

Description

PRODUCTION PROCESS OF DISSOLVED FOOD FIBER

5 Technical Field of the Invention

10 The present invention relates generally to dietary fiber, and more particularly to a production process of soluble dietary fiber that is not easily broken down in human intestines and useful for the growth of good bacteria (probiotics) inside human intestines. Dietary fiber produced from the invention is in the form of digestive resistant maltodextrin (DRM) as a soluble dietary fiber that is not easily broken down in human intestines. Digestive resistant maltodextrin are produced using a pyrolysis process of corn starch, Tapioca and other materials having properties commonly starch at high temperatures and acidic atmospheres. The pyrolysis process is able to change the starch properties to be more resistant to enzymatic reactions and increases the solubility properties of starch in water. Then proceeded with a liquefaction and saccharification process to break down the remaining carbohydrates in a pyrolysis process into glucose, maltose and other simple sugars. The separation of simple sugars in the production process of digestive resistant maltodextrin is carried out by filtration through nano membranes or other methods such as fermentation. The result is resistant oligosaccharide with a series of 3 to 9 glucose molecules as the main component of dissolved dietary fiber.

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Background of the Invention

25 Public awareness about choosing a healthy food menu is increasing along with the emergence of various degenerative diseases caused by dietary mistakes. One of the dietary mistakes is the intake of foods that are low in fiber. Dietary fiber can be defined as part of the plants whose existence in the human intestine cannot be digested by the digestive enzymes present in the human body. Among the commonly known soluble dietary fibers are inulin and pectin. The examples of insoluble dietary fiber are cellulose and hemicellulose. At the end of the 20th century, resistant starches and some oligosaccharides that were also difficult to digest by endogenous secretions of the human digestive tract were included in a group of soluble fibers.

35 On its way through the human digestive tract, this soluble fiber will absorb water and expand like a gel which can function to inhibit the emptying of food in the stomach, or in other words, provide a longer full effect. This condition is stated by nutritionists as a function of diet and blood sugar control. In the

human colon, this soluble fiber will be fermented by good bacteria to become a food source for these bacteria. In addition, it is a good medium for these good bacteria to reproduce, and these bacteria are useful in the digestive system of food in the human body. Another function of fiber is to lower cholesterol levels and launch regular bowel movements.

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Currently, there are patents related to soluble dietary fiber production that cannot be digested in the human body, with the purpose of being an additional nutrient in processed human food ingredients so that the nutritional function increases and has a good impact on human health. There are several ways of naming soluble fiber that are currently known in the market, ranging from resistant dextrin, resistant maltodextrin, soluble corn fiber, soluble tapioca fiber and others, of which production methods have also been published. The patents include United States Patent No. US5620873 dated May 8, 1995 by Matsutani Chemical Industries Co., LTD under the title PROCESS FOR PREPARING DEXTRIN CONTAINING FOOD FIBER. According to the patent, dextrans containing at least 27% dietary fiber as measured by Prosky-AOAC method or at least 45% dietary fiber as measured by HPL method, are produced. The process includes the addition of 300 ppm HCl into starch which is then dried at a temperature of 100-120°C so that the water content drops to 5% and the DE value is 1-10. Then it is heated through a pyrolysis process at a temperature of 150-220°C for 1-5 hours. Next, the pyrodextrin is dissolved into water so that the concentration becomes 30-40% w/w, and amylase enzyme is added with a concentration of 0.05-0.2% w/w. The temperature of the solution is maintained at 85-100°C for 30-120 minutes. After that, the hydrogenation process is carried out using Transglucosidase and b-amylase enzymes. The next process is the enzymatic process with the glucoamylase enzyme, filtering, deodorizing and desalting, chromatography on strong acid cation exchange resins, and collecting dietary fibers.

The drawback of the patent is that the water content resulting from the drying of starches having been added with 300 ppm HCl reaches 5%. With a water content of up to 5%, the energy required to heat and evaporate water is quite large. Therefore, it will take a high cost for fuel involved in the drying. In addition, the drying process takes a long time so that the overall productivity of the process decreases. Another drawback of the patent is that the separation process uses chromatography, so the resulting product is thin (diluted). The disadvantage is that it takes a lot of energy for the concentration process, so the costs are also higher.

