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— 国際調査報告（条約第 21 条(3)）

(54) **Title**: METHOD FOR PRODUCING SUGAR

(54) 発明の名称 : 砂糖の製造方法

(57) **Abstract**: Provided is a method for efficiently producing sugar and simultaneously efficiently producing ethanol. A method for producing sugar characterized by comprising a pretreatment step in which a plant-origin sugar solution is fermented by a microorganism having no sucrose-degrading enzyme and a step for producing sugar from the fermented sugar solution. A method for producing sugar characterized by comprising a pretreatment step in which a plant-origin sugar solution is fermented by a microorganism in the presence of a sucrose-degrading enzyme inhibitor and a step for producing sugar from the fermented sugar solution.

(57) 要約: 本発明は、効率よく砂糖を製造し、同時に効率よくエタノールを製造する方法を提供することを目的とする。本発明は、蔗糖分解酵素を有さない微生物で植物由来の糖液を発酵させる前処理工程と、発酵させた糖液から砂糖を製造する工程とを有することを特徴とする砂糖の製造方法を提供する。また、本発明は、蔗糖分解酵素阻害剤の存在下で、植物由来の糖液を微生物で発酵させる前処理工程と、発酵させた糖液から砂糖を製造する工程とを有することを特徴とする砂糖の製造方法を提供する。

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DESCRIPTION

TITLE OF THE INVENTION: SUGAR PRODUCTION METHOD

TECHNICAL FIELD

The present invention relates to a sugar production method, and more specifically relates to a method for efficiently producing sugar and ethanol.

BACKGROUND ART

Ethanol fuel derived from plants is expected to be liquid fuel alternative to gasoline to prevent increase in carbon dioxide gas. When both sugar and ethanol are produced from a sugar juice derived from a plant, the following method has been employed. Specifically, first, sugar is produced from a sugar juice. The sugar juice after the sugar production is fermented by using a microorganism to produce ethanol (see, for example, JP-A 2004-321174).

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

In the above-described method, a crystallization process is needed to produce sugar from a sugar juice. For the crystallization process, the sugar concentration needs to be high. For this reason, it has been practiced that the sugar juice is heated to evaporate the water content and thereby is concentrated. Meanwhile, the high sugar concentration and the salinity in the sugar juice thus increased by heating and concentrating act as the inhibitory factor for the fermentation. Accordingly, a treatment such as dilution needs to be performed to produce ethanol from molasses after the sugar production. In addition, the above method is very ineffective in terms of energy, because the fermented liquid is heated again to extract the ethanol by

distillation. Moreover, the sugar crystallization process has a problem such as reduction in a yield of sugar crystals, unless it uses a sugar juice with a high sucrose ratio, in other words, a sugar juice in which the content of a sucrose as a raw material of sugar is high relative to the total sugar amount including sugars that are other than the sucrose, and are not raw materials of the sugar. Accordingly, there is a problem that sugar cannot be produced, for example, in a period or from a cultivar having a low sucrose ratio.

An object of the present invention is to provide a method for efficiently producing sugar and efficiently producing ethanol simultaneously.

MEANS FOR SOLVING THE PROBLEMS

The present invention provides a sugar production method characterized by including: a pretreatment step of fermenting a sugar juice derived from a plant by using a microorganism not having sucrase; and a step of producing sugar from the fermented sugar juice. In addition, the present invention provides a sugar production method characterized by including: a pretreatment step of fermenting a sugar juice derived from a plant by using a microorganism in the presence of a sucrase inhibitor; and a step of producing sugar from the fermented sugar juice.

EFFECTS OF THE INVENTION

In the methods of the present invention, a sugar juice that is low in both sugar concentration and salinity is fermented. Thus, it is possible to efficiently produce ethanol.

BRIEF DESCRIPTION OF THE DRAWINGS

[Fig. 1] Fig. 1 is a flowchart of a process used in Example 1.

[Fig. 2] Fig. 2 is a chart illustrating the mass balance in the process of Example 1.

[Fig. 3] Fig. 3 is a chart illustrating the mass balance in a process of Example 2.

[Fig. 4] Fig. 4 is a chart illustrating the mass balance in a process of Example 3.

[Fig. 5] Fig. 5 shows graphs for a result of a fermentation test on sugarcane-pressed juices using yeasts not having sucrase and a yeast having a sucrase gene disrupted.

[Fig. 6] Fig. 6 shows graphs for a result of a fermentation test on sugarcane-pressed juices using a sucrase inhibitor.

MODES FOR CARRYING OUT THE INVENTION

A sugar production method of the present invention includes a pretreatment step of fermenting a sugar juice from a plant by using a microorganism not having sucrase, or a pretreatment step of fermenting a sugar juice derived from a plant by using a microorganism in the presence of a sucrase inhibitor. Since the sugar juice is fermented under such a condition, sucrose is not decomposed, but ethanol and so forth are produced only from invert sugars such as glucose and fructose. As a result, the proportion of sucrose in the sugar juice is increased, and thus the efficiency of crystallizing sugar can be improved. Meanwhile, the conventional method has a problem of difficulty in crystallizing raw materials which have high sugars other than sucrose and which have low sucrose ratios (due to the

cultivar and the harvesting period). However, in the sugar production method of the present invention, the sugars other than sucrose are consumed by the fermentation, thus increasing the sucrose ratio. Accordingly, even raw materials having low sucrose ratios can be crystallized. This leads to increase in the utilizable range of sugarcane cultivars and extension in the harvesting period. Additionally, in the conventional method, nitrogen and the sugars combine with each other during the sugar production, coloring the molasses. This causes a problem of coloring exhaust water. However, in the sugar production method of the present invention, nitrogen is consumed by the fermentation, thus reducing the coloring of molasses. Furthermore, in the conventional method, the production period is long (approximately 48 to 72 hours) because all of the high-concentration sugar after the sugar production has to be converted into ethanol. The fermentation is also inhibited by the salt concentration. However, in the sugar production method of the present invention, the low-concentration sugar is fermented. Accordingly, the fermentation is completed in a short period of time with less salt concentration. Thus, the production period can be shortened greatly.

Examples of the plant include plants that accumulate sugars such as sugarcane and sugar beet. Sugarcane is preferable.

