FE 401 FOOD TECHNOLOGY
CONFECTIONERY
CANDY
CACAO
CHOCOLATE

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Sweets

ART OF SUGAR
TEXTURAL MAGIC

Candy cane

lollipop

Marshmallow

Rockets
Candy is a term for a type of confectionery prepared by dissolving sugar in water or milk and boiling it until it starts to caramelize. The sugar solution is called a syrup. Depending upon the solvent and upon end result of the process the candy may be called candy, caramel, toffee, fudge, praline, or tablet. The recipe also governs how hard, soft, chewy or brittle the end result may be.
ECONOMICAL VALUES AND BUSINESS
In 2015

(24.77%) of total sales  ➔  Hard boiled sweets
(22.5%) of total sales  ➔  Caramel and toffees

Source: Technavio
Candy Industry Magazine has published the top 100 list for the confectionery manufacturers in its February 2014 issue.

The top 12 players are these:

1- Mars Inc., USA
2- Mondelez International
3- Nestlé SA, Switzerland
4- Meiji Holdings Inc. Japan
5- Ferrero Group, Italy
6- The Hershey Co., USA
7- Arcor Group, Argentina
8- Perfetti Van Melle SpA, Italy
9- Perfetti Van Melle SpA, Italy
10- Lindt
11- Ezaki Glico Co., Japan
12- Yıldız Holding
Confectionary:

• There are 2000 different type confectionary
• Over 100 sub-types
  • Nougats (500 different)
  • Marshmallows (1000 different)
CONFECTIONERY CLASSIFICATION
(3 main groups-2 subgroups)

Hard candy

Chewing candy
  - Candy product from supersaturated sugar sol’n by crystallization of sugar (particular candy)
  - Candy product from unsaturated sugar sol’n without (w/o) crystallization (non-particular candy)

Foamed candy
  - Candy product from supersaturated sugar sol’n by crystallization of sugar (particular candy)
  - Candy product from unsaturated sugar sol’n without (w/o) crystallization (non-particular candy)
## CLASSIFICATION ACCORDING TO GRAIN TYPES

<table>
<thead>
<tr>
<th>1-Grained particular candy (include crystal in structure):</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Cream filled candy (cream centers)</td>
</tr>
<tr>
<td>- Fudge</td>
</tr>
<tr>
<td>- Fondant</td>
</tr>
<tr>
<td>- Pulled grained mints</td>
</tr>
<tr>
<td>- Hard-grained marshmallow</td>
</tr>
<tr>
<td>- Soft and hard; covered on tray</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2-Ungrained particular candy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Marshmellow</td>
</tr>
<tr>
<td>- Toffee</td>
</tr>
<tr>
<td>- Nogatte</td>
</tr>
<tr>
<td>- Caramel</td>
</tr>
<tr>
<td>- Gel</td>
</tr>
<tr>
<td>- Chewy</td>
</tr>
</tbody>
</table>

| 3-Other (Combination of grains and ungrained)             |
EXAMPLES

High boilings
Milk toffees & fudges
Gums and jellies
Licorice

Fondant

CONFECTIONERIES

Sugar crusted liquor pralines

Chocolate
Aerated sweets
Chewing gums
Compressed goods
BASICS FOR CONFECTIONERY

- Manipulation of crystallization
- Control of sugar-water ratio
- Control of temperature
- Control of ingredients
Confectionery includes:

- Sugar (Major)
- Water
- Milk products
- Egg whites
- Food acids
- Gums
- Pectine
- Starch
- Fat/Oil
- Emulgator
- Sweeteners
- Aroma/Flavor
- Nuts
- Fruits
- Cacao
- Chocolatte
- Others
To produce different confectionary;

- Amount of evaporated water or remained water in candy
- Different cooking/boiling techniques (atmospheric or vacuum cooking)
- Different cooking/boiling temperature
- Control or prevention of crystallization of sugar

Ex:
- Hard candy → Hard due to less <1% water content (via heating and vacuum evaporation)
- Chewing candy → moisture contents (caramel < toffee < nougats)
- Soft candy → moisture contents (cream candy < fac < marshmallow < gel)
Crystallization control in candy

Depends on:
- Functional additives (milk products, lecithin, lactose etc.)
- Boiling & Evaporation (concentration) Temperature
- Cooling (with mixing (w/) or w/o (without) mixing)

Products;
Crystal or non-crystal (amorphous) candy
## Sugar Confectionery Texture

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brittle, crisp, Crunchy, flaky</td>
<td>chewy, fluffy, hard, light, short, Soft, spongy, Springy, stiff, Tender, tough</td>
<td>chalky, coarse, crystalline, lumpy, powdery, rough, sandy, smooth</td>
<td>Crumbly, dough, fibrous, mushy, pasty, spongy, Stringy</td>
<td>greasy, dry moist, oily sticky, tacky tready, waxy, wetty,</td>
</tr>
</tbody>
</table>
Texture variation can be achieved for confections by one or more of the following procedures:

- vary the moisture content
- vary the content type and strength of gelling agent
- vary the sucrose-glucose syrup ratio
- vary the sucrose-invert sugar solid ratio
- vary the pH
- alter the process temperature conditions
- vary the milk protein content
- seed the batch with fondant or icing sugar
- change the required level of total sugars
- alter processing conditions to vary the particle size
- alter the incorporated air content
# CANDY TEMPERATURE REFERENCE TABLE

<table>
<thead>
<tr>
<th>Name</th>
<th>Temp</th>
<th>Description</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thread</td>
<td>223-235° F</td>
<td>The syrup drips from a spoon, forms thin threads in water</td>
<td>Glacé and candied fruits</td>
</tr>
<tr>
<td>Soft ball</td>
<td>235-245° F</td>
<td>The syrup easily forms a ball while in the cold water, but flattens once removed</td>
<td>Fudge and fondant</td>
</tr>
<tr>
<td>Firm ball</td>
<td>245-250° F</td>
<td>The syrup is formed into a stable ball, but loses its round shape once pressed</td>
<td>Caramel candies</td>
</tr>
<tr>
<td>Hard ball</td>
<td>250-266° F</td>
<td>The syrup holds its ball shape, but remains sticky</td>
<td>Divinity and marshmallows</td>
</tr>
<tr>
<td>Soft crack</td>
<td>270-290° F</td>
<td>The syrup will form firm but pliable threads</td>
<td>Nougat and taffy</td>
</tr>
<tr>
<td>Hard crack</td>
<td>300-310° F</td>
<td>The syrup will crack if you try to mold it</td>
<td>Brittles and lollipops</td>
</tr>
<tr>
<td>Caramel</td>
<td>320-350° F</td>
<td>The sugar syrup will turn golden at this stage</td>
<td>Pralines</td>
</tr>
</tbody>
</table>
# Traditional Degree of sugar boilings

<table>
<thead>
<tr>
<th>Name (Consistency)</th>
<th>Observation</th>
<th>Approx. temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thread (gloss)</td>
<td>Thin strands</td>
<td>103°C</td>
</tr>
<tr>
<td>Large Thread (large gloss)</td>
<td>Stronger strand</td>
<td>104°C</td>
</tr>
<tr>
<td>Small pearl</td>
<td>form small droplets</td>
<td>105°C</td>
</tr>
<tr>
<td>Large pearl</td>
<td>form large droplets</td>
<td>106°C</td>
</tr>
<tr>
<td>Blow (scuffle)</td>
<td>bubbles set on syrup</td>
<td>110°C</td>
</tr>
<tr>
<td>Feather</td>
<td>form feathery hard strands</td>
<td>111°C</td>
</tr>
<tr>
<td>Small ball</td>
<td>syrup form soft ball</td>
<td>116°C</td>
</tr>
<tr>
<td>Large ball</td>
<td>syrup form hard ball</td>
<td>120°C</td>
</tr>
<tr>
<td>Large Crack</td>
<td>form thin sheet</td>
<td>129°C</td>
</tr>
<tr>
<td>Medium Crack</td>
<td>form slightly brittle sheet</td>
<td>132°C</td>
</tr>
<tr>
<td>Hard crack</td>
<td>rapidly formed sheet</td>
<td>143°C</td>
</tr>
<tr>
<td>Extra hard crack</td>
<td>sheet shows signs of browning</td>
<td>168°C</td>
</tr>
<tr>
<td>Caramel</td>
<td>brown brittle sheet</td>
<td>180°C</td>
</tr>
</tbody>
</table>
INGREDIENTS
AND THEIR FUNCTION
1. Solubility of Sugar

- **Saturation concentration of sugar:** (at room temperature a part of $\text{H}_2\text{O}$ will dissolve 2 parts of sugar (67% soluble in water at room temp.).

