# DESCRIPTION

## TITLE OF INVENTION

# METHOD FOR PRODUCING EXTRACT OF BIOLOGICAL TISSUE, AND METHOD APPARATUS AND METHOD FOR PROCESSING BIOLOGICAL TISSUE

## TECHNICAL FIELD

[0001] The present disclosure relates to a method for producing an extract of a biological tissue, and an apparatus and a method for processing a biological tissue.

## BACKGROUND ART

[0002] Most of proteins contained in tea leaves are slightly soluble or insoluble in water, are hardly extracted during production of tea beverages, and are difficult to ingest from tea beverages produced using an ordinary method. According to the Standard Tables of Food Composition in Japan, 2020 (Eighth Revised Edition), tea leaves, which are used as raw materials of green tea beverages, black tea beverages, and the like, contain proteins at about 20 g/100 g to 30 g/100 g. Meanwhile, tea leaf infusions such as green tea beverages and black tea beverages produced through extraction of these tea leaves serving as raw materials contain proteins only at about 0 g/100 g to 1.3 g/100 g, and a large quantity of proteins remains in tea leaves (used tea leaves) after being subjected to extraction for production of tea beverages.

[0003] As in the case of tea leaves, coffee beans, which are used as raw materials of coffee beverages, also contain proteins, but coffee beverages, which are coffee bean infusions, contain substantially no proteins, and a large quantity of proteins remains in used coffee beans after being subjected to extraction for production of coffee beverages.

[0004] In most cases, these used tea leaves and used coffee beans are discarded without being subjected to further processing operations, and are not effectively utilized.

[0005] As a method for increasing efficiency of extracting components contained in tea leaves, methods for preparing a protein decomposition product by allowing an enzyme to act on an extract obtained by adding an alkaline solution to tea leaves have been proposed (Patent Literature 1 and Patent Literature 2). The references above disclose that the methods can be used to extract water-insoluble proteins contained in tea leaves, and it is also possible to reduce production cost and to effectively use unused resources because used tea leaves resulting from the extraction step of the tea beverage production process can be utilized.

[0006] Also, as a means for effectively using components contained in food such as the above-

operation (e.g., cutting, shearing, or homogenization), a chemical processing operation (e.g., a redox reaction, a hydrolysis reaction, or an enzyme reaction), a high/low-temperature processing operation (e.g., heating, refrigeration, or freezing), or the like.

[0035] The term "extracellular matrix" as used herein means a structure that exists outside a cell. The extracellular matrix of the above-mentioned animal may include, for example, components such as collagen, proteoglycan, hyaluronic acid, fibronectin, laminin, tenascin, elastin, and chitin. The extracellular matrix of the above-mentioned plant may include, for example, a cell wall (containing cellulose, hemicellulose, lignin, pectin, cuticle, etc.), and the like.

[0036] The term "enzyme" as used herein means any enzyme capable of decomposing a target component. When the biological tissue is derived from an animal, examples of the enzyme include enzymes that decompose the components of the extracellular matrix, such as collagen, proteoglycan, hyaluronic acid, fibronectin, laminin, tenascin, elastin, and chitin. When the biological tissue is derived from a plant, examples of the enzyme include enzymes that decompose a cell wall (containing cellulose, hemicellulose, lignin, pectin, cuticle, etc.) and the like. The enzyme may be, for example, a protease, a cellulase, a hemicellulase, and/or pectinase.

[0037] The term "microbial culture solution" as used herein means a culture solution obtained by culturing microorganisms that express a target enzyme. Examples of the microbial culture solution include a culture solution in which the microorganisms proliferate to an extent that they contribute to decomposition of a target component; a culture solution in which an enzyme secreted into a culture solution by the microorganisms accumulates to an extent that the enzyme contributes to the decomposition; and the like. In the latter case, the microbial culture solution may or may not contain the microorganisms. The microorganisms are not particularly limited as long as, for example, they express the target enzyme. There is no particular limitation on the culture solution as long as the microorganisms can be cultured therein.

