

Stages of Sugar Cookery

Quadrant - I

Making Sugar Syrups and caramel always begins with heating and melting ordinary granulated sugar and recrystallizing it according to need. During the heating process the sugar first dissolves into syrup. As the temperature gets higher the syrup begins to thicken. As the temperature continues to rise and the water evaporates, the sugar begins to caramelize and turn a darker color.

As long as there is a lot of water in the syrup mixture the temperature will not raise much above the boiling point. As the water begins to evaporate the temperature of the mixture also begins to rise. As the water continues to evaporate, the temperature continues to rise. When most of the water has evaporated the temperature of the syrup will begin to rise rapidly. At 320°F there is no water left, the sugar is melted and begins to caramelize, and the sweetness starts to decrease. The hotter the caramel gets the darker it becomes, and the deeper and less sweet the flavor becomes.

Basically, temperature and the chemical interaction between a given component and the water molecule determine the component's solubility in water. Sucrose can be kept in solution in pure water at temperatures between 0 and 140°C. At temperatures above 100°C, pressurisation is necessary to achieve the solubility. The relatively high solubility of sucrose is an important parameter for its bulking

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effect in many foods and beverages. The dissolved sugar increases the viscosity of water-based solutions or mixtures, resulting in enhanced mouthfeel. Dissolved sugar lowers the freezing point of ice cream by preventing the water molecules from combining to form ice crystals, which slows down the freezing process. The frozen water crystals no longer in solution increase the sugar concentration in the remaining solution and lower the freezing point even further. In bakery products, the solubility, or hygroscopicity, of sugar makes it compete with flour proteins and starch granules for the available water, which minimises gluten formation and decreases gelatinisation of the starch. This makes the final product more moist and tender, and the hygroscopicity of the sugar ensures that it remains that way longer. Mixing glucose or invert sugar with sucrose increases the solubility of the combined sugar matrix and allows for production of products with higher total sugar solids than when using single components.

Candy making is the preparation of candies and sugar confections. Candy making includes the preparation of many various candies, such as hard candies, jelly beans, gumdrops, taffy, liquorice, cotton candy, chocolates and chocolate truffles, dragées, fudge, caramel candy and toffee.

Candy is made by dissolving sugar in water or milk to form a syrup, which is boiled until it reaches the desired concentration or starts to caramelize. The type of candy depends on the ingredients and how

long the mixture is boiled. Candy comes in a wide variety of textures, from soft and chewy to hard and brittle. Formally the sugar syrup undergoes 6 distinct stages or forms when it has been boiling from room temperature to the utmost temperature of 320 degrees Ferenhite. These stages are named as per the methods used to test the syrup before thermometers became in use. The "thread" stage is the first stage which is tested by cooling a little syrup, and pulling it between the thumb and forefinger. When the correct stage is reached, a thread will form. This stage is used for making syrups. For subsequent stages, a small spoonful of syrup is dropped into cold water, and the characteristics of the resulting lump are evaluated to determine the concentration of the syrup. A smooth lump indicates "ball" stages, with the corresponding hardness described. At the "soft crack" stage, the syrup forms threads that are just pliable. At the "hard crack" stage, the threads are brittle.

The final texture of candy depends on the sugar concentration. As the syrup is heated, it boils, water evaporates, the sugar concentration increases, and the boiling point rises. A given temperature corresponds to a particular sugar concentration. In general, higher temperatures and greater sugar concentrations result in hard, brittle candies, and lower temperatures result in softer candies. These "stages" of sugar cooking are given in following table

Stage	Fahrenhe it	Celsius (degre	Sugar conce	Appearance and Uses
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	(degrees F)	(degrees C)	Concentration	
Thread	223-234	106-112	80%	Syrup will form a loose thin thread. Used for making sugar syrups.
Soft Ball	234-240	112-115	85%	Syrup will form a soft, sticky ball that can be flattened when removed from the water. Used for caramels, fudge, pralines, fondant, and butter creams.
Firm Ball	242-248	116-120	87%	Syrup will form a firm but pliable, sticky ball that holds its shape briefly. Used for caramels, butter creams, nougat, marshmallows, meringues, gummies, and toffees.
Hard Ball	250-266	122-130	92%	Syrup will form a hard, sticky ball that holds its shape. Used for caramels, nougat, divinity and toffees.
Soft Crack	270-290	132-143	95%	Syrup will form strands that are firm yet pliable. Used for butterscotch, firm nougat, and

