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(54) Process for the manufacture of a sweetener based on milk and a sweetener manufactured according to the process.

(57) A process for the manufacture of a sweetener based on milk, in which lactose is hydrolysed while being transformed to glucose and galactose by means of a strongly acidic cation exchanger having a cross linking degree of between 5 and 10 % in a parallel flow of a lactose solution through a fixed bed of the strongly acidic cation exchanger, whereby the hydrolysis is run to a hydrolysing degree of 40-100 % at a temperature of 80-150°C or preferably 90-120°C and with a flow cycle speed of between 2 and 0,5 bed volumes per hour corresponding a cycle speed of transforming lactose to glucose and galactose of between 0,5 and 2 hours, whereupon the glucose-galactose product thereby obtained is cooled to a temperature of 10-20°C and is withdrawn for direct use, for being temporarily stored or for being further treated. The dry matter content of the treated lactose is kept at 40 to at least 80% or preferably 50 to 60%. The invention also relates to a sweetener manufactured according to the process.

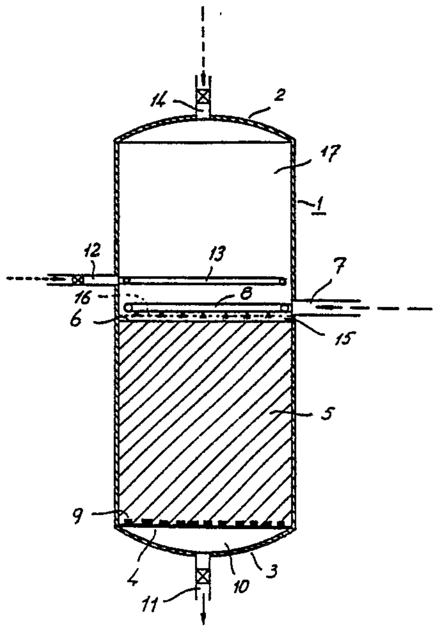

Fig. 1

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Process for the manufacture of a sweetener based on milk and a sweetener manufactured according to the process

The present invention relates to a process for the manufacture of a sweetener from milk-sugar or lactose and a sweetener manufactured according to the process.

Lactose can be derived from any type of milk product like whole milk, skim milk, butter milk, whey, cottage cheese whey etc. Of particular interest is to make use of lactose from whey which is often considered a non-useful rye side product. Lactose has little sweet taste and for making use of lactose as a sweetener the lactose has to be transformed or split up into glucose and galactose which are sweeter types of sugar. It is known that such transforming of lactose is made by hydrolysis with some acid, some ion exchanger or some enzym. Such a method and other hydrolysing methods are described for instance in Journal of Dairy Science, Vol. 64, pages 1759-1771, "Beta-Galactosidase: Review of Recent Research", M. L. Richmond, J. I. Gray and C. M. Stine.

The said previously known methods for transforming lactose to glucose and galactose, however, have been achieved with a relatively low content of dry matter and/or a relatively low degree of hydrolysis, and the transforming speed during the hydrolysis has been low. It has not been considered possible to hydrolyse lactose having a dry matter content of more than about 20-40%, and therefore the degree of hydrolysis or the transforming speed during hydrolysis has been unprofitably low. Due to the low degree of hydrolysis in some previously known processes the sugar solution, in addition to glucose and galactose, also contains some amounts of remaining lactose, which especially during long storage at low temperature tends to separate as crystals. The low dry matter content or the low degree of hydrolysis leads to the effect that the methods are disadvantageous from an economical viewpoint and that the final product may be so diluted or may have such composition that it must be treated further in order to become practically useful for different purposes.

A method for hydrolysing of lactose is also known from the US Patent 4,067,748. According to this known method the lactose is hydrolysed by means of a strongly acidic cation exchanger preferably a strongly acidic polystyrene ion exchanger resin. In the patented method it is stated that the hydrolysing can be made for a dry matter content of 20-40%, for instance 30%, and that the hydrolysing is made by means of an ion exchanger resin having a very low cross linking number, preferably a cross linking number of between 0,5 and 5%.

Even in the said patented method the lactose to be treated has a dry matter content which is of such low magnetude that the hydrolysed lactose for many purposes is not directly useful but has to be subjected to further treatments like evaporazation etc. Further an ion exchanger resin having a very low cross linking degree. Such low cross linking degree can be used and can be advisable for the indicated low dry matter contents, but on the contrary it is not practically possible to use such low cross linking degrees for higher dry matter contents since the osmothic pressure at high dry matter contents is so high that there is a risk that the ion exchanger resin balls crack and thereby are destroyed.

