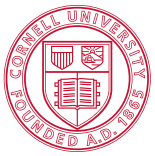

Cornell University
New York State Agricultural Experiment Station

Science & Technology of Making Preserves

Fact Sheets for the Small Scale Food Entrepreneur

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Science & Technology of Making Preserves

by Malcolm C. Bourne, Ph.D., Professor Emeritus, Cornell University

Jams, Jellies, Marmalades and Conserves 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 jams and jellies. We will concentrate on fruit products considered of standard formulation.

Definitions:

- Jam – a product contains both soluble and insoluble fruit constituents.
- Conserve or preserve – large pieces of fruit are present
- 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.

In the U.S. jams and jelly products are frequently characterized 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

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

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

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.

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.

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.

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.

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.

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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. 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.

pH of mixture	°Brix of mixture
3.6 – no gel	70 – crystallization may occur
3.4 – weak gel	68 – good texture of jelly
3.2	66
3.0 – good firm gel	65 – legal minimum
2.8	64
2.6 – weak gel – syneresis may occur	62 – weak gel
2.4 – no gel	60 – no gel, viscous liquid

General Procedure for Making Preserves and Jellies

1) Prepare fruit – sort, wash, peel, chop or slice as needed
2) Cook fruit – If making jelly, strain to remove solids; 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
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.

Desirable

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

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

Undesirable

5. Volatilizes fruity aromas
6. Darkens color (carmelization)
   Sugar solutions + heat => caramel
   (black color, strong flavor)
7. Degrades pectin

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.

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