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				taffy.
Hard Crack	295-310	146-155	99%	Syrup will form threads that are stiff (brittle) and break easily. Used for brittles, toffees, glazed fruit, hard candy, pulled poured and spun sugar.
clear liquid	320°F	160°C	100%	At this temperature all the water has boiled away. The remaining sugar is liquid and light amber in color.
brown liquid Caramel	320-360	160-182	100%	Syrup will become transparent and will change color, ranging from light golden brown to dark amber. Used for pralines, brittles, caramel-coated molds, and nougatine.
burnt sugar	350°F	177°C	100%	The sugar begins to burn and develops a bitter, burnt taste.

Thread Stage: Thread Stage is a cooking term meaning that sugar syrup being heated has reached 106 - 112 C (223 - 234 F.). It is a test of how hot sugar syrup is, and of how much water is left in it. At this point of heating, the sugar concentration in the syrup is 80%.

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It is tested by dropping a small amount of the sugar syrup from a spoon into a cup of cold water. If the stage has been reached, the syrup will form fine threads or clump for you at the bottom of the glass instead of merely dissolving away in the water instantly. The Thread Stage is called for in recipes for syrups, fruit liqueurs and some icing.

Soft-Ball Stage: Soft-Ball Stage is a cooking term meaning that sugar syrup being heated has reached 112 - 116 C (234 - 240 F.) It is a test of how hot sugar syrup is, and of how much water is left in it. At this point of heating, the sugar concentration in the syrup is 85%. To test this stage a small amount of the sugar syrup could be dropped from a spoon into a cup of cold water. If the stage has been reached, the syrup will come together and briefly form a soft ball or more accurately, a soft clump with a bit of height to it. If the clump takes out of the water, it will hold its shape for a short while then start to flatten back down further. The Soft-Ball Stage is used in making fudge, fondant, pralines, peppermint creams, Italian meringue, butter-creams, etc.

Firm-Ball Stage: Firm-Ball Stage is a cooking term meaning that sugar syrup being heated has reached 118 -121 C (245 - 250 F.) It is a test of how hot sugar syrup is, and of how much water is left in it. At this point of heating, the sugar concentration in the syrup is 87%. To test this stage when a small amount of the sugar syrup dropped from a spoon into a cup of cold water, the syrup will form a

firm ball or a firm clump. The ball when take out of the water, will hold its shape, but it is very pliable. The Firm-Ball Stage is called for in recipes for caramels, nougats, taffy, etc.

Hard-Ball Stage: Hard-Ball Stage is a cooking term meaning that sugar syrup being heated has reached 121 - 130 C (250 - 266 F.) It is a test of how hot sugar syrup is, and of how much water is left in it. At this point of heating, the sugar concentration in the syrup is 92%. When a small a small amount of the sugar syrup from a spoon dropped into a cup of cold water the syrup will form a firm ball (clump). If it has been pressed down it will hold its shape; even after taking it out of the water and it will hold its shape.

Soft-Crack Stage: Soft-Crack Stage is a cooking term meaning that sugar syrup being heated has reached 132 - 143 C (270 - 290 F.). At this point of heating, the sugar concentration in the syrup is 95%, which could be tested by drizzling a small amount of the sugar syrup from a spoon into a cup of cold water. If the stage has been reached, the syrup will form pliable threads that will bend a bit before cracking. The sound of cracking is hearable and which is like the glass cracking, but it is the sugar. The simmering sugar syrup will have its bubbles becoming denser. The Soft-Crack Stage is called for in recipes for butterscotch, saltwater taffy, etc.

Hard-Crack Stage: Hard-Crack Stage is a cooking term meaning that a sugar syrup being heated has reached 149 - 154 C (300 - 310 F.)