Another patent is United States Patent No. US5620873 dated March 25, 2015 by Matsutani Chemical Industries Co.,LTD under the title METHOD FOR PRODUCING INDIGESTIBLE DEXTRIN. According to the the invention of the patent, the production of colorless and indigestible dextrin is carried out by diluting Pyrodextrin and Pyrodextrin saccharification with an activated carbon added. Pyrodextrin

dilution with or without enzymes is carried out by heating the pyrodextrin solution at a temperature of 80-115°C for 15-60 minutes with the activated carbon addition of 0.1-5.0% mass activated carbon relative to the solid content in the reaction solution.

5 The drawback of the patent is that during the dilution of Pyrodextrin and Pyrodextrin saccharification, the activated carbon is added. Accordingly, the dilution of Pyrodextrin using enzymes and the added activated carbon will cause the activated carbon to absorb enzymes. Therefore, the total activity of the enzyme is disrupted and additional enzymes are needed so that the process runs smoothly. In addition, the use of enzymes during the Pyrodextrin and Pyrodextrin saccharification dilution process may cause a
10 deadlock in the Jet Cooker unit.

 In view of the problems in the production process of the existing soluble dietary fiber which is not easily broken down in human intestines so far, the inventor made a breakthrough with the purpose of solving the existing problems. With the present invention, provided is a process for producing soluble dietary fiber
15 which is not easily broken down in human intestines while also useful for the growth of good bacteria (probiotics) in human intestines at the same time. The dietary fiber produced from the invention is in the form of digestive resistant maltodextrin as a soluble fiber that is not easily broken down in human intestines.

20 **Summary of the Invention**

 The present invention relates to a process of producing soluble dietary fiber which is not easily broken down in human intestines and is useful for the growth of good bacteria (probiotics) in human intestines. The dietary fiber produced from the present invention is in the form of digestive resistant
25 maltodextrin as a soluble dietary fiber that is not easily broken down in the human intestine. Digestive resistant maltodextrin is produced by using the pyrolysis process of corn starch, tapioca and other materials that have generally starch properties at high temperatures and acidic conditions. Then proceeded with liquefaction and saccharification processes to break down the remaining carbohydrates in the pyrolysis process into glucose, maltose and other simple sugars. The separation of simple sugars in the production
30 process of digestive resistant maltodextrin is carried out by filtration through nano membranes or other methods such as fermentation. The result is an oligosaccharide group with a sequence of 3 to 9 glucose molecules as the main component.

 The main objective of the present invention is to provide a production process of soluble dietary
35 fiber in the form of digestive resistant maltodextrin with high productivity. According to the present

invention, the separation process of digestive resistant maltodextrin from glucose and maltose is carried out using nano membranes. The separation using the nano membranes is to flow a mixture of digestive resistant maltodextrin with simple sugars in the form of glucose and maltose through a membrane with a hole size of 300–500 Daltons. Materials that are smaller in size than a nano membrane hole will penetrate the membranes and are called permeate, while components that have a larger size than the nano membrane hole will be stuck in the membrane and are called concentrate. Permeate a mixture of simple sugars, the sugars consisting of one and two glucose molecules bonded through $\alpha(1-4)$ bonds as the main component is a material that must be separated or reduced from the produced soluble dietary fiber. Concentrate is a material that is retained by the pores of the nano membranes, consisting of molecular groups of 3 to 12 glucose groups with $\alpha(1-2)$ and $\alpha(1-3)$ bonds as the main component, and the remaining simple sugars in very small amounts. Glucose groups with long chains of 3–12 with $\alpha(1-2)$ and $\alpha(1-3)$ bonds are called soluble dietary fiber. By using of these nano membranes, soluble dietary fiber with high purity and low sugar contents, that is the amount of glucose and maltose, to below 10% is produced so that this soluble food fiber is very good for human health.