- **Factors that determine concentration of sugar:** temperature, rate of agitation, degree of under saturation and inversely to the crystal size.
• **Super-saturated sugar solution**: (a solution containing more sugar than the saturation level), when heated and allowed to cool to room temperature – a 74% solution may be obtained.

• **Instability of super-saturated sugar**: any vibration or ingress of solid particles (which act as nuclei) may result in rapid crystallization of excess sugar.
Sucrose sol’n  
\[\downarrow\]  
Cooling w/o mixing  
\[\downarrow\]  
Supersaturated sol’n

Sucrose sol’n  
\[\downarrow\]  
Cooling w/ mixing  
\[\downarrow\]  
Crystal  
\[\downarrow\]  
Sol’n

If supersat’d sol’n contacts with 1 sugar crystal → cause seeding/nuclei → start rapidly crystallization
2. Bulkiness property of sugar

• It acts as a bulking agent (filler), a diluents and carrier of trace ingredients like colourants, flavours thereby improving their dispersion.

• Sugar crystals improve the particulate flow characteristics of mixture, an important feature in a highly mechanized food industry.
• When mixed with fats, it enables the incorporation of air into the mixture which makes it important in generating the lightens of cake.

• It provides mouth feel in soft drinks at relatively low concentration while at high concentration, it gives the characteristics e.g. in boiled sweets.
# Typical analyses of cane or beet sugar

<table>
<thead>
<tr>
<th></th>
<th>White Sugar (%)</th>
<th>Brown Sugar (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purity (Sucrose)</td>
<td>99.8</td>
<td>92.0</td>
</tr>
<tr>
<td>Moisture</td>
<td>0.1</td>
<td>3.5</td>
</tr>
<tr>
<td>Reducing Sugar (as in invert sugar)</td>
<td>0.05</td>
<td>4.0</td>
</tr>
<tr>
<td>Ash</td>
<td>0.02</td>
<td>0.5</td>
</tr>
<tr>
<td>Impurities</td>
<td>0.005</td>
<td>0.01</td>
</tr>
</tbody>
</table>
# Physical properties of sucrose

<table>
<thead>
<tr>
<th>1.</th>
<th>Solubility</th>
<th>Temperature</th>
<th>Solubility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>°C</td>
<td>°F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100</td>
<td>212</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.</th>
<th>Specific heat (SH) (67% solution)</th>
<th>Temperature</th>
<th>SH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>°C</td>
<td>°F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>106</td>
<td>218</td>
</tr>
</tbody>
</table>

| 3. | Equilibrium relative humidity |          | 60% |

| 4. | Boiling point |          | 67% solution boils at 105°C (225°F) |

| 5. | Optical rotation |          | +66.5° |

| 6. | Specific gravity (SG) |          | Temp  | SG  |
|    | for 67.1% solution |          | 20    | 1.33 |
|    | for 74% solution |          | 60    | 1.29 |
|    |                   |          | 20    | 1.37 |
|    |                   |          | 60    | 1.33 |

| 7. | Bulk density 47 -55lb/ft³ (varying according to package) |

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INVERT SUGAR

1 Disaccharide $\rightarrow$ 2 monosaccharides
(sucrose+water $\rightarrow$ glucose+fructose)

«acid –citric/tartaric- or enzyme»

[SUGAR SOLN]

Why is it used?
• Increase solubility and inhibit crystallization
• Increase sugar content in sol’n (Biscuit, Jam)
  • (In industry terminology: glucose: dekstose, fructose: levulose)
• Invert sugar (glucose/fructose) : very slow crystallization
• To control crystallization of sugar
• It is hydrosopic, so, supply softness to candy
• Increase sweetness of candy
  • (sucrose:100, glucose:75, fructose:175)—
    • Average is higher than sucrose
GLUCOSE SYRUP

• Glucose syrup - key ingredient in the confectionery industry.

• Glucose syrup ➔ glucose (dextrose, in industry) + maltose + big molecular sugars + dextrine ➔ it is viscous, colorless, Uncrystalize syrup

• Note:
  – Reducing sugar: maltose, lactose
  – Nonreducing sugar: sucrose
• **DE** (Dextrose Equivalent) is the **degree of hydrolysis** of starch that takes place and it is the total reducing power i.e. in the acid hydrolysis of glucose syrup, we have the composition of dextrose, maltose, malto-triose, malto-tetrose, malto-pentose, malto-hexose and higher sugars in various percentages making a total of 100% for each DE, as shown below:
<table>
<thead>
<tr>
<th>Type</th>
<th>Glucose syrup</th>
<th>Maltose syrup</th>
<th>Fructose syrup</th>
<th>Glucose fructose syrup</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td>40 – 43</td>
<td>49</td>
<td>66 – 70</td>
<td>80 – 82</td>
</tr>
<tr>
<td>Glucose (%)</td>
<td>17</td>
<td>3</td>
<td>30</td>
<td>41</td>
</tr>
<tr>
<td>Fructose (%)</td>
<td>–</td>
<td>–</td>
<td>9</td>
<td>28</td>
</tr>
<tr>
<td>Maltose (%)</td>
<td>14</td>
<td>49</td>
<td>38</td>
<td>20</td>
</tr>
<tr>
<td>Maltotriose (%)</td>
<td>12</td>
<td>22</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Polysaccharide (%)</td>
<td>57</td>
<td>26</td>
<td>20</td>
<td>8</td>
</tr>
</tbody>
</table>
## Dextrose Equivalent of sugars

<table>
<thead>
<tr>
<th>Type</th>
<th>Low</th>
<th>Low</th>
<th>Regular</th>
<th>Intermediate</th>
<th>High</th>
<th>High Maltose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DE 26</td>
<td>DE 38</td>
<td>DE 42</td>
<td>DE 55</td>
<td>DE 64</td>
<td></td>
</tr>
<tr>
<td>Monosaccharide-dextrose</td>
<td>8.0</td>
<td>15.0</td>
<td>19.3</td>
<td>30.8</td>
<td>37.0</td>
<td>5.9</td>
</tr>
<tr>
<td>Disaccharide-maltose</td>
<td>7.5</td>
<td>12.5</td>
<td>14.3</td>
<td>18.1</td>
<td>31.5</td>
<td>44.7</td>
</tr>
<tr>
<td>Trisaccharides</td>
<td>7.5</td>
<td>11.0</td>
<td>11.8</td>
<td>13.2</td>
<td>11.0</td>
<td>12.7</td>
</tr>
<tr>
<td>Tetra-saccharides</td>
<td>7.0</td>
<td>9.0</td>
<td>10.0</td>
<td>9.5</td>
<td>5.0</td>
<td>3.3</td>
</tr>
<tr>
<td>Penta-ssacharides</td>
<td>6.5</td>
<td>8.0</td>
<td>8.4</td>
<td>7.2</td>
<td>4.0</td>
<td>1.3</td>
</tr>
<tr>
<td>Hexo-saccharide</td>
<td>5.0</td>
<td>7.0</td>
<td>6.6</td>
<td>5.1</td>
<td>3.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Hepta-saccharides</td>
<td>4.5</td>
<td>5.0</td>
<td>5.6</td>
<td>4.2</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>High sugars</td>
<td>54.0</td>
<td>32.5</td>
<td>24.0</td>
<td>11.9</td>
<td>6.5</td>
<td>27.4</td>
</tr>
</tbody>
</table>
SWEETNESS OF GLUCOSE SYRUPS

