

Science & Technology of Jams and Jellies

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Introduction

- Jams, Jellies, Marmalades, Conserves and Fruit Butters are made by boiling together fruit and sugar to give a high solids product.
- The methods and formulations used vary widely.
- Many edible products such as peppers, herbs and even edible flowers are made into preserves
- We will concentrate on fruit products considered of standard formulation

Definitions:

- Jam – a product containing both soluble and insoluble fruit constituents
- Conserve or preserve – large pieces of fruit are present
- Butter - a smooth, semisolid fruit mixture with no fruit pieces or peel. May be spiced
- Marmalade – are made from citrus fruits and contain some peel
- Jelly – is made from filtered fruit juice, no pieces of fruit or insoluble solids present

Grade

In the U.S. jams and jelly products are graded as follows:

- Fancy – 50 parts fruit to 50 parts sugar
- Standard – 45 parts fruit to 55 parts sugar
- Imitation – 35 parts fruit to 65 parts sugar
- All fruit butters have at least 5 parts fruit to 2 parts sugar or other sweeteners; final sugar is no less than 43%

Ingredients

The essential ingredients of a preserve are sugar, fruit, pectin and acid

■ Sugar

- The final sugar content must be 65% to 69%. The high sugar content:
 - » 1) suppresses microbial growth
 - » 2) sweetens the product
 - » 3) helps set the pectin
 - » 4) makes the product glisten

Sugar

- Some sugar comes from the fruit, most from added sugar (common sugar is called sucrose), for example:
- 45 lb. Fruit @ 10% = 4.5 lb. Sugar
- 55 lb. Sugar @ 100% = 55 lb. Sugar
- Total = 59.5 lb. Sugar

Sugar Content

- The sugar content is expressed as percent soluble solids or °Brix
- It is usually measured with a refractometer. Good refractometers can be purchased for under \$150.00

Types of Sugars

- The finished product should contain some non-crystallizing sugar such as glucose and or fructose to prevent the growth of sucrose crystals in the preserve during storage or after opening
- In the U.S., a portion of corn syrup is often used to replace some of the sucrose. The solubility of pure sucrose is 66% at 70°F
- If the fruit contains enough acid, sufficient inversion will occur during boiling to prevent sucrose crystallization in the finished product

Pectin

- Roughly 1% of most fruits is pectin. Some fruits, such as citrus and apple, are rich in good quality pectin and make good gels. Other fruits, such as strawberry and raspberry, have poor quality pectin so pectin must be added to obtain a satisfactory gel. However, the quantity of pectin is not as important as its setting quality

Pectin

- Commercial pectins are manufactured from citrus peel or apple pomace and are sold as a dry powder
- The pectin grade is the number of pounds of sugar that 1 pound of pectin will set to a gel with correct sugar content and pH level. 100 grade, 150 grade and 200 grade are the most common commercial pectins

Pectin

- For home use, pectin powder is blended with acid and sugar and sold in small packets (dry form) or bottles (liquid form). Each packet or bottle is sufficient to make one kitchen-sized batch of preserve or jelly
- For viscous jams the pectin content is not important because the insoluble solids impart a thick consistency. However, these products require a high fruit content, typically 50 lb. sugar to 50 lb. fruit

Acid

- The acid 'cuts' the sweetness of the sugar and achieves the pH necessary to set the pectin. Fruits supply some acid
- Frequently an addition of fruit acid is needed to bring pH into the correct range for gel formation and for flavor purposes
- Acid is essential for tropical fruits such as ripe papaya, mango and fig which are very low in acid content

Acid

- The most common acids are citric, malic, fumaric, tartaric and lactic. Use the cheapest fruit acid available
- A pH range of 2.8 to 3.3 is needed to set the gel depending on the nature of the pectin. The most common cause of gel failure is insufficient acid

Conditions for Gelling

pH of mixture

- 3.6 – no gel
- 3.4 – weak gel
- 3.2
- 3.0 – good firm gel
- 2.8
- 2.6 – weak gel –
syneresis may occur
- 2.4 – no gel

°Brix of mixture

- 70 – crystallization may occur
- 68 – good texture of jelly
- 66
- 65 – legal minimum
- 64
- 62 – weak gel
- 60 – no gel, viscous liquid

“The ideal fruit jelly will quiver, not flow, when removed from its mold; a product with texture so tender that it cuts easily with a spoon, and yet so firm that the angles so produced retain their shape; a clear product that is neither syrupy, gummy, sticky nor tough; neither is it brittle and yet it will break, and does this with a distinct beautiful cleavage which leaves sparkling characteristic faces” (Goldthwaite 1911).

Chemical Analysis of a Typical Preserve

■ Soluble solids	66 to 69%
■ Water	31 to 34%
■ Titratable acidity	0.3 to 1.1%
■ Crude pectin (alcohol precipitate)	0.5 to 1.5%
■ Ash	0.1 to 0.5%

General Procedure for Making Preserves and Jellies

- 1) Prepare fruit – sort, wash, peel, chop, slice, or puree as needed
- 2) Cook fruit
 - • If making jelly, strain to remove solids
 - • If making butter, cook until pulp is soft and then push through a food mill or sieve
 - • It is best to mix with some sugar (1 part pectin and 5 parts sugar) to prevent clumping
 - • If using dry pectin, add it to cooking fruit and simmer 1-2 minutes to dissolve
- 3) Add sugar, cook and stir to dissolve

General Procedure for Making Preserves and Jellies

- 4) Boil vigorously until desired °Brix is reached (67-69%). The end point may be determined by:
 - • instructions on the pectin package
 - • use of a refractometer (most accurate)
 - • use of a thermometer (219°-220°F)
- 5) When the end point is reached, turn off the heat and remove the scum
- 6) Fill into containers while hot (above 180°F), seal and invert to sterilize lids. After a minimum of 2 minutes in the inverted position, containers may be cooled by immersion in gradually cooling water. Most glass can withstand a thermal shock of approximately 60°F without breaking. It is advisable to warm the containers before filling with hot preserves

Boiling Preserves

- Boiling of the sugar-fruit mixture causes a number of changes that range from essential to undesirable

Essential:

- 1) Increases the solids content by boiling out some of the water in the fruit
- 2) Destroys enzymes in the fruit and microorganisms on the fruit
- 3) Allows the sugar to penetrate into the tissue of the fruit more readily

Changes due to Boiling

Desirable

- Inverts some of the sugar to help prevent crystallization during storage.

Sucrose + heat, acid	=>	glucose + fructose
(crystallizes easily)	=>	(crystallizes
		with
difficulty)		

Changes due to Boiling

Undesirable

- Volatilizes fruity aromas
- Degrades pectin
- Darkens color (carmelization)

Sugar solutions + heat => caramel
(black color, strong flavor)

Conclusion

- The best quality preserves are made when the mixture is brought to a boil as quickly as possible, boiled as vigorously as possible until the desired solids content is reached, then filled, sealed and cooled as quickly as possible