



FOOD CHEMISTRY

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Jams, Jellies and Pickles

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Jams, Jellies and Pickles



- **Jams** and **jellies** => made => from fruits , also => from some vegetables - sweet potatoes, tomatoes, carrots, and some legumes.
- **preserve** or **jam** => product manufactured with => one or combination of **fruit ingredients** => combination of some **optional ingredients**.
- **Fruit ingredients** => mature and properly prepared => including fresh, concentrated, frozen, or canned.

- **Pickling** => ancient art of food preservation.
- process of preserving food :
- anaerobic fermentation in **brine** (salt solution) to produce acid, or
- storing in **acid solution** (usually vinegar).
- resulting food preparation => **pickle** => edible product preserved and flavored => in solution of **common salt** and **vinegar** along with **spices and oils**.

JAMS AND JELLIES

- Jams are produced => one kind of fruit.
- thickened by => boiling and constant stirring of the whole or sliced fresh or fresh stored raw material, or of fruit pulp.
- Ordinary jams are also made => fruit slurry.
- Boiling under a vacuum at 65–80 °C offers => advantage of preserving the aroma and color.
- disadvantages => absence of sucrose inversion and the low caramelization.
- These reactions produce => characteristic taste of jams boiled in an open kettle.
- optimal pH of 3.0 required for gelling => adjusted by addition of lactic, citric or tartaric acid, if necessary.

- **Jellies** => gelled food => one or a permitted combination of **fruit juice** ingredients and one or any combination of optional ingredients => **concentrated** => with or without heat.
- **Fruit juice** => **filtered** or strained liquid extracted with or without application of **heat** => with or without addition of **water** from mature, properly prepared fruits => that are fresh, frozen, or canned.
- **fruits used** => **jellies** => **apple, apricot, blackberry (other than dewberry), black raspberry, cherry, fig, gooseberry, grape, grapefruit, guava, orange, peach, pineapple, pomegranate, pear, quince, raspberry, red raspberry, strawberry.**

ESSENTIAL INGREDIENTS IN JAMS AND JELLIES

- Jams and jellies are products based => in **texture** formation.
- characterized by the formation of :
- **special viscous structure** in jam and
- **gel formation** in jellies, and
- both properties are developed by => interaction of **sugar, pectic substances, and acidity (pH)**.
- In **jams** => **viscosity** is => result of an interaction between **sugar and pectin** => in presence of **high fiber content**.
- All cell wall materials are present in => product and effects of **cellulose and hemicellulose molecules** => **do not permit the formation of a continuous gel**.
- In **jellies** => **clarified or strained juices** with **very low fiber content** are used => hence the relationship between **pectin** and **sugar** permits => formation of a **continuous gel structure**.