In the present invention, a starch with an addition of HCl is delivered to a reactor called a flash dryer and dried using hot steam until the temperature reaches 120–160°C. The drying stage is producing a starch with a water content of less than 8%. With a water content that is not too low, the drying stage can be carried out quickly. Overall, by separating soluble dietary fiber from sugars resulting from the saccharification process using nano membranes, more soluble dietary fiber products produced per unit time may be produced. In this case, the productivity of the production process of soluble dietary fiber is becoming high.

A further object of the present invention is to provide a production process of soluble dietary fiber in the form of digestive resistant maltodextrin with less energy requirements. The process of the drying stage with a target water content of less than 8% can be done quickly since it has less water amount that should be evaporated compared to other processes. In this case, the drying stage in another process is pursuing to have a water content of up to 5%. The advantage of drying in the present invention is that the energy requirement is reduced. In addition, with the use of nano membranes in the separation of soluble dietary fiber from the sugars in it, the water content in the resulting soluble dietary fiber is lower. Therefore, the energy required to evaporate the water present in the soluble dietary fiber becomes smaller in amount.

A further object of the present invention is to produce digestive resistant maltodextrin with fiber content of 70-90% and sugar content of less than 10%. By separating digestive resistant maltodextrin from glucose and maltose using nano membranes with a hole size of 300–500 Daltons, glucose and maltose will

be separated from digestive resistant maltodextrin. This is because glucose with a molecular weight of 180 g/mol and maltose with a molecular weight of 342 g/mol will flow and penetrate the nano membrane holes. Meanwhile, dietary fiber with long chains or groups with a molecular weight of more than 500 g/mol cannot penetrate the membrane. The result of the separation with the nano membranes is soluble dietary fiber in the form of digestive resistant maltodextrin with fiber content of 70-90% and sugar content of less than 10%.

A further object of the present invention is to reduce the potential for deadlock in the jet cooker unit. According to the present invention, the addition of activated carbon for the clarification of digestive resistant maltodextrin products is carried out after the liquefaction stage in the jet cooker unit. The liquefaction stage is carried out in the reactor in the form of a jet cooker unit, where the starch suspension is directly contacted with hot water vapor until the temperature is more than 95°C. The liquefaction step is the breakdown of long chains of starch carbohydrates into oligosaccharide groups with monomer groups consisting of 1-12 chains of glucose molecules. With the addition of activated carbon after the liquefaction stage in the jet cooker unit, the potential deadlock of the jet cooker unit by activated carbon can be eliminated. Therefore, the potential deadlock of the jet cooker unit may be minimized.

Another object of the present invention is to reduce the use of enzymes during the production process of soluble dietary fiber in the form of digestive resistant maltodextrin. According to the present invention, the addition of activated carbon for the clarification of digestive resistant maltodextrin products is carried out at the final stage after the addition of enzymes is completed. This activated carbon has the property of absorbing enzymes, so that the total activity of the enzymes can be disrupted and additional enzymes are needed to make the process run smoothly. It is because in the present invention the addition of activated carbon is done after the enzymatic process has completed. Therefore, the use of enzymes may be minimized compared to other processes.

Brief Description of the Drawings

The embodiment of the present invention will be further described in more detail with reference to the drawings provided, wherein:

Figure 1 is a diagram of the production process of soluble dietary fiber in the form of digestive resistant maltodextrin according to the present invention.

Figure 2 is a drawing of the equipment arrangement for the production process of soluble dietary fiber in the form of digestive resistant maltodextrin according to the present invention.

5 Detailed Description of the Invention

The inventor made a breakthrough to provide a production process of soluble dietary fiber in the form of digestive resistant maltodextrin which is efficient and high in productivity. This results in a digestive resistant maltodextrin with a dietary fiber content of 70-90% and a sugar content of less than 10%.
10 Figure 1 shows a diagram of the production process of soluble dietary fiber in the form of digestive resistant maltodextrin according to the present invention. The raw material used for the production of digestive resistant maltodextrin is starch derived from tapioca, corn, sago or other materials having chemical and physical properties, commonly starch. The first stage is to transfer the raw material (1) in the form of starch using a vacuum type conveyor into Ribbon Mixer-type mixing machine. The second stage is to mix starch
15 and HCl (2) in Ribbon Mixer-type mixing machine so that the acidity or pH level is below 3.