A step of preparing the sugar juice derived from the plant can be accomplished by methods known to those skilled in the art, for example, a pressing step. Specifically, cane stem portions of reaped sugarcane are cut into pieces of 15

to 30 cm length with a cutter, and finely shredded with a shredder. The sugar juice is squeezed out with a roll mill. To improve the efficiency of squeezing out the sugars, water is poured into an end roll, and 95 to 97% of the sugars are squeezed out. Then, in a lime mixing bath, lime is added to the juice. After impurities aggregate and precipitate, the precipitate and the clarified liquid are separated from each other with an oliver filter. The clarified liquid is concentrated by evaporation. The obtained sugar juice mainly contains sucrose, glucose, fructose, and so on.

Examples of the microorganism not having sucrase include Saccharomyces dairenensis NBRC 0211, Saccharomyces transvaalensis NBRC 1625, Saccharomyces rosinii NBRC 10008, Zygosaccharomyces bisporus NBRC 1131, and the like. Meanwhile, among the microorganisms having sucrase, it is possible to use a fungal strain of microorganisms whose six sucrase genes (SUC1, SUC2, SUC3, SUC4, SUC6, SUC7) are all or partially disrupted by genetic engineering.

Examples of the sucrase inhibitor include a silver ion, copper ion, mercury ion, lead ion, methyl-α-D-glucopyranoside, PCMB (p-chloromercuribenzoate), glucosyl-D-psicose, and the like.

The fermentation can be carried out by methods known to those skilled in the art. Examples thereof includes a batch method in which a fermentable microorganism and a sugar juice are blended at a predetermined ratio for fermentation, a continuous method in which a fermentable microorganism is immobilized and then supplied with a sugar juice continuously for fermentation, and the like.

The sugar production method of the present invention

subsequently includes a step of producing sugar from the fermented sugar juice. The sugar can be produced from the fermented sugar juice by methods known to those skilled in the art. Examples thereof include crystallization of sugar, and the like. Specifically, the fermented sugar juice is repeatedly heated and concentrated little by little (0.5 to 1 kl) under reduced pressure by suction. Sugar crystals of a certain size or larger is taken out. Then, the sugar crystals and the sugar juice are separated from each other with a centrifuge.

The sugar production method of the present invention may include a step of collecting ethanol from the fermented sugar juice before the sugar is produced from the fermented sugar juice. The ethanol can be collected from the fermented sugar juice by methods known to those skilled in the art. An example includes separation of the ethanol through distillation. If the ethanol is separated through the distillation, the sugar juice is concentrated simultaneously. Thus, it is no longer necessary to perform the heating and concentrating again in the sugar production. Hence, both of time and energy can be saved.

Examples

(Example 1: Process Verification for case of Using Sugarcane as Raw Material and Yeast Not Having Sucrase)

(1) Pressing step

Cane stem portions, weighing 3200 g, of a sugarcane (NiF8) after harvest were shredded with a shredder, and then pressed with a four-roll mill. Thereby, 3114 mL of a pressed juice was obtained (pressed juice weight = 3348 g, sucrose content = 563 g, invert sugar content = 65 g, sucrose ratio =

79.4%).

(2) Clarification/fermentation steps

The pressed juice was transferred to a 5-L jar fermentor, and hydrated lime $Ca(OH)_2$ of 0.05% by weight relative to the weight of the pressed juice was added thereto for the pH adjustment and aggregation of impurities. Then, 0.3 g in dry weight of yeast Saccharomyces dairenensis (NBRC 0211) not having sucrase was planted therein for ethanol fermentation under anaerobic conditions at 30°C for 3 hours. The yeast precultured in advance in a YM medium was used. After the fermentation was completed, the yeast and the aggregated impurities were filtered through a filter. Thereby, separated was a fermented liquid of 3080 mL (pressed juice weight = 3288 g, ethanol concentration of 1.17 vol%, sucrose content = 558 g, invert sugar content = 0 g).

(3) Ethanol distillating/sugar juice concentrating steps

The fermented liquid was heated under reduced pressure, and 28.6 g of ethanol thus evaporated was cooled and collected. Then, 2193 mL of water was successively evaporated. Thereby, 837 mL of a concentrated sugar juice was obtained (sugar juice weight = 1066 g, sucrose content = 558 g, invert sugar content = 0 g, sucrose ratio = 93.8%).

(4) Crystallization step

Half of the sugar juice was extracted, which was further heated under reduced pressure and concentrated until the supersaturation for the sucrose reached 1.2. Then, 50 g of a seed crystal (particle size of 250 μm) for the sugar was added, and a crystal was formed in approximately 3 hours while the rest of the concentrated sugar juice was added

little by little.

(5) Raw sugar/molasses separation step

The mixture of the crystallized sugar and the molasses was centrifuged in a perforated wall type centrifuge using a filter cloth of 50- to 100-μm mesh at 3000 rpm for 20 minutes. Thereby, 371 g of the sugar (sucrose collecting rate = 65.9%: excluding the added seed crystal) and 234 g of the molasses (sucrose content = 151 g, invert sugar content = 0 g, sucrose ratio = 87.4%) were separated from each other.

Fig. 1 shows a flowchart of the production process, and Fig. 2 shows the result of the mass balance.

(Example 2: Process Verification for case of Using Sugarcane as Raw Material and Sucrase-gene-disrupted Strain)

(1) Pressing step

Cane stem portions, weighing 3200 g, of a sugarcane (NiF8) after harvest were shredded with a shredder, and then pressed with a four-roll mill. Thereby, 3000 mL of a pressed juice was obtained (pressed juice weight = 3264 g, sucrose content = 546 g, invert sugar content = 60 g, sucrose ratio = 78.9%).

(2) Clarification/fermentation steps

The pressed juice was transferred to a 5-L jar fermentor, and hydrated lime $Ca(OH)_2$ of 0.05% by weight relative to the weight of the pressed juice was added thereto for the pH adjustment and aggregation of impurities. Then, 0.3 g in dry weight of yeast strain Saccharomyces cervisiae BY4742 whose sucrase gene SUC2 was disrupted was planted therein for ethanol fermentation under anaerobic conditions at 30°C for 3 hours. The disrupted strain precultured in advance in a YM medium was used. After the fermentation was

completed, the yeast and the aggregated impurities were filtered through a filter. Thereby, separated was a fermented liquid of 2986 mL (pressed juice weight = 3180 g, ethanol concentration of 1.38 vol%, sucrose content = 546 g, invert sugar content = 0 g).