According to the patent the lactose transforming into glucose and galactose also is made by stirring the lactose solution together with the ion exchange resin what causes cracking and wear of the ion exchange resin balls. Alternatively it is indicated that the lactose transformation can be made in that the ion exchange resin is allowed to successively fall to the bottom of a column in counter current towards a rising lactose bearing liquid and while the ion exchange resin is recirculated to the top of the column.

As mentioned the previously known methods are disadvantageous both in that it is necessary to keep low dry matter contents of lactose solution and in that has been considered necessary or advantageous to carry out the hydrolysing by means of an ion exchange resing having a very low cross linking degree what causes a destroying of the ion exchange resin in case of high dry matter conetnts, and in that the process is run while stirring the lactose solution and the ion exchange resin. In total the known steps lead to long periods for transforming lactose into glucose and galactose.

It might be expected that the use of an ion exchange resin having a higher cross linking degree than that mentioned in the above cited publications, or that a lactose transforming treatment of a lactose solution having rather high dry matter contents or a treatment of the lactose solution by having same pass through a fixed bed of an ion exchange mass, should lead to long periods for transforming lactose into glucose and galactose, or alternatively to a lower degree of hydrolysis for a maintained transforming period. It has, however, surprisingly proved that this is not the case. According to the invention, it is on the contrary, possible to treat lactose solutions having high dry substance contents by using ion exchange masses having a rather high crosslinking degree, and by providing the lactose transforming in a fixed bed of ion exchange mass, and in spite thereof the lactose transforming periods are surprisingly short and the hydrolysing degree is extreemly high.

The object of the invention is therefore to solve the problem of providing a new process for the manufacture of a sweetener from lactose, which process allows a practical and economical manufacture of the intended sweetener.

The invention also relates to a sweetener manufactured according to the said process.

A further object of the invention is to provide such a process, in which the dry matter content in the lactose solution can be kept substantially higher than has so far been possible, and in which the dry matter content of the final product is correspondingly higher than previously considered possible without evaporating or further treating the hydrolysed product.

A further object of the invention is to provide a process for the manufacture of sweeteners of lactose, according to which a substantially higher dry matter content is obtained than has previously been usual, at which a higher degree of hydrolysis is obtained than has previously been usual and which process can be proceeded so that the cycle speed is substantially higher than has previously been possible.

The starting material in the process according to the invention is lactose in a water solution or permeate having a dry matter content of between 40 and at least 80%. Preferably lactose solution is given a dry matter content of between 50 and 60 %. If the lactose is to be dissolved in water the temperature is raised to between 80 and 150°C or preferably between 90 and 120°C. At high temperatures lactose is dissolved more completely and as a consequence a higher dry matter content is obtained than at lower temperatures. The high dry matter content of the lactose solution is advantageous in that a concentrated solution is obtained which need not be evaporated and which gives the process a high capacity. Depending of what starting material is used from which the lactose is otained the pH-value of the lactose solution may vary, but normally the pH-value is less than 7 and preferably the pH-value is between 5 and 6.

If found advisable the lactose solution may be filtered for the purpose of polishing the solution, but this is not quite necessary. On the contrary the lactose solution may be further treated for splitting the lactose up to glucose and galactose immediately after having been dissolved in water.

This further treatment of the lactose solution is made by an acid heterogeneous catalysis, in this case a hydrolysis, whereby the lactose solution is treated with a strongly acidic cation exchanger for instance polystyrene-sulfonic acid or any other ion exchanger built on a polymere.

In order to make it possible to keep the dry matter contents of the high magnetude as mentioned above and at the same time keep the transforming cycle period short in hydrolysing of lactose into glucose and galactose a cation exchanger for this purpose preferably should have a moderately low cross linking degree, or for instance a cross linking degree of 5,5-10% or preferably 5,5-6%. In this connection the strongly acidic cation exchanger acts as a heterogeneous catalysor in which the hydrogen ions split the lactose to glucose and galactose. The acid heterogeneous catalysis is proceeding at a temperature of 80-150°C or preferably 90-120°C. Depending on how long the lactose solution is kept in contact with the strongly acidic cation exchanger the process can be proceeded to a hydrolysis degree of between 40% and practically 100%. For commercial use and for maximum obtainable sweetness and best taste, the hydrolysis is preferably proceeded to a hydrolysation degree of about 70-90%. At a hydrolysation degree of less than 70-80%, there is a risk that lactose and/or galactose will crystallize after long storing time and at low temperatures. If it is required to further increase the sweetness of the hydrolysed lactose solution, a slight amount of extra lactose may be added which will strengthen the taste of sweetness of the glucose and the galactose. When combining the lactose solution with the strongly acidic cation exchanger the acidity of the lactose solution is successively increased, and the glucose-galactose product leaving the process may have a pH-value of 1.5-2.5. It may be considered advantageous that the glucose-galactose solution is kept at a relatively low pH-value since the microbiological resistance is high at low pH-value.

