Syrup is important since the Corn Syrup is the largest, and most times the only, source of moisture in a Gum formula. The control of the Baumé is perhaps the most important specification of all Gum ingredients.

CORN SYRUP OR GLUCOSE

Different Baumé in Corn Syrup

same water content



35°C, 10% HR

NCA

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CORN SYRUP OR GLUCOSE

- The range of the specification is always a problem between Gum producers and Corn Syrup suppliers. The acceptable range for Baumé is ± 0.2 degrees for good and consistent gum processing.
- The most common Baumé for Corn Syrup used in Chewing Gum and Bubble Gum is 45 Bé, but many manufacturers use 43 Bé because of availability.

CORN SYRUP OR GLUCOSE

- The use of 45 Bé allows a high level of Corn Syrup to be used which gives strength and body to the Gum for chewing and processing. Gums made with lower Baumé Corn Syrup can be processed on most machines but some compromises may be necessary in formulation or productivity levels.

CORN SYRUP OR GLUCOSE

- In general, to replace 45 Baumé Corn Syrup with a lower Baumé Syrup requires that the water content of the Gum be kept constant. It is easy to calculate the new water levels using tables of water content of Corn Syrup.

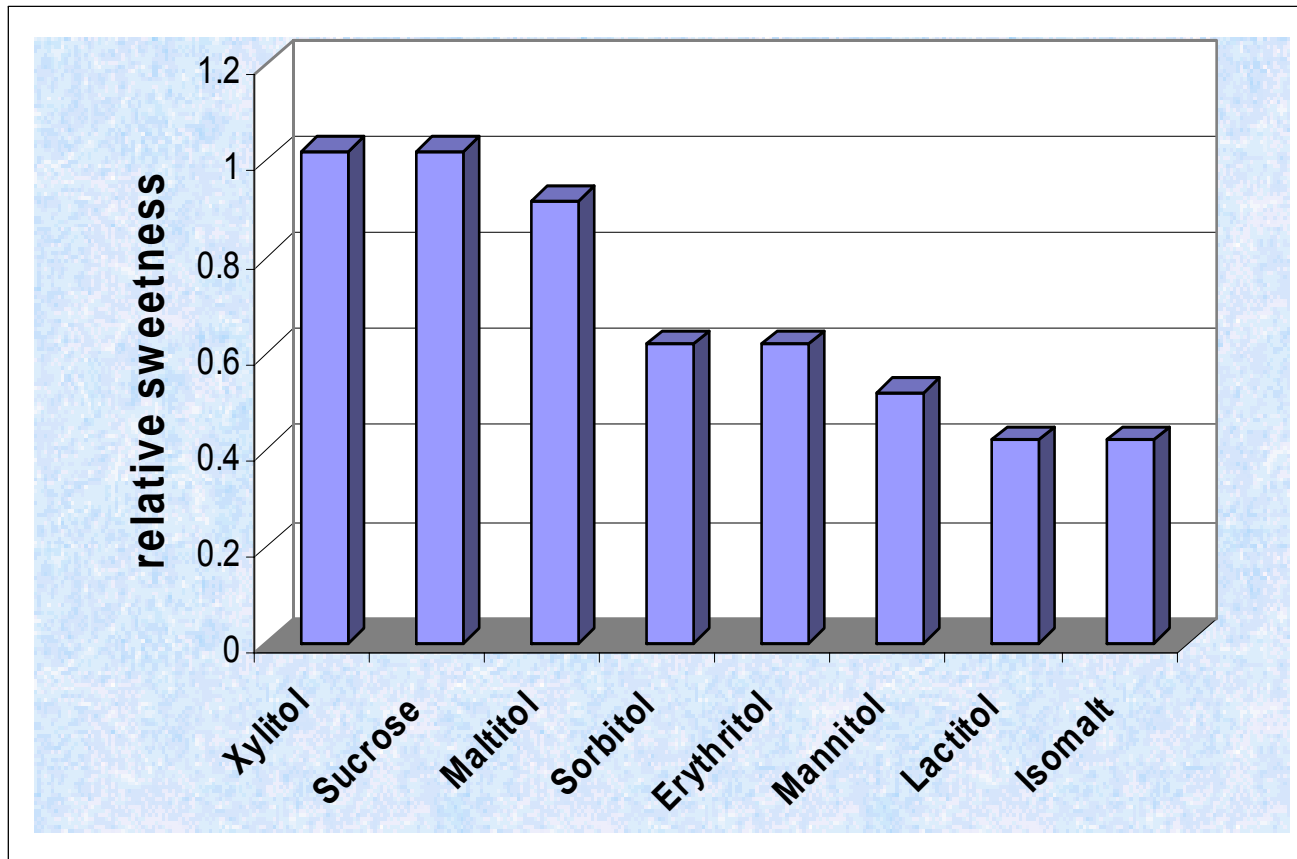
CORN SYRUP OR GLUCOSE

- The Sulfur Dioxide (SO_2) content of the Corn Syrup must be less than 20 PPM (Parts Per Million) for Gum making because there is nothing in the processing of Gum to remove the SO_2 . Sulfur Dioxide is added to Corn Syrup to retain the water white color and levels up to 300-400 PPM can be present if the Corn Syrup is used for candy manufacturing.

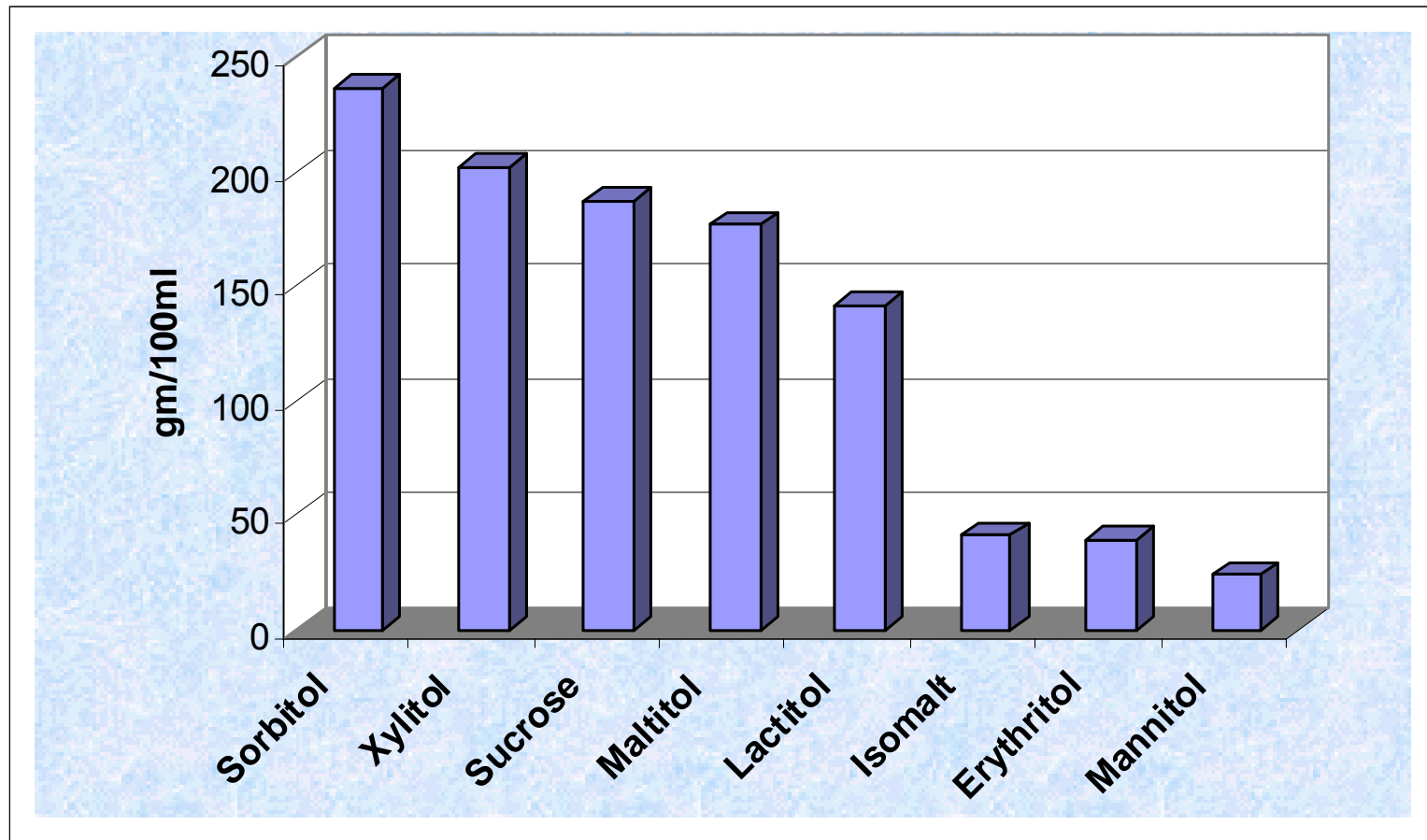
POLYOLS

	P O L Y O L S			
	N° additive EEC	(Sweetening Power)	Heat of Solution negative (Kcal/gr)	Hygroscopicity
SORBITOL	E-420	0,50 - 0,60	-26,50	++
MANNITOL	E-421	0,50 - 0,65	-28,90	+
ISOMALT	E-953	0,45 - 0,65	- 9,40	0
MALTITOL	E-965	0,90 - 0,95	-18,90	++
LACTITOL	E-966	0,30 - 0,40	-13,90	0
XYLITOL	E-967	1	-36,60	+++
ERITRITOL	- - -	0,60 - 0,70	-23,30	+

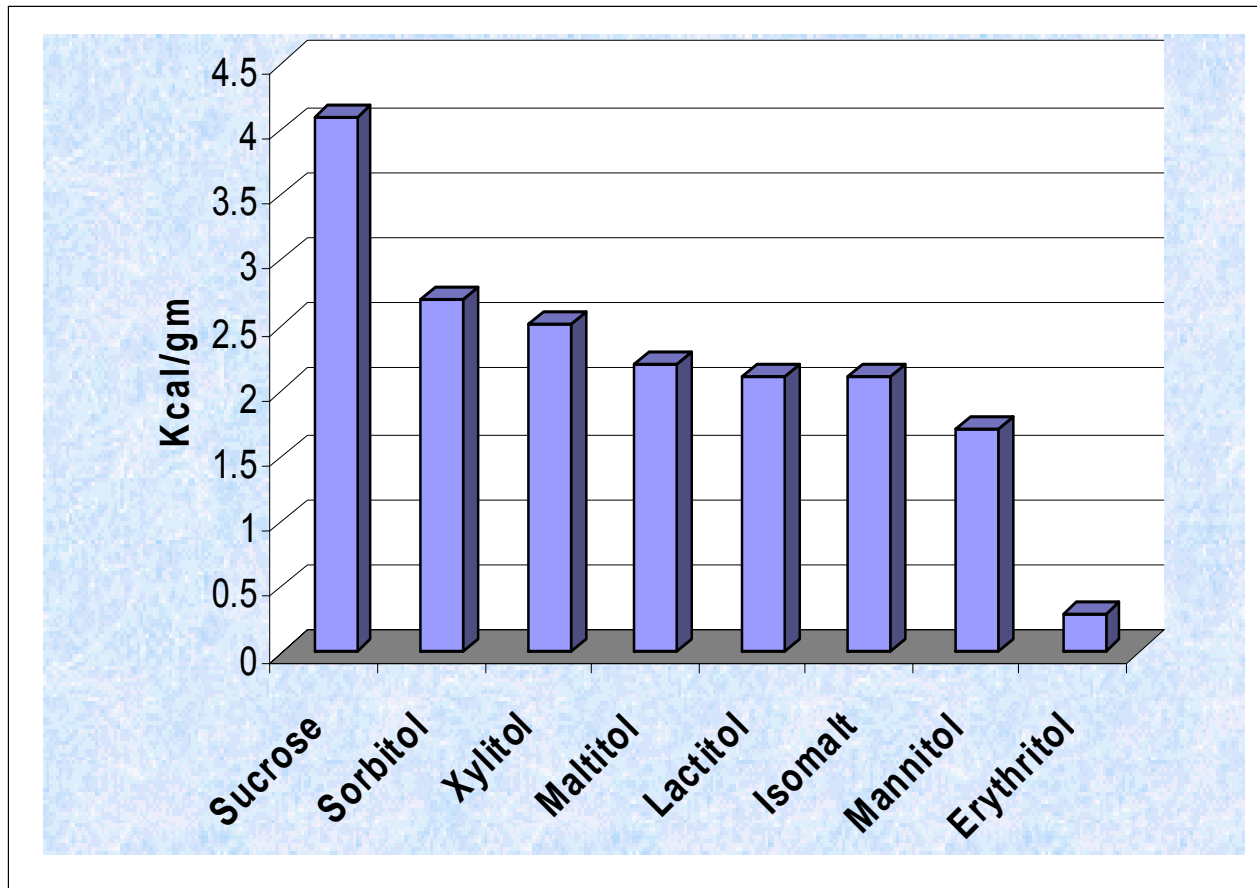
Polyols - Relative Sweetness



Polyols - Solubility at 25°C in Water



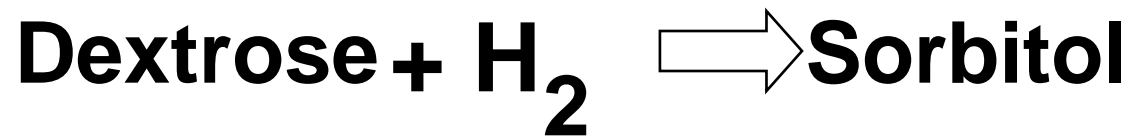
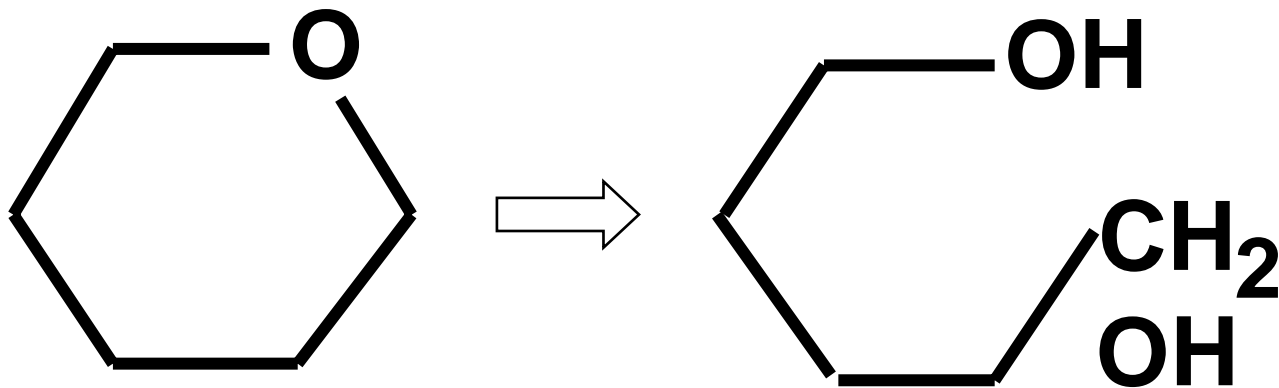
Polyols - Caloric Value



SORBITOL

- **Sorbitol is the most common used Sugarfree bulk sweetener because of its low cost, availability, and long term acceptance as a food additive. Sorbitol is manufactured by the hydrogenation of D-Glucose or Dextrose. It is commercially available in solution forms and in a variety of crystalline powder forms.**

Hydrogenation of Glucose to Sorbitol



SORBITOL

- As a crystal, Sorbitol is a white, odorless, hygroscopic powder with a sweet cool taste. The cool taste is due to its negative heat of solution, about -26.5 cal/g. It is considered GRAS and has a nutritive value of 3.9 cal/g by the FDA, the EEC accepts a 2.4 cal/g value. Sorbitol, as most polyols, has a slight laxative and diuretic effect and is metabolized as Fructose, therefore, does not elevate blood glucose levels.