(3) Ethanol distillating/sugar juice concentrating steps

The fermented liquid was heated under reduced pressure, and 32.8 g of ethanol thus evaporated was cooled and collected. Then, 2083 mL of water was successively evaporated. Thereby, 860 mL of a concentrated sugar juice was obtained (sugar juice weight = 1065 g, sucrose content = 546 g, invert sugar content = 0 g, sucrose ratio = 87.1%).

(4) Crystallization step

Half of the sugar juice was extracted, which was further heated under reduced pressure and concentrated until the supersaturation for the sucrose reached 1.2. Then, 50 g of a seed crystal (particle size of 250 μm) for the sugar was added, and a crystal was formed in approximately 3 hours while the rest of the concentrated sugar juice was added little by little.

(5) Raw sugar/molasses separation step

The mixture of the crystallized sugar and the molasses was centrifuged in a perforated wall type centrifuge using a filter cloth of 50- to 100-μm mesh at 3000 rpm for 20 minutes. Thereby, 351 g of the sugar (sucrose collecting rate = 64.3%: excluding the added seed crystal) and 239 g of the molasses (sucrose content = 123 g, invert sugar content = 23 g, sucrose ratio = 65.8%) were separated from each other.

Fig. 3 shows the result of the mass balance.

(Example 3: Process Verification for case of Using Sugarcane as Raw Material and Sucrase Inhibitor)

(1) Pressing step

Cane stem portions, weighing 3000 g, of a sugarcane (NiF8) after harvest were shredded with a shredder, and then pressed with a four-roll mill. Thereby, 2868 mL of a pressed juice was obtained (pressed juice weight = 3120 g, sucrose content = 524 g, invert sugar content = 61 g, sucrose ratio = 78.3%).

(2) Clarification/fermentation steps

The pressed juice was transferred to a 5-L jar fermentor, and hydrated lime $Ca(OH)_2$ of 0.05% by weight relative to the weight of the pressed juice was added thereto for the pH adjustment and aggregation of impurities. After methyl-α-D-glucopyranoside serving as a sucrase inhibitor was added thereto at a concentration of 60 mM, 0.6 g in dry weight of yeast Saccharomyces cervisiae (Taiken 396 strain) having sucrase was planted therein for ethanol fermentation under anaerobic conditions at 30°C for 6 hours. The yeast precultured in advance in a YM medium was used. After the fermentation was completed, the yeast and the aggregated impurities were filtered through a filter. Thereby, separated was a fermented liquid of 2870 mL (pressed juice weight = 3064 g, ethanol concentration of 6.20 vol%, sucrose content = 252 g, invert sugar content = 0 g).

(3) Ethanol distillating/sugar juice concentrating steps

The fermented liquid was heated under reduced pressure, and 150 g of ethanol thus evaporated was cooled and collected. Then, 2494 mL of water was successively

evaporated. Thereby, 330 mL of a concentrated sugar juice was obtained (sugar juice weight = 420 g, sucrose content = 252 g, invert sugar content = 0 g, sucrose ratio = 94.0%).

(4) Crystallization step

Half of the sugar juice was extracted, which was further heated under reduced pressure and concentrated until the supersaturation for the sucrose reached 1.2. Then, 50 g of a seed crystal (particle size of 250 μm) for the sugar was added, and a crystal was formed in approximately 3 hours while the rest of the concentrated sugar juice was added little by little.

(5) Raw sugar/molasses separation step

The mixture of the crystallized sugar and the molasses was centrifuged in a perforated wall type centrifuge using a filter cloth of 50- to 100-μm mesh at 3000 rpm for 20 minutes. Thereby, 203 g of the sugar (sucrose collecting rate = 29.2%: excluding the added seed crystal) and 151 g of the molasses (sucrose content = 88 g, invert sugar content = 0 g, sucrose ratio = 81.0%) were separated from each other.

Fig. 4 shows the result of the mass balance.

(Example 4: Fermentation Test on Sugarcane-pressed Juice for case of Using Yeast not having Sucrase)

S. dairenensis (NBRC 0211), S. transvaalensis (NBRC 1625), S. rosinii (NBRC 10008), Z. bisporus (NBRC 1131), which are yeasts not having sucrase and a strain (BY4742 SUC2-) of a yeast S. cervisiae BY4742 having sucrase gene disrupted were planted in a sugarcane-pressed juice. A fermentation test was conducted to confirm whether the sucrose was not decomposed and only the invert sugars were converted into ethanol. As reference for the comparison, a

similar fermentation test was conducted using a yeast S. cervisiae (Taiken 396 strain) having sucrase.

Each of the fungal strains used for fermentation had been pre-precultured by shaking in 5 mL of a YM medium at 30°C for 24 hours, and then further precultured by shaking in 300 mL of a YPD medium at 30°C for 12 hours. The yeast was collected from the precultured medium by centrifugation. The yeast was suspended for fermentation in 100 mL of the pressed juice (in the pressed juice, the sucrose concentration was 12.0%, and the invert sugar concentration was 3.0%) placed in a 300-mL Erlenmeyer flask with a fermentation lock. The fermentation was carried out by shaking at 30°C at 120 rpm. Fig. 5 shows the examined result of the changes in the sugar concentration and the ethanol concentration due to the fermentation over time.

For S. cervisiae (Taiken 396 strain) which is an ordinary yeast, due to the action of the sucrase, almost all of sucrose was decomposed into the invert sugars in 3 hours after the fermentation was started. In 24 hours, all of the sugars were converted into ethanol.

Meanwhile, for the four yeasts not having sucrase and the strain having the sucrase gene disrupted, although the ethanol synthesis speed varied among one another, sucrose decomposition was observed in none of the cases, and it was confirmed that only the invert sugars were converted into ethanol.

(Example 5: Fermentation Test on Sugarcane-pressed Juice for case of Using Sucrase Inhibitor)

S. cervisiae (Taiken 396 strain) which is a general yeast having sucrase was planted in a sugarcane-pressed

juice. Methyl-α-D-glucopyranoside serving as a sucrase inhibitor was added thereto at a concentration 60 mM. A fermentation test was conducted to examine the changes in the concentrations of sucrose, invert sugars, and ethanol over time.