[0038] The term "cell" as used herein means any cell derived from the biological tissue. For example, one or two or more cells may be used. One type of cell or a plurality of types of cells may be used. When a plurality of cells or a plurality of types of cells are used, the cells may be separate from one another or form an aggregate.

[0039] The term "extraction" as used herein means removal of a certain component from a target, and/or a state in which a certain component is removed from a target. The "extraction" can be achieved, for example, through at least one extraction process. In this specification, a substance containing a component removed from the target is referred to as an "extract". In addition, a solution containing a component removed from the target is referred to as an "extract

solution". The extract or extract solution may contain a cellular component of the biological tissue. The cellular component may be, for example, a low-molecular-weight compound, a nucleic acid, an amino acid, a peptide, a protein, and/or extracellular matrix. When the extract or extract solution contains extracellular matrix such as a cell wall, the extract or extract solution may contain, for example, cellulose microfibers and/or cellulose nanofibers. The extract may be, for example, cellulose fibers. The cellulose fibers include cellulose microfibers, cellulose nanofibers, and/or hemicellulose. The cellulose microfibers, cellulose nanofibers and/or hemicellulose can be isolated by, for example, subjecting the cellulose fibers to delignification or the like. These substances can be independently trading targets as various materials. Also, the cellulose fibers themselves can be trading targets. The cellulose fibers may be cellulose fibers (i.e., venous cellulose fibers) contained in a leaf vein of any plant. Also, the cellulose fibers may be cellulose fibers contained in cellulose fibers contained in a mesophyll or cellulose fibers contained in a cell wall.

[0040] The term "purification" as used herein means identification and separation of a substance, collection of a substance from components in a natural state, a state in which a substance is identified and separated, and/or a state in which a substance is collected from components in a natural state. The "purification" can be achieved, for example, through at least one purification process. The purification can also be referred to as "isolation".

[0041] The term "low-molecular-weight compound" means a compound with a low molecular weight (lower than 900 daltons). Examples of the low-molecular-weight compound include an amino acid, a lipid, a sugar, a fatty acid, and the like. Specifically, the low-molecular-weight compound may be, for example, catechin or the like.

[0042] The term "peptide" as used herein means a polymer composed of unmodified amino acids (natural amino acids), modified amino acids, and/or artificial amino acids.

[0043] The term "protein" as used herein means a polymer composed of unmodified amino acids (natural amino acids), modified amino acids, and/or artificial amino acids. The protein is, for example, a peptide composed of 10 or more amino acids.

[0044] Although the following describes examples of the present disclosure, the present disclosure is not limited to the following examples and the like, and can be implemented with any modifications. Also, each description in the present disclosure and embodiments can be applied to other descriptions unless otherwise stated. Note that the expression "to" as used herein means that the numerical or physical values before and after "to" are included. In addition, the expression "A and/or B" as used herein encompasses "only A", "only B", and "both A and B".

[0045] [Method for Producing Extract of Biological Tissue]

source 4a of the agitation device 4 is operated, the following situations 1) to 4) occur in the mixed solution L1 simultaneously or in a multiplex manner, thus making it possible to achieve a state in which the extracellular matrix M, etc., the cells C, and the extract E are suspended in the mixed solution L while the extracellular matrix M, etc., and the cells C and the extract E are separated from the biological tissues T. Note that when flowing out from the cells C, an extract E in a liquid form can be suspended in the mixed solution L or be mixed in the mixed solution L.

[0083] 1) As mixing of the solution L1 and the biological tissues T progresses due to the rotation of the agitation blade 4c, the enzyme contained in the solution L1 comes into contact with the biological tissues T, and thus the extracellular matrix M, etc., of the biological tissues T is decomposed with the enzyme. Thus, in a portion of the biological tissues T, the cells C and the extract E of the biological tissue T are separated from the extracellular matrix M, etc., at a position at which the extracellular matrix M, etc., is decomposed, and flow out therefrom. Also, in a portion of the biological tissues T, the cells C and the extract E of the biological tissue T are not separated from the extracellular matrix M, etc. Thus, the biological tissue T in which the cells C and the extract E are linked to the extracellular matrix M, etc., and are exposed from the extracellular matrix M, etc., (such a biological tissue T may also be referred to as a "non-separate-type biological tissue T1") is suspended in the mixed solution L.