SORBITOL

- **There is a multiplicity of crystal forms and particle size Sorbitols available. Crystalline Sorbitol is made by grinding a cake that is produced by drying a Sorbitol solution. Different crystallizing conditions and grinding techniques along with screen sizing gives each of these Sorbitols very different properties.**

SORBITOL

- **As a liquid, Sorbitol is available as a 70% solution. There is a variety of liquid Sorbitols available some are almost pure Sorbitol others with some contents of Mannitol or Maltitol to prevent crystallization.**

SORBITOL

- **In Sugarfree Gums, the re-crystallization of Sorbitol has a definite effect on the shelflife. The selection of the best powdered Sorbitol for each product is most important and must be found by actual laboratory and production trials**

SORBITOL

- **Sorbitol is used in Pan Coating of Sugarfree gums because of its low cost compared to other polyols. Pan Coating with Sorbitol requires a very good control of the panning conditions. It is influenced by Syrup and Center temperature and the purity of the starting Sorbitol solution.**

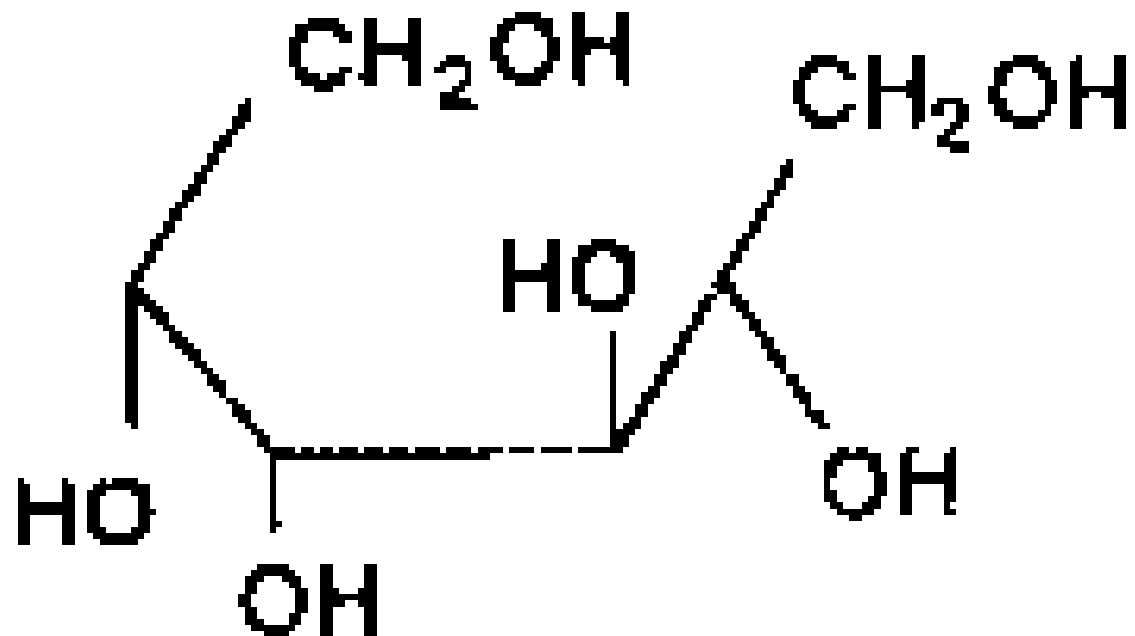
MANNITOL

- Mannitol can be made in a similar way as Sorbitol, it is the hydrogenation of D-Fructose made from invert sugar. Controlling the process conditions the yields of different amounts of Sorbitol and Mannitol are possible.

MANNITOL

- These are then separated and the Mannitol is crystallized. Other production methods are used such as catalytic or enzymatic isomerization before hydrogenation to increase yields.

MANNITOL



MANNITOL

- Mannitol is not as sweet as Sorbitol and does not have the strong cooling effect. It is much less soluble in water and is non-hydroscopic. It is available in powdered form with some variation in particle sizes.

MANNITOL

- Mannitol is more expensive as compared to Sorbitol and is therefore used in Sugarfree Gum at much lower levels, or not at all. It is commonly used as a dusting material or a processing aid in Gum manufacture.
- Mannitol contributes to systems that prevent the re-crystallization of Sorbitol thereby effecting the shelf life of the Gum.

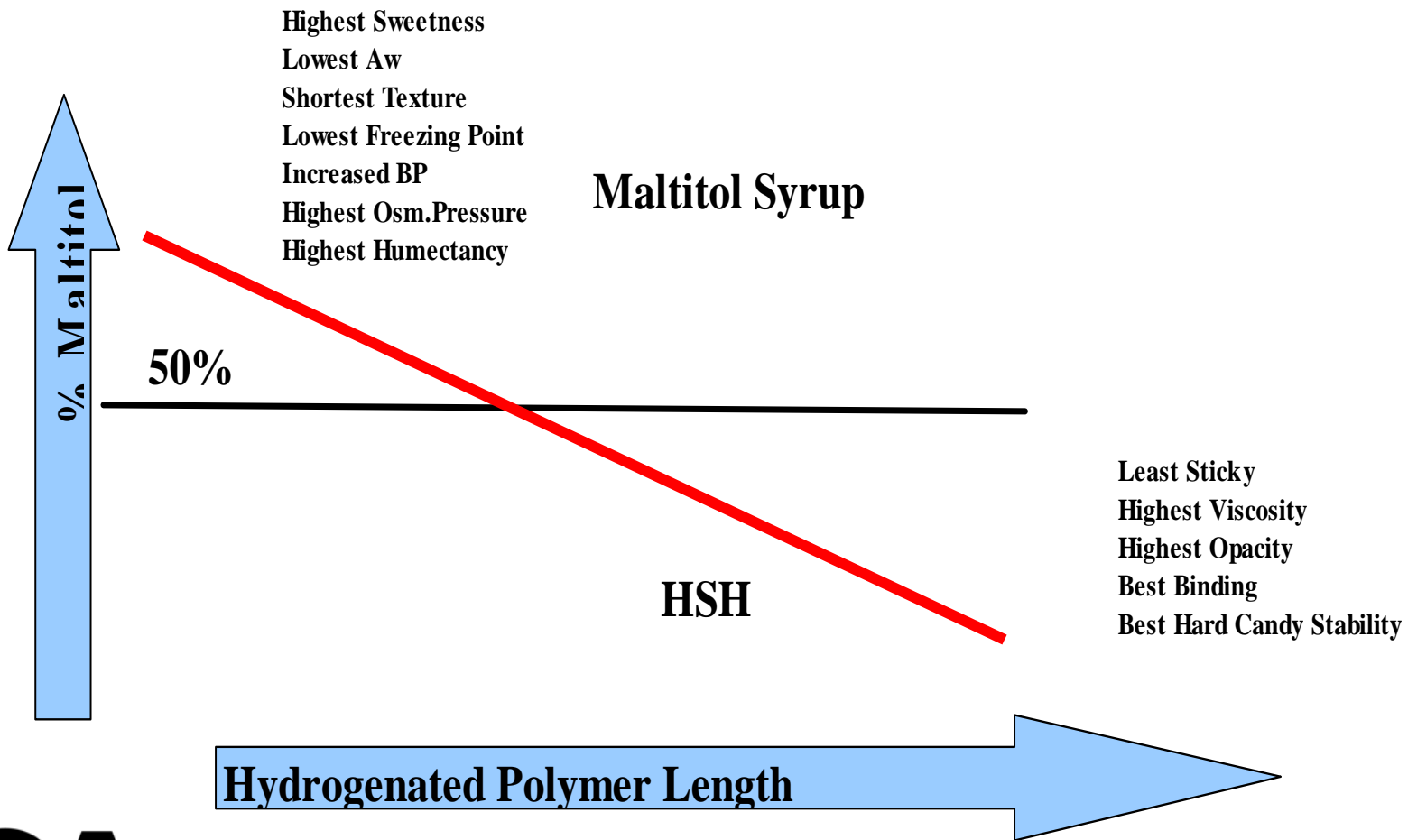
HYDROGENATED STARCH HYDROLYZATES

- Hydrogenation of a not fully hydrolyzed starch gives a material that is very useful in Chewing Gum, since the major problem in the shelf life of Sugarfree Gum is the re-crystallization of the Sorbitol causing the Gums to become hard and break.

HYDROGENATED STARCH HYDROLYZATES

- **Traditionally a 70% solution of Sorbitol was used in Chewing Gums to give a soft flexible texture to the Gum but this material gave a perfect media for the re-crystallization. Materials that retard or prevent this re-crystallization are different polyols such as Mannitol, Maltitol, etc.**

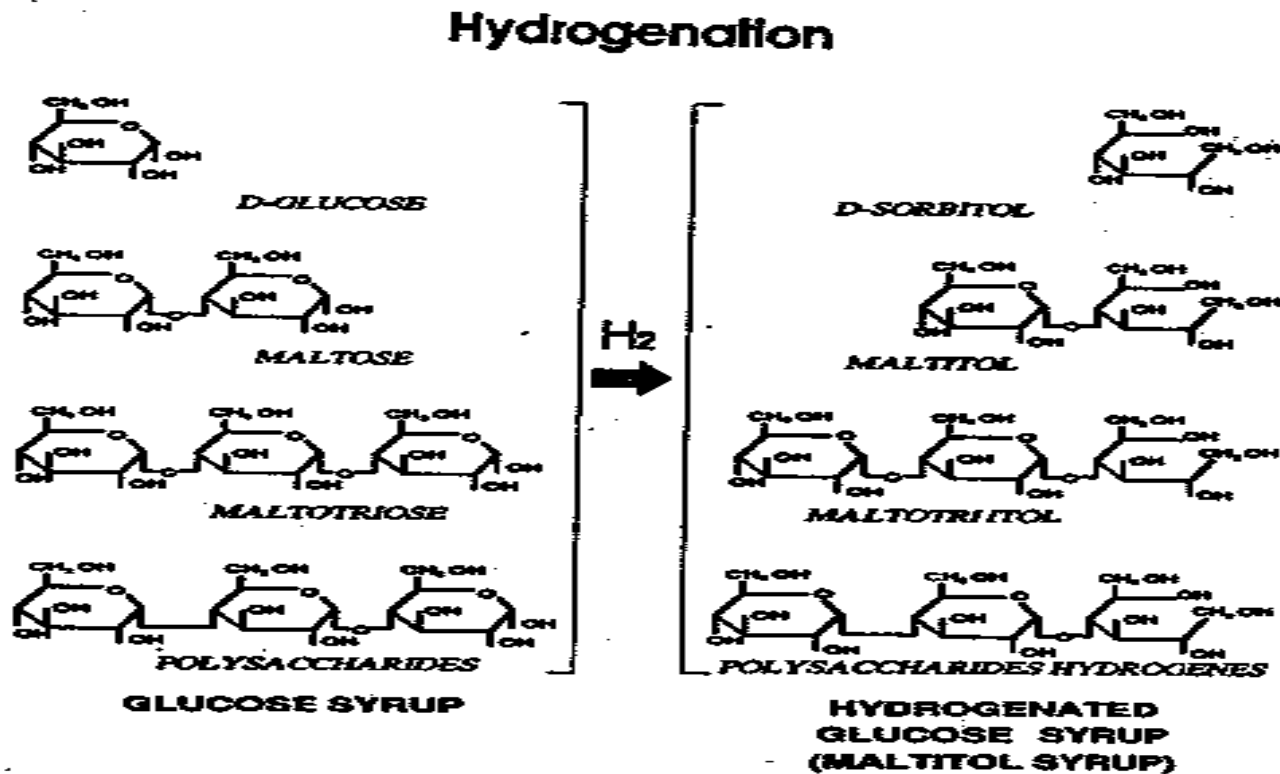
HSH and Maltitol Syrups - Form and Functionality



HYDROGENATED STARCH HYDROLYZATES

- One way to manufacture these “other” polyol is to not fully hydrolyze the starch to Dextrose before doing the hydrogenation. These materials are called "Hydrogenated Starch Hydrolyzate" or "Hydrogenated Glucose Syrup" or Maltitol Syrup”.

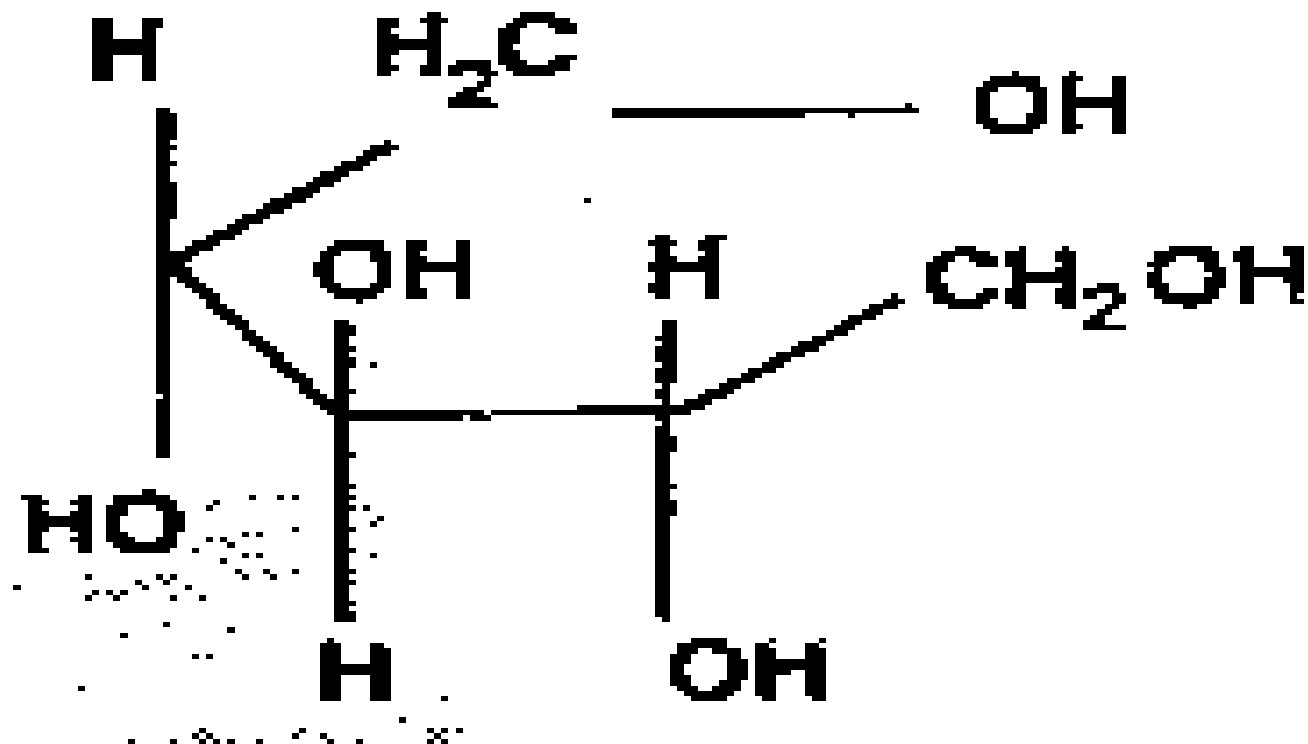
HYDROGENATED STARCH HYDROLYZATES



XYLITOL

- **Xylitol is another polyol but slightly different than Sorbitol or Mannitol. Sorbitol and Mannitol are six carbon chain polyols whereas Xylitol is a 5 carbon chain polyol. It is manufactured by the hydrogenation of Xylose. Xylose is made from hydrolysis of Xylan, a polysaccharide found in hemicellulose. The commercial source is Birchwood.**

XYLITOL



XYLITOL

- **Xylitol is about equal to sugar in sweetness and has a cool taste similar to Sorbitol. It is very soluble in water and this gives a distinct cooling sensation in the mouth.**

XYLITOL

- **Studies have been done on Xylitol and dental carries, and these show Xylitol to be more effective than other polyols. Xylitol elevates mouth and plaque pH to 7.0, which is felt to be one of the best indicators or anti carries properties of sweeteners.**

XYLITOL

- **Formulating Gum with Xylitol requires some testing. Xylitol is costly compared to other polyols and levels of 10 - 20% of the Chewing Gum are common instead of using Xylitol as the only bulk sweetener.**

XYLITOL

- **Xylitol is commonly used in Sugarfree Chewing Gums in Europe where strong anti carries claims can be made, but has not met with large success in the US market where these claims cannot be made.**