The fungal strain used for fermentation had been pre-precultured by shaking in 10 mL of a YM medium at 30°C for 24 hours, and then further precultured by shaking in 500 mL of a YPD medium at 30°C for 12 hours. The yeast was collected from the precultured medium by centrifugation. 100 mL of the pressed juice (in the pressed juice, the sucrose concentration was 10.0%, and the invert sugar concentration was 3.0%) and 60 mM of methyl-α-D-glucopyranoside were placed in a 300-mL Erlenmeyer flask with a fermentation lock. The yeast collected from the precultured medium by centrifugation was added into the flask for fermentation. The fermentation was carried out by shaking at 30°C at 120 rpm. Fig. 6 shows the examined result of the changes in the sugar concentration and the ethanol concentration due to the fermentation over time.

For S. cervisiae (Taiken 396 strain) which is an ordinary yeast, in a condition where no sucrase inhibitor exists, due to the action of the sucrase, almost all of sucrose was decomposed into the invert sugars in 6 hours after the fermentation was started, and then converted into ethanol. Since the sucrose decomposition speed was faster than the invert sugar-consumption speed of the yeast, the sucrose was completely consumed by the time when the invert sugars were consumed to thereby increase the sucrose ratio. It was accordingly confirmed that production of sugar from

the fermented liquid was impossible.

Meanwhile, under the condition where the inhibitor existed, the sucrose decomposition speed was made slow, and approximately half of the sucrose remained in 6 hours after the fermentation was started, while all the invert sugars were converted into ethanol. The sucrose ratio of the fermented liquid was as high as 94.0% in 8 hours after the fermentation was started. The sucrose ratio of the fermented liquid would allow the crystallization of the sugar readily.

CLAIMS

[Claim 1]

A sugar production method characterized by comprising:

a pretreatment step of fermenting a sugar juice derived from a plant by using a microorganism not having sucrase; and

a step of producing sugar from the fermented sugar juice.

[Claim 2]

A sugar production method characterized by comprising:

a pretreatment step of fermenting a sugar juice derived from a plant by using a microorganism in the presence of a sucrase inhibitor; and

a step of producing sugar from the fermented sugar juice.

[Claim 3]

The production method according to claim 1 or 2, further comprising a step of collecting ethanol from the fermented sugar juice before the sugar is produced from the fermented sugar juice.

[Claim 4]

The production method according to any one of claims 1 to 3, wherein the step of collecting the ethanol from the fermented sugar juice includes separation of the ethanol through distillation.

[Claim 5]

The production method according to any one of claims 1 to 4, wherein the plant is sugarcane.

FIG.1

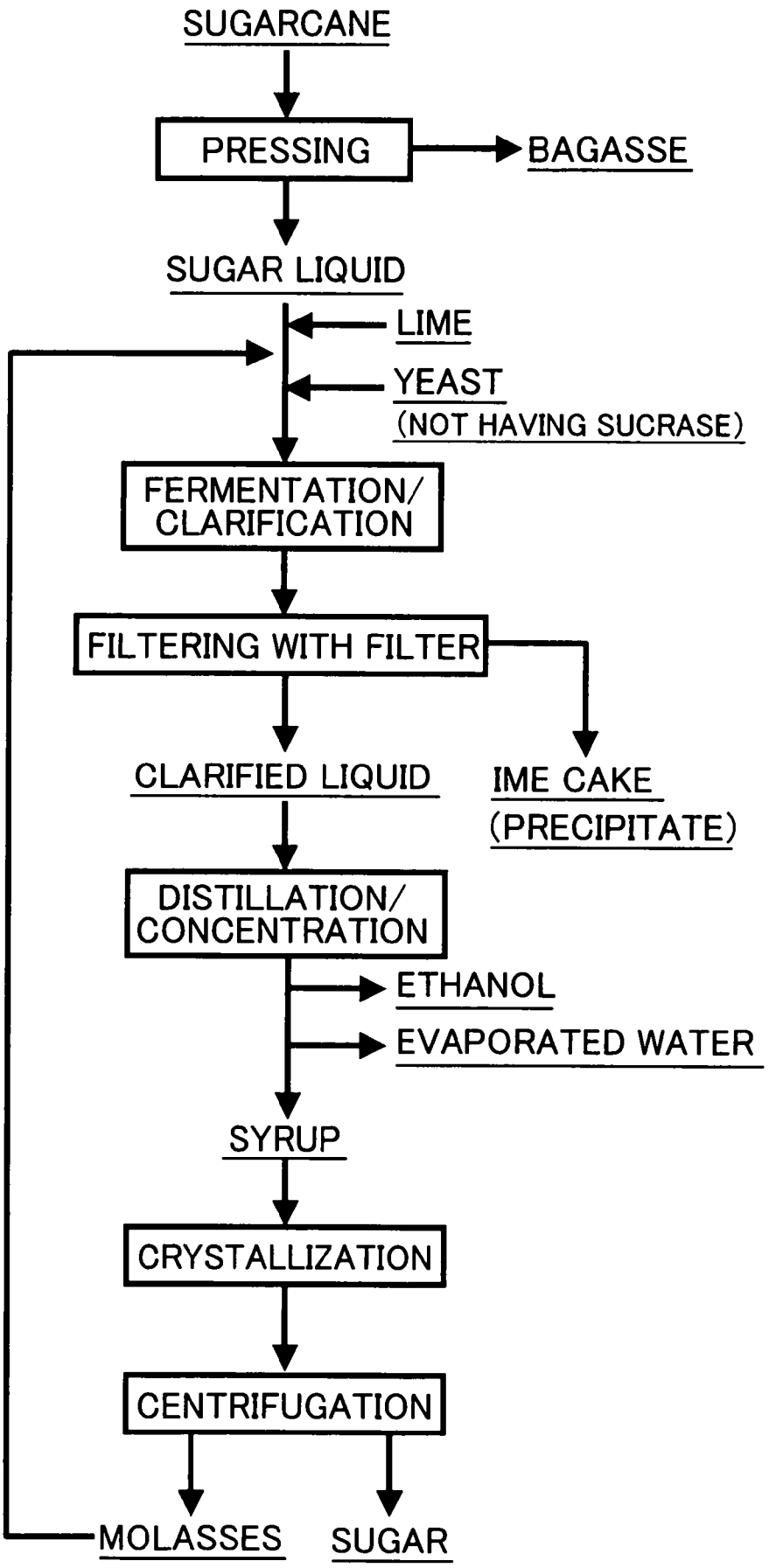

SUGARCANE
PRESSING
BAGASSE
SUGAR LIQUID
LIME
YEAST
(NOT HAVING SUCRASE)
FERMENTATION/
CLARIFICATION
FILTERING WITH FILTER
CLARIFIED LIQUID
IME CAKE
(PRECIPITATE)
DISTILLATION/
CONCENTRATION
ETHANOL
EVAPORATED WATER
SYRUP
CRYSTALLIZATION
CENTRIFUGATION
MOLASSES
SUGAR