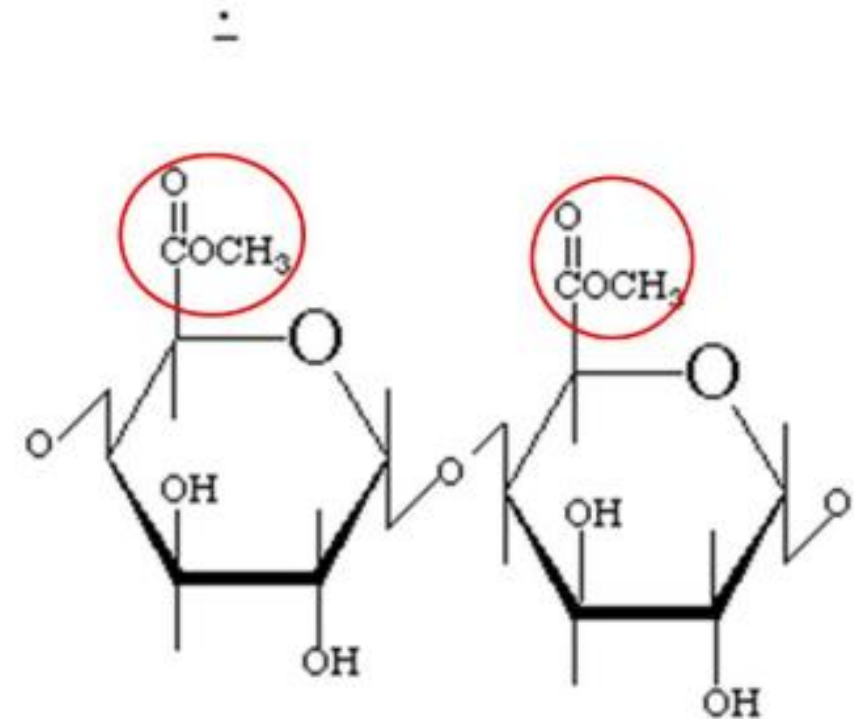
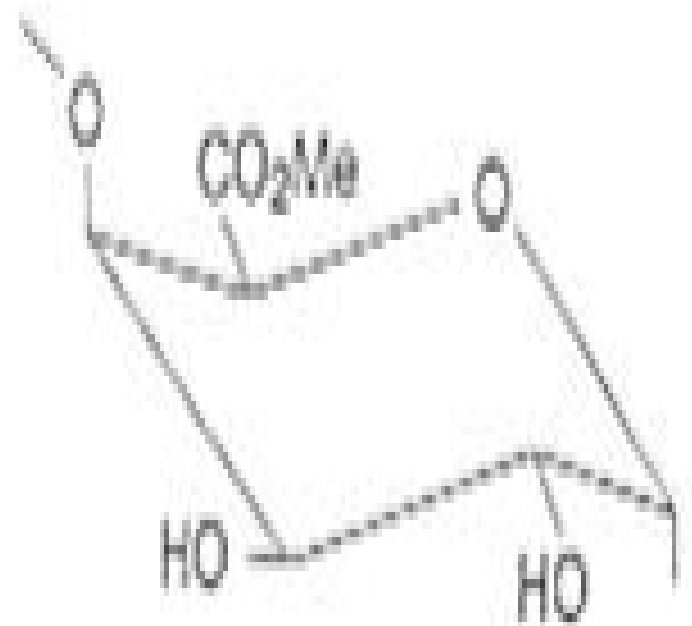
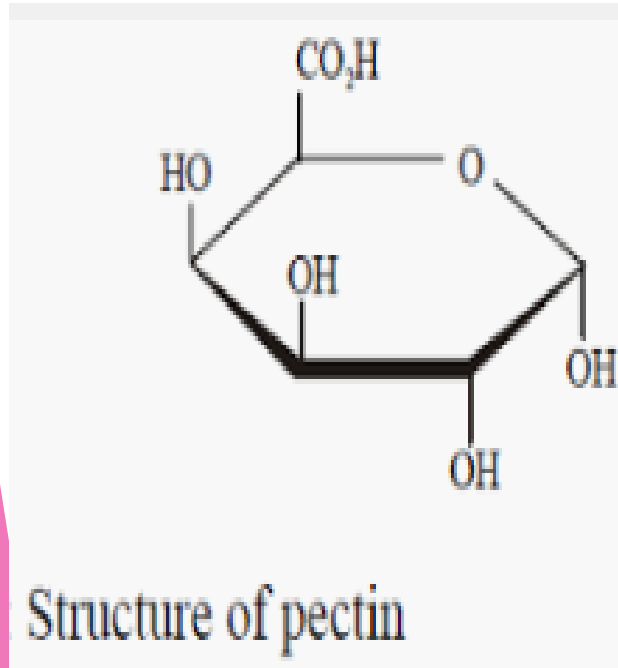
Sugar:

- jams and jellies => 65% of sugar.
- types and concentrations of sugar => responsible => **taste** in jams and jellies => added sugar (normally sucrose) does not have => same effect on => this important quality factor.
- Jam and jellies fall under => category of so-called **intermediate products** => having aw of 0.80 to 0.85.
- These products => **not self-preserved** because => **water activity** values are **not low enough** to => control microbial growth or chemical reactions.
- principal microbiological problems => **molds and yeast**, not bacteria.

Pectin:

- Pectin is => **very complex molecule** formed by => polymer of **D-galacturonic acid**.
- **degree of esterification** indicates => capacity of pectin to form a gel.
- **Gel formation** is produced by => relationship between pectin, water in the fruit, and **sugar**, under a **controlled pH**.
- **High methoxy pectin** gel => acid pH (< 3.5) => presence of sugar.
- **Low methoxy pectin** gel => higher pH => in presence of divalent cations - Ca^{2+} .