The next step is to transfer the mixture of starch and HCl (3) from Ribbon Mixer-type mixing machine to Flash Dryer-type heating machine using a screw conveyor. The next is to dry the mixture of starch and HCl (6) using hot water vapor in Flash Dryer-type drying machine, until the water content is less
20 than 8%. In this Flash Dryer-type heating machine, a mixture of starch and HCl is heated to a temperature of 120–160°C. The next is to transfer the dried starch with low pH (5) from the Flash Dryer-type heating machine to a roasting tank using a vacuum-type conveyor machine. The next stage is to heat the dried starch with low pH (6) until the temperature reaches 160-180°C, wherein the stage is called pyrolysis to change the thermochemical properties of starch. The pyrolysis process is a thermochemical process that increases
25 the solubility of starch in water and improves the starch resistance to digestive process in human intestines. The pyrolysis process of starch occurs under acidic conditions with a pH of less than 3 and a high temperature of 160–180°C.

The next step is to suspend the starch (7) in the suspension tank by mixing the starch and hot water
30 or hot water vapor condensate. The result is a starch suspension with a density of Beume 20-22. Afterwards, the starch suspension is transferred to a slurry tank and proceeded to mix NaOH solution with the starch suspension (8). The purpose is to increase the pH of the starch suspension so that the pH of the starch suspension rises to more than 4.5. The next is to mix the alpha amylase enzyme with the starch suspension (9) in the slurry tank, and then the starch suspension is transferred to a reactor called Jet Cooker. The next
35 is to contact hot water vapor with the starch suspension (10) in Jet Cooker reactor so that the temperature

risers to more than 95°C. In this case, there is a direct contact between the hot water vapor and the starch suspension. This process is known as liquefaction, which is the breakdown of long-chain starch carbohydrates into oligosaccharide groups, which are monomeric groups composed of 1~12 chains of glucose molecules.

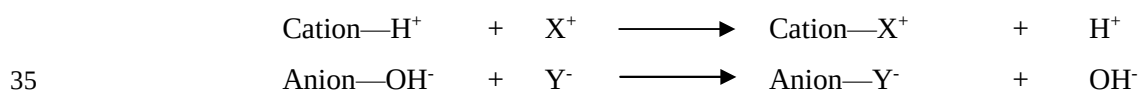
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The next stage is to add HCl to the oligosaccharides (11) using a dosing pump to the oligosaccharides output from Jet Cooker reactor, so that the pH of the oligosaccharides drops to 4.0–4.5. Afterwards, the temperature of oligosaccharide (12) is lowered from 95°C to about 50-60°C using a heat exchanger. The next is to carry out the reaction between the glucoamylase enzyme with oligosaccharides (13) in the saccharification tank, where the glucoamylase enzyme was added using a dosing pump. In the saccharification tank, oligosaccharides are broken down into simple sugars, which is called a saccharification process.

Sugar resulting from this hydrolysis process is dark brown colored and contains a lot of ionic impurities and physical impurities. To remove these impurities, the first stage of separation must be carried out, that is to remove physical impurities by purification using activated carbon and filtering. To increase the effectiveness of the absorption of color and odor-causing impurities as well as physical impurities, the step of heating a liquid resulting from the saccharification (14) is carried out from a temperature of 50–60°C to more than 80°C using a heat exchanger. The next is to clarify the liquid resulting from the saccharification (15) by adding activated carbon in the amount of 10 kg of activated carbon per ton of dry product at a minimum. The clarification is carried out with a contact time between liquid sugar and activated carbon of 4 hours at a minimum. The next step is to filter the liquid resulting from the saccharification (16) with a filter press-type filtering machine so that the liquid which is a mixture of sugars and soluble food fiber becomes clear.