STARCH 0
MALTODEXTRIN DE 4-20 0.1
GLUCOSE SYRUP DE 30 0.2
GLUCOSE SYRUP DE 40 0.35
GLUCOSE SYRUP DE 60 0.54
GLUCOSE SYRUP DE 90 0.62
GLUCOSE /DEXTROSE DE 100 0.65
Usage of glucose/or syrup in candy

- Regulates the sweetness
- Sandy form in texture
- Improvement texture of candy
- Increase shelf life (encapsulate moisture to prevent loss of water. Prevent hardness).
- Prevent crystallization of sucrose
- Preserve moisture in candy (prevent dryness)
- Increase body form of candy/volume
- Cheap, so filling material to increase mass
- When used in fudge, fondant, cream candies ➔ supply good texture and perfect taste
- Due to taste, viscosity and moisture preservation ➔ it is used instead of invert sugar.
Note:

- Glucose is hydrosopic, it increase with high DE, so used as a stabilizer.
- It contains high molecular sugars → gives cohesiveness and adhesiveness → chewiness

- If moisture absorption problem is available and cause perspiration –so cause stickness (due to high encapsulation of water by glucose) → decrease amount of glucose in the recipe.
## Function of Glucose syrup in confectionery

<table>
<thead>
<tr>
<th>Property/functional use</th>
<th>Low DE</th>
<th>High DE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body agent</td>
<td>⋄</td>
<td>⋄</td>
</tr>
<tr>
<td>Browning reaction</td>
<td>⋄</td>
<td></td>
</tr>
<tr>
<td>Cohesiveness</td>
<td>⋄</td>
<td>⋄</td>
</tr>
<tr>
<td>Colour stabilization</td>
<td></td>
<td>⋄</td>
</tr>
<tr>
<td>Crystallise control</td>
<td>⋄</td>
<td>⋄</td>
</tr>
<tr>
<td>Emulsion stabilizer</td>
<td>⋄</td>
<td></td>
</tr>
<tr>
<td>Fermentability</td>
<td></td>
<td>⋄</td>
</tr>
<tr>
<td>Flavour enhancement</td>
<td></td>
<td>⋄</td>
</tr>
<tr>
<td>Flavour transfer medium</td>
<td></td>
<td>⋄</td>
</tr>
<tr>
<td>Foam stabilizer</td>
<td>⋄</td>
<td>⋄</td>
</tr>
<tr>
<td>Freezing point depression</td>
<td></td>
<td>⋄</td>
</tr>
<tr>
<td>Humenctancy</td>
<td>⋄</td>
<td>⋄</td>
</tr>
<tr>
<td>Hygroscopicity</td>
<td></td>
<td>⋄</td>
</tr>
<tr>
<td>Increased vapour pressure</td>
<td>⋄</td>
<td></td>
</tr>
<tr>
<td>Nutritive value</td>
<td>⋄</td>
<td></td>
</tr>
<tr>
<td>Osmotic pressure</td>
<td>⋄</td>
<td></td>
</tr>
<tr>
<td>Preservation</td>
<td></td>
<td>⋄</td>
</tr>
<tr>
<td>Prevention of coarse ice crystals</td>
<td>⋄</td>
<td></td>
</tr>
<tr>
<td>Prevention of sucrose crystallisate</td>
<td>⋄</td>
<td></td>
</tr>
<tr>
<td>Sheen power</td>
<td>⋄</td>
<td></td>
</tr>
<tr>
<td>Solubility effect</td>
<td>⋄</td>
<td></td>
</tr>
<tr>
<td>Sweetness</td>
<td></td>
<td>⋄</td>
</tr>
<tr>
<td>Thickening agent</td>
<td>⋄</td>
<td></td>
</tr>
<tr>
<td>Viscosity</td>
<td>⋄</td>
<td></td>
</tr>
</tbody>
</table>

**Key:** ⋄ type of syrup which have the function

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Fig. 12: Gel strength of a jelly fruit mass, manufactured with glucose syrups of different composition (see page 14)
LACTOSE

(Reduced sugar/Milk sugar-produced from whey)

- Low hygroscopic
- Low solubility
- Low sweetness (200)
It is used for:
• To preserve moisture in candy
• To improve and preserve taste
• Due to its crystallization capability; it is used to control crystal
• Due to its low sweetness; it is used for control sweetness to gether with texture and moisture controls
• Due to its high caramelization T, used to control color of candy during boiling
• For some candy product, it gives crispiness (Fudge candy)
• 10% usage gives crispiness to marshmellow, increase loaf volüme and preserve moisture by regulate capability
• In rotary coating kettle, used for coating to decrease process time
• Re-coating (due to its low solubility and rapid solidification)
• It is important ingredient for hot and humid enviroment and storage conditions
POLYALCOHOLS

- Sorbitol (5%, gives plasticity, humectant, protect moisture, softness)
- Mannitol (used for chewing gum, low hygroscopic, suitable for low RH places, used for grainy candy)
- Xylitol (sweetness 700, good for teeth health, expensive)
- Maltitol, lactitol

- They are;
- Sweeteners
- No insulin required in body, so used for diabetic products
- Their sweetness is less than other sugars. Need extra sweeteners
STARCH

• Used for;
  • Gelling former
  • Powder dip for candy (Turkish delight, marshmallow, chewy gum to decrease stickiness, control m.c.)
  • Molding material
  • To increase firmness
  • To increase chewiness
### Sweeteners

<table>
<thead>
<tr>
<th>Sweetener</th>
<th>Sweetness (Sucrose = 1)</th>
<th>Taste Characteristics</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acesulfame-K (sunette)</td>
<td>130-200</td>
<td>Rapid onset, persistent side-tastes at high concentrations</td>
<td>Table sugar, dry beverage mixes, chewing gum</td>
</tr>
<tr>
<td>Aspartame (Nutrasweet)</td>
<td>180</td>
<td>Clean, similar to sucrose, no bitter after taste</td>
<td>Table sugar, dry beverage, chewing gum, beverage confections, fruit spreads, toppings and fillings</td>
</tr>
<tr>
<td>Saccharin</td>
<td>200-700</td>
<td>Slow onset persistent after taste, bitter at high concentrations</td>
<td>Soft drinks, juice, fruit drink, other beverage, table use sweeteners, processed fruits, chewing gum and confections, gelatins desserts, salad dressing, baked goods.</td>
</tr>
<tr>
<td>Sucralose (Splenda)</td>
<td>600</td>
<td>Can withstand high temperature without losing flavour</td>
<td>Soft drinks, baked goods, chewing gum, table use sweetener or table sugar.</td>
</tr>
</tbody>
</table>
PECTIN

- For soft candy
- For gel candy
- Functional at acidic condition!
- Solid content should be 80% in candy to use it
- To prevent crystallization w/ glucose syrup

Prof. Dr. Mustafa BAYRAM

Fig. 1: Poly-D-galacturonic acid partially esterified (pectin) and amidated (amidated pectin)

Fig. 2: Bonding zones in the gel network

Fig. 3: Gelting mechanisms of high methyl ester pectins
A. Addition of neutral sugars, e.g. sucrose, dehydrating the pectin molecules which facilitates the approach of the polymer chains and enables the cross linkage by hydrogen bonds.

B. Lowering the pH value in the medium will suppress the dissociation of the free carboxyl groups. This strongly reduces the electrostatic repulsion of the usually negatively charged pectin chains enabling the clustering.
Pectin+Gelatine in recipe

**Pure gelatine product**

*Prior to storage*  
*afterwards*

![Gummy bear](image1.png)

**Gelatine pectin combination**

*Prior to storage*  
*afterwards*

![Gummy bear](image2.png)

*Fig.: 15: Gum confectionery prior to storage at 50 °C for 24 hours and afterwards*
ADDITIVES

- Aroma;
  - Vanillin
  - Coconut
  - Cacao
  - etc........
- Antioxidant
  - Shelf-life (nut candy, oil mix candy)
- Color additives
- Acid regulators
  - Citric, tartaric, malic, lactic, cream tartar
  - Used for;
    - Taste
    - To control crystallization
    - To improve peçtin
    - To increase shelf life
    - Doctoring agent for sandy form (potassium bitartarate)
Fat/Oils

- Butter, sunflower oil, cotton oil, soyoil, cacao oil (best)
- Used in fondant, fac, chewy candy, toffee candy
- Supply crispiness texture for carameli fac and toffee
- Good texture, resistency
- Good shape
- If emulsied, prevent crystallization due to preventing moisture
PROTEIN

• For texture
• For loafing and foaming
• For gelling
• To regulate foam size (small\& good size) \(\rightarrow\) stirring is used

• Egg, soybean, gelatin (Jelibon)
• Used in masrsmellow, fac candies
GUMS

- Carob bean (keçiboynuzu), Arabic gums, guar gums, karaya gums etc.