XYLITOL

- **Xylitol is used in Pan Coating of Sugarfree gums but is quite expensive for this application. It is usually applied as a blend with Mannitol**

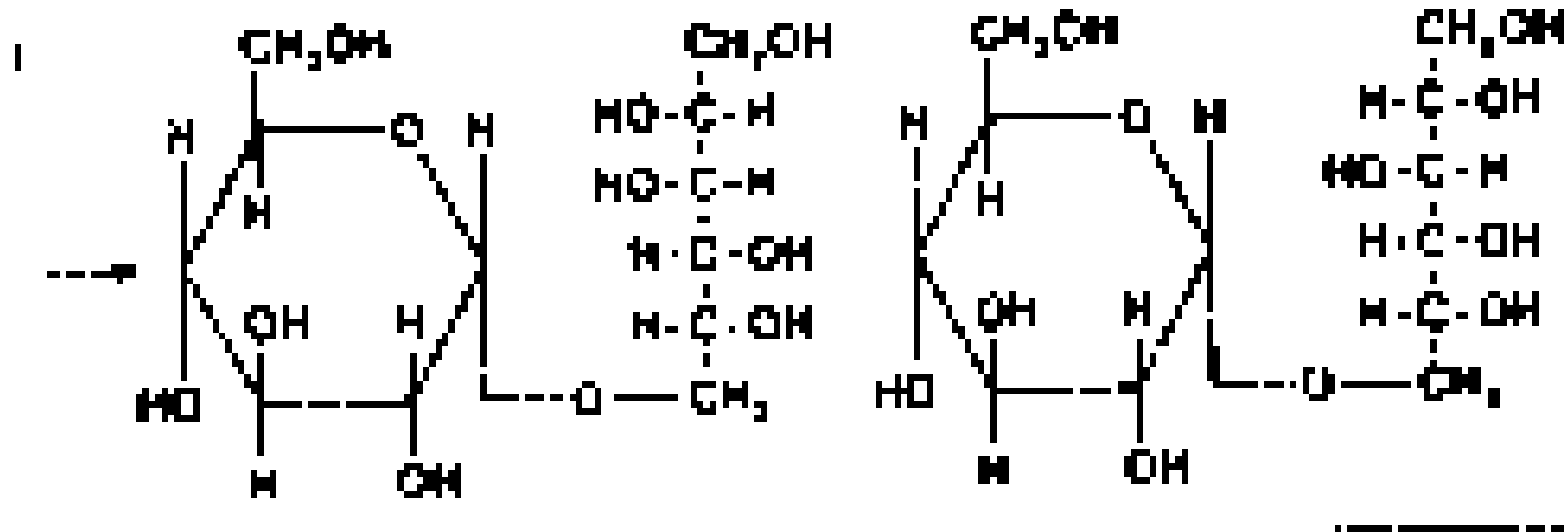
ISOMALT

- **is the trade name for crystalline Isomalt Palatinit. It is made from the enzymatic rearrangement of Sucrose to isomaltose which is then hydrogenated to Isomalt. Isomalt is about 0.6 times as sweet as Sucrose and has a low or no cooling effect in the mouth.**

ISOMALT

α -D-glucopyranosyl-
1,6-mannitol

α -D-glucopyranosyl-
1,6-sorbitol



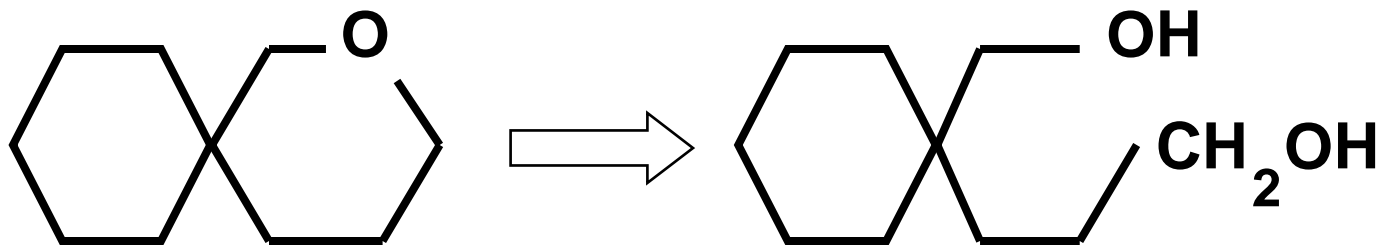
ISOMALT

- **Isomalt is very useful and easy to apply in Pan Coating of Sugarfree Gums. It is more expensive than Sorbitol but is not as difficult to use and obtain a good smooth coating. Isomalt also gives a crisp coating similar to Sugar.**

MALTITOL

- **Maltitol is made from the hydrogenation of maltose. Maltose is made from the enzymatic hydrolysis of starch. Maltitol is very useful in chewing gum because it is almost as sweet as sugar.**

Hydrogenation of Maltose to Maltitol



+ H₂

Maltose

Maltitol

Appendix B

HIGH INTENSITY SWEETENERS

More Specific Information on:

- **Types**
- **Structures**
- **Characteristics**
- **Guidelines in Gum**

Sensory Properties of Intense Sweeteners

Sweetener	Approx. Sweetness Intensity	Sweetness Quality	Synergistic With:
Sucrose	1	Clean sweetness, no after taste	Saccharin, Aspartame, Cyclamate and Stevioside
Acesulfame-K	200	Sweet, Slight Bitter and Metallic Aftertaste	Aspartame, Cyclamate, Sorbitol Isomalt & Fructose
Alitame	2000	Clean Sweet Taste	Acesulfame-K & Cyclamate
Aspartame	200	Clean Sweetness, Sweet Aftertaste	Saccharin, Cyclamate, Acesulfame-K, Stevioside
Cyclamate	30	Chemical Sweet,	Saccharin, Aspartame,
		No Aftertaste	Acesulfame-K & Sucralose, Alitame & Stevioside
Glycyrrhizin	33	Bitter, Licorice, Cooling	
Neotame	8000	Clean Sweet, Delayed Onset, Lingering Sweetness, Licorice Like	Saccharin
NHDC	1500-2000	Delayed Onset Cooling, Methol Like Taste	Most Sweeteners
Sodium Saccharin	300	Sweet, Bitter, Metallic Aftertaste	Cyclamate, Aspartame, Sucralose & Alitame
Sucralose	600	Sweet Taste, Close to Sucrose, Slight Delayed Onset, Lingering Sweetness	Cyclamate
Thaumatococ	3000	Slow Onset, Linger, Licorice	Saccharin, Acesulfame K, Stevioside

ASPARTAME

Aspartame is currently used in many Chewing and Bubbles Gums sold in the USA. It is a good sweetener for Chewing Gum giving a nice smooth and long lasting sweetening effect. The major problem is aspartame's stability in Chewing Gum.

ASPARTAME

Without protection Aspartame will disappear in a Gum at a constant rate depending on pH, moisture and flavor. Aspartame will react with some flavor components, particularly Cinnamon or other aldehydes. Some patents have been granted on systems to retard or prevent the loss of Aspartame.

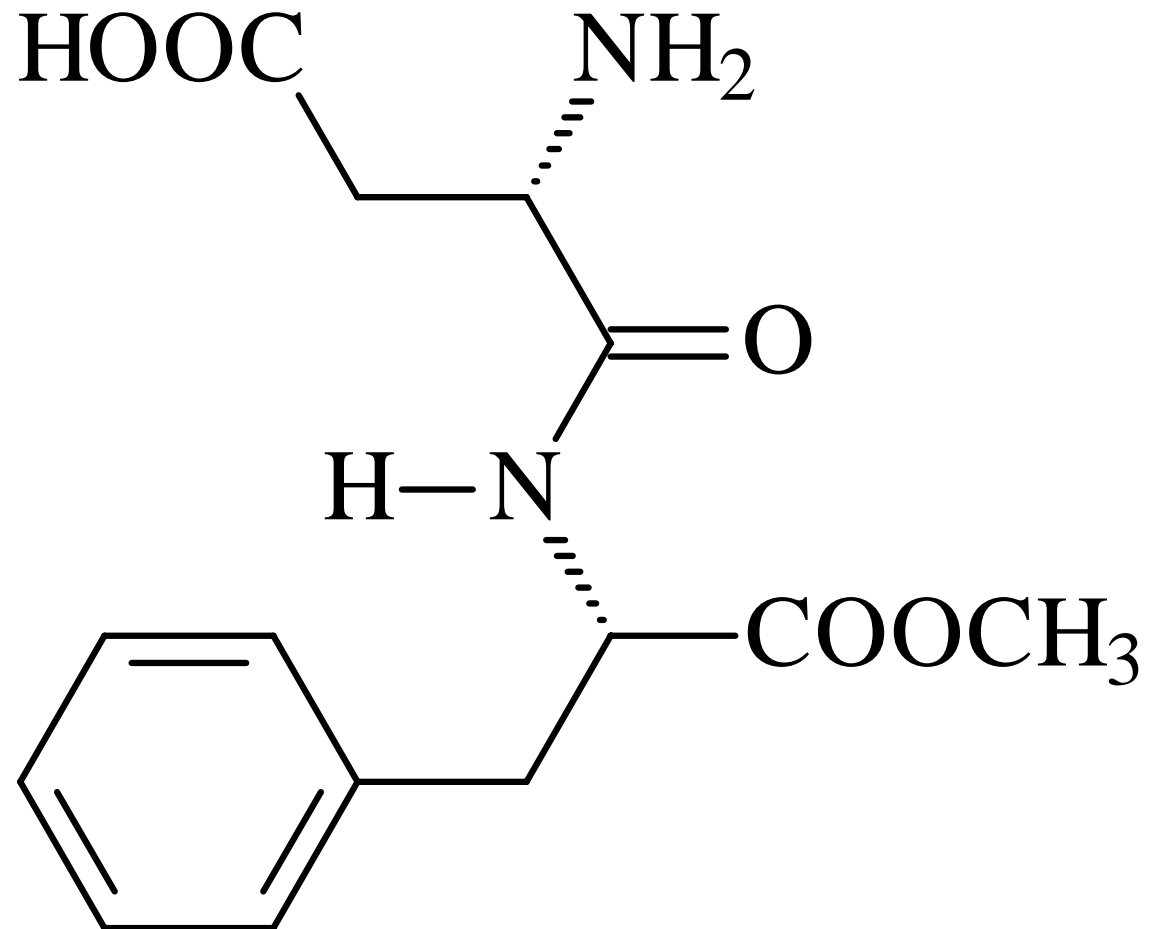
ASPARTAME

Many of the Chewing Gums on the market that contain Aspartame do use some type of protective system for the Aspartame. Many of these are protected by patents and are proprietary. Most of these protection systems are some type of encapsulation system.

ASPARTAME

- Usual levels of Aspartame in sugar free chewing gum are 0.15% or higher
- Many sugar gum sold in the US contain aspartame or another intense sweetener.

ASPARTAME



NEOTAME

Neotame was discovered by French scientists Nofre and Tinti for which they were awarded a patent in 1996 that was assigned to the NutraSweet Company

NEOTAME

Neotame was approved for use in foods and beverages by the US FDA on July 9, 2002

NEOTAME

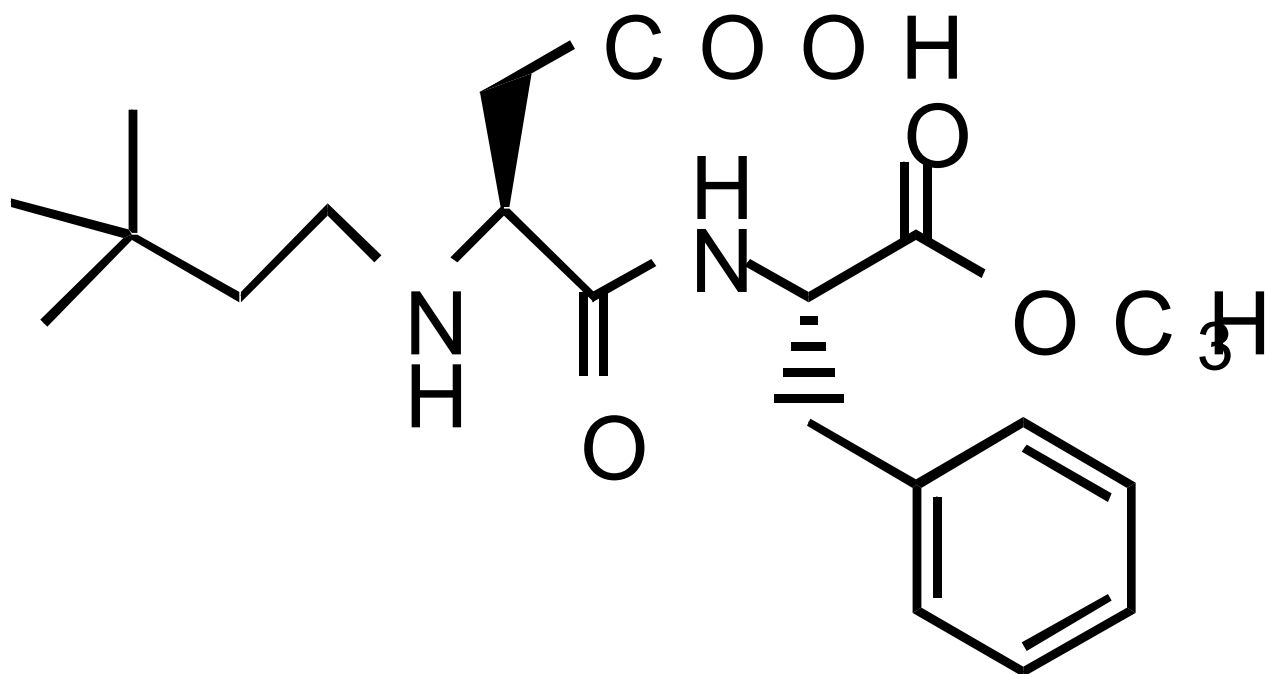
Neotame is 6000-13,000 times sweeter than sugar. In addition to being a sweetener, it is a flavor and mouth-feel modifier and is synergistic with saccharin.

NEOTAME

No special labeling or warnings are required for Neotame.

Neotame does exhibit similar stability problems as aspartame in chewing gum.

NEOTAME



ACESULFAME - K

Acesulfame K is a good sweetener for Chewing Gum, it is very stabile and has a clean sweet taste. Its sweetening power is slightly less than Aspartame so slightly higher levels are required in Chewing Gum.

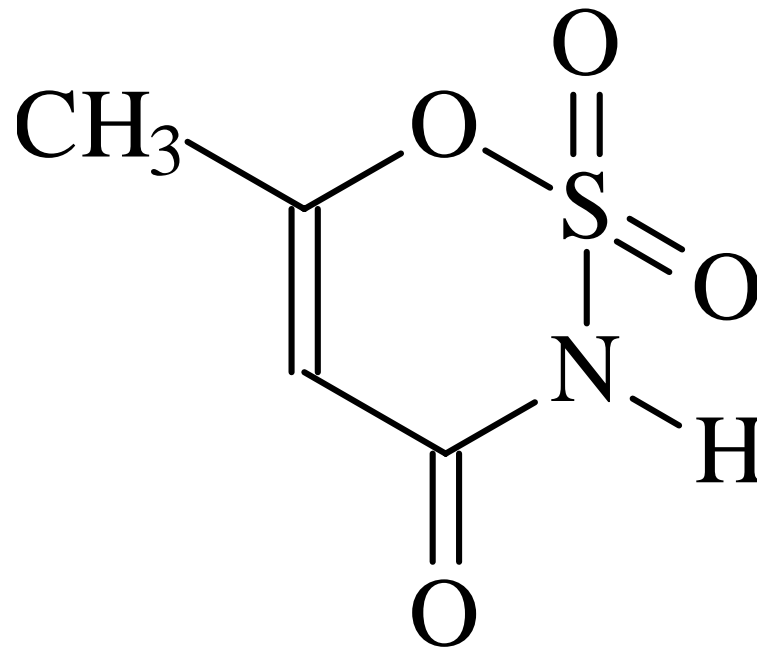
ACESULFAME - K

Acesulfame K is very soluble in water and is extracted quickly from chewing gum. This means it is very sweet for the initial impact and has a poor "long lasting" effect. Some patents have been granted to retard the extraction by encapsulation.