By starting with a lactose solution having as high dry matter content as between 40 and at least 80% or preferably 50-60% the capacity of the process becomes high, and a flow cycle speed of 0.2-2.0 bed volymes per hour is quite possible for a degree of hydrolysis of more than 80%. Such flow speed is substantially higher than has previously been possible.

In spite of the relatively high temperature during the entire process there is only a little, if any, risk of caramellizing and in the hydrolysed final product there are very small and neglectable amounts of caramellizing products.

In order to further improve the taste and remove possible caramellizing substances of the ready hydrolysed glucose-galactose product, the milk sugar product may be polished for instance by being filtered through activated carbon. Such a polishing step, however, is only necessary for certain products in which a clear non-coloured product is required.

Upon demand the final sugar product may be evaporized, but since the dry matter content is as high as 45-80% or preferably 50-60% evaporizing is generally not necessary. The final hydrolysed product normally has a pH-value of 1.5-2.5. For adapting the sugar product to its intended field of use the pH-value may be raised upon demand.

The sugar product, manufactured accoding to the process, is well suited for many different purposes, for instance for use in food stuffs like bakery products of different kinds, beverages such as beer, lemonades etc., or different types of canned products for which some sweetener is desired, for cheese products like cheese dip, spreadable cheeses, cream cheese etc., for sweetening of sweet meats and confiture, for dairy products like condensed milk, acidified culture type of milk, sour cream, yoghurt etc., for dry mix powders such as baking mix powder, pancake mix powder, sallad dressings, sausages, hamburgers, soups etc. or for sweetening of ice-cream. There are numerous fields of use which further can be envisaged. As mentioned above the product, manufactured according to the process, has a high content of dry matter, and a high lactose to glucose-galactose transforming speed, and it is possible to proceed the process, according to the invention, to a very high degree of hydrolysis for the product.

It should be noted that it is very well possible to control the degree of hydrolysis as far as ±1 or 2% by varying the bed volymes, i.e. by varying the periods of time for transforming lactose into glucose and galactose.

In the following some examples of the process according to the invention will be described. In all examples an equipment for the treatment of 100 kg lactose solution has been used, and when only the weight of the final product is mentioned in the following examples it is consequently pre-supposed that in all cases 100 kg of a lactose solution was added to the processing equpiment for treatment.

EXAMPLE 1

40 kg lactose powder obtained from whey was added to 60 l water having a temperature of 80°C. The said temperature was maintained until the greatest part of the lactose powder was dissolved, whereupon the lactose solution was treated with a strongly acidic cation exchanger consisting of polystyrene-sulfonic acid having a cross linking degree of 8%. The hydrolysis was proceeded to a hydrolysing degree of 40%, whereupon the ready hydrolysed product was withdrawn and analysed. The transforming cycle speed corresponded to a bed volume of 0.50 per hour. The product had a brown-yellow colour and a soft caramel taste. After the product had been filtered over activated carbon the brown-yellow colour had disappeared and practically all caramel taste had disappeared and the final product was considered to have a moderate sweetness. After storing in cooled condition at a temperature of less than 10°C the product by time became turbid in that non-transformed lactose was crystallized and by time dropped to the bottom.

EXAMPLE 2

65 kg lactose obtained from whey was dissolved in 35 l water having a temperature of 97°C. When all lactose had been dissolved in the water the pH was found to be 5.51. With kept temperature of 97°C the lactose solution was treated with an ion exchanger mass, which ion exchanger is a strongly acidic cation exchanger having a cross linking degree of 5,5%. The hydrolysis was proceeded as far as a hydrolysing degree of 96%. Immediately after the hydrolysis was finished the pH-value was found to be 1.82. The treated product had

a pure sweet taste without any substantial extraneous flavour. The colour was slightly yellow. After the product had been polished over activated carbon the product was clear and completely without any flavour. The transforming cycle speed according to this example corresponded to 1.0 bed volyme per hour. Depending on the high degree of hydrolysing no crystallization was observed, not even after long storing at low temperatures.