- Used for tablet candy as adhesiness
SURFACE ACTIVE MATERIALS

- To prevent adhesiveness to teeth
- For bloom delaying
- For other functions
- To delay hardening of starch gel
- To decrease cooking time
- To improve mint candy taste and appearance
- To stabilize taste and oil emulsion
- To improve foaming body
- To prevent oil migration
- To control crystallization for grainy candies

- Glycerol monostearate, ester of monoglyceride, sorbitan etc.
LECITIN

- Surface active material
- To control viscosity (to decrease)
- To prevent adhesiveness
- As emulsion for oil and water in candy

- Used in fac, caramel, toffee
PROCESSES AND UNIT OPERATIONS
1-Mixing and Cooking

Cooking lies at the heart of the confectionery making process. All the important properties critical to end product quality are dependent on consistent mixing and controlled cooking.

There are three main ways by which to boil the sugar solution:

- a simple open boiling pan
- a steam jacketed pan
- a vacuum cooker

Steam jacketed pans are often fitted with scrapers and blades which make the mixing and heating process more uniform, and lessen the possibility of localized over-heating. Vacuum cookers are not generally used at a small scale.
2-Cooling

All sweets are cooled slightly before being shaped. Most simply, the boiled mass is poured onto a table (this should be made from metal, stone, or marble to cool the product uniformly). The table should be clean and free from cracks, as they may harbour dirt and microorganisms.

3-Beating

Beating is a process which controls the process of crystallization and produces crystals of a small size.
4-Forming/setting

There are two main ways of forming sweets:
• cutting into pieces, or
• setting in moulds.
5-Wrapping:

Wrapping Machine

Cut and Wrap Machine
PRODUCTION TECHNOLOGIES
High boiled candies

High boilings are made of a **supersaturated carbohydrate solution** (usually sucrose and glucose syrup) obtained by cooking.

The products are in a **glassy state**, i.e. that they are totally **free of sugar crystals**.

They are characterised by:
- a **very low residual moisture** (1 -3 %)
- a low E.R.H., below 30%

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Basic recipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucrose</td>
<td>15.0 kg</td>
</tr>
<tr>
<td>Glucose syrup 42 DE</td>
<td>15.0 kg</td>
</tr>
<tr>
<td>Water</td>
<td>5.0 kg</td>
</tr>
</tbody>
</table>
• High boiled sweets are sugar products which are glossy in appearance. They can be considered as sugar liquids with very high viscosities.
• The finished product of boiled sweet is a super cooled liquid at ambient temperature with a solid content of 97 – 98%.
• Although there is super saturation at the solid state with respect to sucrose, but because of the addition of glucose syrup, the formulation cannot crystallize.

• Other ingredients that can be added to boiled sweets are flavours, milk, fruits, chocolate, colours etc.
Production of High Boiled Sweets (HBS)
There are 3 main production methods for HBS. They are

- Open pans
- Vacuum cookers
- Continuous cookers

Each of this require different ratio of sugar to glucose syrup to give the best result.

<table>
<thead>
<tr>
<th>Method</th>
<th>Sucrose: glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open pan</td>
<td>70:30 to 66.5:33.5</td>
</tr>
<tr>
<td>Vacuum cookers</td>
<td>65:35 to 50:50</td>
</tr>
<tr>
<td>Continuous cookers</td>
<td>60:40 to 45:55</td>
</tr>
</tbody>
</table>
• Approximate temperature of 156°C is used during open pans.
• Vacuum cooking can be as low as 110 – 129°C

**Precautions during HBS production:**

• During cooling, prevent seeding (introduction of nuclei), this is because a grain of sugar drop into the mass will induce crystallisation
• Ensure good doctoring
• Stop stirring after attaining desired temperature
Product types of boiled sweets

• High boiled sweets manufacturing technology ranges from lollipops, candies, cones, medicated confectioneries, lettered rock, soft centred sweets, butter boilings, laminated (crackened or honey combed sweets to grained Edinburgh rock; marshmallow, Nougat, butterscotch, candy etc.

• Description of some Boiled sweets

E.G

Laminated or Honey comb sweet:

• This is a multilayered sweets with a crunchy texture made from many layers of cooked sugar having its centre filled with honey, nut paste, peanuts or other suitable fillings and finally wrapped in a thin envelope of high boiled sweets or sugar.
Fondant

Fondants is a white soft to semi-hard paste.

Fondant consists of tiny sugar crystals that are dispersed in a saturated sugar solution.

It contains a maximum of 12% of residual water and 98% of the sugar crystals have a size < 20μm.

Fondant thus consists of two phases, which are formed by the combined cooling and beating of a supersaturated solution.
Fat based masses & fillings

These masses are suspensions, fat being the continuous phase and crystalline sugar part of the dispersed phase.

The manufacturing process is usually a mixing process, followed by a refining process, with a final homogenizing process.
Nougat bars

Nougat bars are aerated products made of sucrose, glucose syrup, water and other added dry ingredients like skimmed milk powder, icing sugar, coconut rasps, cocoa powder.

The sugar mass is cooked and added to the previously prepared foam. Finally the dry ingredients are added, the mass is spread and cut after cooling.

Lactose can be used in the cooked sugar mass and as a dry ingredient. A WPCs and WPIs may replace part of the egg white solids for the preparation of the foam.
Milk toffees

Soft caramels are supersaturated solutions made of sucrose, glucose syrup, fat and an emulsifier produced during a cooking process.

They have a soft texture due to their water content of 6 to 10%.

Milk toffees additionally contain milk products. These milk products are responsible for the browning reaction which give the milk toffees their typical caramel color and taste.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Basic recipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucrose</td>
<td>5.4 kg</td>
</tr>
<tr>
<td>Glucose syrup 42 DE A</td>
<td>8.25 kg</td>
</tr>
<tr>
<td>Water</td>
<td>5.0 kg</td>
</tr>
<tr>
<td>Sweetened condensed milk</td>
<td>6.2 kg</td>
</tr>
<tr>
<td>Hard fat</td>
<td>1.8 kg</td>
</tr>
<tr>
<td>Lecithin</td>
<td>0.05 kg</td>
</tr>
</tbody>
</table>
Gums, Jellies and Pastilles:

- Gums, Jellies and Pastilles constitute a large class of confectionery which can be manufactured with many variations.

- They are comparatively low boiled and contain about 20% moisture.

- Obtained by the use of various types of water binding gelling agents such as gum Arabic, starch, gelatin, agar and pectin.
Tablets and Lozenges:

- Tablets are made by compressing powdered or granulated ingredients in a confined space (die) until the particles bond together.
- They have very smooth surface and very little amount of moisture.

- Ingredients: Base material (sucrose), binders (gum) lubricants, starch (which swells upon contact with water and breaks up the tablet).
• Lozenges are made from icing sugar, mixed with a binder, sheeted, but into shape and allowed to dry.

• When menthols/mints, vitamin C or other sore throat medicines are added, they are called medicated lozenges.

• In effervescent tablets, citric acid and sodium bicarbonate are included. Colours and flavours can also be added.

• Lozenges tend to have hard rough finishing while compressed tablets have smooth shiny surfaces.
Chewing and Bubble gum:

- Chewing gums are *sticky candy* to be chewed but not swallowed. It is composed of mixed natural (chicle-milky juice of the tropical sapodilla tree *Archras zapota* of Central America) and synthetic gums, resins together with various sugars and flavouring materials (such as mints).