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The next is to lower the temperature of the liquid resulting from saccharification (17) with a heat exchanger so that the previous temperature of more than 80°C will drop to less than 60°C. The second stage of separation is to remove cationic impurities from the liquid resulting from the saccharification (18) and proceeded to remove anionic impurities from the liquid resulting from the saccharification (19). The way is to flow the liquid sugar into ion exchange columns containing cation and anion resins. At this stage, an anionic purification process occurs where cationic impurities or positive ions are captured by a cation exchanger, and anionic impurities are captured by an anion exchanger. The reaction is as follows:



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The next stage is to flow the liquid resulting from the saccharification into a buffer tank (20) and proceeded with the flowing of the liquid resulting from the saccharification which has been clarified with activated carbon and ion exchange to the feeder tank (21). Afterwards, it is proceeded with the purification stage, that is separating digestive resistant maltodextrin from sugars resulting from the saccharification of which main components are glucose and maltose (22). Glucose and maltose are included in the category of simple sugars formed during the liquefaction and saccharification stage. The purpose of purification of digestive resistant maltodextrin is to reduce the total sugar content and increase the total value of dietary fiber. The equipment used for purification of digestive resistant maltodextrin is nano membranes having a hole size of 300–500 Daltons. Since glucose has a molecular weight of 180 g/mol and maltose has a molecular weight of 342 g/mol, glucose and maltose penetrate a nano membrane hole and flow in the permeate stream. Meanwhile, dietary fiber with long chains or clusters with a molecular weight of more than 500 g/mol is unable to penetrate the membranes so that it flows as a concentrate for digestive resistant maltodextrin which in the present invention is referred to as soluble dietary fiber. The purification of digestive resistant maltodextrin separates glucose and maltose from digestive resistant maltodextrin and produce soluble dietary fiber with fiber content of 70-90% and sugar content of less than 10%.

The digestive resistant maltodextrin concentrate still contains ionic impurities and physical impurities. To remove these impurities, the first stage of separation should be carried out, that is to remove physical impurities by purification using activated carbon and filtering. To increase the effectiveness of absorption of color and odor-causing impurities as well as physical impurities, heating of the digestive resistant maltodextrin concentrate (23) is carried out from a temperature of less than 70°C to more than 80°C using a heat exchanger. The next is to clarify the digestive resistant maltodextrin concentrate (24), by adding activated carbon in the amount of 10 kg per ton of dry product at a minimum, with a contact time between the digestive resistant maltodextrin concentrate and activated carbon of 4 hours at a minimum. The next step is to filter the digestive resistant maltodextrin concentrate (25) with a filter press-type filtering machine so that the digestive resistant maltodextrin concentrate is separated from the physical impurities and the pre-added activated carbon.

The final stage of purification of the digestive resistant maltodextrin concentrate is the removal of the cationic impurities (26) and proceeded with the removal of the anionic impurities from the digestive resistant maltodextrin concentrate (27). The way is to flow the digestive resistant maltodextrin concentrate into ion exchange columns containing cation and anion resins. At this stage, an anionic purification process occurs where cationic impurities or positive ions are captured by the cation exchanger, and anionic impurities are captured by the anion exchanger. The purpose of removing the cationic impurities (26) and

removing the anionic impurities from digestive resistant maltodextrin concentrate (27) is to reduce or even eliminate ionic impurities which will only cause the color of digestive resistant maltodextrin products turn bad when concentrated. The next step is to filter the cation and anion resins that may pass (28) using a bag filter-type filter, and the last step is to concentrate digestive resistant maltodextrin concentrates (29) using a multistage vacuum evaporator. The process of concentrating the digestive resistant maltodextrin concentrates is carried out by heating the digestive resistant maltodextrin concentrates so that the concentration increases from a concentration of 30% to 75%.

