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EXTRACTION AND PURIFICATION OF SUGAR JUICES

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The present invention relates to the extraction and purification of sugar juices. One of its principal objects has been to effect a removal of impurities from the sugar juices in connection with these operations to a sufficient extent to produce a sugar juice which is superior from the standpoint of facility of crystallization and which affords upon crystallization a sugar from which a larger proportion of the coloring matter and other impurities has been removed than is the case in connection with sugars produced by prior art processes. A secondary object of the invention has been to effect a treatment of juice from which the major portion of the natural impurities has been preliminarily removed to facilitate the subsequent removal of added reagents without impairing the quality of the purified juice.

To these ends the invention comprises primarily an operation in which the natural organic impurities of the sugar juices, such as pectins, albumins, gums, cane wax, etc., are preliminarily removed after the treatment of the juice with a reagent adapted to facilitate such preliminary removal, and the reagent is thereafter removed by operations including neutralization and precipitation of reaction products.

In accordance with the preferred practice of the invention the preliminary removal of natural impurities is effected by centrifugal clarification after treatment of the sugar juice with an alkali to render the removal of the major portion of these impurities feasible and the added reagent is thereafter removed by acidification to an extent sufficient to effect solution of the major portion of the unremoved natural impurities, and subsequent addition of alkali until a hydrogen ion concentration best adapted for removal of the products of neutralization is reached, without, however, decreasing the hydrogen ion concentration in this last-mentioned alkali treatment to such an extent as to effect reprecipitation of a substantial proportion of these natural impurities, and filtration of the juice to effect removal of the products of neutralization at this last mentioned hydrogen ion concentration.

A feature of the invention consists in the performance of the extraction operation, the addition of reagent, and the initial centrifugal removal of organic and inorganic impurities from the sugar juice while the temperature is maintained at a point sufficiently low to avoid fixation of impurities in the sugar juice prior to such centrifugal removal. I have discovered that it is necessary to maintain the sugar juice at a temperature not substantially above 50° C. during the initial extracting operation and during the succeeding series of operations prior to centrifugal removal of organic and inorganic impurities, in order to effect a maximum degree of separation of such impurities and thus preclude the presence of such impurities in the clarified sugar juice to such an extent as to impede the subsequent adequate crystallization of the juice or impair the color of the sugar produced therefrom.

Another important feature of the invention consists in the use of non-ferrous apparatus in connection with the second addition of alkali after the acidification of the previously alkaline juice to effect solution of the unremoved natural impurities has been completed.

In the preferred practice of the invention with respect to cane sugar, sugar juice is first extracted from the cane in accordance with known methods of procedure. In connection with the extraction of juice adapted to be treated in accordance with the invention, it is important that the temperature of all portions of the juice during the extraction operation be maintained within the limits indicated above. In the case of extraction by crushing and maceration, for example, it is important that cold water be used in the macerating operation if the entire mass of juice obtained by this operation is to be treated in accordance with my process. In case a roll mill is used including a series of pressure rolls, hot water may be used in countercurrent extraction of the juice, provided only such portions of the extracted juice are used in connection with treatment in accordance with the invention as do not come into contact with water which is at a temperature substantially above 50° C.

At the conclusion of the extraction and subsequent straining operations, the juice is preferably treated with an alkali until its hydrogen ion concentration is decreased to an extent sufficient to facilitate the centrifugal extraction of the major portion of the organic and inorganic impurities. In connection with this treatment, the amount of alkali reagent added should not be so great as to cause the formation of insoluble reaction products between the alkali and sucrose or glucose. Lime may, for example, be added until a hydrogen ion concentration between pH 10.8 and 11.3 is attained, the juice being maintained in an unheated condition during this operation. The juice is then passed through a centrifugal clarifier bowl which is preferably of the Sharples

type, in order to effect removal of the major portion of the suspended organic and inorganic impurities. I have found that, by avoiding the application of heat to the juice both before and after the addition of alkaline reagent in connection with an operation of this type; a much larger proportion of suspended impurities may be removed than in cases in which heat is applied to the treated or untreated juice.

The alkaline juice is next treated with an acidifying agent until a decidedly acid reaction is attained, the addition of acidifying agent being in sufficient amount to increase the hydrogen ion concentration of the juice to such an extent as to effect solution of the small proportion of natural impurities which may not be removed in the centrifugal clarifier. During this acidifying operation it is desirable to avoid heating the juice to a temperature substantially above 50° C. until a condition of substantial neutrality is reached. After such condition is reached or after the acidification of the juice has been completed, its temperature is preferably raised to approximately 80° C. In this treatment the alkaline juice may, for example, be treated with sulphur dioxide until a hydrogen ion concentration of pH 6.1 is reached and the acidified juice may be heated to 80° C. at the conclusion of this operation.