FIG.2

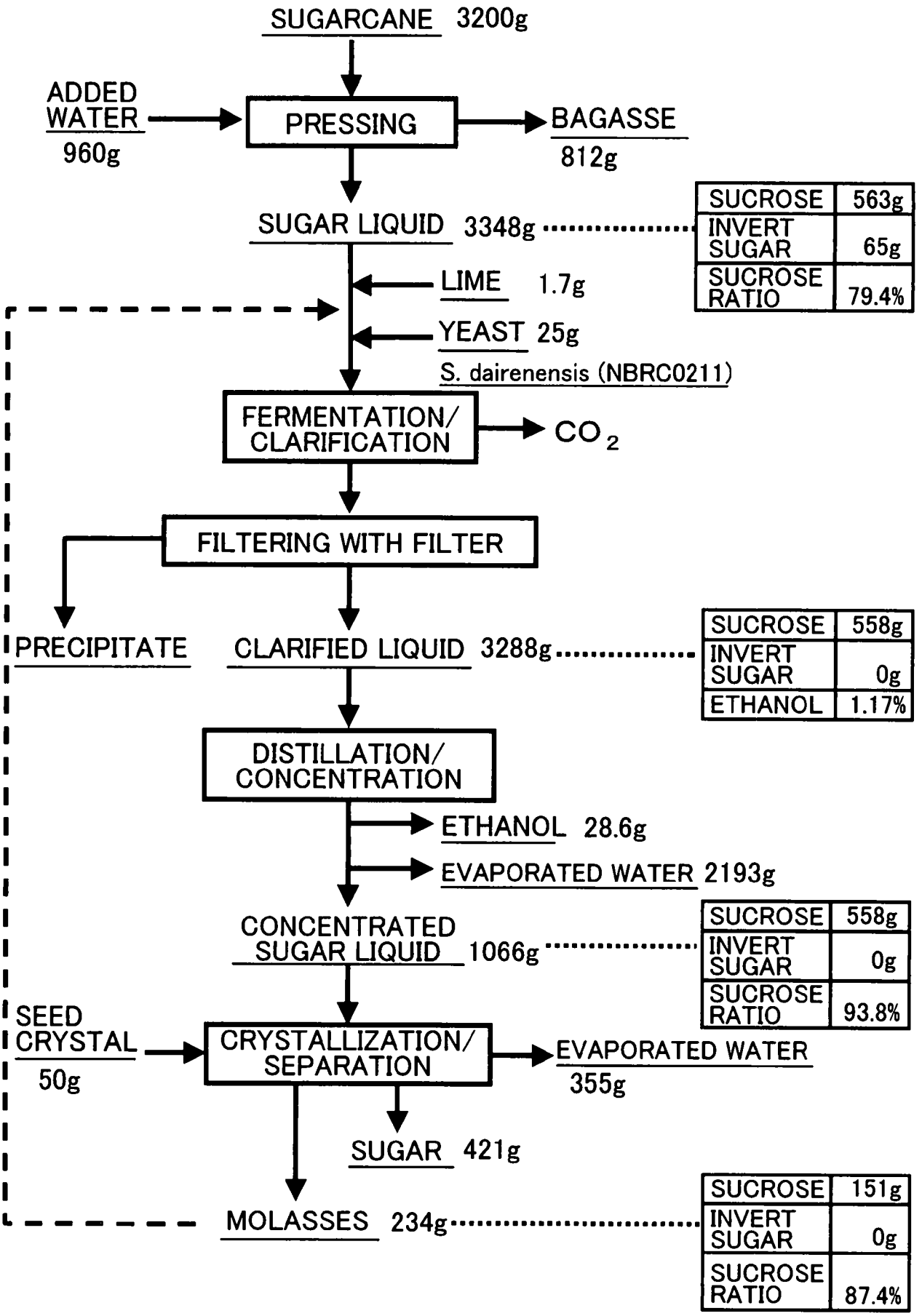
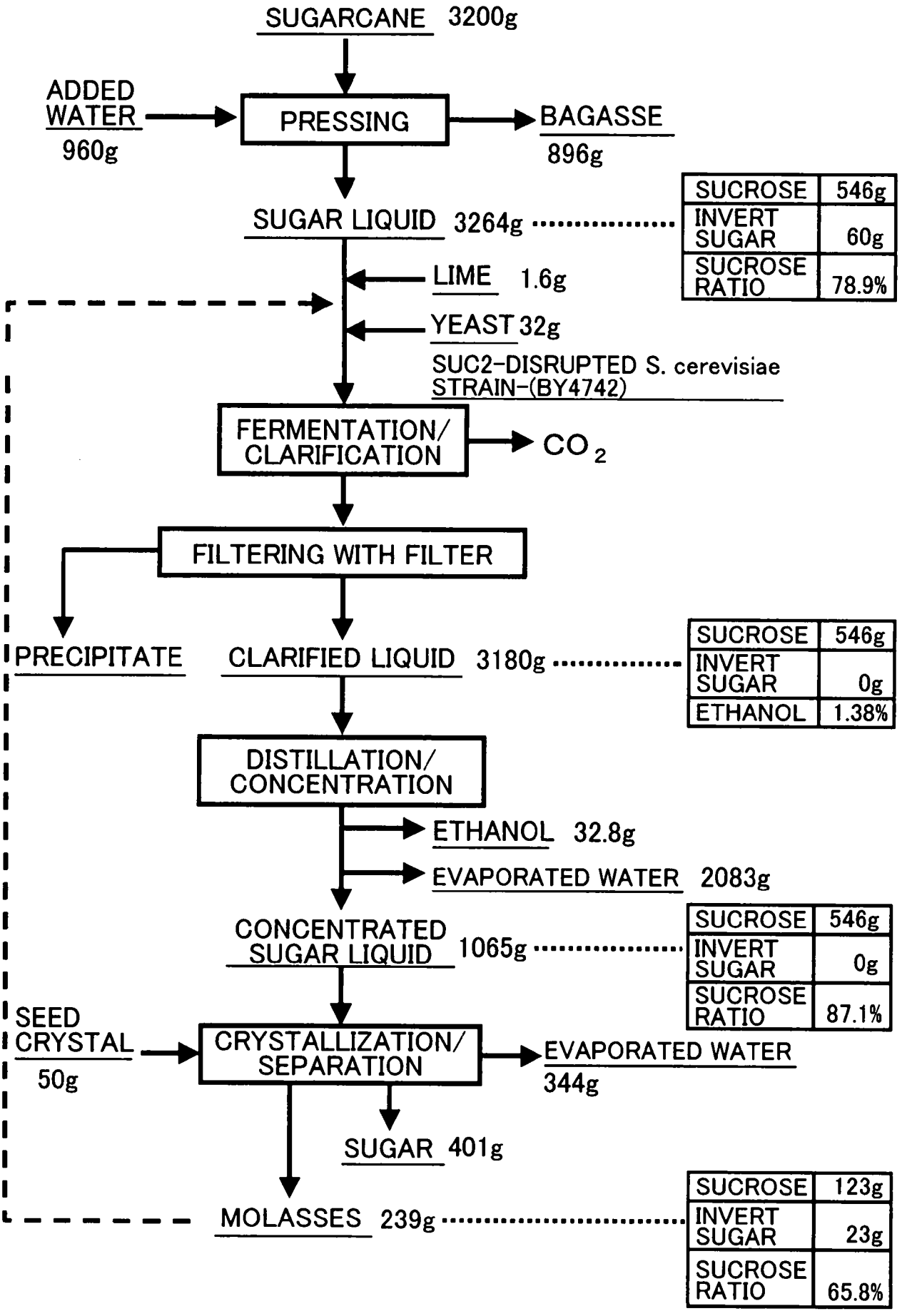