- The *difference* between chewing gum and bubble gum is the ability of Bubble gum to make bubbles and *stretch* when blown. Bubble gum contains higher levels of polymers or rubbers.

- In sugar free or sugar less chewing gum, *sorbitol, mannitol, xylitol* are used.
Basic continuous system for gelly candy

Fig. 17: Components for a continuous production

1. Heatable scaling chamber
2. Heatable storage chamber
3. Pressure Dissolver
4. Vacuum chamber
5. Vacuum pump
6. Buffer chamber
7. Moulding equipment
PLANT & PROCESS FOR MAKING CANDY
PLANT & PROCESS FOR MAKING LOLLIPOPS
PLANT & PROCESS FOR MAKING FILLED CANDIES & ECLAIRS

Dissolving Tank
Milk Emulsion Preparation Tank
Continuous Vacuum Batch Cooker
Vacuum Batch Cooker
Rotary Kneading Machine
Center Filler
Batch Former with Sizing Machine
Uni Plast-O-Plast Sweet Forming Machine
Automatic Candy Wrapping Machine
Automatic Pillow Pack Machine
Single/Double Twist Candy Wrapping Machine
ANALYSIS

Analysis Approaches

**Starch:** enzymatic / colorimetric

**Sugars:** HPLC, soluble solids
ENZYMATIC ANALYSIS

• Gelatinization
  Disrupting the hydrogen bonding/ crystalline structure of starch chains

• Hydrolysis
  a-amylase, amyloglucosidase

• End product detection
  Glucose
1. Place a drop of sample on the measuring surface beneath the ViewPoint Illuminator.
2. Look through eyepiece and press the ViewPoint Illuminator.
3. Take your reading at the point where the contrast line (difference between light and dark areas) crosses the scale.

An alternative method can be done using digital refractometer like the one below.

Refractometer reading is represented in degree brix, ºBrix. One ºBrix is equivalent to one gram sugar per 100 ml solution.
Cocoa & Chocolate
## Major Cocoa Processing Countries (Based on Bean Grind)

(\times 1,000 \text{ MT and \%})

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>140</td>
<td>268</td>
<td>452</td>
<td>491</td>
<td>475</td>
</tr>
<tr>
<td>USA</td>
<td>186</td>
<td>268</td>
<td>456</td>
<td>391</td>
<td>355</td>
</tr>
<tr>
<td>Germany</td>
<td>180</td>
<td>294</td>
<td>227</td>
<td>385</td>
<td>335</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>60</td>
<td>118</td>
<td>285</td>
<td>374</td>
<td>440</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>80</td>
<td>145</td>
<td>151</td>
<td>108</td>
<td>110</td>
</tr>
<tr>
<td>France</td>
<td>48</td>
<td>71</td>
<td>145</td>
<td>160</td>
<td>150</td>
</tr>
<tr>
<td>Malaysia</td>
<td>7</td>
<td>78</td>
<td>125</td>
<td>331</td>
<td>260</td>
</tr>
<tr>
<td>Former USSR</td>
<td>114</td>
<td>83</td>
<td>102</td>
<td>96</td>
<td>88</td>
</tr>
<tr>
<td>Indonesia</td>
<td>13</td>
<td>32</td>
<td>87</td>
<td>160</td>
<td>110</td>
</tr>
<tr>
<td>Others</td>
<td>730</td>
<td>974</td>
<td>1,035</td>
<td>1,262</td>
<td>1,192</td>
</tr>
</tbody>
</table>

**Total world grindings**

| 1,558           | 2,331   | 3,065   | 3,758   | 3,515   |

*Source: International Cocoa Organization Quarterly Bulletin*
Diagram of World’s Cocoa Products Flow

- Cocoa beans: 3,500
- Cocoa nibs: 2,825
- Press industry:
  - Cocoa liquor: 1,800
- Chocolate industry:
  - Cocoa liquor: 1,025
- Shell: 675
- Sugar
- Milk
- Cocoa powder: 1,000
- Cocoa butter: 800
- Chocolate: 5,000 (estimate)
2. THE RAW MATERIAL

Standards
Certainly the condition of the starting material, the cocoa bean, determines the ultimate characteristics of the end products. Close scrutiny of the raw material is essential, and several aspects have to be taken into account.

Cocoa is traded on terminal markets around the world, and standard contracts define a number of quality requirements. An average shipment of cocoa should comply with the following:

- Fermentation - adequately fermented (if fermented)
- Foreign matter - nil
- Waste - < 2%
- Moisture content - < 7.5%
- Smoky or foreign odors - absent
- Bean size uniformity - reasonably uniform
- Packing weight, bag quality, and marking - should be as defined (if applicable)
Cocoa beans vary in size, shape, color, and other features.
<table>
<thead>
<tr>
<th>Component</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aliphatic, Alicyclic</td>
<td></td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>39</td>
</tr>
<tr>
<td>Organic acids</td>
<td>51</td>
</tr>
<tr>
<td>Amines</td>
<td>45</td>
</tr>
<tr>
<td>Alcohols</td>
<td>25</td>
</tr>
<tr>
<td>Aldehydes</td>
<td>22</td>
</tr>
<tr>
<td>Ketones</td>
<td>24</td>
</tr>
<tr>
<td>Esters</td>
<td>58</td>
</tr>
<tr>
<td>Lactones</td>
<td>7</td>
</tr>
<tr>
<td>Ethers</td>
<td>8</td>
</tr>
<tr>
<td>Sulfides</td>
<td>10</td>
</tr>
<tr>
<td>Phenols</td>
<td>6</td>
</tr>
<tr>
<td>Heterocyclic</td>
<td></td>
</tr>
<tr>
<td>Furans</td>
<td>19</td>
</tr>
<tr>
<td>Thiazoles</td>
<td>8</td>
</tr>
<tr>
<td>Thiophenes</td>
<td>1</td>
</tr>
<tr>
<td>Pyridines</td>
<td>12</td>
</tr>
<tr>
<td>Pyrroles</td>
<td>18</td>
</tr>
<tr>
<td>Oxazoles</td>
<td>15</td>
</tr>
<tr>
<td>Pyrazines</td>
<td>95</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>463</strong></td>
</tr>
</tbody>
</table>
PRODUCTS FROM CACAO

PRODUCTION FLOW SHEET

Beans
- Pre-cleaning
- Storage
- Blending (optional)

Nibs
- Breaking & winnowing
- Sterilization
- Alkalizing (optional)
- Roasting

Liquor
- Liquor grinding

Pressing
- Cake
  - Breaking
  - Cake blending
  - Pulverization
  - Cooling
  - Packaging

Butter
- Filtering
  - Deodorization (optional)
  - Blending
Quality control parameter

Flavor evaluation
Determination of fat content
Determination of pH
Determination of sieve residue
Determination of moisture content
Color evaluation
Refractive index
Melting point
Extinction values
Microbiological

BUTTER PART:
Free fatty acid content
Peroxide value
Unsaponifiable matter
Iodine value by Wijs method
Blue value
Cocoa Liquor Processing Methods

Cocoa Beans

Whole Bean Roasting
- Breaking and Winnowing
  - Grinding
    - Thin Layer Treatment
      - Treated Liquor
    - Liquor
  - Liquor
- Breaking and Winnowing
  - Nib Roasting
    - Grinding
      - Thin Layer Treatment
      - Treated Liquor
# Standard Specification