EXAMPLE 3

80 kg lactose obtained from whey was dissolved in 20 l water of 140°C temperature under a pressure of 3.10 bar. The pH-value of the lactose solution was measured to 5.0. With a maintained temperature of 140°C the lactose solution was treated with a strongly acidic ion exchanger, based on a polystyrene-sulfonic acid having a cross-linking degree (DVB-degree) of 6%. The hydrolysis was run to a hydrolysing degree of 92%. The transforming cycle speed corresponded to a bed volume of 1.1 per hour. The ready product was brownish and had a slight caramel taste. Without being polished the product was considered well suited for bakery purposes. Some tendency of cracking of the polystyrene sulfonic acid balls was observed, what is supposed to depend on the high osmotic pressure obtained at the high dry matter content in this example.

EXAMPLE 4

50 kg lactose obtained from whey of cottage cheese was mixed with 50 l water of 100°C. The pH-value of the lactose solution was measured to 4.5. With maintained temperature the lactose solution was treated with a strongly acidic cation exchanger having a cross linking degree of 10% and the hydrolysis was run to a hydrolysis degree to 95%. The transforming speed corresponded to a flow cycle speed of 0,7 bed volumes per hour. The ready product was slightly

yellow and had a good sweetness without any flavour. After the product had been polished over activated carbon a clear non-coloured product without any noticable flavour had been obtained. The product was considered well suitable as a sweetener for beverages, i.e. beverages of the brewery inndustry like beer and lemonades etc. In spite of the relatively high cross linking degree of the cation exchanger the hydrolysis could be carried out as far as to a hydrolysing degree of 95% with a flow cycle speed of 0.7 bed volymes corresponding to a period for transforming lactose into glucose and galactose of less than 1.5 hours.

EXAMPLE 5

71 kg lactose powder obtained from whey was dissolved in 29 l water and was mixed at a temperature of 119°C and at a pressure of 1.9 bar. The pH-value of the lactose solution was measured to be 1.8. With a maintained temperature, the lactose solution was treated with a strongly acidic cation exchanger having a cross-linking degree of 5.5%. The hydrolysis was run to a hydrolysis degree of 93%. The transforming speed corresponded to flow cycle speed of 1.9 bed volumes per hour. The ready product was slightly yellowish and had a pure sweet taste without any noticable flavour.

In spite of the high dry matter content, the high hydrolysing degree and the relatively low cross linking degree of the cation exchanger the hydrolysis could be carried out with a flow cycle speed of 1.9 bed volyme per hour corresponding to a period for transforming lactose into glucose and galactose of not more than about half an hour. No substantial crack formation or any other damage of the ion exchange resin could be noticed.

EXAMPLE 6

60 kg lactose powder from whey was dissolved in 40 l water of 100°C temperature. The lactose mixture was treated with a strongly

acidic cation exchanger which was a mixture of 50% of a strongly acidic cation exchanger having a cross linking degree of 5.5% and the remaining a cation exchanger having a cross linking degree of 8%. The hydrolysis was run to a hydrolysing degree of 98% at a transforming speed cycle of 1.5 bed volumes per hour. The product thereby manufactured was practically completely clear and non-coloured and had a strong sweet taste.

EXAMPLE 7

50 kg lactose powder was solved in 50 l water at a temperature of 97°C. The lactose solution was hydrolysed as far as to 96% by means of a strong acidic cation exchanger having a cross linking degree of 5.5%. The hydrolysed lactose had a relatively sweet taste. To the hydrolysed lactose was thereafter added 15% of non-hydrolysed lactose, and a taste panel considered the sweetness of the product substantially higher than the sweetness of the hydrolysed lactose without the addition of non-hydrolysed lactose.

An additional large number of tests have been made for which are made account in the following tables:

TABLE 1

Ex	Flow speed BV/h	Temp. °C	Pressure bar	Conc. DM	Result hydrolysis degree %
8	0.2	60		36	29 (34)
9	1	75		42	33
10	0.4	83		50	45
11	1	96		59	89
12	0.7	97		65	95
13	1	120	2.0	72	96
14	1	141	3.8	81	96
15	1.5	60		35	30
16	1.5	74		41	36
17	1.5	86		50	45
18	1.5	95		60	82
19	2.0	97		66	97
20	1.9	119	1.9	71	93

In the above examples was used a strongly acidic cation exchanger having a low cross-linking degree. The content of Divinylbenzene in this strongly acidic cation exchanger is about 5.5%.

("BV/h" stands for bed volume per hour; "DM" stands for dry matter content).

TABLE 2

In the following examples was used a strongly acidic cation exchanger, which had a cross linking degree (DVB content) of about 6%.