At the conclusion of the acidifying operation the heated juice is again treated with alkali to decrease its hydrogen ion concentration to a condition of substantial alkalinity. In connection with this treatment, the juice should be maintained in non-ferrous apparatus after the application of heat in order to avoid fixation of discoloring impurities in the juice in a form rendering their subsequent removal difficult or impossible. The juice may, for example, be held in a copper or glass container during such treatment. I have made the surprising discovery that the application of lime to heated juice may be carried out without decomposition of glucose provided such treatment is carried out in non-ferrous apparatus. The addition of alkali in this last mentioned operation should be in sufficient amount to decrease the hydrogen ion concentration of the juice to a pH adapted for precipitation and separation of the products of neutralization of the acid and alkaline reagent, but the amount of alkali added should not be so great as to effect re-precipitation of unremoved natural impurities, as such precipitation would render the subsequent removal of these impurities from the juice exceedingly difficult. In this last-mentioned alkali treatment, lime may, for example, be added until a pH of approximately 8.7 is reached. At the conclusion of the above mentioned neutralizing operation the juice is filtered in non-ferrous apparatus in order to remove products of neutralization therefrom. The filtered juice is preferably further purified by filtration over animal or vegetable char. An acid reagent such as phosphoric acid may be added to the juice either before or after the char treatment in order to adjust the hydrogen ion concentration of the final juice to a satisfactory point for the subsequent evaporation or crystallization steps.

Modifications will be obvious to those skilled in the art and I do not therefore wish to be limited except by the scope of the sub-joined claims as interpreted in the light of the broad generic spirit of the invention.

I claim:

1. In a process of extracting and purifying sugar juice, the steps comprising extracting the juice, adding to the juice an alkaline earth metal hydroxide in sufficient amount to render the juice distinctly alkaline and centrifugally separating the impurities from the alkaline juice, the juice being maintained at a temperature not substantially above 50° C. during the extracting operation and subsequent treatment preceding the centrifugal separation of such impurities.

2. In a process of extracting and purifying sugar juice, the steps comprising extracting the juice, adding to the juice lime in sufficient amount to raise the hydrogen ion concentration of said juice to a pH of approximately 11 and centrifugally separating impurities from the juice, the juice being maintained at a temperature not substantially above 50° C. during the extracting operation and subsequent treatment preceding the centrifugal separation of such impurities.

3. In a process of extracting and purifying sugar juice, the steps including extracting the juice at a temperature not substantially above 50° C., adding an alkaline earth metal compound having an alkaline reaction to render the juice distinctly alkaline, separating the major portion of the precipitated natural impurities from the alkaline juice, thereafter adding an acid, that will form a relatively insoluble salt with the alkaline earth compound, to the alkaline juice until the major portion of the remaining organic impurities are dissolved in the juice, thereafter adding an alkaline earth metal compound having an alkaline reaction to the acidified juice until a degree of alkalinity is attained facilitating removal of products of reaction between the acid and alkaline reagents from the juice without effecting substantial re-precipitation of dissolved organic impurities and filtering said juice to effect removal of precipitated products of reaction.

4. In a process of extracting and purifying sugar juice, the steps including extracting the juice at a temperature not substantially above 50° C., adding an alkaline earth metal compound having an alkaline reaction to such juice in an amount sufficient to render the juice distinctly alkaline, separating the major portion of the precipitated natural impurities from the alkaline juice, thereafter adding an acid that will form a relatively insoluble salt with the alkaline earth compound to the alkaline juice until the major portion of the remaining organic impurities are dissolved in the juice, heating the juice and adding an alkaline earth metal compound having an alkaline reaction to the acidified juice until a degree of alkalinity is attained facilitating removal of products of reaction between the acid and alkaline reagents from the juice without effecting substantial reprecipitation of dissolved organic impurities and filtering said juice to effect removal of precipitated products of reaction.

5. In the process of extracting and purifying sugar juice, the steps including extracting the juice at a temperature not substantially above 50° C., adding lime to such juice in an amount sufficient to render the juice distinctly alkaline, separating the major portion of the precipitated natural impurities from the alkaline juice, thereafter adding sulphur dioxide to the alkaline juice until the major portion of the remaining organic impurities are dissolved in the juice, heating the juice to a temperature of approximately 80° C. and adding lime to the acidified juice until a degree of alkalinity is attained facilitating removal of products of reaction between the acid

and alkaline reagents from the juice without effecting substantial reprecipitation of dissolved organic impurities and filtering said juice to effect removal of precipitated products of reaction.

6. In a process of extracting and purifying sugar juice, the steps including extracting the juice at a temperature not exceeding 50° C., adding an alkaline earth metal hydroxide to such juice in an amount sufficient to render the juice distinctly alkaline, separating the major portion of the impurities from the alkaline juice, thereafter adding sulphur dioxide to the alkaline juice until the major portion of the remaining organic impurities are dissolved in the juice, heating the acidified juices and adding an alkaline earth metal hydroxide to the acidified juice until a degree of alkalinity is attained facilitating removal of products of reaction between the acid and alkaline reagents from the juice without effecting substantial reprecipitation of dissolved organic impurities and filtering said juice to effect removal of precipitated products of reaction.

7. In a process of extracting and purifying sugar juice, the steps including extracting the juice at a temperature not substantially above 50° C., adding lime to such juice in an amount sufficient to render the juice distinctly alkaline, separating the major portion of the impurities from the alkaline juice, thereafter adding sulphur dioxide to the alkaline juice until the major portion of the remaining organic impurities are dissolved in the juice, heating the juice and adding lime to the acidified juice until a degree of alkalinity is attained facilitating removal of products of reaction between the acid and alkaline reagents from the juice without effecting substantial reprecipitation of dissolved organic impurities and filtering said juice to effect removal of precipitated products of reaction.

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