Figure 2 shows a drawing of the equipment arrangement for the production process of soluble dietary fiber in the form of digestive resistant maltodextrin according to the present invention. The equipments used are:

- vacuum-type conveyor machine (30): to transfer raw materials (1) in the form of starch,
- Ribbon Mixer-type mixing machine (31): to mix a starch with HCl (2),
- screw-type conveyor machine (32): to transfer the mixture of the starch and HCl (3),
- Flash Dryer-type drying machine (33): to dry the mixture of the starch and HCl (4),
- vacuum-type conveyor machine (34): to transfer the dried starch with low pH (5),
- roasting tank (35): to heat the dried starch with low pH, pyrolysis process (6),
- suspension tank (36): to suspend the starch (7),
- slurry tank (37): to mix NaOH solution with the starch suspension (8) and to mix alpha amylase enzyme with the starch suspension (9),
- Jet Cooker reactor (38): to bring a hot water vapor into contact with the starch suspension (10),
- dosing pump (39): to add HCl to oligosaccharides (11),
- heat exchanger (40): to lower the temperature of the oligosaccharides (12),
- dosing pump (41): to add glucoamylase enzyme to oligosaccharides,
- saccharification tank (42): to react glucoamylase enzyme with oligosaccharides (13),
- heat exchanger (43): to heat a liquid resulting from the saccharification (14),
- clarification tank (44): to clarify the liquid resulting from the saccharification (15),
- filter press-type filtering machine (45): to filter the liquid resulting from the saccharification (16),
- heat exchanger (46): to lower the temperature of the liquid resulting from the saccharification (17),
- cation exchanger (47): to remove cationic impurities from the liquid resulting from the saccharification (18),

- anion exchanger (48): to remove anionic impurities from the liquid resulting from the saccharification (19),
- buffer tank (49): to accommodate the liquid resulting from the saccharification before entering the previous process,
- 5 – feed tank (50): to accommodate the liquid resulting from the saccharification,
- nano membranes (51): to separate digestive resistant maltodextrin from glucose and maltose (22),
- storage tank for glucose and maltose (52): to accommodate sugars separated from digestive resistant maltodextrin,
- heat exchanger (53): to heat digestive resistant maltodextrin concentrates (23),
- 10 – clarification tank (54): to clarify the digestive resistant maltodextrin concentrates (24),
- filter press-type filtering machine (55): to filter the added activated carbon from the digestive resistant maltodextrin concentrates (25),
- cation exchanger (56): to remove cationic impurities from the digestive resistant maltodextrin concentrates (26),
- 15 – anion exchanger (57): to remove anionic impurities from the digestive resistant maltodextrin concentrates (27),
- bag filter-type filter (58): to filter cation and anion resins that may pass (28),
- multistage vacuum evaporator (59): to concentrate the digestive resistant maltodextrin concentrates (29).

20 Explanations and definitions referring to the drawings described in the description, are intended only for illustration, and do not constitute limitations to the invention, since modifications can be made without deviating from the patent protection claimed in the present invention.

Claims

1. A production process of soluble dietary fiber that is not easily broken down in human intestines which is a digestive resistant maltodextrin, the method consisting of the following steps:

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a. transferring raw materials (1) of starches derived from tapioca, corn, sago or any other material having physical and chemical properties commonly starch, using a vacuum-type conveyor machine into Ribbon Mixer-type mixing machine;

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b. mixing the starch and HCl (2) using Ribbon Mixer-type mixing machine in order the acidity level or pH of the starch to be lower than 3;

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c. transferring the mixture of the starch and HCl (3) using screw-type conveyor machine to Flash Dryer-type heating machine;

d. drying the mixture of the starch and HCl (4) using hot water vapor in Flash Dryer-type drying machine and, in which the mixture of the starch and HCl is heated with the temperature reaching 120-160°C until the moisture of the starch is lower than 8%;

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e. transferring the dried starch with low pH (5) using vacuum-type conveyor machine to a roasting tank;

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f. heating the dried starch with low pH (6) using the roasting tank until the temperature reach 120-160°C and under an acidic condition with pH lower than 3, in which a pyrolysis process occurs so the solubility of the starch in the water increases and improves the starch resistance of digestion process in human intestines;

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g. suspending the starch (7) by mixing the starch with hot water or hot water vapor condensate in a suspension tank thereby resulting in a starch suspension with a density of Beume 20-22;

h. mixing NaOH solution with the starch suspension (8) in a slurry tank so the pH of the starch suspension increases to be higher than 4.5;