Example	Flow speed BV/h	Temp. °C	Pressure bar	Conc. DM	Result hydrolysis degree %
21	1	60		35	29
22	1	74		42	33
23	1	85		50	47
24	1	95		59	93
25	1	99		65	98
26	1	119	2.0	73	97
27	1	141	3.8	82	96
28	1.5	61	0.21	35	28
29	1.5	73		41	40
30	1.5	85		51	45
31	1.5	96		60	89
32	1.5	98		65	96
33	1.5	121	2.0	73	97
34	1.5	141	3.8	82	96

TABLE 3

In the following examples was used a strongly acidic cation exchanger, having a cross linking degree (DVB content) of 8%.

Example	Flow speed BV/h	Temp. °C	Pressure bar	Conc. DM	Result hydrolysis degree %
35	0.4	60		35	35
36	1.2	74		41	34
37	1.5	85		50	46
38	1.5	96		59	90
39	1.5	99		66	97
40	1.7	119	2.0	73	96
41	1.9	141	3.8	79	96

TABLE 4

Example	Flow speed BV/h	Temp. °C	Pressure bar	Conc. DM	Result hydrolysis degree %
42	0.8	61		35	34
43	1.2	73		42	35
44	1.5	85		50	42
45	1.5	97		60	98
46	1.5	99		65	98
47	1.8	120	2.0	71	97
48	2.0	141	3.8	81	97

In the above examples was used a strongly acidic cation exchanger in the form of a mixture of 50% having a cross linking degree of 8% and 50% of another cation exchanger having a cross linking degree of 5.5% the combined cross linking degree being (DVB content) 6.75%.

It should be noted that a strongly acidic cation exchanger having a low cross linking degree within the above mentioned interval makes the hydrolysis run more easily, so that a higher flow speed can be maintained without the risk that the hydrolysis degree decreases. At a hydrolising degree of more than 80% the product is so stable that there is practically no crystallizing, not even at long time of storing.

Cation exchangers having a low cross linking degree, however, are rather sensitive to pressure or are brittle, and as mentioned above the osmotic pressure at high dry matter contents becomes so high that there is a risk that the cation exchanger is damaged. When using high dry matter contents it is therefore often considered necessary to use cation exchangers having a higher cross linking degree than the above indicated cross linking degree interval of 5.5-10% than should have been desired, depending on operating technical viewpoints.

In all of the above mentioned examples an apparatus has been used, which is illustrated in the accompanying figure 1, and the lactose or the permeate respectively have been treated mainly at the temperatures in relation to the dry matter substance as illustrated in the accompanying curve, figure 2, in which the dry matter content is plotted along the vertical axis and the temperature in centigrades have been plotted along the horizontal axis.

The apparatus illustrated in figure 1, comprises a closed container 1 having a top dome 2 and a bottom dome 3 and an intermediate bottom 4 adjacent the bottom dome 3. On the intermediate bottom 4 and up to about half the height of the container has been applied a bed 5 of a cation exchanger, and on a level slightly above the upper surface 6 of the cation exchanger bed there is an inlet 7 for lactose. The inlet 7 is connected to a spreading device having several nozzles (not illustrated) which spread the lactose evenly over the surface of the ion exchanger bed. At the intermediate bottom 4 there are several screen type nozzles 9 for letting the hydrolysed lactose out to a volyme 10 between the intermediate bottom 4 and the bottom dome 3, and the hydrolysed lactose is withdrawn through an outlet conduit 11. On a level slightly above the inlet 7 for lactose there is another inlet 12 for introducing regenerating acid which inlet 12 likewise is formed with a spreading device 13 for evenly distributing the regenerating acid over the surface of the ion exchanger bed. On a level above the upper surface 6 of the ion exchanger bed there is a further inlet 14 for pessurized air or any other gas.

When hydrolysing the lactose the acid inlet 12 and the air inlet 14 are closed and the lactose solution is pumped into the container in a predetermined amount per unit of time, preferably by means of a positive pump. The lactose is spread over the surface 6 of the ion exchanger bed 5 by means of the spreading device 8. The lactose successively passes through the ion exchanger bed at a certain speed, but if the lactose is pumped into the container with a higher speed than can pass through the ion exchanger bed 5 a layer 15 of lactose solution appears on top of the surface 6 of the ion exchanger bed. It is considered advisable to maintain a layer of about 5 centimeters of lactose solution 15 on top of the surface 6 of the ion exchanger bed, but if the level 16 of the lactose solution tends to rise pressurized air is blown dose by dose into the pressure chamber 17 above the ion exchanger bed, whereby the lactose solution under pessure is brought to pass through the ion exchanger bed. The level 16 of the lactose layer may in automatical way be maintained rather constant dose by dose letting pressurized air into the pressure chamber 17. The hydrolysed lactose may batchwise or continuously be withdrawn through the outlet conduit 11 at the bottom of the container. Since the ion exchanger bed is fixed there is no wear of the ion exchanger balls. The lactose solution which is pumped into the container through the inlet 7 always meets the strongest part of the acid at or adjacent the outlet, even if the acid of the ionexchanger resin is partly consumed, what is advantageous in order to maintain the highest possibly degree of hydrolysis.