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flavor</strong></td>
<td>up to standard</td>
</tr>
<tr>
<td><strong>Fat content, extraction with petroleum ether</strong></td>
<td>50-51% or 52-54% or 54-56%</td>
</tr>
<tr>
<td><strong>pH</strong></td>
<td>5.3-6.0</td>
</tr>
<tr>
<td><strong>Fineness (%), 75μm sieve, water-suspension</strong></td>
<td>99.0 min. (or micrometer fineness 10-12)</td>
</tr>
<tr>
<td><strong>Moisture content (%)</strong></td>
<td>1.5 max.</td>
</tr>
<tr>
<td><strong>Standard plate count</strong></td>
<td>5,000 max. (or up to 25,000 max)</td>
</tr>
<tr>
<td><strong>Molds per g</strong></td>
<td>50 max.</td>
</tr>
<tr>
<td><strong>Yeasts per g</strong></td>
<td>50 max.</td>
</tr>
<tr>
<td><strong>Molds and yeast per g</strong></td>
<td>100 max.</td>
</tr>
<tr>
<td><strong>Enterobacteriaceae (Coliforms in the US) in 1g</strong></td>
<td>negative</td>
</tr>
<tr>
<td><strong>E. coli in 1g</strong></td>
<td>negative</td>
</tr>
<tr>
<td><strong>Salmonellae</strong></td>
<td>negative</td>
</tr>
</tbody>
</table>
Figure 6: Principle Component Analysis of Four Cocoa Liquor Types Based on the Same Bean Blend of West African Origin

Type 1 - Low roast + thin film treatment
Type 2 - Medium roast
Type 3 - Full roast + thin film treatment
Type 4 - Full roast
Figure 7: Principal Component Analysis of Various Cocoas

@ProfDrMusBay
Prof. Dr. Mustafa BAYRAM
FIGURE 8: INFLUENCE OF THE FINENESS ON THE VISCOSITY OF A WEST AFRICAN COCOA LIQUOR
Manufacture of chocolate
2-step refining process

1. Ingredient bins
2. Mixing / kneading
3. Pre-refining
4. Final refining
5. Conching
6. Electric plant control
In chocolate, sugar has following functions:

• sweetening the product
• reducing the bitterness of cocoa
• giving body to the chocolate

Milk will give its special flavor to the milk chocolate. Commonly, recipes will contain sucrose and milk powder.
Chocolate bloom (crystallization) is a whitish coating that can appear on the surface of chocolate. This effect is one of the main concerns in the production of chocolate. There are two types of bloom: fat bloom, arising from changes in the fat in the chocolate; and sugar bloom, formed by the action of moisture on the sugar ingredients. The crystals of fat and sugar bloom limit the shelf life of many chocolates. Chocolate that has "bloomed" is still safe to eat (as it is a non-perishable food due to its sugar content), but may have an unappetizing appearance and surface texture. In general, Chocolate bloom can be 'repaired' by melting the chocolate down, stirring it, then pouring it into a mould and allowing it to cool, bringing the sugar or fat back into the solution.
Chocolate and fat fillings

Chocolate and fat fillings are suspensions made of a continuous fat phase in which finely ground solids (sugar crystals, cocoa dry substance, milk solids, …) are evenly distributed.

They are characterised by:

• a very low residual moisture of usually less than 1%
• a smooth texture (particle size less than 30μm)
• hard to creamy texture at room temperature (depending on the fat used)
ANNEX

RECIPES
Jelly fruit

**Product**  Jelly fruit with Pectin Classic AS 501

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectin (= 1.3%)</td>
<td>13 g</td>
<td></td>
</tr>
<tr>
<td>Sucrose</td>
<td>500 g</td>
<td></td>
</tr>
<tr>
<td>Maltose containing glucose syrup</td>
<td>330 g (3% dextrose, 49% maltose, 22% maltotriose)</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>220 g</td>
<td>Colourant, flavour</td>
</tr>
<tr>
<td>Tri sodium citrate x 2 H₂O</td>
<td>4 g</td>
<td></td>
</tr>
<tr>
<td>Citric acid solution 50%</td>
<td>approx. 15 ml (to adjust the pH value)</td>
<td></td>
</tr>
</tbody>
</table>

**Manufacturing:**

**A** Mix pectin and sodium citrate with approx. 100 g sucrose (from total sugar amount).

**B** Stir in mixture “A” into water and boil up until the pectin has completely dissolved.

**C** Add remaining sugar and glucose syrup and boil up until final soluble solids are reached.

**D** Add colourant and flavour.

**E** Add citric acid solution to adjust the pH value.

**F** Depositing temperature approx. 95 °C.

**Input weight:** approx. 1080 g

**Output weight:** approx. 1000 g

**Soluble solids:** approx. 78 %

**pH value:** approx. 3.2 – 3.4
<table>
<thead>
<tr>
<th>Product</th>
<th>Jelly fruit with Pectin Amid CS 005</th>
</tr>
</thead>
</table>

- **15 g** Pectin (= 1.5 %)
- **500 g** Sucrose
- **330 g** Maltose containing glucose syrup
  (3% dextrose, 49% maltose, 22% maltotriose)
- **220 g** Water
- **approx. 4.5 ml** Citric acid solution 50 %
  (to adjust the pH value)

**Input weight:** approx. 1070 g  
**Output weight:** approx. 1000 g  
**Soluble solids:** approx. 78 %  
**pH value:** approx. 3.2 – 3.4

**Manufacturing:**

**A** Mix pectin with approx. 100 g sucrose (from total sugar amount).

**B** Stir in mixture “A” into water and boil up until the pectin has completely dissolved.

**C** Add remaining sugar and glucose syrup and boil up until final soluble solids are reached.

**D** Add colourant and flavour.

**E** Add citric acid solution to adjust the pH value.

**F** Depositing temperature approx. 95°C.
**Pectin bears**

**Product**  
*Pectin bears with Pectin Classic AS 507*

- 25 g Pectin (= 2.5%)
- 370 g Sucrose
- 50 g Fructose
- 475 g Glucose fructose syrup  
  (28% fructose, 41% dextrose, 20% maltose)
- 200 g Water
- Colourant, flavour
- 1 g Tri sodium citrate x 2 H₂O
- approx. 15 ml Citric acid solution 50%  
  (to adjust the pH value)

**Manufacturing:**

A  Mix pectin and sodium citrate with approx. 100 g sucrose (from total sugar amount).

B  Stir in mixture “A” into water and boil up until the pectin has completely dissolved.

C  Add remaining sugar and glucose syrup and boil up until final soluble solids are reached.

D  Add colourant and flavour.

E  Add citric acid solution to adjust the pH value.

F  Depositing temperature approx. 95°C.
**Pectin pastilles**

<table>
<thead>
<tr>
<th>Product</th>
<th>Pectin pastilles with Pectin Classic CS 502</th>
</tr>
</thead>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>40 g</td>
<td>Pectin (= 4.0 %)</td>
</tr>
<tr>
<td>360 g</td>
<td>Sucrose</td>
</tr>
<tr>
<td>475 g</td>
<td>Glucose fructose syrup</td>
</tr>
<tr>
<td></td>
<td>(28 % fructose, 41 % dextrose,</td>
</tr>
<tr>
<td></td>
<td>20 % maltose)</td>
</tr>
<tr>
<td>200 g</td>
<td>Water</td>
</tr>
<tr>
<td></td>
<td>Colourant, flavour</td>
</tr>
<tr>
<td>2 g</td>
<td>Tri sodium citrate x 2 H₂O</td>
</tr>
<tr>
<td>approx. 17 ml</td>
<td>Citric acid solution 50 %</td>
</tr>
<tr>
<td></td>
<td>(to adjust the pH value)</td>
</tr>
</tbody>
</table>

**Manufacturing:**

A  Mix pectin and sodium citrate with approx. 100 g sucrose (from total sugar amount).

B  Stir in mixture “A” into water and boil up until the pectin has completely dissolved.

C  Add remaining sugar and glucose syrup and boil up until final soluble solids are reached.

D  Add colourant and flavour.

E  Add citric acid solution to adjust the pH value.

F  Depositing temperature approx. 95°C.

