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CANE SYRUP.

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THE MANUFACTURE OF SYRUP FROM CANE.

The manufacture of syrup for home use or local consumption has been carried on upon a small scale in southern and middle Alabama for many years, and in many of the villages and towns of this section, home made cane or sorghum syrup is found upon the market during the fall and early winter months.

Even during the period of the year referred to, however, the home made product only partially supplies the demand for this article, while during the spring and summer months the syrup of home manufacture is not to be obtained at all, and the demand is supplied by syrup from the outside markets.

These imported syrups are frequently adulterated with corn glucose or else have been obtained by reboiling syrups and molasses which have undergone partial fermentation, while in still other cases the syrups consist of low grade and originally dark colored products which have been bleached or brightened by chemical processes.

That a portion of the local demand for syrups throughout such a large section of the State can be successfully supplied during a small portion of the year, is already an established fact, and with an increased cultivation of cane and an improvement in the present crude methods of manufacture, it is not too much to say that within a comparatively short period, the demand for syrup for the greater portion of the State, throughout the entire year, can be satisfactorily filled with a product of high quality, manufactured within the borders of the State. The composition of cane produced on hill lands in this State, as indicated by analyses made during a number of seasons, exhibits a marked superiority as regards saccharine content when compared with the cane grown upon the alluvial lands in

Louisiana, the proportion of sugar contained in the former being from 2% to 4% in excess of that found in the latter.

Experiments with regard to the adaptability of cane to soils of varying quality and character have almost invariably shown that light, easily drained soils produce a cane of higher sugar content than rich alluvial or bottom lands, though the latter soils give the larger yield in almost all cases. While the lands throughout such a large portion of this State are capable of producing cane with such a high sugar content, there has been made, as yet, very little progress in the employment of intelligent and improved methods in the manufacture of syrup from sugar cane, and the processes at present in use are extremely crude and in most cases quite uneconomic.

The process of manufacture, as carried out at present, makes little if any provision for the clarification or purification of the juice prior to evaporation, the only impurities removed being those which come to the surface as froth or scum during the process of evaporation, the skimmings being removed by means of a small perforated ladle.

As the cooking of the juice to syrup is commonly effected in the ordinary shallow copper evaporator, the evaporation is of course quite rapid, and in many cases considerable proportions of the impurities escape the skimming ladle and are boiled down along with the syrup, contaminating the product and giving a darker color to the syrup.

In ordinary practice, no appliance of value is employed to ascertain when the syrup has reached the proper density, and in most cases the evaporation is carried too far, a product being obtained which permits the deposition or crystallization of it's sugar within a comparatively short time.

Owing to this tendency on the part of the thicker syrups to crystallize, it is quite difficult to obtain the home-made article for more than a few months after the period of manufacture, while syrups that may have partially escaped this defect will be likely to ferment somewhat later in the season.

The presence of organic impurities has the effect of increasing the tendency of syrups to ferment, so that a failure to properly clarify or defecate (remove impurities from) the syrups during the process of manufacture will almost invariably lead to the fermentation of the syrup, after the lapse of a few months, at least.

A lack of care in regulating the heat during the cooking process frequently results in the scorching of a portion of the syrup and a consequent darkening of the liquid, owing to the formation of caramel or similar substances.

While a dark syrup may equal a syrup of lighter and brighter shade as regards sweetness and flavor, the lighter and brighter syrups almost invariably command a higher price on the market, so that it is advantageous to make as clear and bright an article as possible, if the syrup is being manufactured for sale.

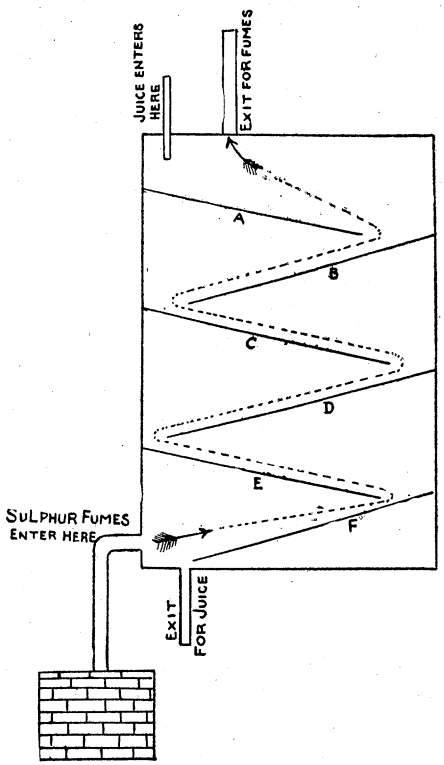
The materials and appliances for the proper clarification or purification of syrups are quite simple in character, and in order to show that they could be successfully employed in syrup making on a small scale in this section, a series of experiments were conducted by the writer during last November.