ACESULFAME - K

Acesulfame K is accepted in many countries in the world. It does not require any special label warnings.

ACESULFAME - K



SUCRALOSE

In 1998 the US FDA approved the use of Sucralose in some foods including Chewing Gum. Sucralose is trichlorogalactosucrose (TGS Sugar.) It is a derivative of Sucrose produced by chlorine substitution of hydroxyl groups.

SUCRALOSE

- **600 times sweeter than sugar. Sucralose does not break down in the body; it is non-caloric.**
- **Sucralose is currently approved for use in foodstuffs in more than 35 countries around the world.**

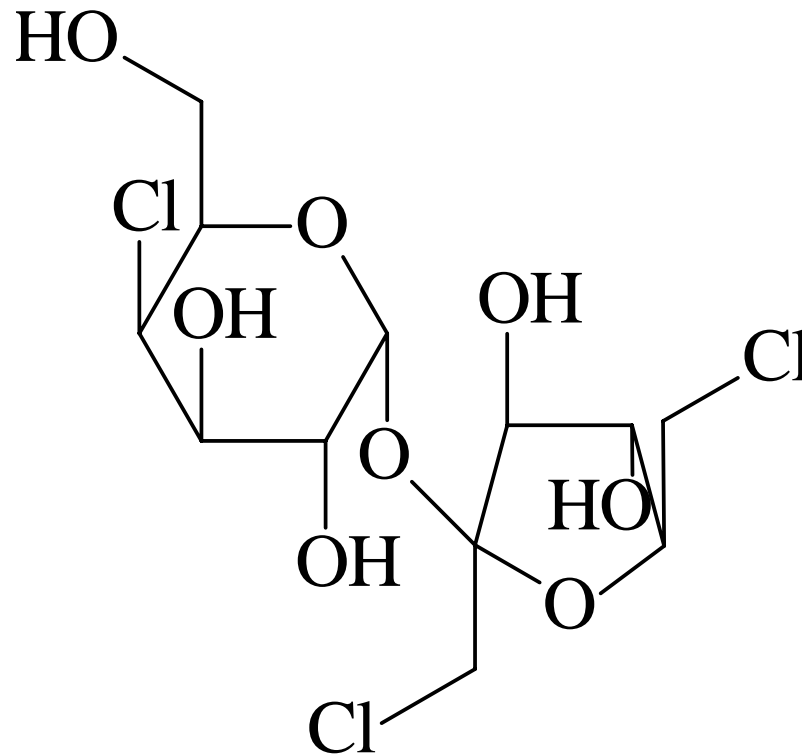
SUCRALOSE

- **Approved by the European Union's Scientific Committee on Food in September 2000.**
- **Approved by EU for use in chewing gum 5/2003 at 3000 mg/kg.**

SUCRALOSE

- **The Acceptable Daily Intake (ADI) for Sucralose was set at 0-15 mg per kilogram of bodyweight by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) in 1990 and by the European Commission's Scientific Committee on Food in September 2000.**

SUCRALOSE



SACCHARIN

Saccharin has been used for many years in Chewing Gum. It was introduced into human foods in 1890, over 100 years ago. It is 200 - 500 times as sweet as Sucrose and is available in three different forms.

SACCHARIN

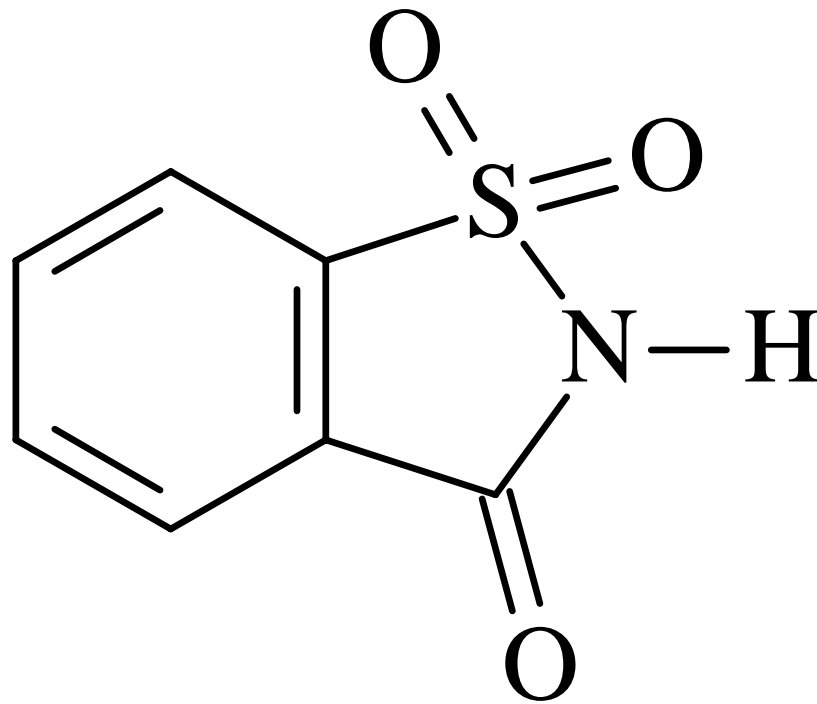
these forms are the acid form, Calcium salt and the most common form, the Sodium salt. Saccharin continues to be used in Sugarfree Chewing Gums because of its stability and acceptable sweetening effects.

SACCHARIN

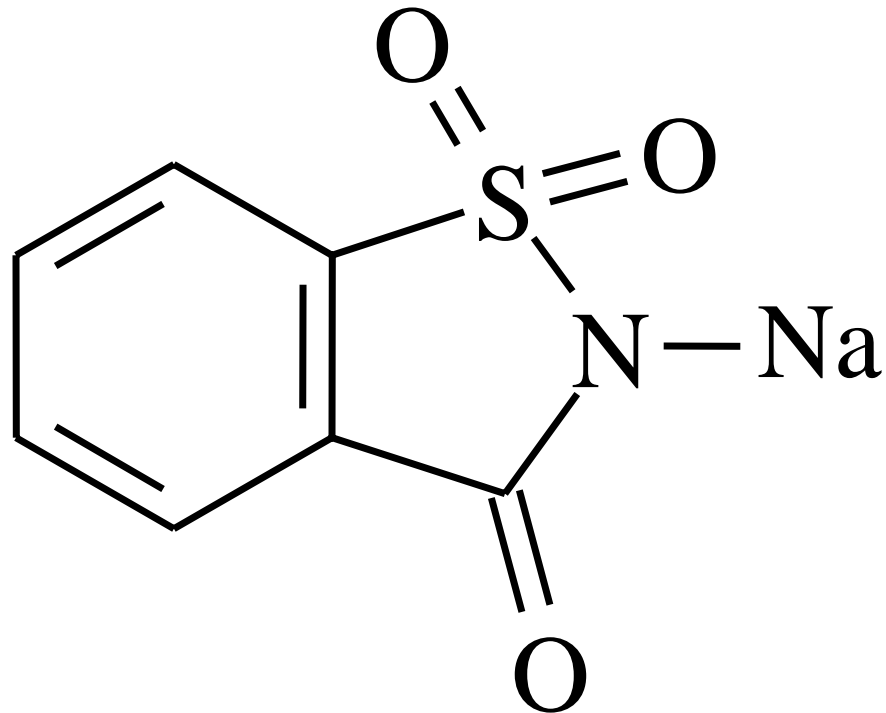
The Acceptable Daily Intake (ADI) for saccharin was increased to 5.0 mg per kilogram of body weight (JECFA) in February 1993.

The Scientific Committee for Food of the European Commission increased the ADI for saccharin to 5.0 mg per kilogram of body weight in June 1995.

SACCHARIN



SODIUM SACCHARIN



NEOHESPERIDINE DC

Neohesperidine DC is a low-calorie sweetener and flavor enhancer which may be produced by hydrogenation of neohesperidine, a flavonoid occurring naturally in bitter oranges.

Neohesperidine DC is 1500-1800 times sweeter than sucrose at threshold levels. At practical use levels, it is about 400-600 times as sweet as sucrose. Relative to and in mixture with aspartame and acesulfame K, neohesperidine DC is several (7 to 20) times sweeter depending upon the food in which such mixtures are used.

NEOHESPERIDINE DC

Neohesperidine DC is a flavonoid dihydrochalcone. While neohesperidine DC has not yet been found in nature, structurally related flavonoids and their corresponding dihydrochalcones occur naturally in many plants

NEOHESPERIDINE DC

Neohesperidine DC is typically used in combination with other sweeteners. In such mixtures, it exhibits remarkable synergistic effects and can enhance the quality of sweetener blends. Even at very low concentrations (≥ 5 ppm), Neohesperidine DC can still improve the overall flavor profile and mouth feel of certain foods.

NEOHESPERIDINE DC

The safety of neohesperidine DC was confirmed in 1987 by the Scientific Committee for Food (SCF) of the European Commission.

Neohesperidine DC is an authorized sweetener in the *European Parliament and Council Directive 94/35/EC of 30 June 1994 on sweeteners for use in foodstuffs*. The date of implementation of this directive for Member States was December 31, 1995.

NEOHESPERIDINE DC

Approval for food use in countries outside the European Union has been granted or is being sought.

The Acceptable Daily Intake (ADI) for neohesperidine DC has been set at 0-5 mg/kg per kilogram of body weight by the SCF.

GLYCYRRHIZIN

Glycyrrhizin is the principle flavoring constituent of the Licorice root. It is isolated from licorice extract by Sulfuric acid precipitation. Crude Glycyrrhizin is then purified to a brown powder called Ammoniated Glycyrrhizin (AG) or a very pure white powder form called Mono-ammonium Glycyrrhizinate (MAG).

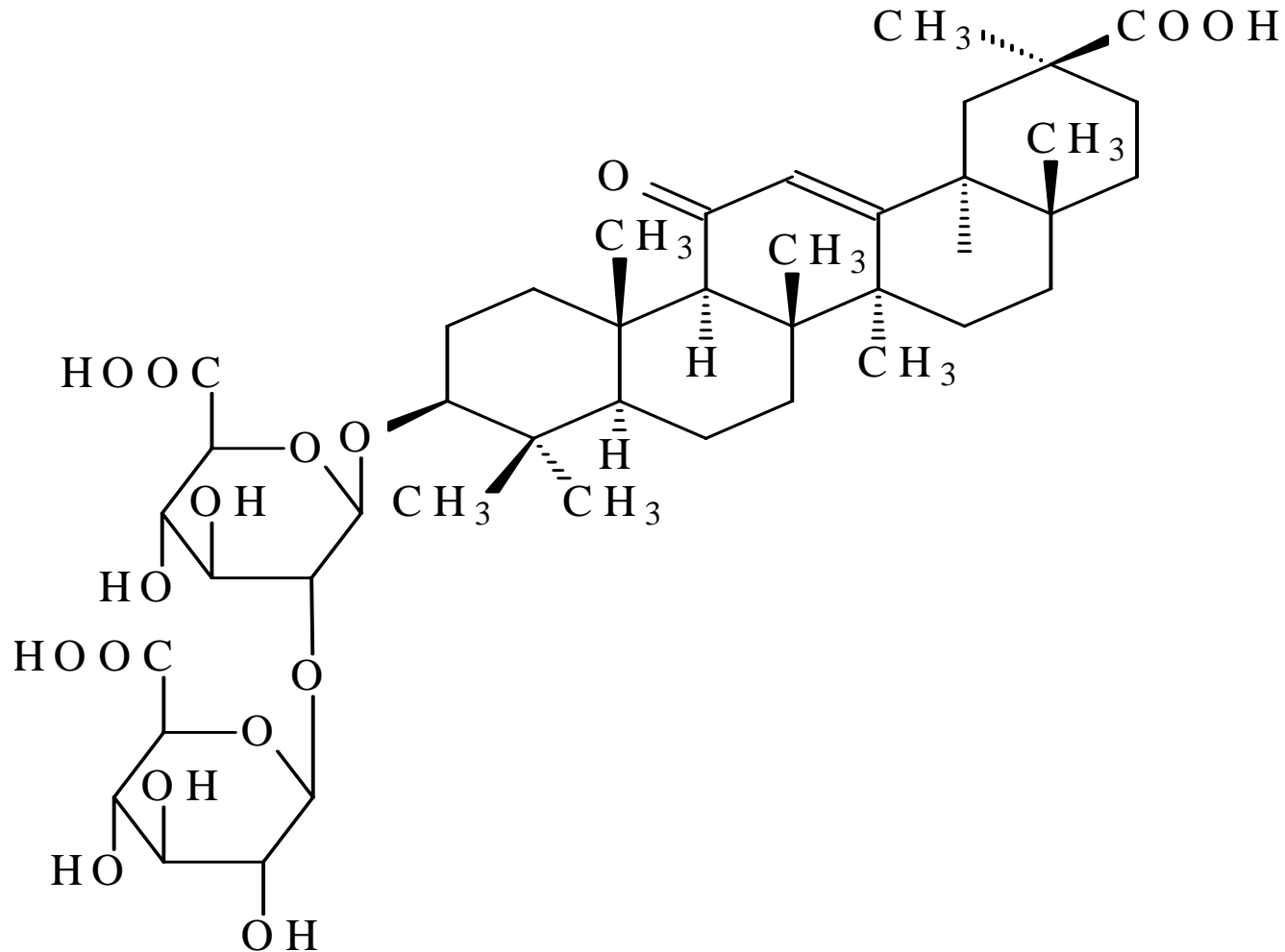
GLYCYRRHIZIN

Glycyrrhizin is considered as a GRAS Flavoring by the US FDA. It does not require any special labels or warnings.

GLYCYRRHIZIN

Glycyrrhizin is about 50 times sweeter than Sucrose but does have a distinct licorice taste. If this compliments the desired flavor then it can be used at levels that will give good sweetening effects, but if the licorice taste conflicts or can be detected then levels must be kept low.

GLYCYRRHIZIC ACID



THAUMATIN

Thaumin or Talin is a natural protein extracted by physical methods from the berry of a West African plant called the Katemfe fruit or Miraculous fruit. It is between 2,000 to 2,500 times sweeter than Sugar.

THAUMATIN

Thaumatococcus is an authorized sweetener in the European Parliament and Council Directive 94/35/EC of 30 June 1994 on sweeteners for use in foodstuffs and as a flavor enhancer.

Thaumatococcus is classified as GRAS (Generally Recognized as Safe) by the US FDA.

The JECFA gave **Thaumatococcus** an Acceptable Daily Intake (ADI) "not specified".

STEVIOSIDE

Stevioside is derived from the leaves of the *Stevia rebaudiana* plant. *Stevia* originates in South America, but it is also grown in several Asian countries.

Stevioside is a glycoside formed by three molecules of glucose and one of steviol, a diterpenic carboxylic alcohol.

STEVIOSIDE

Stevioside is a non-caloric sweetener approximately 100-150 times sweeter than sugar. The sweetness of stevioside is accompanied by a liquorice-like aftertaste.

STEVIOSIDE

The European Commission published a Decision on February 22, 2000, refusing a request for the marketing authorization of Stevia Rebaudiana Bertoni plants and dried leaves.

Stevioside, as a sweetener, is not permitted in the USA by the FDA (Food and Drug Administration).

STEVIOSIDE

JECFA (Joint FAO/WHO Expert Committee on Food additives) reviewed stevioside in 1998, but could not quantify an Acceptable Daily Intake (ADI) because of inadequate data on the composition and safety of stevioside.