SUGARCANE 3200g
ADDED WATER 960g
PRESSING
BAGASSE 812g
SUGAR LIQUID 3348g
SUCROSE 563g
INVERT SUGAR 65g
SUCROSE RATIO 79.4%
LIME 1.7g
YEAST 25g
S. dairenensis (NBRC0211)
FERMENTATION/ CLARIFICATION
CO2
FILTERING WITH FILTER
PRECIPITATE
CLARIFIED LIQUID 3288g
SUCROSE 558g
INVERT SUGAR 0g
ETHANOL 1.17%
DISTILLATION/ CONCENTRATION
ETHANOL 28.6g
EVAPORATED WATER 2193g
CONCENTRATED SUGAR LIQUID 1066g
SUCROSE 558g
INVERT SUGAR 0g
SUCROSE RATIO 93.8%
SEED CRYSTAL 50g
CRYSTALLIZATION/ SEPARATION
EVAPORATED WATER 355g
SUGAR 421g
MOLASSES 234g
SUCROSE 151g
INVERT SUGAR 0g
SUCROSE RATIO 87.4%

FIG.3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ADDED WATER 960g
PRESSING
BAGASSE 896g
SUGAR LIQUID 3264g
SUCROSE 546g
INVERT SUGAR 60g
SUCROSE RATIO 78.9%
LIME 1.6g
YEAST 32g
SUC2-DISRUPTED S. cerevisiae STRAIN-(BY4742)
FERMENTATION/ CLARIFICATION
CO_2
FILTERING WITH FILTER
PRECIPITATE
CLARIFIED LIQUID 3180g
SUCROSE 546g
INVERT SUGAR 0g
ETHANOL 1.38%
DISTILLATION/ CONCENTRATION
ETHANOL 32.8g
EVAPORATED WATER 2083g
CONCENTRATED SUGAR LIQUID 1065g
SUCROSE 546g
INVERT SUGAR 0g
SUCROSE RATIO 87.1%
SEED CRYSTAL 50g
CRYSTALLIZATION/ SEPARATION
EVAPORATED WATER 344g
SUGAR 401g
MOLASSES 239g
SUCROSE 123g
INVERT SUGAR 23g
SUCROSE RATIO 65.8%