- i. mixing and alpha amylase enzyme with the starch suspension (9) in the slurry tank, so the starch suspension is ready to be reacted inside Jet Cooker reactor;
- j. bringing hot water vapor into contact with the starch suspension (10) inside the Jet Cooker reactor so the temperature is higher than 95°C and liquefaction/hydrolysis process occurs, that is breaking down a long chain of starch carbohydrate into oligosaccharide group, which is a monomer group consisting of 1~12 glucose molecule chains;
- k. adding HCl into oligosaccharide (11) output from Jet Cooker reactor using a dosing pump in order the pH of oligosaccharide lowered to be 4,0-4,5;
- l. lowering the temperature of oligosaccharide (12) using a heat exchanger so that the temperature decreases from 95°C to about 50-60°C;
- m. reacting glucoamylase enzyme with oligosaccharide (13) inside the saccharification tank so that a saccharification process that is breaking down oligosaccharide to simple sugars, occurs;
- n. heating a liquid resulting from the saccharification (14) using the heat exchanger until the temperature increases from 50-60°C to higher than 80°C;
- o. clarifying the liquid resulting from the saccharification (15) that is adding an activated carbon in the amount of 10 kg per ton of dry product at a minimum, wherein a contact time between the liquid and the activated carbon is 4 hours at a minimum;
- p. filtering the liquid resulting from the saccharification (16) using filter press-type filtering machine so that the liquid becomes clear;
- q. lowering the temperature of the liquid resulting from the saccharification (17) using heat exchanger so that the prior temperature of 80°C decreases to be lower than 60°C;
- r. removing cationic impurities from the liquid resulting from the saccharification (18) and proceeded by removing anion impurities from the liquid resulting from the saccharification (19), wherein the liquid resulting from the saccharification is caused to flow to ion exchanger columns containing cation and anion resins so that the cationic impurities or positive ions are caught by cation exchangers, and the anionic impurities are caught by anion exchangers;

- s. flowing the liquid resulting from the saccharification to a buffer tank (20) and proceeded to flow the liquid resulting from the saccharification having passed through the clarification with activated carbons and the ion exchangers to a storage tank (21);
- 5 t. separating digestive resistant maltodextrin from glucose or maltose (22) by passing the liquid resulting from the saccharification containing digestive resistant maltodextrin and simple sugars consisting of glucose and maltose in the nano membrane having a hole size of 300-500 Daltons, so that glucose and maltose penetrate the nano membrane hole and flow within a permeate stream, whereas digestive resistant maltodextrin dietary fiber with the molecule weight of higher than 500
10 g/mol is not be able to penetrate the membranes thereby flowing as concentrates, and resulting in soluble dietary fiber which is a digestive resistant maltodextrin with the fiber level of 70-90% and the sugar level of less than 10%;
- u. heating digestive resistant maltodextrin concentrates (23) using the ion exchanger so that the
15 temperature increases from 70°C to be higher than 80°C;
- v. clarifying the digestive resistant maltodextrin concentrates (24) that is adding an activated carbon in the amount of 10 kg per ton of dry product at a minimum, wherein a contact time between the digestive resistant maltodextrin concentrates and the activated carbon is 4 hours at a minimum;
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- w. filtering the digestive resistant maltodextrin concentrates (25) using filter press-type filtering machine so that the digestive resistant maltodextrin concentrates are separated from physical impurities and the pre-added carbon active;
- 25 x. removing cationic impurities from the digestive resistant maltodextrin concentrates (26) and proceeded by removing anionic impurities from the digestive resistant maltodextrin concentrates (27), wherein it is conducted by flowing the digestive resistant maltodextrin concentrates to ion exchanger columns containing cation and anion resins will be caught by the cation exchanger, and anionic impurities will be caught by the anion exchanger;
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- y. filtering cation and anion resins likely to pass (28) by bag filter-type filter;
- z. concentrating the digestive resistant maltodextrin concentrates (29) by heating using a multistage vacuum evaporator so that the concentration increases from the concentration of 30% to 75%.