**Input weight:** approx. 1090 g  
**Output weight:** approx. 1000 g  
**Soluble solids:** approx. 78 %  
**pH value:** approx. 3.4 – 3.5
# Geleefrucht

## Product

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectin</td>
<td>13 g</td>
</tr>
<tr>
<td>Fruit pulp (approx. 10% TSS)</td>
<td>200 g</td>
</tr>
<tr>
<td>Sucrose</td>
<td>480 g</td>
</tr>
<tr>
<td>Maltose containing glucose syrup</td>
<td>330 g</td>
</tr>
<tr>
<td>(3% dextrose, 49% maltose, 22% maltotriose)</td>
<td></td>
</tr>
<tr>
<td>Citric acid solution 50%</td>
<td>approx. 10 ml</td>
</tr>
<tr>
<td>(to adjust the pH value)</td>
<td></td>
</tr>
</tbody>
</table>

### Manufacturing:

- **A** Mix pectin with approx. 100 g sucrose (from total sugar amount).
- **B** Stir in mixture “A” into fruit pulp and boil up until the pectin has completely dissolved.
- **C** Add remaining sugar and glucose syrup and boil up until final soluble solids are reached.
- **D** Add citric acid solution to adjust the pH value.
- **E** Depositing temperature at approx. 95°C.

**Input weight:** approx. 1030 g  
**Output weight:** approx. 1000 g  
**Soluble solids:** approx. 78%  
**pH value:** approx. 3.2 – 3.4
### Fruit gum with Pectin Classic CS 502 and gelatine

<table>
<thead>
<tr>
<th>Product</th>
<th>Fruit gum with Pectin Classic CS 502 and gelatine</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectin</td>
<td>6 g</td>
</tr>
<tr>
<td>Sucrose</td>
<td>400 g</td>
</tr>
<tr>
<td>Glucose fructose syrup</td>
<td>440 g</td>
</tr>
<tr>
<td>Gelatine</td>
<td>54 g</td>
</tr>
<tr>
<td>Water</td>
<td>220 g</td>
</tr>
<tr>
<td>Citric acid solution 50%</td>
<td>approx. 25 ml</td>
</tr>
</tbody>
</table>

**Manufacturing:**

A. Mix pectin, gelatine with approx. 20 g sucrose (from total sugar amount) and stir into hot water (95°C). Keep the formulation for approx. 30 min. at 80°C.

B. Mix remaining water, sucrose and glucose syrup and let boil.

C. Let the sugar mass boil up to 126°C (825 g) and cool to 100°C.

D. Add the pectin gelatine solution under stirring ⇒ approx. 1095 g (74.5% soluble solids).

E. Add colourant and flavour.

F. Add citric acid solution to adjust the pH value.

G. Deposit into dried starch moulds.

H. Depositing temperature approx. 95°C.

I. Let it gel in the starch moulds for 24 hours at 20°C until 81 – 82% soluble solids are reached.
Product  Zefir with Pectin Classic AS 401

- 12 g Pectin (= 1.2%)
- 200 g apple pulp (10% TSS)
- 670 g Sucrose
- 140 g Maltose containing glucose syrup (3 % dextrose, 49 % maltose, 22 % maltotriose)
- 70 g Egg white solution (approx. 12 % TSS)
- 50 g Water
- Colourant, flavour
- 3 g tri sodium citrate x 2 H₂O
- 10 ml Citric acid solution 50% (to adjust the pH value)

Manufacturing:

A Mix pectin, sodium citrate with approx. 50 g sucrose (from total sugar amount) and stir into hot water (95 °C). Keep the formulation for approx. 30 min. at 80 °C.

B Stir in mixture “A” in apple pulp and let swell overnight.

C Mix egg white solution with 270 g sucrose (from total sugar amount).

D Heat sugar solution consisting of 350 g sucrose, 140 g glucose syrup and 50 g water. For better solubility of the sugar the water amount can be increased. The mass has to be boiled up to 540 g (= 85% TSS).

E Mix mixture “B” and “C” and froth up cold.

F Add hot sugar solution under slow stirring to frothed mass.

G Add colourant and flavour.

H Add citric acid solution under stirring.

I Processing temperature approx. 55 °C.
**Aerated product**

<table>
<thead>
<tr>
<th>Product</th>
<th>Aerated product with Pectin Amid CS 025-B</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectin (= 2.5%)</td>
<td>25</td>
</tr>
<tr>
<td>Sucrose</td>
<td>275</td>
</tr>
<tr>
<td>Sorbitol</td>
<td>45</td>
</tr>
<tr>
<td>Fructose</td>
<td>40</td>
</tr>
<tr>
<td>Maltose containing glucose syrup</td>
<td></td>
</tr>
<tr>
<td>(3% dextrose, 49% maltose, 22% maltotriose)</td>
<td>360</td>
</tr>
<tr>
<td>Dry egg white powder</td>
<td>10</td>
</tr>
<tr>
<td>Water</td>
<td>160</td>
</tr>
<tr>
<td>Colourant, flavour</td>
<td></td>
</tr>
</tbody>
</table>

**Manufacturing:**

A. Mix egg white powder with fourfold amount of water (from total water amount).

B. Mix pectin with fivefold amount of sucrose (from total sugar amount).

C. Stir in mixture “B” in remaining water and heat to 90°C.

D. Add remaining sucrose, fructose, sorbitol and glucose syrup and heat to 95°C.

E. Add colourant and flavour.

F. Add egg white solution “A” and stir.

G. Deposit the mass into the heated storage chamber of the pressure frothing machine.

H. Frothed mass ready to process resp. to deposit in starch moulds.

Deposit temperature approx. 65°C.
**Product**  
**Jelly fruit with Pectin Amid CS 025-B**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectin (= 2.5%)</td>
<td>25 g</td>
<td></td>
</tr>
<tr>
<td>Sucrose</td>
<td>360 g</td>
<td></td>
</tr>
<tr>
<td>Maltose containing glucose syrup (3% dextrose, 49% maltose, 22% maltotriose)</td>
<td>475 g</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>220 g</td>
<td>Colourant, flavour</td>
</tr>
</tbody>
</table>

**Input weight:** approx. 1080 g  
**Output weight:** approx. 1000 g  
**Soluble solids:** approx. 78%  
**pH value:** approx. 4.2 – 4.5

**Manufacturing:**

- **A**  Mix pectin with approx. 50 g sucrose (from total sugar amount).
- **B**  Stir in mixture “A” into water and boil up under stirring until the pectin has completely dissolved.
- **C**  Add remaining sugar and glucose syrup and boil up until final soluble solids are reached.
- **D**  Add colourant and flavour.
- **E**  Depositing temperature approx. 90°C.
**Product**  
**Milk/caramel jelly with Pectin Amid CS 025-B**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (g)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectin</td>
<td>25</td>
<td>(= 2.5%)</td>
</tr>
<tr>
<td>Sucrose</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>Maltose containing glucose syrup</td>
<td>475</td>
<td>(3% dextrose, 49% maltose, 22% maltotriose)</td>
</tr>
<tr>
<td>Sweetened resp. caramelised condensed milk</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>200</td>
<td>Colourant, flavour</td>
</tr>
</tbody>
</table>

**Input weight:** approx. 1120 g  
**Output weight:** approx. 1000 g  
**Soluble solids:** approx. 79 – 80 %  
**pH value:** approx. 4.5 – 5.0

**Manufacturing:**

A  
Mix pectin with approx. 50 g sucrose (from total sugar amount).

B  
Stir in mixture “A” into water and boil up under stirring until the pectin has completely dissolved.

C  
Add remaining sugar and sweetened condensed milk and boil up until final soluble solids are reached.

D  
Add colourant and flavour.