The acid content of the ion exchanger resin successively is reduced during the hydrolysing process, and at a certain stage it is necessary to regenerate the ion exchanger resin. This is made in that the inlet tube 7 for the lactose, the spreading device 8 and the ion exchanger bed 5 are flushed clean by means of water, whereafter water is pumped into the ion exchanger bed from underneath through the outlet conduit 11, whereby the ionexchanger bed is lifted and is loosened. By means of air from the pressurized air 14 the ion exchanger bed 5 is thereafter forced down to its original level, acid, for instance hydrochloric acid, of about 5% concentration is pumped into the container through the acid inlet 12 and the spreading device 13 and is allowed to pass through the ion exchanger bed 5 from above until the ion exchanger mass is saturated. Excess of acid is removed by flushing water through the bed, and thereafter the equipment is ready for once again being taken into use for hydrolysing lactose into glucose and galactose.

In figure 2 there is shown a diagram of suitable handling temperatures. Along the vertical shaft is plotted the dry matter content in percent and along the horizontal shaft is plotted the solution temperature for lactose or permeate respectively in water. It is evident that the temperature for completely solving lactose of for instance 40% dry matter content in water is about 92°C and that the temperature becomes higher corresponding to a higher dry matter content to about 140°C for a dry matter content of 80%. The above temperatures relate to the lactose curve L. Corresponding temperatures for permeate P are about 55°C for a permeate having a dry matter content of about 40% and about 100°C for a permeate of 80% dry matter content.

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Arla, ekonomisk förening

"Process for the manufacture of a sweetener based on milk and a sweetener manufactured according to the process"

1	container
2	top dome
3	bottom dome
4	intermediate bottom
5	bed of cation exchanger
6	upper surface (of 5)
7	inlet (for lactose)
8	spreading device
9	screen type nozzle
10	volume
11	outlet conduit
12	inlet (for regenerating acid)
13	spreading device
14	inlet (for air or gas)
15	layer (of lactose solution)
16	level (of lactose solution)

CLAIMS

1. Process for the manufacture of a sweetener, characterized in that lactose is dissolved in water having a temperature of 80-150°C or preferably 90-120°C, to a dry matter content of 40 to at least 80% or preferably 50-60%, or a lactose permeate having the same dry matter content is heated to the same temperature, whereupon the lactose solution thereby obtained is hydrolysed by being treated with a strongly acidic cation exchanger having a cross linking degree of 5.5-10%, whereby the lactose is transformed to glucose and galactose, and the hydrolysis is run to a hydrolysing degree of 40-100 % or preferably 70-90% for a flow cycle speed of 2.0-0.5 bed volymes per hour corresponding to a period of time for transforming lactose to glucose and galactose of 0.5-2.0 hours, whereupon the glucose-galactose product thereby obtained is cooled to a temperature of 10-200°C and is withdrawn for direct use, for intermediate storing or for further treatment.

2. Process according to claim 1, characterized in that the hydrolysis is proceeded without change of the temperature at which the lactose is dissolved in water or to which the lactose permeate is heated.

3. Process according to claim 1 or 2, characterized in that the lactose solution is polished before the hydrolysis treatment.

4. Process according to any of the preceding claims, characterized in that the lactose solution in a parallel flow is pressed through a fixed bed of the strongly acidic cation exchanger.

5. Process according to claim 4, in which the strongly acidic cation exchanger is polystyrene-sulfonic acid or any other polymere based acid ion exchanger having a cross linking degree of preferably between 5.5 and 6%.

6. Process according to claim 1, in which the glucose-galactose product obtained by the hydrolysis is filtered through activated carbon for polishing of the product and for removing

possible caramel taste.

7. Process according to any of the preceding claims, characterized in that the ready hydrolysed product is subjected to one or more of the following treatments: filtering through activated carbon, evaporation to any required dry matter content, control of pH-value according to the product for which the sweetener is intended.

8. Process according to any of the preceding claims, characterized in that the lactose solution is given a pH-value of 1-7 or peferably 5-6 before the catalysing treatment, and in that the ready hydrolysed product is kept at a pH-value of 1.5-2.5.

