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U. of N. Agr. College & U. S. Dept. of Agr. Cooperating  
W. H. Brokaw, Director, Lincoln

MAKING SIRUP FROM SUGAR BEETS

The following information has been taken from U. S. Dept. of Agriculture, Farmers' Bulletin No. 1241, entitled "An Improved Method of Making Sugar Beet Sirup."

Preparing the Roots

The first step in making beet sirup consists in cleaning the roots and removing the top portion. Roots from which the tops have been removed at the time of harvest, are soaked in water for a few minutes, in order to loosen the dirt, and are scrubbed thoroughly, preferably with a brush having stiff bristles, in a tub of clean water or under a stream of clean water. Cool water should be used for soaking and washing, as it restores the crispness of the roots that may possibly have become slightly wilted; roots that have been stored for some time and have become wilted to the point of softness should not be used for making sirup.

The crown or top portion of the cleaned beets should be cut off squarely at the line between the green and white portions. If this line extends to a considerable point below the lowest leaf scars, the cut may be made at the line of the lowest leaf scars and the green portions then removed by trimming. The reason for this further topping is that the crown contains the greater part of the salts taken from the soil in the process of growth, and it is desirable to have the sirup as free as possible from these mineral salts, because if present in too large quantities they may impart an unpleasant taste. Coloring matter and other materials in the green portions cause a darker colored sirup and tend to impart an unpleasant taste and flavor. This is true also of the skin or peel, which should be removed. The most satisfactory way to remove the peel is to slice it off with a large-bladed knife.

Extracting the Juice

To extract the juice containing the sugar, the peeled beets are sliced and the slices permitted to fall directly into hot water of sufficient depth to cover them and prevent access of air. Exposure of the peeled or sliced beets to the air results in the rapid darkening of the surfaces, which if permitted to take place to any extent, causes a dark color in the sirup and tends to impart an unpleasant flavor. The slices should not be thicker than one-sixteenth of an inch and preferably much thinner, because the thinner the slices the more rapidly and thoroughly the juice will be extracted. A large-bladed butcher knife will be found satisfactory for slicing where a comparatively small quantity of beets is to be handled. An ordinary kraut cutter or some type of vegetable-slicing machine is more suitable for handling large quantities.

The slices should be permitted to soak for about an hour at a temperature of 174° to 180°F. (78° to 82°C.). An excess of water should be avoided, because it increases the amount of evaporation--and consequently time, labor, and heat--required to reduce the extract to sirup. The proper quantity of water is just sufficient to cover the slices and keep the air from them during the time of extraction, and hot water may be added from time to time as the quantity of slices in the container increases. The top slices may be held under the surface of the water by means of a



plate or small wooden rack. A 10-gallon container will hold the slices from 100 pounds of original (untopped and unpeeled) beets and afford room for stirring them occasionally during the extraction.

The extracting should be done in clean vessels made of tin, enamel ware, aluminum, or crockery, or in a wooden container, such as a barrel. If a barrel or other wooden container is used, special care must be taken to have it perfectly clean. If a barrel is used it will be advantageous to have a faucet at the bottom to draw off the liquid. Copper or iron vessels should not be used either for the extracting or for the subsequent evaporating to sirup, as copper may give an unpleasant taste and iron a very dark color to the sirup. In case a barrel is used for the extracting, the water should be placed in it at a temperature of just about boiling. The addition of the slices will reduce the temperature sufficiently close to 174° to 180° F., and if the top of the barrel is then covered with heavy cloth the temperature will remain high enough during the hour's standing to afford a good extraction. Other containers may cool at a somewhat greater rate, and it may be found advisable to maintain the proper temperature by applying heat; in this case, a thin wooden rack should be placed upon the bottom of the vessel, to avoid scorching the bottom slices. After an hour the liquid is drained off and strained through cheesecloth or muslin. The extract should be of a pale yellow color and slightly opaque. It is not necessary to press the residual slices. A single extraction does not remove all the sugar from the slices, but the greater part is removed where the slices are sufficiently thin and the quantity of sirup that may be obtained from a second extraction is not sufficient to warrant the time and labor involved in its extraction and subsequent evaporation. The refuse is good feed for cattle, hogs, and chickens.

#### Heating the Extract

The extracted juice, or a similar extract prepared in any other manner, is heated under pressure in a container which may be sealed and is provided with a controlled valve for blowing off steam, a thermometer, and a pressure gauge. Pressure cookers, such as are used in many homes in the canning of vegetables, etc., have been found very satisfactory for this purpose;

The cover having been fastened down, the extract is heated to a temperature of 226° to 230°F. (108° to 110°C.)--corresponding to a pressure of approximately 5 pounds--and maintained at this temperature for an hour, blowing off a considerable quantity of steam at approximately 15-minute intervals. When heat is first applied, the valve is left open, to permit the escape of air, and it is closed as soon as steam begins to appear. At the end of the heating the steam is permitted to blow off rapidly, and the extract, which should be of a pale yellow color and entirely clear, is strained through cheesecloth or muslin, to remove the slight quantity of coagulated material, and is then ready to be evaporated to sirup. Ordinarily this treatment removes the objectionable "beety" odor and flavor from the extract and consequently from the sirup. This process is recommended, though the time and temperature are not necessarily confined to those mentioned; thus, very successful results have been obtained by heating to 230° to 233°F. (110° to 112°C.) for one-half hour with the constant blowing off of a slight quantity of steam.

If it is desired to do so, the heating of the extract under pressure may be omitted and the extract boiled directly to sirup. Sirup produced by this process will be palatable, but it will be inferior to sirup produced from pressure-heated extract, because it will retain to a greater or less extent an unpleasant flavor and taste which are eliminated by heating. Further, it will usually be cloudy or opaque to a greater extent, and it may be darker in color.