FIG.4

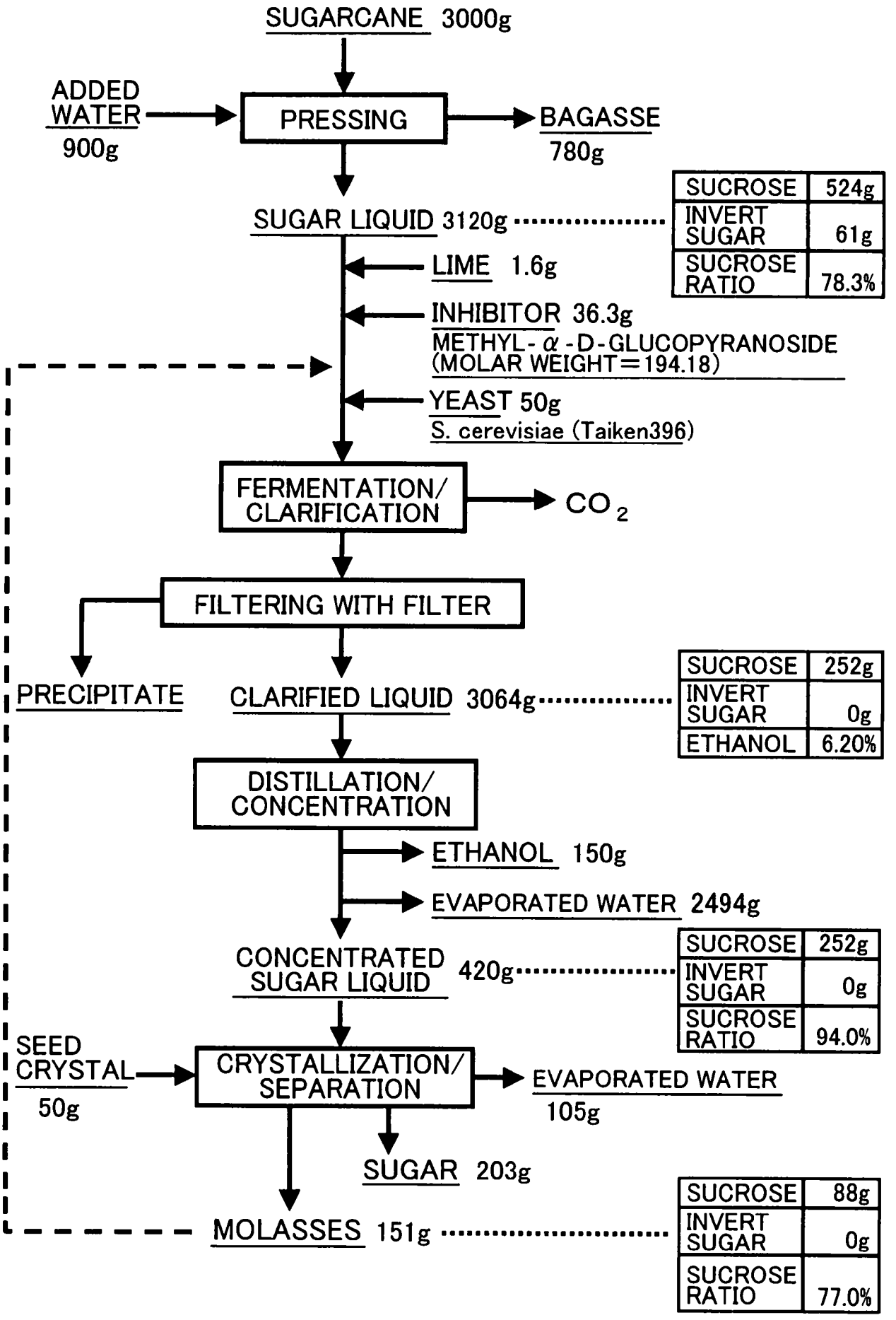
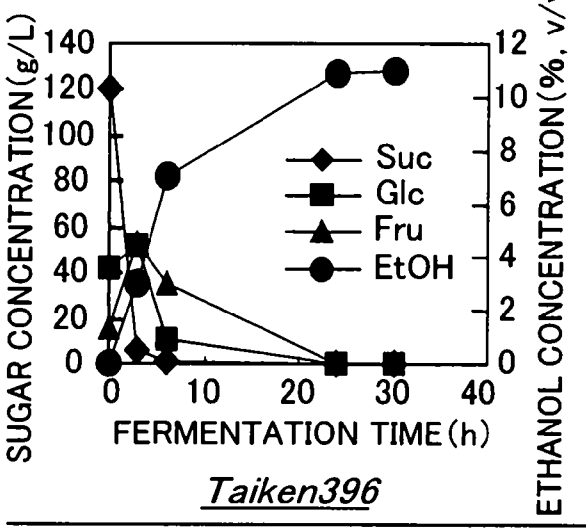

SUGARCANE 3000g
ADDED WATER 900g
PRESSING
BAGASSE 780g
SUGAR LIQUID 3120g
SUCROSE 524g
INVERT SUGAR 61g
SUCROSE RATIO 78.3%
LIME 1.6g
INHIBITOR 36.3g
METHYL-α-D-GLUCOPYRANOSIDE (MOLAR WEIGHT=194.18)
YEAST 50g
S. cerevisiae (Taiken396)
FERMENTATION/ CLARIFICATION
CO2
FILTERING WITH FILTER
PRECIPITATE
CLARIFIED LIQUID 3064g
SUCROSE 252g
INVERT SUGAR 0g
ETHANOL 6.20%
DISTILLATION/ CONCENTRATION
ETHANOL 150g
EVAPORATED WATER 2494g
CONCENTRATED SUGAR LIQUID 420g
SUCROSE 252g
INVERT SUGAR 0g
SUCROSE RATIO 94.0%
SEED CRYSTAL 50g
CRYSTALLIZATION/ SEPARATION
EVAPORATED WATER 105g
SUGAR 203g
MOLASSES 151g
SUCROSE 88g
INVERT SUGAR 0g
SUCROSE RATIO 77.0%

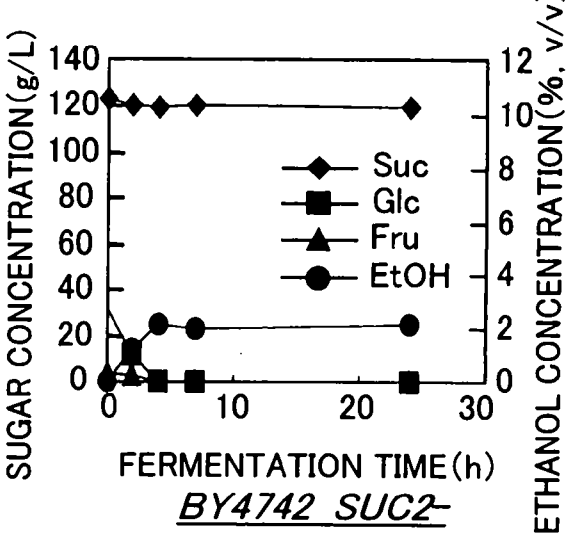
FIG.5

○EXAMPLE OF FERMENTATION OF PRESSED JUICE IN CASE USING GENERAL YEAST (CONTROL PLOT)