Chewing gum Machinery



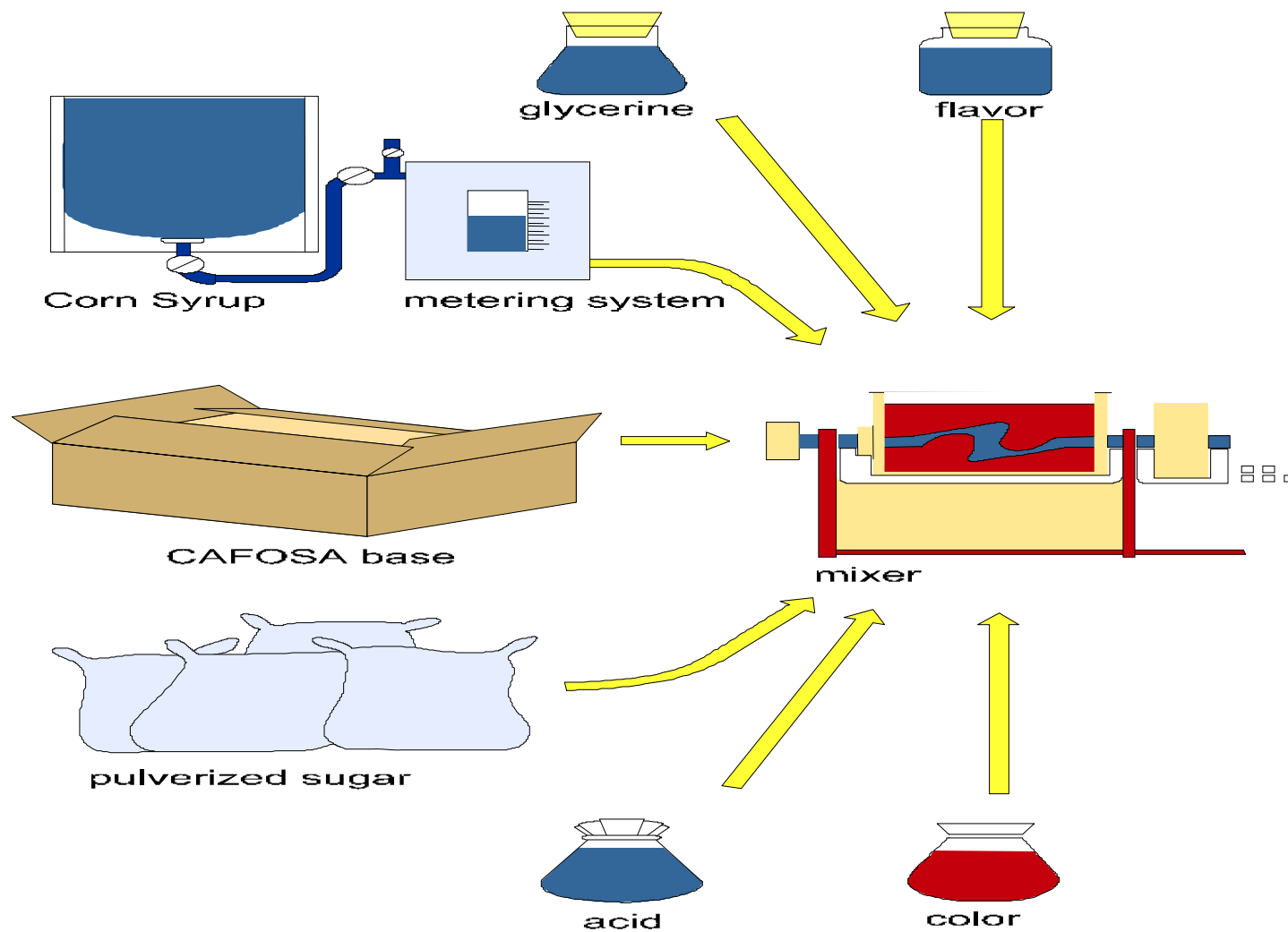
Resident Course in Confectionery Technology

Machinery

Summary

Production lines:

- ✓ **Bubble Gum (Cut & Wrap)**
- ✓ **Sticks (Rolling & Scoring)**
- ✓ **Ball Forming (Piluliers)**
- ✓ **Filled Gum (Forming Machine)**
- ✓ **Lollipops (Batch Roller)**

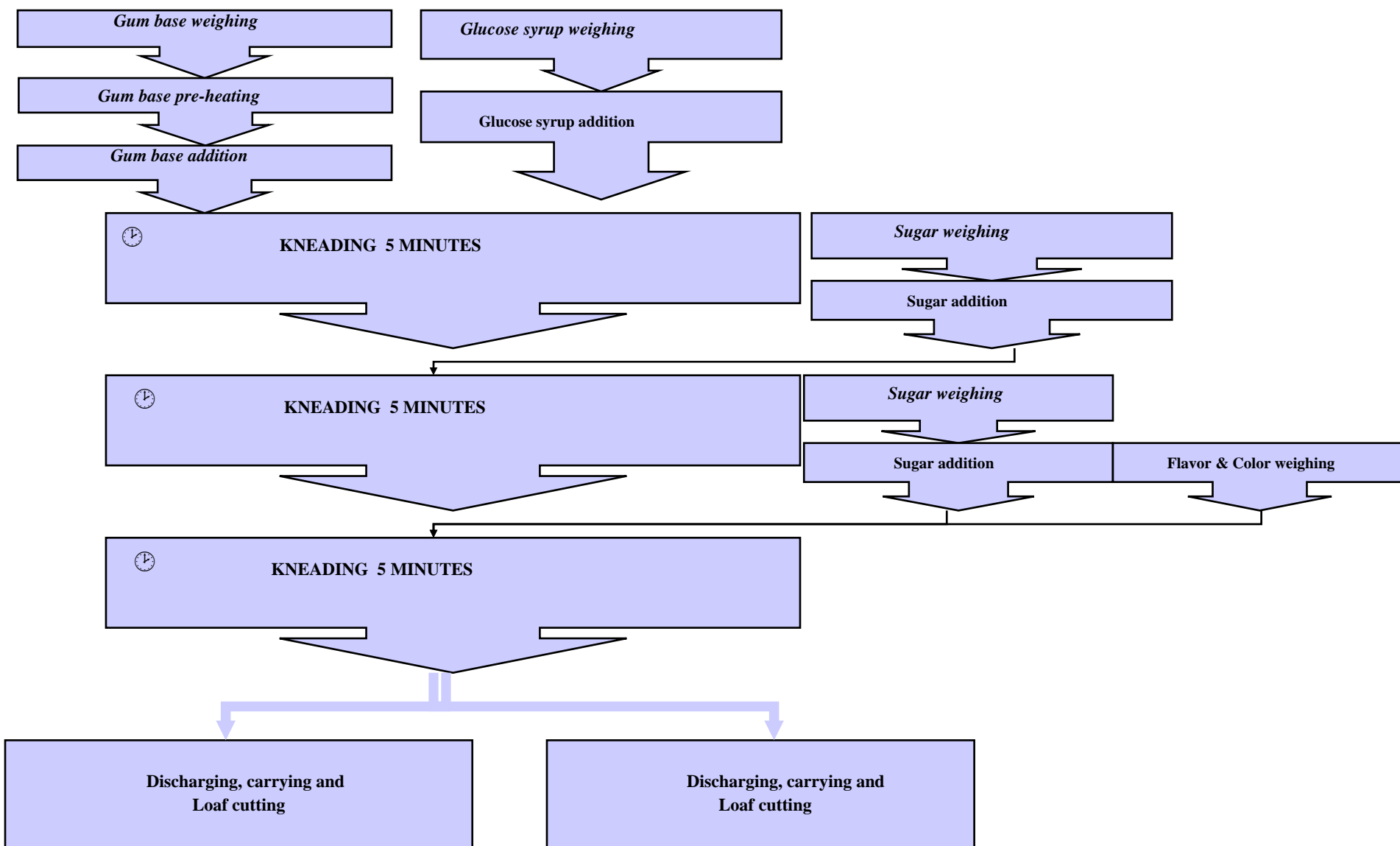


Machinery

Mixer

Double Sigma Mixer: Main Characteristics

- ✓ Batch size
- ✓ Motor Power
- ✓ Speed of the blades
- ✓ Reverse way option



Machinery

Mixer

Double Sigma Mixer (Double Z)

Function: Mix all the ingredients



UK-A Universal Mixing & Kneading Machine

Rotors

Sigma



Masticator



Hub design

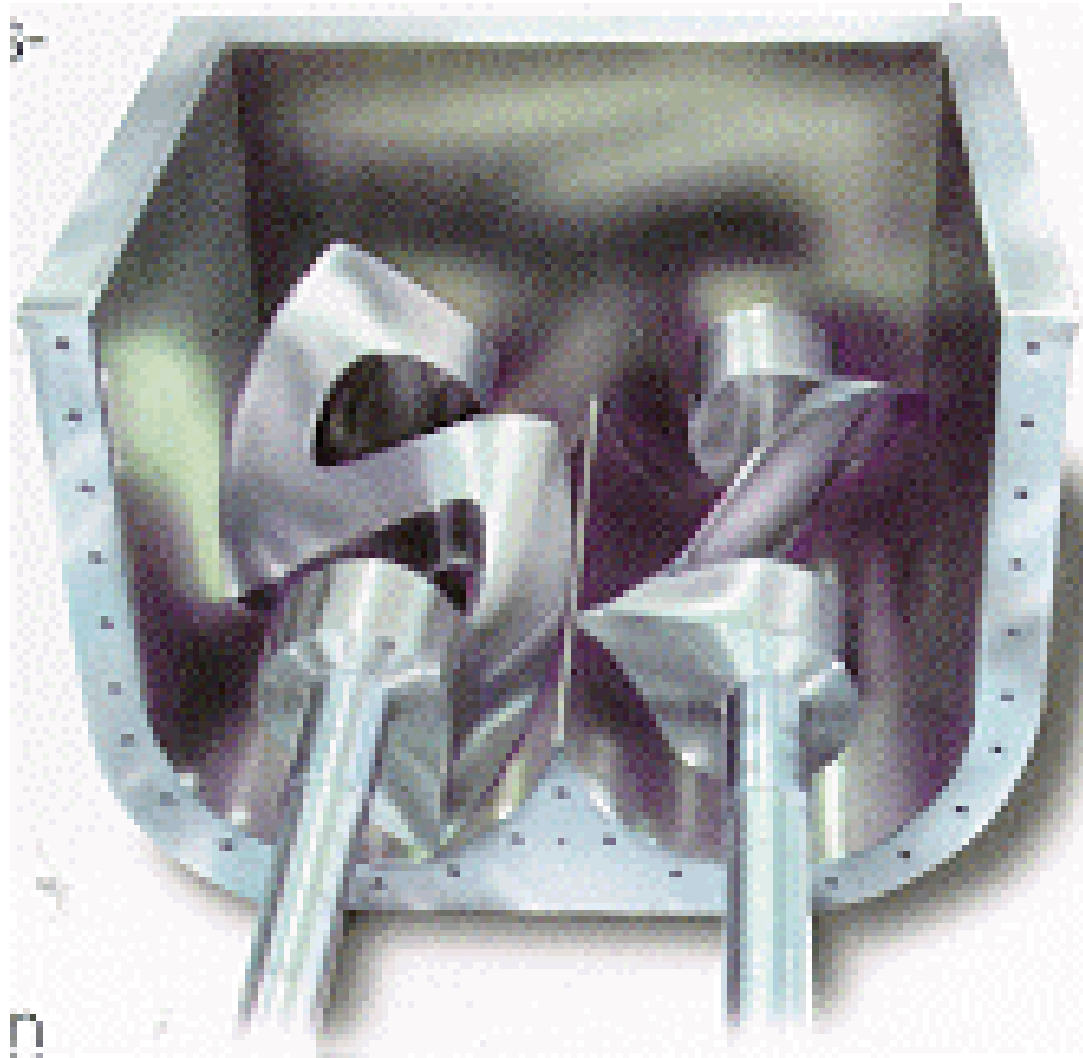


Double-hub design



Shredder



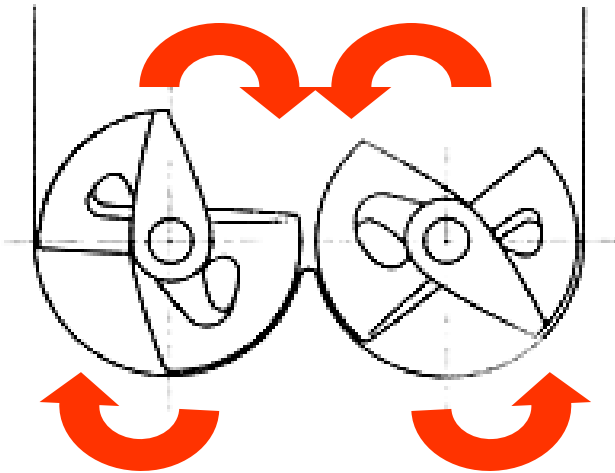


Resident Course in Confectionery Technology

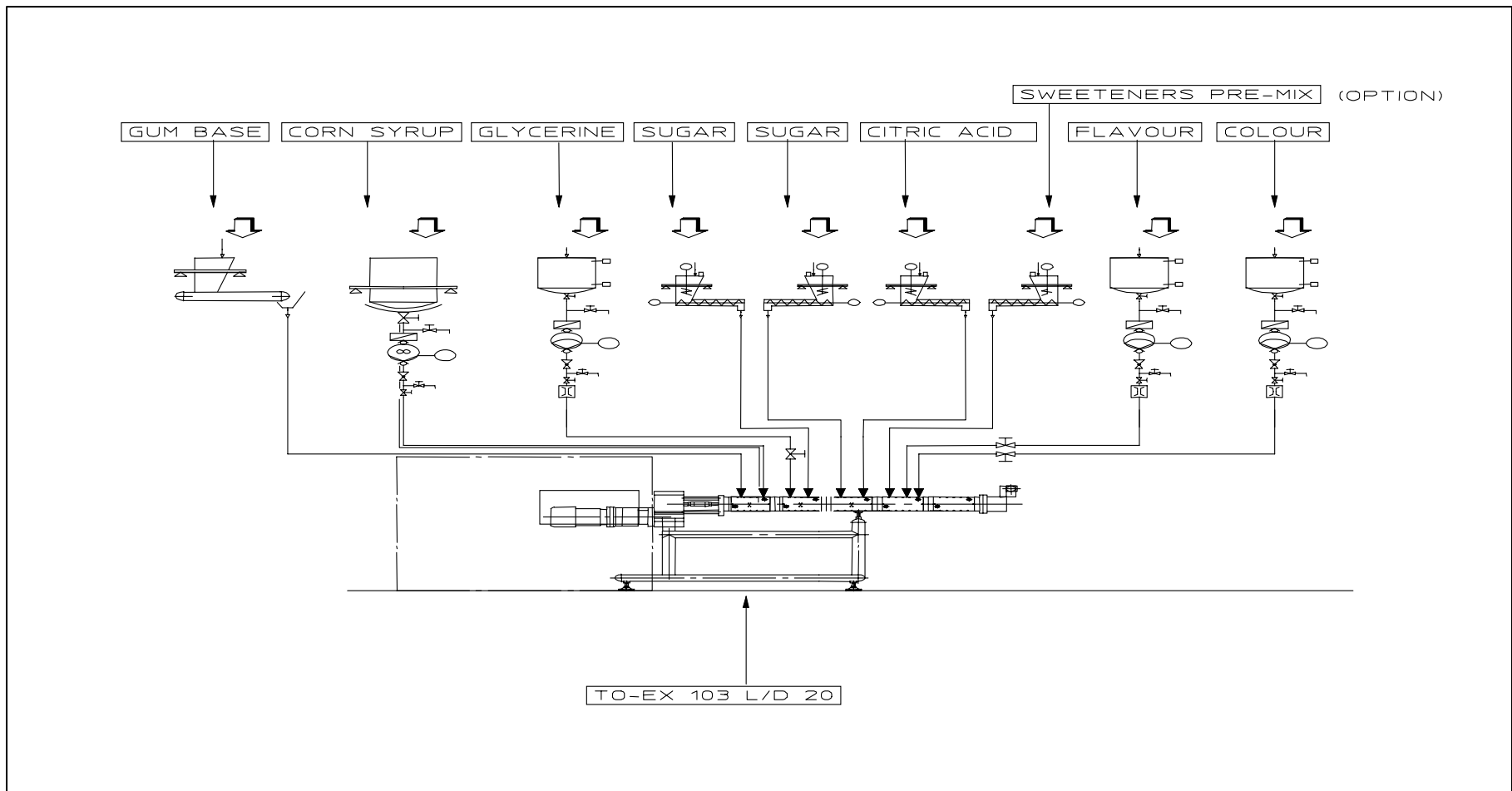
Machinery

Mixer

Double Sigma Mixer



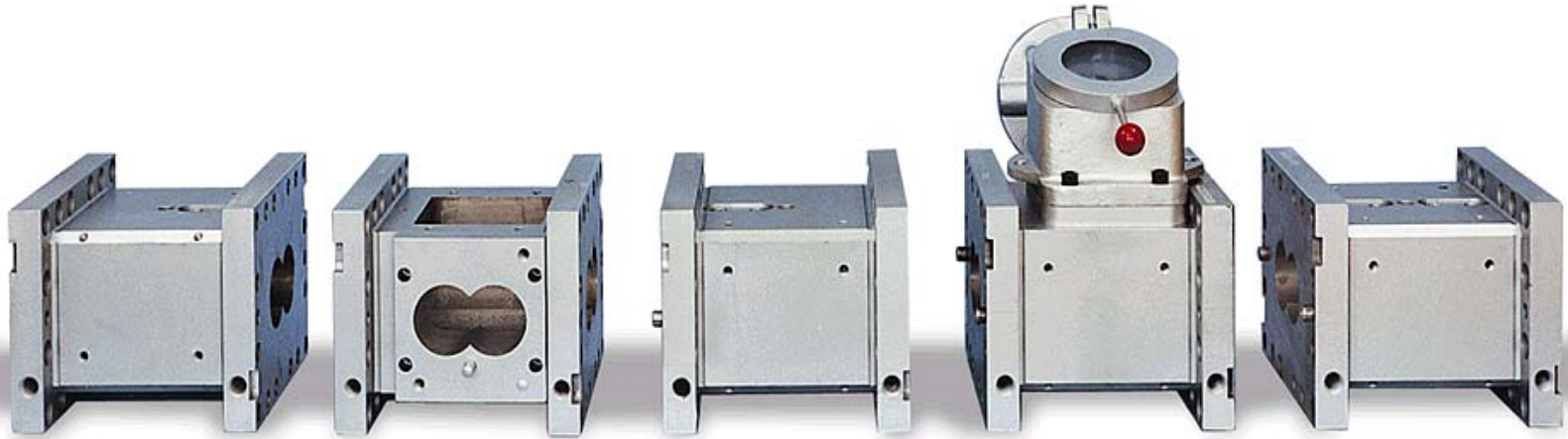
The blades move in different ways: one clockwise and the other anti-clockwise