9. Sweetener manufactured following the process according to any of the preceding claims by hydrolysis of lactose obtained from whey, characterized in that the sweetener without having been evaporated has a dry matter content of 40 to at least 80% or preferably 50-60%.

10. Sweetener according to claim 9, characterized in that the lactose by hydrolysis is transformed to glucose and galactose with a hydrolysing degree of 40-100% or preferably 70-90%.

11. Sweetener according to claim 9 or 10, characterized in that it contains an addition of 1-20% of lactose added after the lactose solution has been hydrolysed.

12. Sweetener according to any of claims 9-11, characterized in that it has a hydrolysing degree of less than 60% and in that it contains an addition of more than 20% lactose added after the lactose solution has been hydrolysed.

13. Sweetener according to any of claims 9-10, characterized in that it has a hydrolysing degree of more than 80%, and in that it has an addition of not more than 20% lactose added after the lactose solution has been hydrolysed.

14. Sweetener according to claim 9 or 10, characterized in that the sweetener after the hydrolysing step has a pH-value of 1.5-2.5 or after adjustment a pH-value of 4-7.

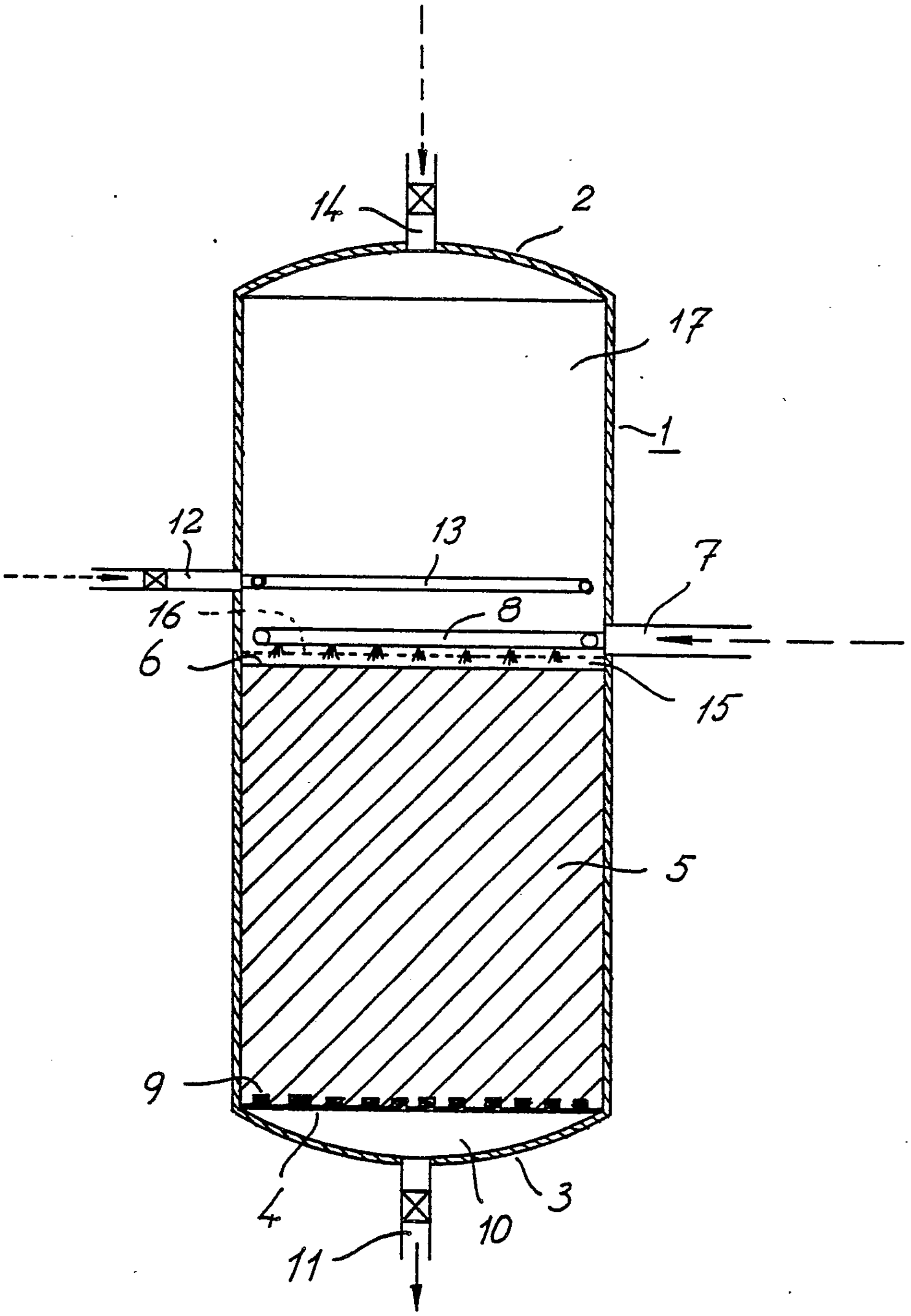

Fig. 1

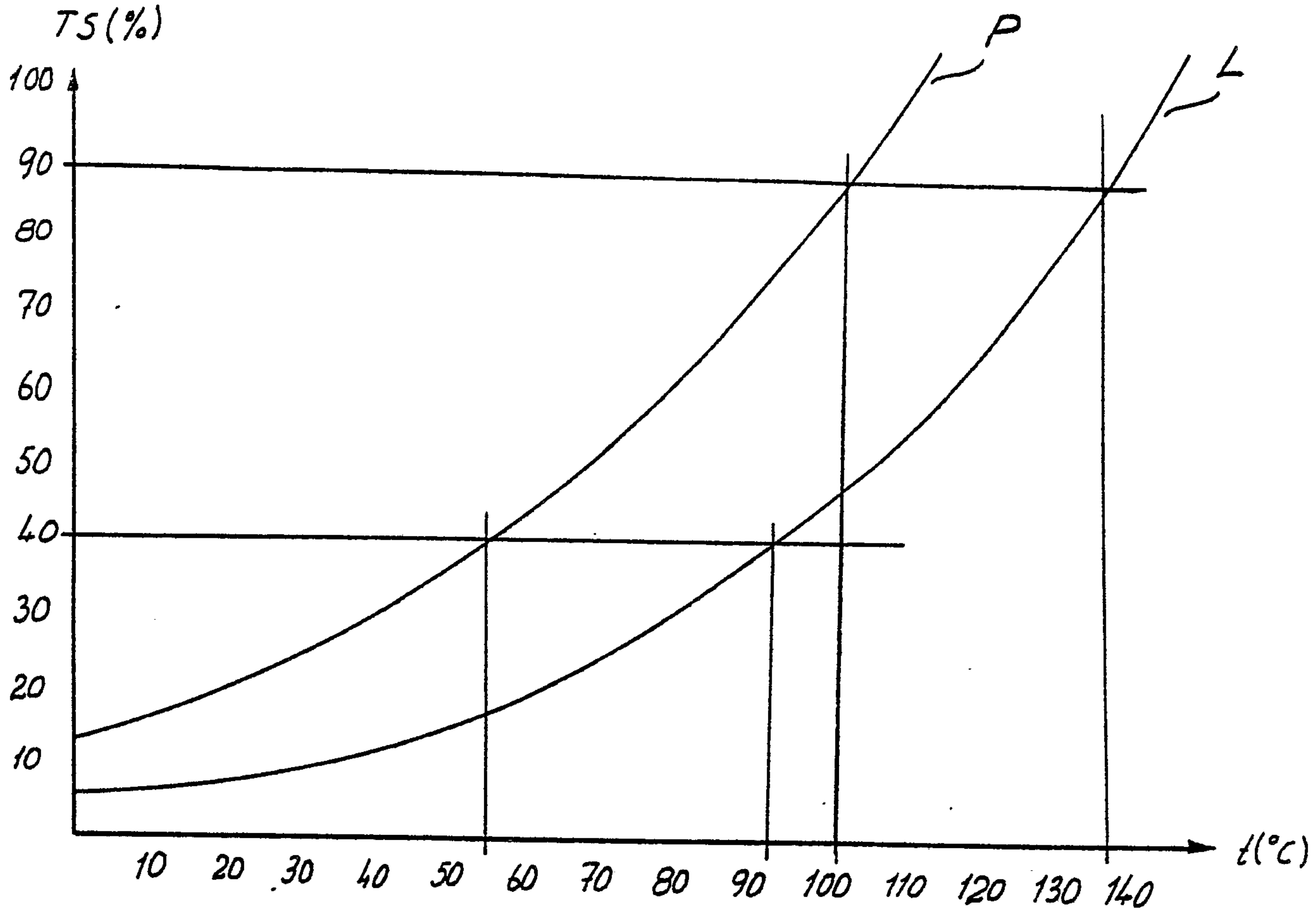
TS(%)
100
90
80
70
60
50
40
30
20
10
P
L
10
20
30
40
50
60
70
80
90
100
110
120
130
140
t(°C)

Fig. 2