Taiken396

○EXAMPLE OF FERMENTATION OF PRESSED JUICE IN CASE USING YEAST HAVING SUCRASE GENE DISRUPTED



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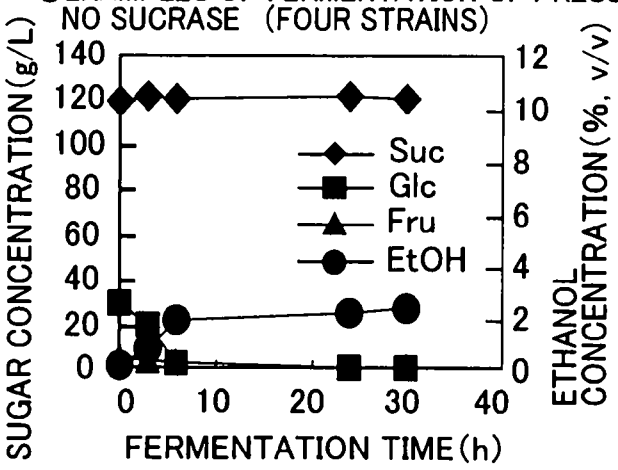
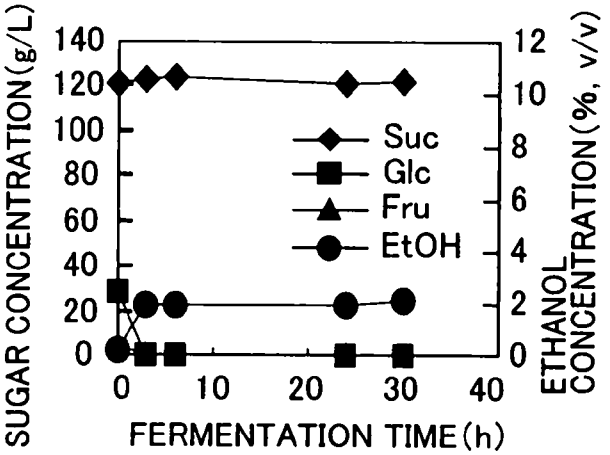
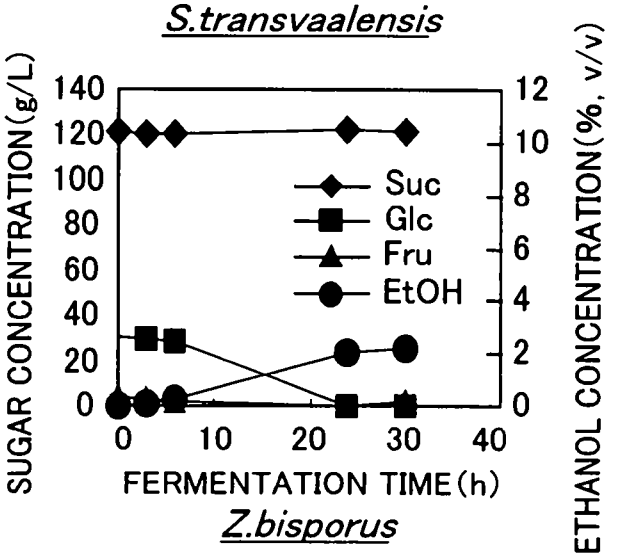
○EXAMPLES OF FERMENTATION OF PRESSED JUICE IN CASE USING YEAST HAVING NO SUCRASE (FOUR STRAINS)



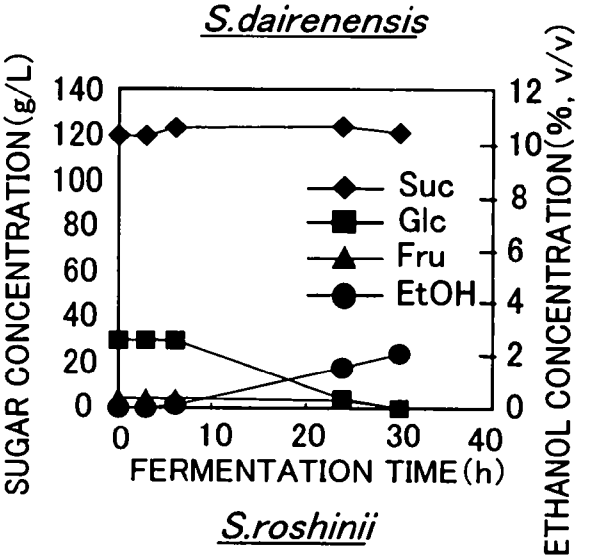
S.transvaalensis



S.dairenensis



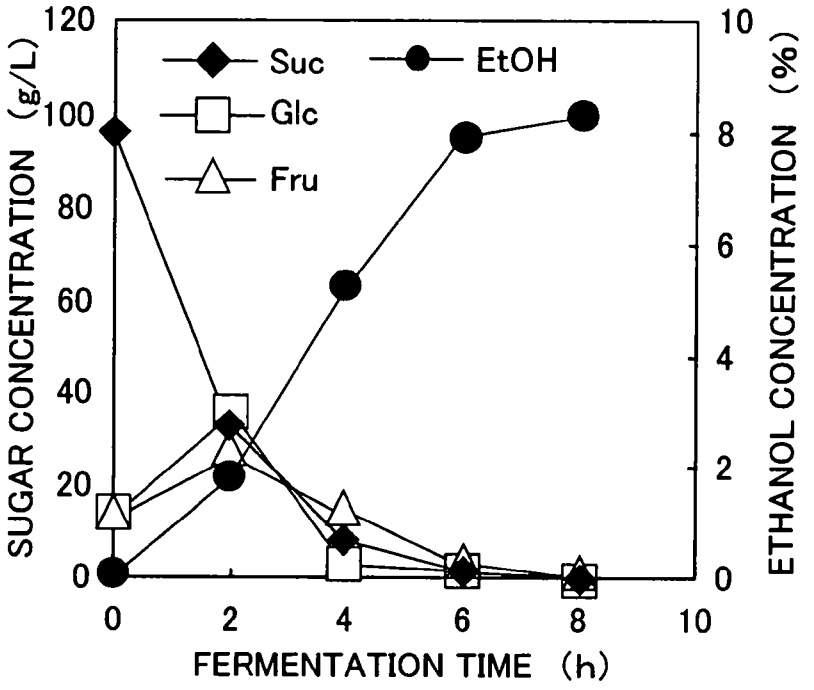
Z.bisporus



S.roshinii

FIG.6

○EXAMPLE OF FERMENTATION OF PRESSED JUICE IN CASE USING GENERAL YEAST (WITHOUT INHIBITOR) (CONTROL PLOT)



○EXAMPLE OF FERMENTATION OF PRESSED JUICE IN CASE USING GENERAL YEAST (WITH INHIBITOR)