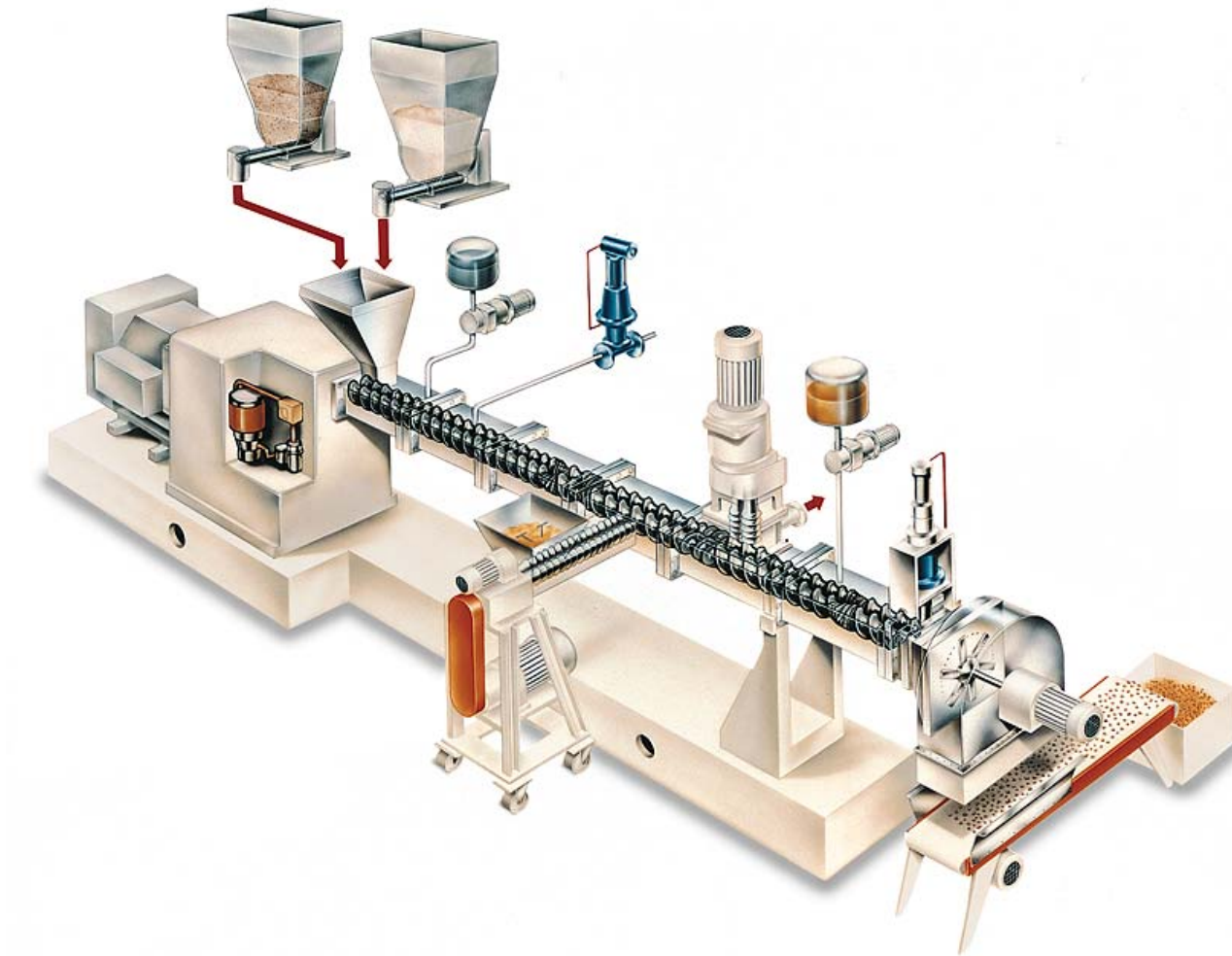
Screw and Kneading Elements



Building Block system for Screw and Barrels

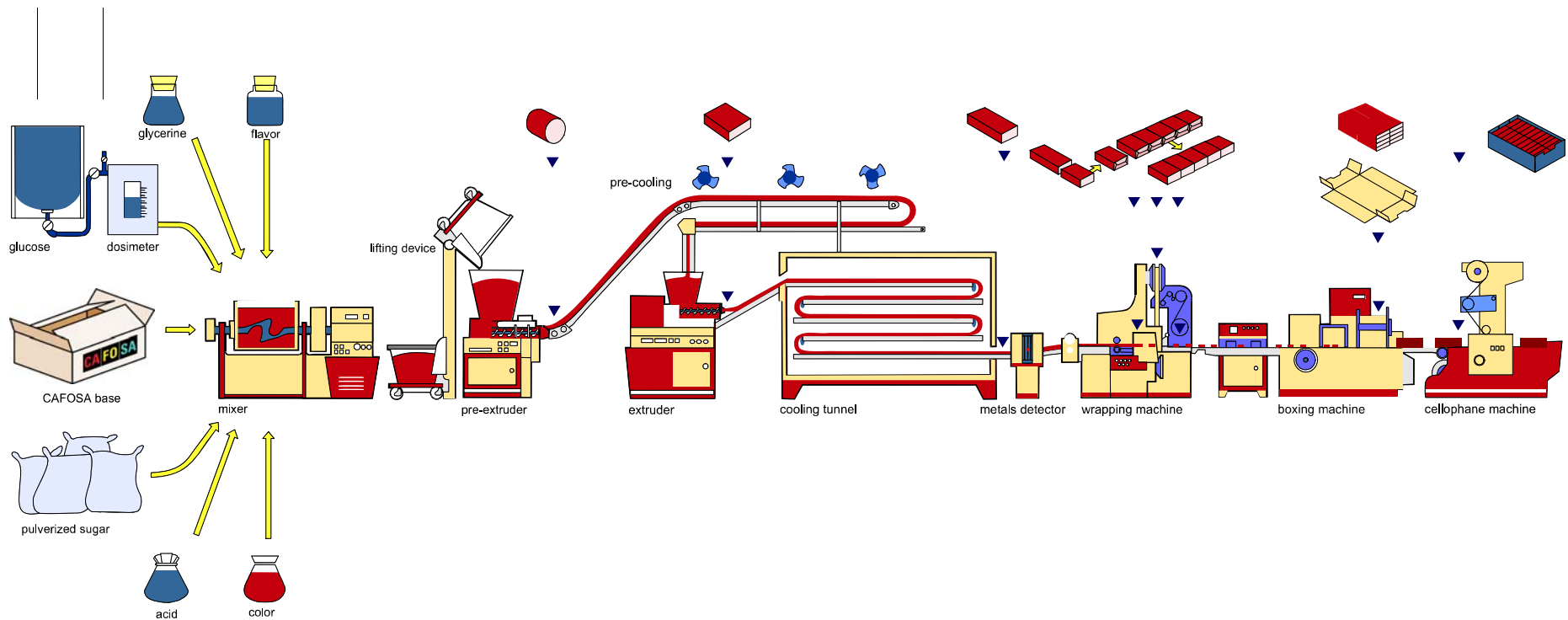


Continuous production line for chewing gum



Machinery

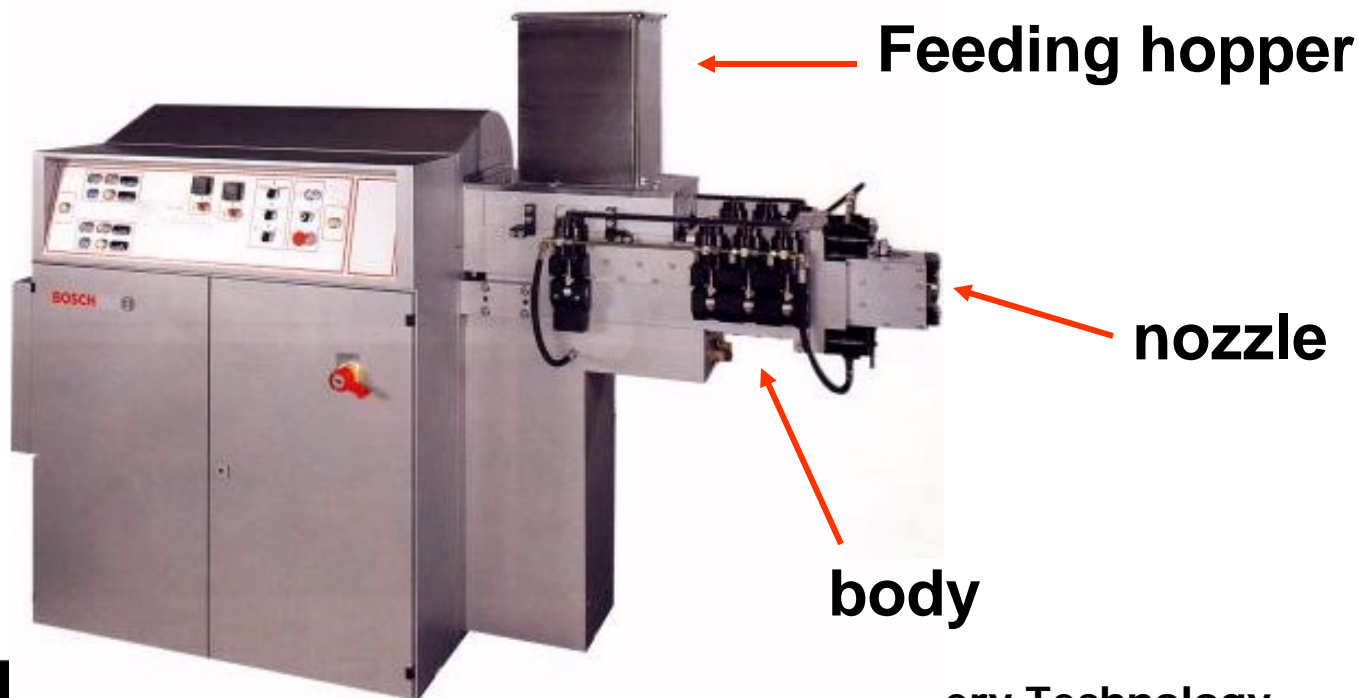
Cut & Wrap Bubble Gum Line



Machinery

Cut & Wrap: Extruder

Function: Extrude the mass and have the shape of the piece



Machinery

Cut & Wrap: Extruder

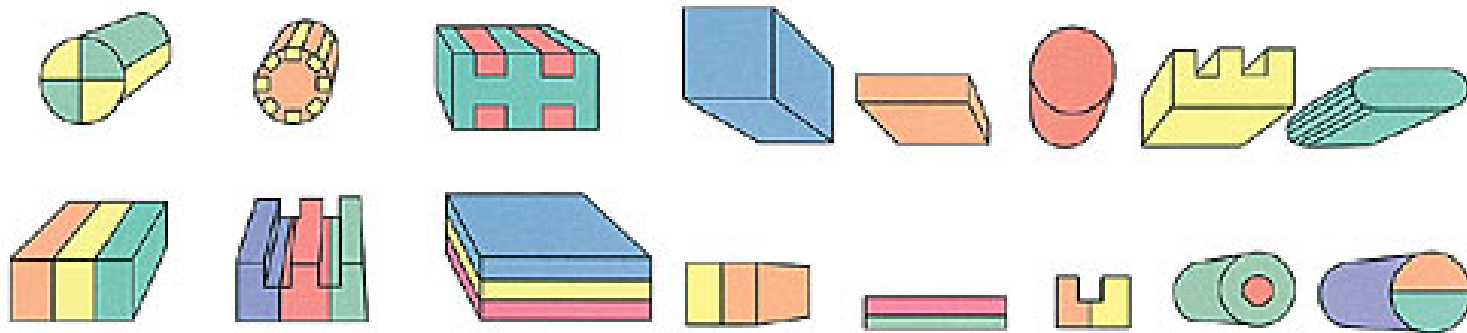
Main Characteristics and Parameters

- ✓ **Torque**
- ✓ **Power of the extruder**
- ✓ **Temperature of the body**
- ✓ **Temperature of the nozzle**

Machinery

Cut & Wrap: Extruder

Different shapes and combinations can be achieved depending on the shape of the nozzle and the number of extruders involved



Machinery

Cut & Wrap: Cooling Tunnels

Function: Cool the rope to the temperature needed for the wrapping machine



Machinery

Cut & Wrap: Cooling Tunnels

Main Characteristics and Parameters

- ✓ **Number of tiers**
- ✓ **Relation between speeds**
- ✓ **Temperature of the tunnel**
- ✓ **Relative Humidity of the Tunnel**