High Methoxy Pectin



Acid:

- an **essential** component in **jams** and **jellies**.
- fruit used => making jams and jellies has => **low pH**.
- Acid => **stabilizes** relation b/w **pectin** and **sugar**.
- Berries have low pH => their content of some common organic acids => **ascorbic, citric, malic** and **tartaric** acid.
- these acids can be used => **increase the acidity** in jams and jellies.
- Acids also help => produce **inversion of sugar** at the beginning of the process.
- **Sucrose** is converted => **glucose** and **fructose** => which may **improve quality** of products by:
 - ❖ increasing the **brightness**,
 - ❖ reducing **crystallization**, and
 - ❖ reducing the **sugar flavor** in products.

Composition of various jams (average values in %)

Fruits Jam	Moisture	Total sugar	Total acid	Ash	Dietary fiber
Strawberries	35.0	58.7	0.89	0.23	0.80
Apricots	36.9	51.3	1.14	0.28	0.60
Cherries	36.6	57.3	1.26	0.28	0.50
Blackberries	34.2	58.0	0.37	0.24	1.20
Raspberries	35.9	54.6	1.03	0.23	1.20
Plums/prunes	31.1	59.1	0.42	0.24	0.43

Mechanism of formation of pectin gels

- most commonly accepted theory of gel formation is that => mechanism of jellying involves => stacking of polysaccharide chains to => form junction zones.
- For gel formation => sugar, acid, water, pectin => must be present.
- Protons of acid shift => the equilibrium b/w ionized and unionized groups.
- Added sugar further => decreases hydration of pectin by competing for water => there by => lowering aw.

- Hence water is less free to => solvate polysaccharide => so there is increased hydrophobic interaction b/w methyl esters group.
- Thus => due to loss of some of their charges and hydration => polymer molecules can now associate over a portion of their length forming junctions => thus a **network of polymer chain is formed** that => entraps aqueous solution of solute molecules.
- Finally => when cooled => **unstable dispersion of hydrated pectin => forms gels.**

Factors affecting gel formation

- A firm gel is that => which is **firm enough** to stand without **appreciable deformation** and => yet **tender enough** to spread readily on bread.
- A firm gel depends on following factors:
 - **Pectin:**
 - As **% pectin increase** in mixture => **firmness** of jellies produced on cooling => **increases**.
 - **satisfactory jelly** is obtained with => around **1% pectin** => but quantity will vary with:
 - ❖ **quality** of pectin preparation,
 - ❖ average **molecular weight** of pectin molecules and
 - ❖ **degree of methylation**.

Degree of methylation in pectin:

- Excellent jellies => prepared from => pectin with **wide range of methoxy content**
- max jellying appears at => about **8%**
- This represents **esterification of => half** of the carboxyl group
- preparations in which => **> 1/2** of the carboxyl groups are in **methyl ester forms => classified as high methoxy pectins .**
- high methoxy pectins **gel => sufficient acid and sugar is present.**

- Preparations \Rightarrow $< 1/2$ of $-\text{COOH}$ groups are \Rightarrow methyl ester form ($< 7\%$) \Rightarrow called **low methoxy** pectins.
- Low methoxy pectins \Rightarrow gels only in presence \Rightarrow **divalent cations**
- can form a gel \Rightarrow even if **percentage of solids** \Rightarrow **very low**.
- Low methoxy pectins \Rightarrow do not require \Rightarrow presence of sugar \Rightarrow formation of gel.
- **divalent ions** (Ca^{2+}) react with **carboxyl group** \Rightarrow on the molecules of pectic acid \Rightarrow form a **bridge** between them.

pH:

- Most pectic products => do not form jellies until => pH is lowered to 3.5.
- firmness of jellies increases => pH decreases.
- With very low pH => amount of pectin required is very less and => satisfactory gel still formed.