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It is a test of how hot a sugar syrup is, and of how much water is left in it. At this point of heating, the sugar concentration in the syrup is 99%. It is being tested by drizzling a small amount of the sugar syrup from a spoon into a cup of cold water. If the stage has been reached, the syrup will form threads. It may actually hear cracking and be alarmed that it's the glass cracking, but it is the sugar. Reaching this stage requires a lot of constant stirring, at first with a whisk to ensure blending, then a wooden spoon. Once the Hard-Crack Stage is reached, proceed with the recipe immediately before the sugar syrup turns to rock (it will also turn amber if heated more.) and begins to set immediately and it is too hot to.

Once the syrup has passed hard crack, the cold water test won't show anything other than hard, brittle strands of sugar when dropped into water, and there are few uses for sugar syrup which has been boiled this high other than as a dessert decoration or a colouring additive to foods which need to be coloured brown such as gravy or treacle toffee. At this point there is little or no water left in the syrup, and the sugar begins to break down, creating rich flavours as the sugar caramelises, but which gradually become bitterer as it burns.

Caramelized sugar, on the other hand, is pure sugar that has been heated to 170° C. At that temperature, the sucrose begins to break down and form other compounds. Even food chemists do not completely understand the chemical reactions that occur during the caramelization process, but the results are delicious. Caramelized

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sugar has complex flavors, ranging from nutty to buttery and it's used to give a rich taste to many desert items.

Testing stages of sugar cookery:

Candy thermometers are the most accurate way of determining the temperature of boiling syrup. It should always be attached to the side of the pan after washing down sugar crystals. Make sure that the thermometer does not touch the bottom of the pan. Read the thermometer at eye level. Verify the accuracy of a candy thermometer by checking its reading in boiling water. Water normally boils at 212°F at sea level. If your thermometer does not read 212°F at sea level the thermometer is not accurate. (Water always boils at a lower temperature above sea level because there is less air pressure) To adjust the temperature of a recipe, add or subtract the difference from 212°F as needed. For example, if thermometer reads 210°F in boiling water and the recipe temperature is 240°F, cook the syrup to 238°F, or 2°F less than the temperature required for that recipe. Much of candy-making starts with making syrup from sugar and water, and then cooking it to certain temperatures depending on the candy being made. All of the temperatures required are over 100 C, which at first seems impossible because the boiling temperature of water is 100 C and it can't get any hotter. When water comes out of the syrup through evaporation, leaving behind molten sugar as an ever increasing percentage of the mixture as the water percentage diminishes. This makes the hotter than boiling water temperatures

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possible, and is also a gauge of both how cooked and how thick the syrup is, as well as what the nature of the molten sugar will be when cooled.

Depending on the source, there will be slightly different temperature ranges as well as descriptions for the various Cooked Sugar Stages. Therefore, it is best to use all of these tables as guides only to familiarize with the various stages of cooked sugar, their corresponding temperatures, what the cooked sugar looks like at each stage, and their uses. One way to test for these stages is to drop about a teaspoon of the cooked sugar into a glass of cold water. Then retrieve the sugar by pressing it gently between your thumb and forefinger and examine it to determine the stage. The higher the temperature of the cooked sugar, the less water there is in the sugar, so the firmer the sugar will be. Another way to determine the stage of the cooked sugar is with an accurate mercury or digital candy thermometer.

As it is known that each of the stage of sugar cookery falls within a range of temperatures, gives some leeway over how hard or soft type of sweet is to be made. This is another advantage of the cold water test over a thermometer - where one can feel with fingers exactly how firm syrup has become and make allowance for having miscalculated the measures for any of the ingredients.

Following on from that particular advantage, one more reason why the cold water test is more accurate for making sweets is altitude. As

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altitude increases, atmospheric pressure drops and the boiling point of water occurs at progressively lower temperatures. Boiling the sugar to the same temperature at say, 10,000' (about 3,000 metres) as would at sea level, the sweets would be overcooked. The cold water test will give the same results regardless of altitude, and helps to turn out perfect sweets every time.

High Altitude Guide for Cooking Sweets (in °F)

	2,000'	5,000'	7,500'
Soft ball	230-233	224-227	219-222
Firm ball	234-239	228-233	223-228
Hard ball	240-250	234-244	229-239
Small crack	260-274	254-268	249-263
Hard crack	275-289	269-283	264-278
Caramel	290-310	284-294	279-289