### Evaporating to sirup

The extract is placed in a kettle made of tin, aluminum, or enamel ware and evaporated to sirup by boiling briskly. A shallow, flat pan is more satisfactory, as it permits the extract to be reduced to sirup in a shorter time through more rapid evaporation and results in a lighter colored sirup. For the reason stated in connection with the extraction, vessels of copper or iron should not be used for treating the extract or for evaporating it with sirup. The slight quantity of scum that collects on the surface during the evaporation should be constantly removed. Skimmers made especially for skimming sirup may be purchased, but a square piece of tin perforated with many fine holes, turned up to a height of about one-half inch along two of its edges and fastened to a wooden handle, will be found satisfactory. Great care must be taken toward the end of the evaporation to avoid burning or scorching the sirup.

In connection with the production of other sirup, such as sorghum sirup and cane sirup, the juice is sometimes clarified by adding lime or other chemicals or by treatment with infusorial earth. Such processes are not satisfactory when the sirup is produced upon a small scale, and it is strongly recommended that no attempts be made to use them in the production of beet sirup upon a small scale, as they will result in sirup of an extremely inferior quality. Such processes can be applied satisfactorily only where the sirup is produced upon a large scale and under chemical control.

The sirup may be evaporated to any thickness desired, but a sirup containing 70 per cent total solids is suggested as suitable for table use. As a liquid thickens, the boiling point is raised; a thermometer, therefore, affords a satisfactory means of determining when the sirup has reached a density of 70 per cent solids. Water at ordinary pressure or at sea level boils at 212°F. (100°C.). In testing a sirup for its density in this manner, it is advisable to test the accuracy of the thermometer by placing it in boiling water and noting the boiling point registered. The sirup is then evaporated until the thermometer registers 12 degrees higher than this point. (in the case of the centigrade thermometer 6.5 degrees higher). Altitude affects the boiling point of liquids. For every 500 feet above sea level, roughly speaking, the boiling point is lowered 1°F., so that water at a point 2,000 feet above sea level would boil at 208°F. and a finished sirup at 220°F. In taking the temperature one must be careful not to permit the bulb of the thermometer to touch the bottom or sides of the evaporating vessel or to be exposed above the surface of the sirup; otherwise, an incorrect reading will be obtained.

### Storing the Sirup

The sirup should be stored in bottles, jars, or cans that have been cleaned and then thoroughly sterilized with boiling water or with steam. The sirup should be placed in the containers while boiling hot and the containers sealed at once in an air-tight manner. Otherwise, the sirup may possibly become inoculated with the micro-organisms that produce fermentation and molding, and "souring" or molding may take place.

### Yield of sirup

The yield of sirup obtained from the slices from 100 pounds of beets varies from 5 to 8 pints. The quantity of debris--crowns, green portion, and peel--varies from 40 to 50 per cent, and consequently the quantity of slices from 100



pounds varies from 50 to 60 pounds. The variation in the yield of sirup depends upon the variation in the percentage of sugar in the beets, which ordinarily runs from 12 to 20 per cent, also upon the quantity of debris and the losses in handling the extracts and in skimming the sirup.

#### Character of the Sirup

Sirups made at different times by the process here described were of a light to dark-amber color and were free from the unpleasant odor and flavor which have frequently been found in sirups produced by direct evaporation of the extract, without the preliminary heating under pressure, and which have usually been found in sirups made from untrimmed and unpeeled beets. Many of the sirups were clear, others somewhat cloudy, the average cloudiness being no greater than in average cane or sorghum sirup. Sirups such as cane, sorghum, and maple, possess characteristic flavors, and the aftertaste of any one of them may be disagreeable to a person who is accustomed to any other. Beet sirup has a flavor quite distinct from any other sirup, the first taste being agreeable and very sweet, while the aftertaste is faintly similar to that of hoarhound, and expressions of opinions from numerous persons indicate that, as in the case of other sirups, it is agreeable to some people and not agreeable to others.

Beet sirup is very likely to crystallize or "sugar out", especially when stored in a cold place, the crystals of sugar usually being large and having the appearance of rock-candy crystals. The sirup part may be drained off and used in the ordinary manner, while the sugar may be used for sweetening. Care should be taken when using it, because it dissolves more slowly than ordinary granulated sugar. In the case of a sirup containing sucrose and invert sugar, the tendency to crystallize decreases as the proportion of invert sugar increases, and when the correct proportion of invert sugar and sucrose has been obtained the sirup will not crystallize. At present, processes for controlling the proportions of invert sugar and sucrose are entirely unsuitable for use in the home or on a small scale, as, when used, they necessitate careful use of special reagents.

#### Uses of Beet Sirup

The principal use of beet sirup is as a table sirup, but it may be used for all purposes for which other sirups are used, as in making candy and in making dark-colored cake and sweet bread. It may also be used in place of part of the sugar used in making jams. A pint of beet sirup containing 70 per cent of total solids will contain very nearly  $14\frac{1}{2}$  ounces of sugar, and thus, when substituting sirup for sugar, it will be necessary to add slightly more than 1 pint for each pound of sugar. A pint of sirup will also contain almost one-half pint of water, and when it is used in making cake or bread less water than usual should be added. When it is used in making jams, longer boiling will be necessary, in order to evaporate this added water.

The process as here described is intended primarily for the production of beet sirup on a small scale, as in the home. It is not improbable, however, that at some time beet sirup may be produced profitably on a factory scale--utilizing the by-products as cattle-feeding material--especially in certain sections of the West admirably suited for the production of beets, but situated far from a beet-sugar factory and where the available agricultural land is insufficient to support a sugar factory.