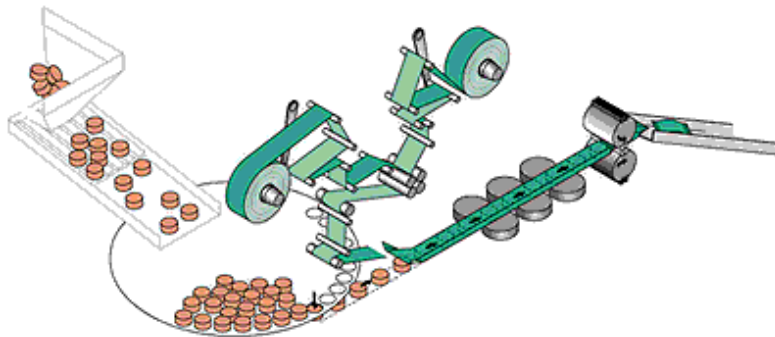
Machinery

Cut & Wrap: Wrapping machines

Function: Wrap the pieces with the final packaging



Flow-Pack



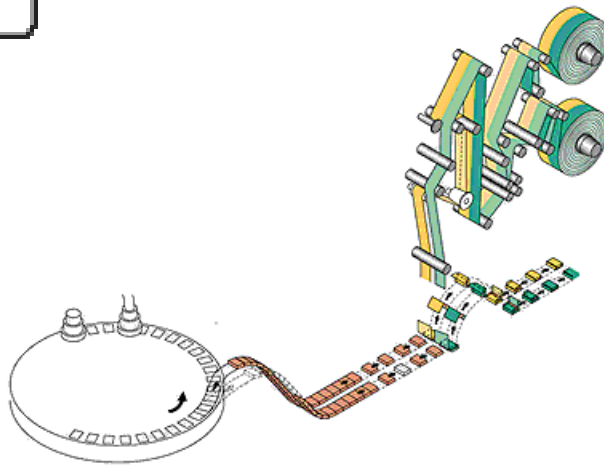
Machinery

Cut & Wrap: Wrapping machines

High-speed machines: around 1000-1500 pieces-min⁻¹

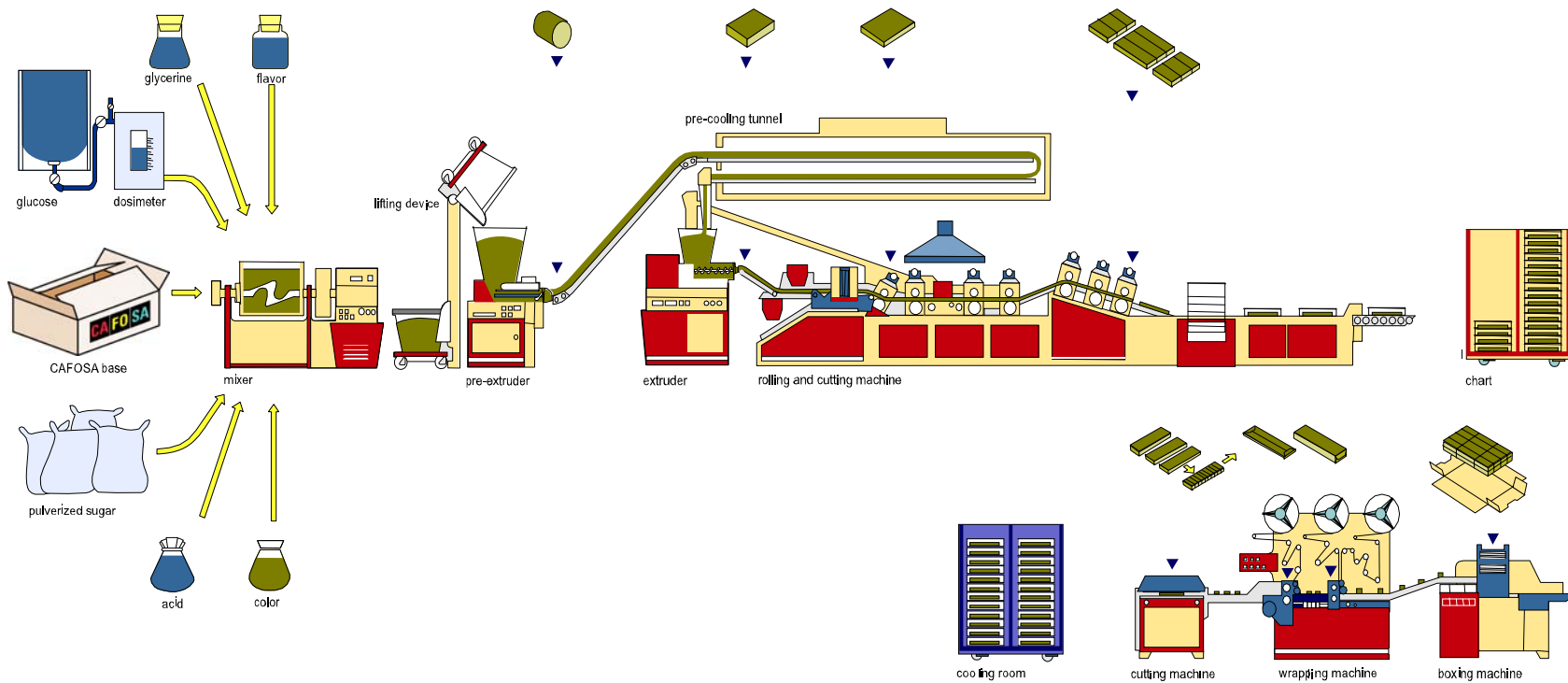


Double end-fold



Machinery

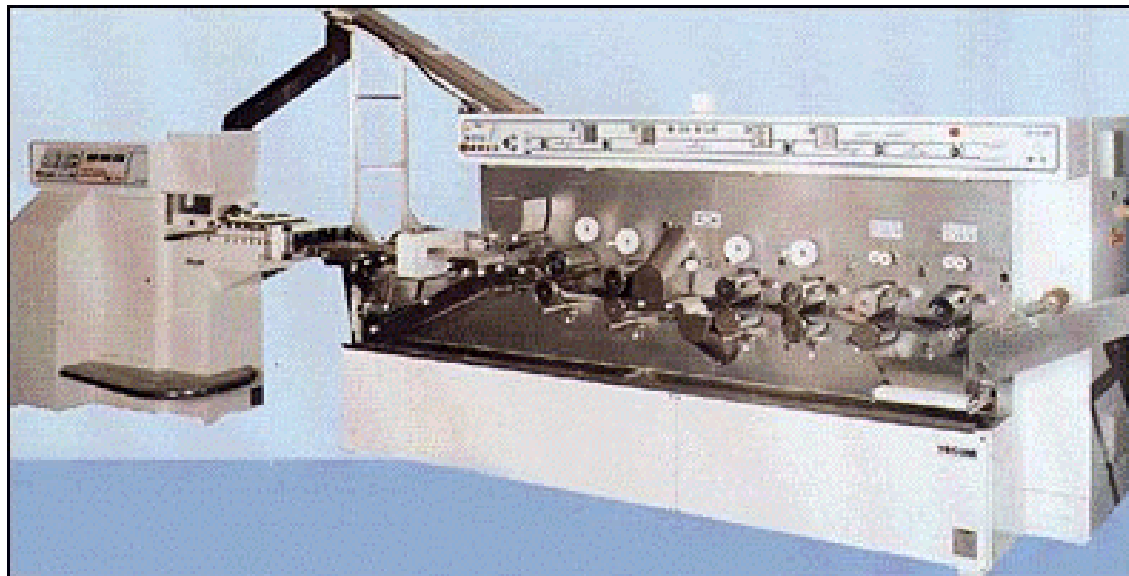
Sticks Line



Machinery

Sticks: Rolling and Scoring Line

Function: Give to the sheet the final thickness, and cut the sticks / dragées



Machinery

Sticks: Rolling and Scoring Line

Main Characteristics and Parameters

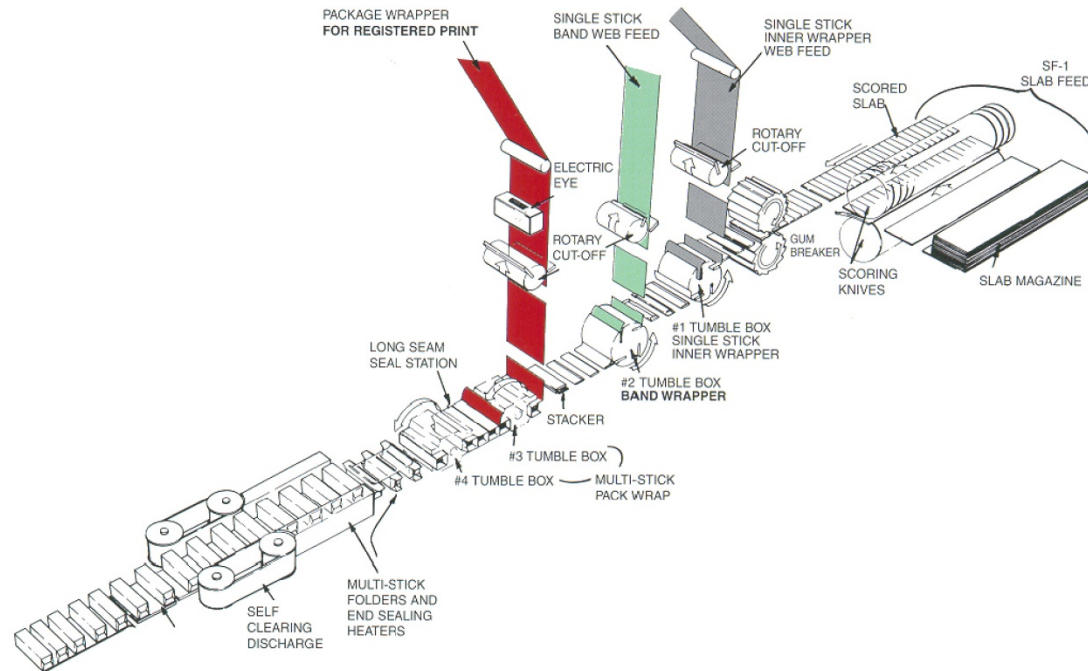
- ✓ **Number of rolls**
- ✓ **Separation between rolls**
- ✓ **Speed of the rolls**
- ✓ **Scrap recovery device**
- ✓ **Anti-sticking powder device**