As it was found difficult to secure a portable furnace or mill for use at the Experiment Station, it was found advisable to conduct the experiments at the adjacent place of Mr. M. Floyd, where both furnace and mill were in operation.

For effecting the clarification or defecation of the juice, both sulphur and lime were employed as raw materials, the former being converted into sulphur di-oxide or sulphur fumes by burning in a small furnace, while the latter was employed in the form of milk of lime.

Both of these agents are successfully employed in Louisiana and in other sugar producing sections upon a large scale, but the manner of applcation with the small outfits at our disposal was necessarily somewhat different.

The apparatus for sulphuring the juice was constructed of an ordinary box about 1 x $2\frac{1}{2}$ x 4 feet and in order to more fully illustrate its construction the following cut is inserted, which gives a vertical cross section of the box, showing interior arrangement of shelves and also the sulphur furnace and pipe connections.



As indicated by the diagram, the shelves *a*, *b*, *c*, *d*, *e*, *f*, are arranged in a gently sloping position in order to permit of the easy, but not too rapid, flow of the juice through the apparatus, the sides and joints of the box being made as nearly air and water tight as possible, in order to provide against waste of either the juice or sulphur fumes.

The raw juice as it comes from the mill is placed in a ves-

sel above the sulphur apparatus, and is allowed to enter the box through the pipe shown at the top of the diagram.

As soon as the stream of liquid encounters the first shelf it spreads out over the whole of the surface exposed to it, and flows in a thin layer down shelf after shelf until it reaches the exit tube at the bottom of the apparatus.

The sulphur furnace can be constructed of a few bricks laid either in moist clay or mortar, while the pipe connecting the furnace with the box can be constructed of sheet iron, or else a piece of $1\frac{1}{2}$ or 2 inch gas pipe can be employed.

An opening is left in one side of the furnace to assist the draught, while the sulphur is burned in a small iron pot or pan, ordinary roll sulphur or brimstone being the form best adapted to this purpose.

The fumes enter the apparatus near the bottom as shown in the cut and, in passing through the box, follow the course indicated by the arrows and dotted lines, the juice as it flows downward being continually met by a stream of sulphur fumes passing upward.

The employment of this form of apparatus insures the ready absorption of the sulphurous acid gas by the juice, and a very marked change is observed in the character and color of the juice as it flows from the box, as compared with the juice fresh from the mill.

The juice, after sulphuring, is allowed to flow into the first compartment, of the evaporator, and when it has almost reached the boiling point, a small amount of a thin milk of lime is added, the juice, however, being left distinctly acid as indicated by litmus test paper.

As soon as boiling commences, and frequently before the boiling point is reached, it will be observed that large quantities of froth and scum have accumulated on the surface, and can be removed in the usual manner as fast as they are formed, a very clear bright juice being obtained in a very short time.

The evaporation is now conducted, in the usual manner,

avoiding sudden or excessive heating of the pan, the syrup being drawn off when it has attained the proper density or thickness.

To ascertain when a sufficient degree of concentration has been reached, it will be found convenient to employ what is known as the Baume hydrometer or saccharometer, which consists of a hollow glass spindle, with graduations on the stem for indicating the density of liquids in which it may be immersed.

In reading the instrument, the point to which the spindle sinks in the syrup is noted, the boiling being continued, if a sample, tested in an ordinary pickle jar with the spindle, is found to be of too thin a consistency.

Ordinarily, it will be found best to boil the syrup to a density of about 32 degrees, as indicated by the Baume spindle, immersed in the hot liquid, since with syrups of greater density, the crystallization of a portion of their sugar will take place in a short time.

(A hydrometer or spindle of the above description can be purchased of I. L. Lyons & Co. of New Orleans for about 75 cents.)

In the experiments conducted last fall, a portion of the syrup was clarified with the use of sulphur fumes alone, while another portion was defecated by means of sulphur fumes, followed by treatment with milk of lime in the evaporator.