Sugar:

- necessary => formation of **pectin gels** and
- be present => **minimum concentration**.
- Most jellies are made => **65%** of sugar.
- If amount is increased **> 65%** :
 - ❖ **crystallization** tends to occur on => jelly's **surface** and
 - ❖ occasionally even **within** the jelly.

Boiling

Addition of citric acid

Judging of end point by further cooking up to 105 degree Celsius or 68% TSS or by sheet test

Filling hot into bottles

Cooling

Waxing

Capping

Storage



PICKLES

- easy to prepare with right ingredients
 - can be preserved for months
 - serve as a flavor enhancer and consumed typically in small quantities
 - add to palatability of a meal,
 - aid in digestion and
 - are good appetizers
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- wide variety of different pickles => made with a mixture of fruits or vegetables => chopped => immersed in a liquid (often oil or lemon juice) with different spices and salt.

- Varieties of pickles include => lemon, mango, amla, ginger, green chilly, mix vegetables, cucumber, cabbage, garlic, carrot and sometimes fish, prawns, eggs or meat etc.
- Addition of salt and acid to pickle gives => salty or sour taste.
- Most distinguishing characteristic of pickle is => low pH i.e. pH 4.6.
- This prevents => bacterial spoilage and preserves perishable foods => for months.
- Antimicrobial herbs and spices => mustard seed, garlic, cinnamon or cloves => also added to pickles.
- Edible oils => play a part as => an oxygen-excluding covering for pre-pickled matter.

Types of pickling

- a) Long , fermentation-based pickling:
Requires a 'curing' period (up to several weeks) at room temperature.

- b) Quick , unfermented pickling: made by adding acid (e.g. vinegar) to prevent bacterial growth.

Classification of pickles:

Acid-based Pickles:

- most common liquid for => acid pickling is => **vinegar**.
- This is an impure, dilute solution of **acetic acid** => obtained by **fermentation**.
- **vinegar-based pickles** => pickled ginger, pickled vegetables (a mixture of onions, carrots, cauliflower), pickled sausages, etc.

Dry-salted Pickles:

- Salt has => **two effects** => when added to fruit or vegetables.
- **draws water** => by osmosis and **triggers** => **fermentation** process of lactic bacteria.
- resultant fermentation produces => particularly rich **range of complex flavors**.
- most **common dry-cured pickle** => sauerkraut, dry salted pickled limes and lemons, plums, etc

Brine-based Pickles:

- Brine-pickling works by => combination of osmosis and lactic fermentation.
- Cucumbers => traditionally pickled in brine along with other flavorings.
- Other examples => brine-pickled vegetables, garlic, chillies, etc.

Lye Pickling:

- Olives can not be eaten => raw state and require pickling => to render them digestible.
- Before pickling => require treatment with lye (NaOH) => to remove substances => which would be toxic to => bacteria causing fermentation.
- Once pickled => olives are packaged => various forms => with addition of various herbs and spices, in brine, vinegar, and oil or dried and salted.

Pickles in Sugar:

- Fruits are sometimes => first pickled (using vinegar) => stored in a syrup or honey.
- Alternately => sweet-sour syrup => made by adding sugar to vinegar.
- Such pickles are normally served => with meats or cheeses.
- Examples => watermelon rinds, walnuts, etc.

Oily Pickles:

- Oil finds its way => into pickles.
- Various species of mushroom => are brine-pickled => before storage in olive oil.
- Mustard oil and other vegetable oils => added => dry salted fruit and vegetables (lemon, mangoes, chillies, etc) => along with spices.

Preservation principles

- Commercial preservation => relied upon => conversion of **fermentable carbohydrates** => **organic acids** during bulk storage and/or addition of sufficient amount of **sugar, vinegar and other ingredients** to => fully cured and packed products => **preclude any microbial growth**.
- **Organic acids, oils, salt and spices** => antimicrobial properties at suitable concentration => especially in combinations => preserve the pickles.
- **Pickles in brine** as such or after fermentation => need some amount of **preservative** or **pasteurization** => prevent the spoilage.

Pickling process

Pickling is done in **two stages**:

1. By curing or fermentation with **dry salting** or
 - ❖ fermentation in **brine** or
 - ❖ salting **without fermentation**.
2. By finishing and packing.

THANKS