E  
Depositing temperature approx. 95°C.
# Jelly layer for bakery products with Pectin Classic AS 501

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>170 g</td>
<td>Pectin solution 5% (= 0.85 %)</td>
</tr>
<tr>
<td>25 g</td>
<td>Orange juice concentrate (approx. 65% TSS)</td>
</tr>
<tr>
<td>340 g</td>
<td>Sucrose</td>
</tr>
<tr>
<td>470 g</td>
<td>Glucose fructose syrup (28% fructose, 41% dextrose, 20% maltose)</td>
</tr>
<tr>
<td>50 g</td>
<td>Water</td>
</tr>
<tr>
<td>3 g</td>
<td>tri sodium citrate x 2 H₂O</td>
</tr>
</tbody>
</table>

**Input weight:** approx. 1060 g  
**Output weight:** approx. 1000 g  
**Soluble solids:** approx. 75%  
**pH value:** approx. 4.0 in semi-finished product, 3.0 in finished product

**Manufacturing:**

A. For details on manufacturing pectin solution see “Technical Information”.

B. Mix fruit juice concentrate, sucrose, glucose syrup, water and sodium citrate and heat to approx. 90°C.

C. Add hot pectin solution and boil up to final soluble solids.

D. Cool down the mass.

**Manufacturing of the final product:**
Heat the cold semi-finished product to min. 75°C. Add 15 ml citric acid solution 50% per 1000 g semi-finished product and mix well. Process the preparation quickly as gelation is initiated irreversibly after acid addition.
<table>
<thead>
<tr>
<th>Pectin</th>
<th>VE° [%]</th>
<th>A° [%]</th>
<th>Standardisation with neutral sugars + composition</th>
<th>Characteristics + properties of the manufactured confectionery</th>
<th>Main application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classic AS 401</td>
<td>61 – 64</td>
<td>–</td>
<td>150 °/± 5 °USA-Sag const. breaking strength, const. setting time E 440</td>
<td>Apple Pectin, medium rapid set, addition of buffer salts usually necessary</td>
<td>• jelly fruits, jelly fillings aerated products (TSS 68 – 80 %, pH 2.8 – 3.4)</td>
</tr>
<tr>
<td>Classic AS 501</td>
<td>55 – 61</td>
<td>–</td>
<td>150 °/± 5 °USA-Sag const. breaking strength, const. setting time E 440</td>
<td>Apple Pectin, slow set, addition of buffer salts usually necessary</td>
<td>• Fruit jellies, jelly fillings, domino ginger (TSS 68 – 80 %, pH 2.8 – 3.4)</td>
</tr>
<tr>
<td>Classic AS 502</td>
<td>56 – 60</td>
<td>–</td>
<td>const. gelling strength, const. setting temperature E 440, E 331</td>
<td>Apple Pectin, slow set</td>
<td>• Fruit jellies, jelly fillings, domino ginger (TSS 68 – 80 %, pH 2.8 – 3.4)</td>
</tr>
<tr>
<td>Classic AS 507</td>
<td>58 – 65</td>
<td>–</td>
<td>const. gelling strength, const. setting temperature E 440, E 337, E 452</td>
<td>Apple Pectin, medium rapid set, firm, short elastic texture, smooth cut</td>
<td>• jelly fruits, jelly fillings, pastilles, gum articles (TSS 68 – 80 %, pH 2.8 – 3.4)</td>
</tr>
<tr>
<td>Classic AS 509</td>
<td>56 – 62</td>
<td>–</td>
<td>const. gelling strength, const. setting temperature E 440, E 337, E 331</td>
<td>Apple Pectin extra slow set, tender texture, smooth, brilliant cut</td>
<td>• jelly fruits, jelly fillings, gum products (TSS 68 – 80 %, pH 3.0 – 3.4)</td>
</tr>
<tr>
<td>Classic CS 401</td>
<td>61 – 65</td>
<td>–</td>
<td>150 °/± 5 °USA-Sag const. gelling strength, const. setting time E 440</td>
<td>Citrus Pectin, medium rapid set, addition of buffer salts usually necessary</td>
<td>• jelly fruits, jelly fillings (TSS 68 – 80 %, pH 3.0 – 3.6)</td>
</tr>
<tr>
<td>Classic CS 501</td>
<td>55 – 61</td>
<td>–</td>
<td>150 °/± 5 °USA-Sag const. gelling strength, const. setting time E 440</td>
<td>Citrus Pectin, slow set, addition of buffer salts usually necessary</td>
<td>• Fruit jellies, jelly fillings (TSS 68 – 80 %, pH 3.0 – 3.6)</td>
</tr>
<tr>
<td>Product</td>
<td>VE°</td>
<td>A°</td>
<td>Characteristics</td>
<td>Applications</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-----</td>
<td>----</td>
<td>------------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Classic CS 502</td>
<td>58 – 65</td>
<td>-</td>
<td>const. gelling strength, const. setting temperature E 440, E 337, E 452</td>
<td>Citrus Pectin, medium rapid set, firm, elastic brittle texture, smooth cut</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Fruit jellies, jelly fillings (TSS 68 – 80 %, pH 3.0 – 3.6)</td>
<td></td>
</tr>
<tr>
<td>Classic CS 509</td>
<td>56 – 63</td>
<td>-</td>
<td>const. gelling strength, const. setting temperature E 440, E 337, E 452</td>
<td>Citrus Pectin, extra slow set, tender, elastic brittle texture, smooth cut</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• jelly fruits, jelly fillings, gum products (TSS 68 – 80 %, pH 3.0 – 3.6)</td>
<td></td>
</tr>
<tr>
<td>Classic CS 510</td>
<td>58 – 64</td>
<td>-</td>
<td>const. gelling strength, const. setting temperature E 440, E 337, E 452</td>
<td>Citrus Pectin, slow set, medium firm, elastic texture, smooth cut</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• jelly fruits, jelly fillings, gum products (TSS 68 – 80 %, pH 3.0 – 3.6)</td>
<td></td>
</tr>
<tr>
<td>Amid CS 005</td>
<td>51 – 59 4 – 9</td>
<td>-</td>
<td>const. gelling strength, const. setting temperature E 440</td>
<td>amidated Citrus Pectin, very slow set, no addition of buffer salts necessary, low acid content possible, low heat viscosity, suitable for high TSS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Fruit jellies, jelly fillings, pastilles (TSS 68 – 85 %, pH 2.8 – 3.6)</td>
<td></td>
</tr>
<tr>
<td>Amid CS 025-B</td>
<td>16 – 24 20 – 25</td>
<td>const. gelling strength, const. setting time E 440, E 450, E 452, E 327</td>
<td>amidated Citrus Pectin, high calcium reactivity, suitable for high pH-value</td>
<td>• confectionery with increased pH value without addition of acid (e.g. Turkish Delight) (TSS 70 – 85 %, pH 4.0 – 5.5)</td>
<td></td>
</tr>
</tbody>
</table>

**VE° = Degree of esterification**    **A° = Degree of amidation**
Fermente Ettirilmiş ve Kurutulmuş Kakao Çekirdekleri
  ↓
  Temizleme
  ↓
  Kavurma
  ↓
  Kırmı
  ↓
Kalburlama ve aspirasyon
  ↓
  İç-kabuk karışımı (İç)
  ↓
  Kabuk
  ↓
  Embriyon (Germ) ayrılır
Embriyondan arındırılmış iç
  ↓
  Öğütme
  ↓
Kakao imali
  ↓
(Cikolata Likörü)
  ↓
  Çikolata imali
(Alkalileştirme)
  ↓
  Presleme
  ↓
  Pres küspesi
  ↓
  Kakao yağı
  ↓
  Kırmı
  ↓
  Öğütme
  ↓
  Eleme
  ↓
  Kakao tozu
  ↓
  Şeker, Tad maddeleri
  ↓
Süt v.b. ile kakao yağı katma
  ↓
  Karıştırma
  ↓
  İnceltme
  ↓
  Yoğurma (Conching)
  ↓
  Ayarlama (standardize etme)
  ↓
  Tavlama
  ↓
  Kalplama
  ↓
  Kaplama
  ↓
  Sade ya da sütlü kaplanmış cikolata yiyeciler

Şekil 2.2. Kakao ve cikolata imali akım şemasi (Potter, 1973)
Şekil 2.6. Kaplama çikolata imali ve şekerlemelerin çikolata kaplanması:
1- Füngasyon, 2- Temizleme, 3- Kavurma, 4- Kırma ve Kalburlama, 
5- Öğütme, 6- Kuru bileşenlerin karıştırılması, 7- Çikolata likörü ve diğer bileşenlerin karıştırılması ve yoğunulması, 8- Şekerlemelerin 
cikolatayla kaplanması ve soğutulması.
Şekil 3.6. Marşmelo üretim hattı
Şekil 3.7. Nugat üretim hattı