The latter treatment gave more satisfactory results in almost every test, the syrup obtained being clear, bright and of excellent flavor.

The advantages resulting from the use of sulphur fumes are as follows :

1st. It bleaches the juice thoroughly and yields a clear, bright product.

2nd. It aids in the defecation or removal of impurities from the juice, the impurities removed consisting largely of easily fermentible organic substances, which interfere with the preservation of the syrup.

3rd. The sulphurous acid remaining in the syrup is of value in tending to prevent or check fermentation, since this substance possesses marked anti-fermentive properties.

The milk of lime is of advantage in partially neutralizing the excess of sulphurous acid and in precipitating albuminous matters and other organic impurities, which would otherwise be difficult of separation.

As previously stated, a great objection to the methods of syrup making in common use is that no attempt is made to thoroughly clarify or defecate the juice, and further that the syrup is boiled too thick a consistency, thus facilitating the crystallization of the sugar contained. Where sulphur fumes have been employed, any excess of free sulphurous acid remaining in the juice will aid in the conversion of the cane sugar into uncrystallizable sugars, and the same result can be attained by the employment of other acids such as acetic and muriatic, though their use for this purpose is not to be strongly recommended.

If, instead of removing the upper green joints of cane preparatory to grinding, the whole stalk is passed through the mill, it will be found that the syrup obtained will have much less tendency to deposit sugar, than where the former plan is adopted, although the product is more susceptible to fermentation and quite likely to be darker in color.

The experiments conducted during the season of 1894, were performed with the aid of an ordinary shallow copper evaporator, together with the sulphuring apparatus previously described, and the results secured were quite satisfactory in almost every particular.

The syrup obtained was much brighter and clearer than the syrups made during the same season without the use of clarifying agents, and portions of this syrup, preserved for almost six months in open vessels, gave no perceptible sign of fermentation at the end of that period, and there was only a partial deposition of the sugar contained.

THE PRESERVATION OF SYRUP.

As before stated, the two chief difficulties in the way of the satisfactory preservation of syrups are—first—the deposition of sugar, and second—fermentation, which frequently takes place at a somewhat later period.

While some of the syrup manufactured in the experiments referred to was kept quite satisfactorily in open vessels for a period of about six months, it is almost invariably difficult to preserve syrups in bulk from fermentation during the summer months.

To show that cane syrup could be successfully preserved, even through the long heated term, without undergoing any material changes, several large glass bottles were filled with the hot syrup and immediately sealed tightly, after which they were set aside in a secure place and were left undisturbed until the first of October, nearly eleven months after the date of making the syrup.

The bottles were about two-thirds of a gallon capacity each, and were rinsed with hot water before being filled with the hot syrup to the full capacity of the bottle.

On opening the bottles there was not the slightest indication of fermentation, nor had any deposition of sugar, whatever, taken place, while at the same time the flavor and taste of the article could not be distinguished from that of a syrup fresh from the evaporating pan.

At the time of filling the large bottles, a small bottle was filled with the same syrup, in order to make comparative analyses of the two samples, the small bottle being labeled "Sample 1" and the large bottles "Sample 2."

The following is the analysis of sample 2, made immediately after unsealing one of the large bottles.

Total solids, - - -	71.2	per cent.
Cane sugar, - - -	46.4	" "
Glucose, - - - -	22.9	" "
Solids not sugur, - -	1.9	" "

On comparing these figures with the analysis of Sample 1, it will be seen that the syrup has undergone scarcely an appreciable change in composition when preserved in bulk sealed vessels, and the preservation in still larger vessels can be effected with fully as satisfactory results.

ANALYSIS OF SAMPLE 1.

Total solids,	71.2	per cent.
Cane sugar,	46.7	" "
Glucose,	22.4	" "
Solids not sugar,	2.1	" "

Instead of employing large bottles, one gallon jugs can be utilized to good advantage, provided that a thoroughly glazed ware is used and that care is observed in sealing the vessels.

In conclusion, it is scarcely necessary to add that by employing intelligent methods both for the clarification and preservation of cane syrup, the greatly enhanced quality of the product will obtain for it better prices upon the market, while the local demand for syrup can be supplied throughout the entire year, instead of for only a few months as at present.

Experiments in syrup making will be continued at the Station this fall, and it is expected that small steam evapoators will be tried as a substitute for the common form of evaporator heretofore employed.