Machinery

Stick: Packing Machine

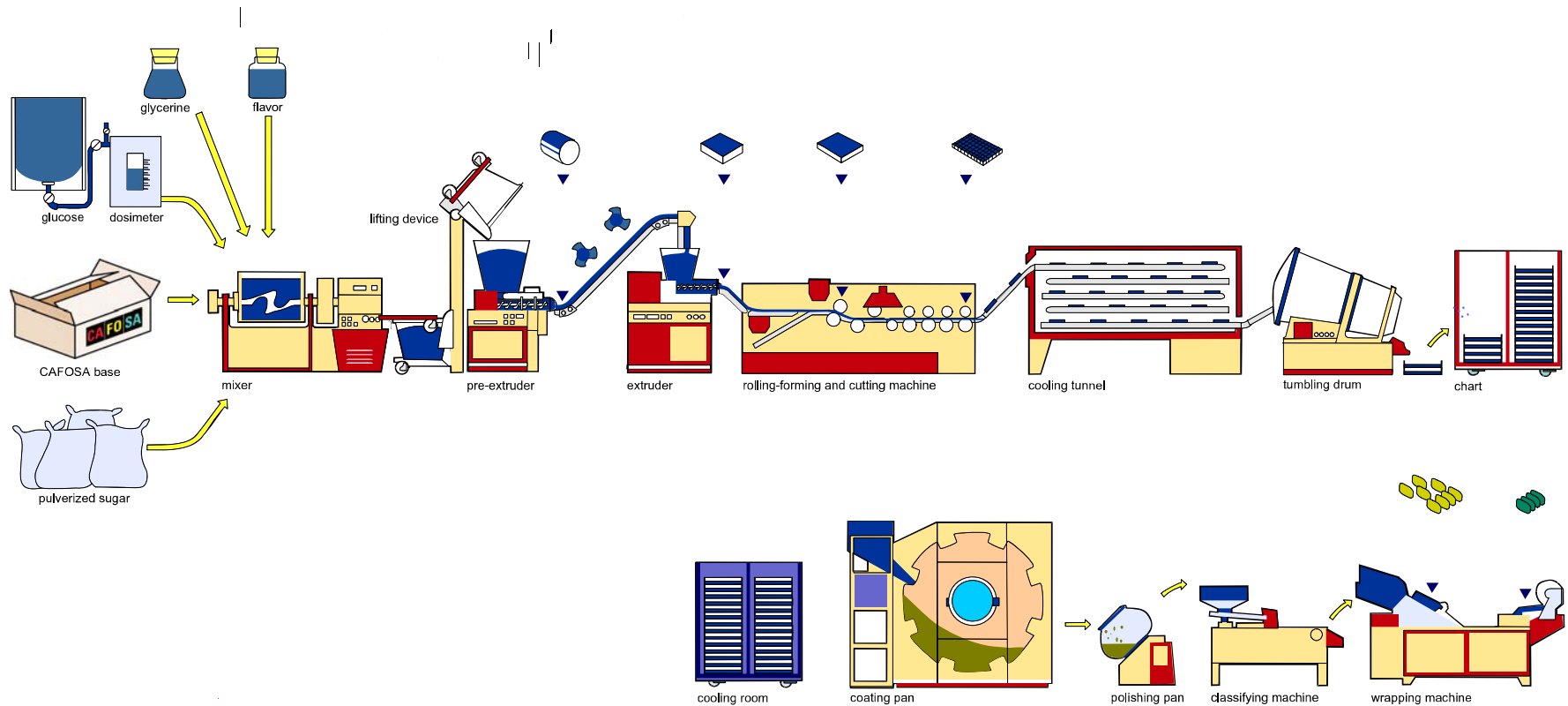


Sticks



Machinery

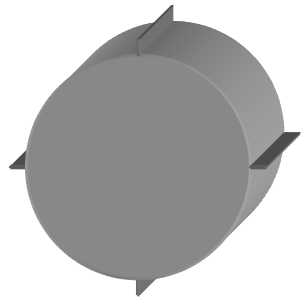
Candy Coated Chewing Gum Line



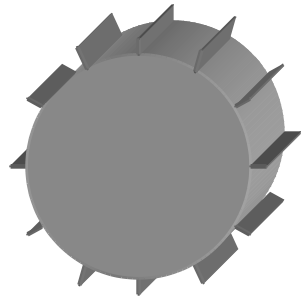
Machinery

Candy Coated: Rolls

The last roll is different depending the final size



Sticks



Dragées

Machinery

Candy Coated: Coating Pans



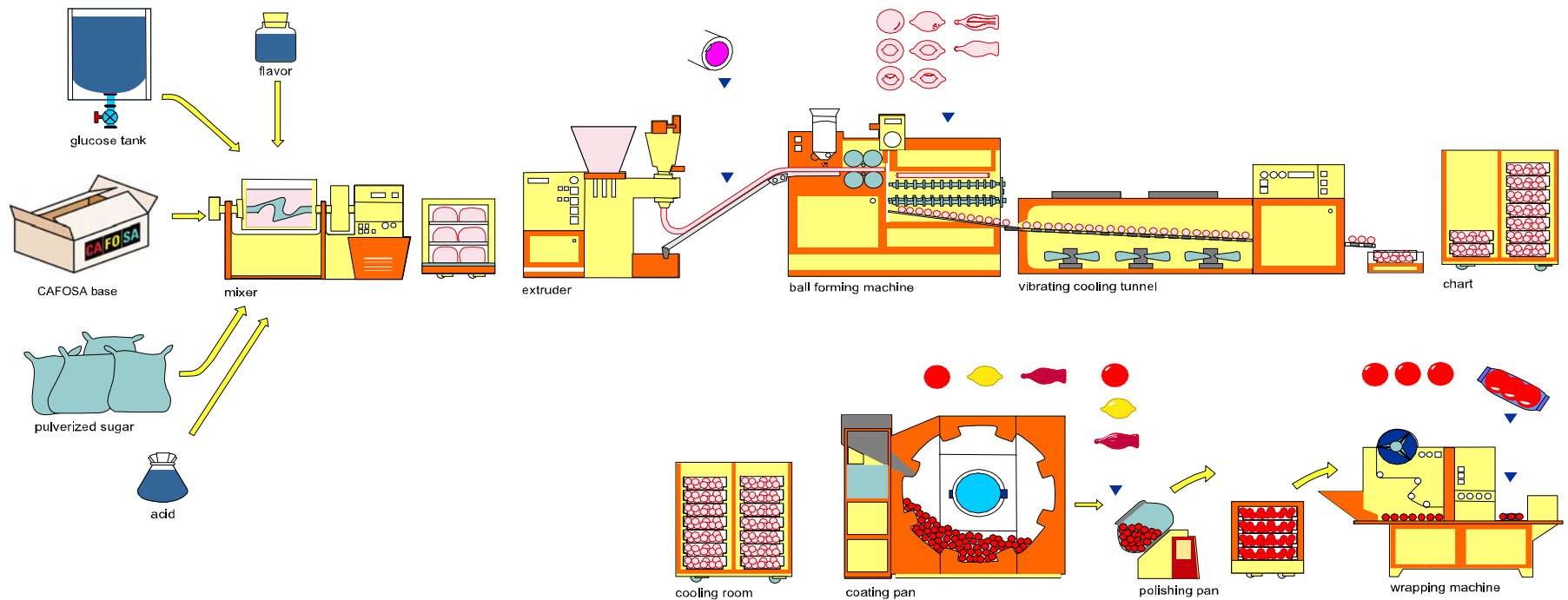
Automatic pans



Manual pans

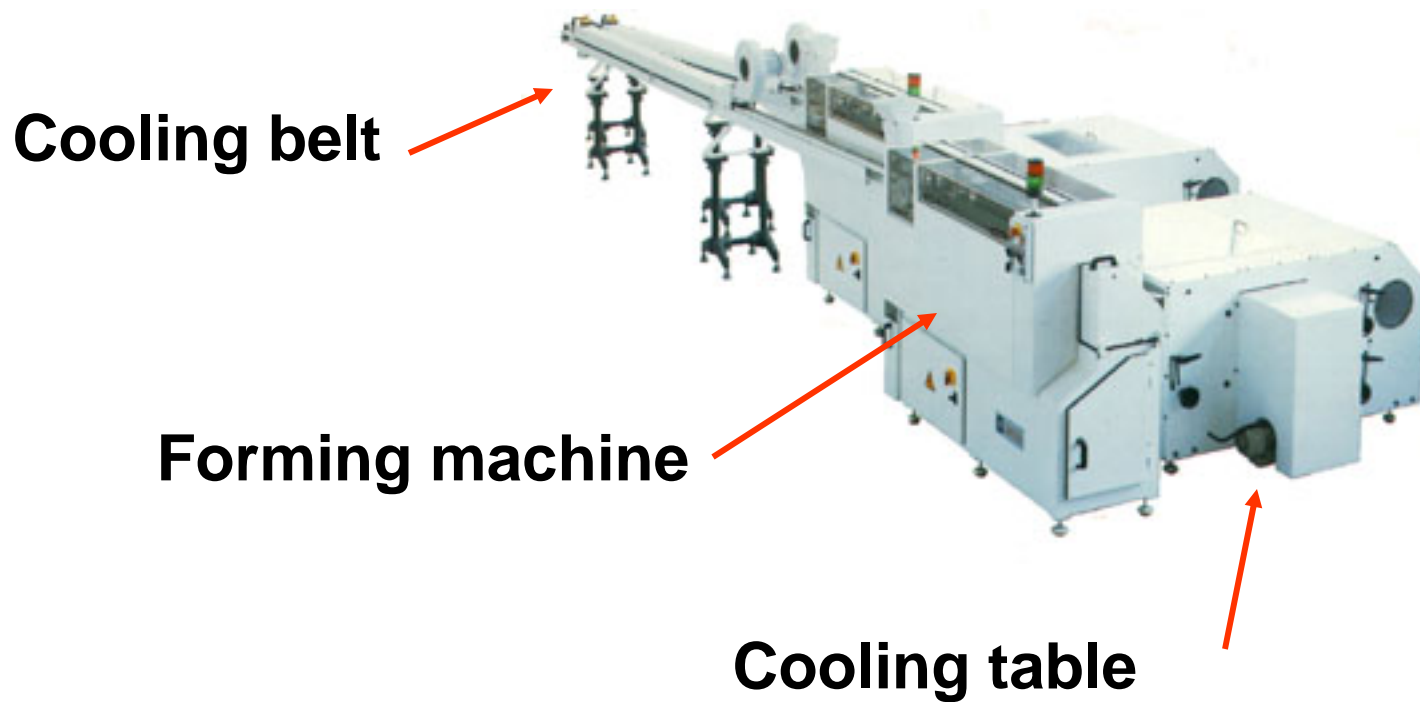
Machinery

Hollow Balls Line



Machinery

Hollow Balls: Forming Machine

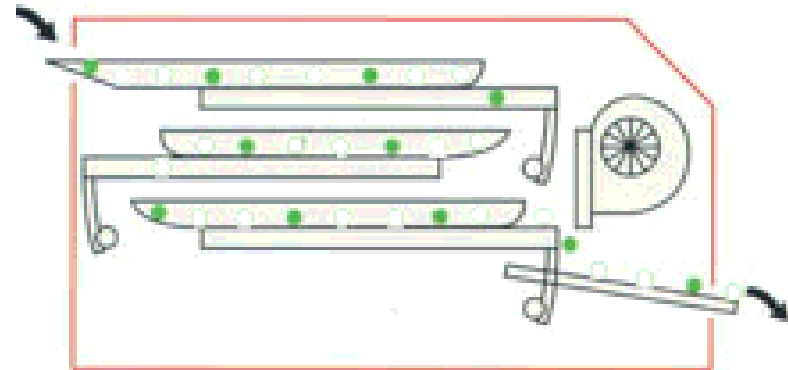
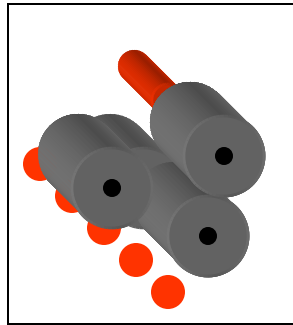


Machinery

Hollow Balls: Forming Machine



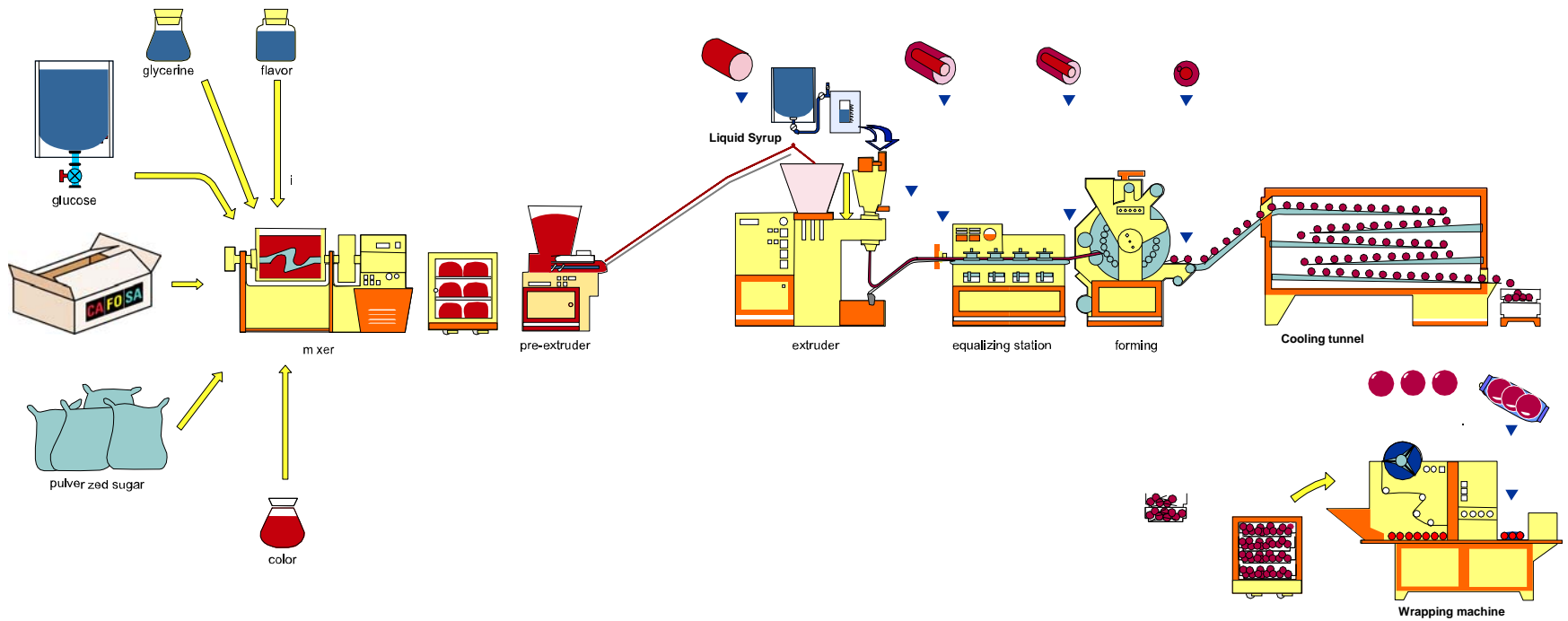
Forming device



Cooling table schema

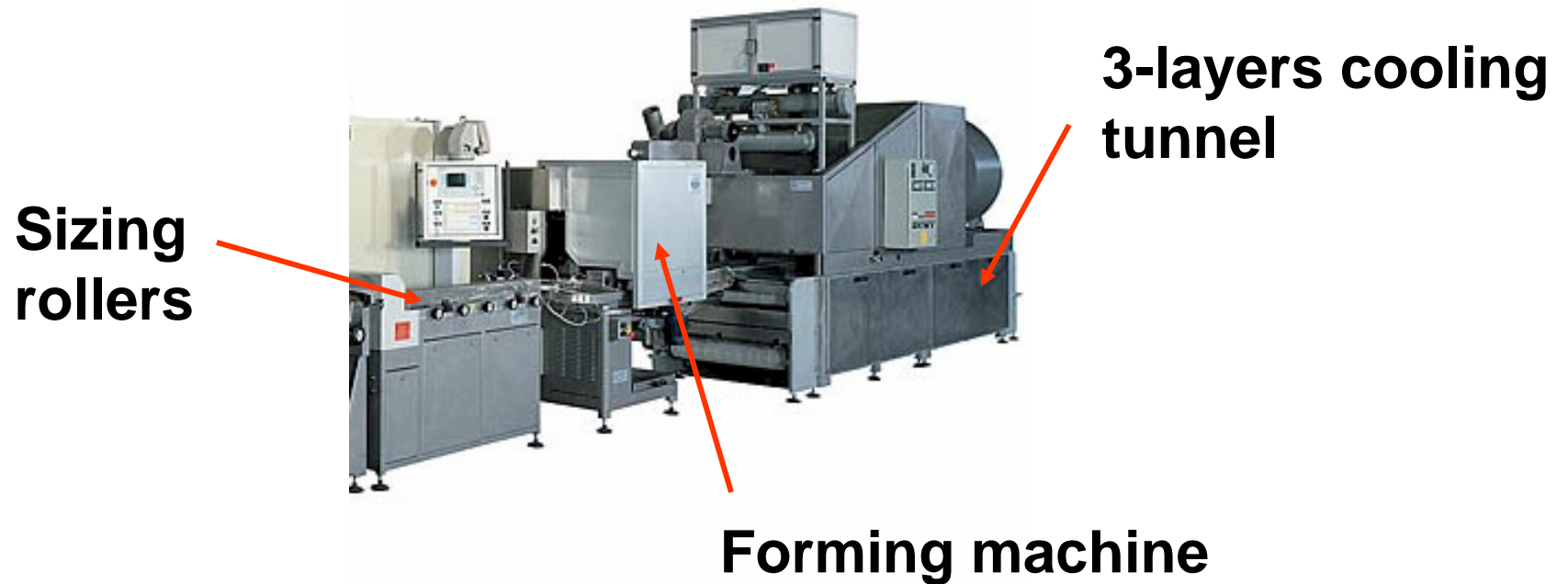
Machinery

Liquid Center Filled Gum Line



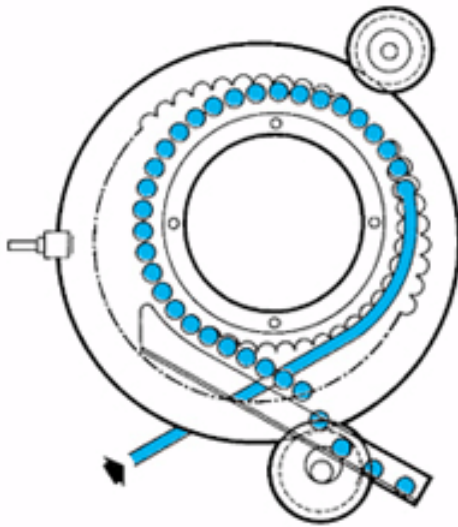
Machinery

Filled Gum: Forming Machine

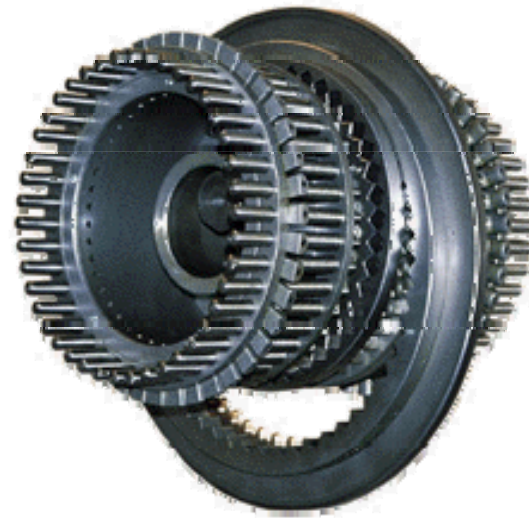


Machinery

Filled Gum: Forming Machine



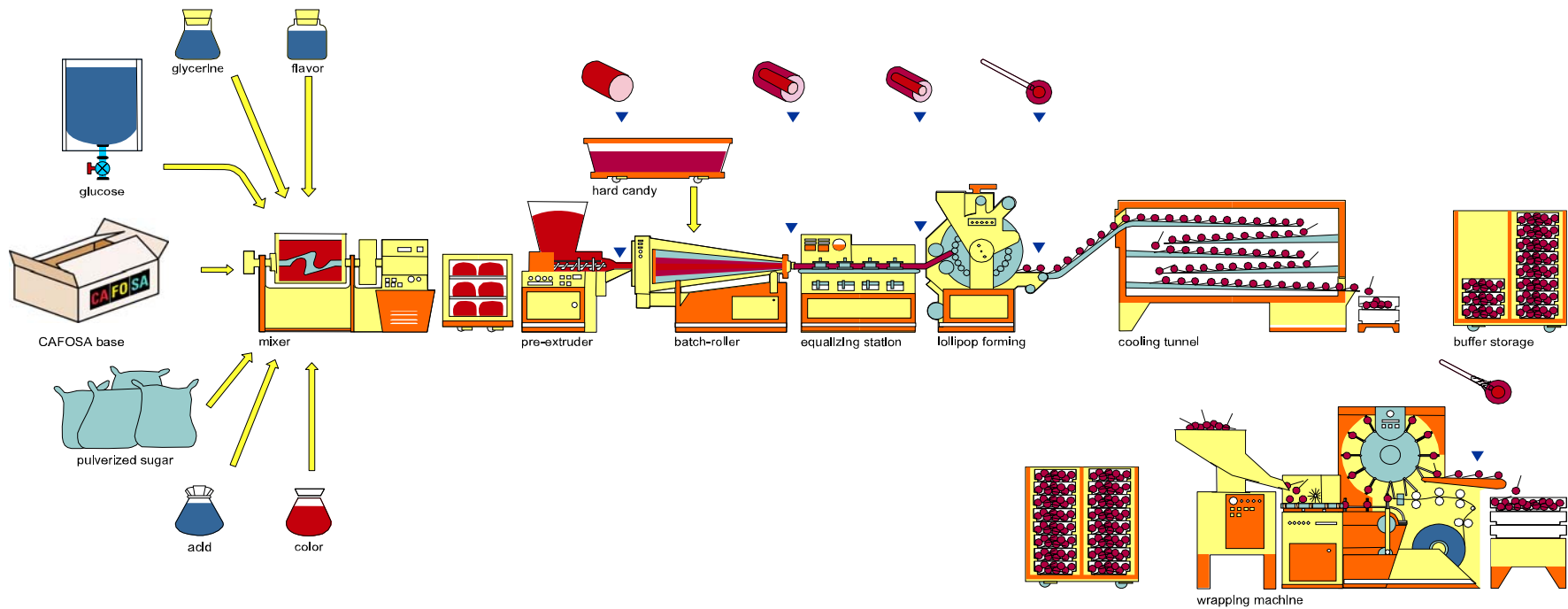
**Schema of the
formation of the
product**



Rotary dies

Machinery

Gum Filled Candy Line



Machinery

Gum Filled Candy: Batch Roller

From the
extruder



To the
sizing
rollers