[0084] 2) A stream is generated in the mixed solution L due to the rotation of the agitation blade 4c (see, for example, FIG. 7), and therefore, mixing of the biological tissues T and non-separate-type biological tissues T1 and the solution L1 progresses due to the stream. Also, a force generated by the stream of the mixed solution L is applied to the biological tissues T, non-separate-type biological tissues T1, and the like. When the force generated by the stream is applied to the non-separate-type biological tissues T1, the cells C and the extract E are separated from the extracellular matrix M, etc., of a portion of the non-separate-type biological tissues T1. Note that in the case of the non-separate-type biological tissue T1 in which the cells C and the extract E are not separated from the extracellular matrix M, etc., even when the force generated by the stream is applied thereto, the non-separate-type biological tissue T1 is suspended in the mixed solution L as it is.

[0085] 3) Due to the rotation of the agitation blade 4c, a situation occurs in which the agitation blade 4c comes into contact with the biological tissue T in the mixed solution L. When the agitation blade 4c comes into contact with the biological tissue T1, a cut S is generated in the extracellular matrix M, etc., in the biological tissues T in which the leading edge e of the agitation blade 4c comes into contact with the extracellular matrix M, etc., at a suitable angle, out of the biological tissues T with which the leading edge e comes into contact. That is to say, a shearing force is applied from the leading edge e of the agitation blade 4c to the extracellular matrix M,

[0090] Meanwhile, a sensor 10s for determining the state of the mixed solution L may be provided to adjust the rotation rate of the agitation blade 4c or stop the agitation (i.e., finish the processing) based on the signals from the sensor 10s. For example, a control unit 10 may be provided on the biological tissue processing apparatus 1A of this embodiment such that the control unit 10 controls the operation of the agitation device 4 based on the signals from the sensor 10s (see FIG. 1B). In this case, examples of the sensor for determining the state of the mixed solution L, namely the sensor 10s for determining the processed state of the biological tissue T, include a viscometer, an image sensor (using a camera for AI analysis of a separation state and colors), a pH sensor, a thermometer, and the like. Note that the signals obtained from the pH sensor, thermometer, or the like can be used as information for determining the processed state of the biological tissue T as well as information for adjusting the state of the mixed solution L when the control unit 10 controls the operation of an electrolytic solution supply device 12, an enzyme addition unit 13, a heater for adjusting the temperature of the mixed solution L, and the like, which will be described below. In order to allow the control unit 10 to control the operation state of the agitation device 4, it is desirable to provide a load sensor, a wattmeter, a strain gage, a rotation rate sensor, and the like for the agitation motor serving as the driving source 4a as the sensors for determining the operation state of the agitation device 4.

[0091] (Method for Supplying Biological Tissue T)

In the description of the example above, the biological tissues T in an amount corresponding to the amount of the solution L1 in the housing space 2h of the housing container 2 are collectively supplied to the housing space 2h of the housing container 2. The biological tissues T may be supplied in small portions to the housing space 2h of the housing container 2. When supplied in small portions to the housing space 2h of the housing container 2, the biological tissues T can be easily dispersed in the solution L1, thus making it easy to adjust the state of mixing the solution L1 and the biological tissues T together, namely the state of the mixed solution L, to a favorable one.

[0092] For example, as shown in FIG. 1B, a biological tissue supply unit 11 for supplying the biological tissues T as appropriate may be provided to supply the biological tissues T in a suitable amount depending on the state of the mixed solution L. In order to allow the biological tissue supply unit 11 to supply the biological tissues T, an operator operates the biological tissue supply unit 11 based on the state of the mixed solution L (for example, based on visual confirmation and the signals from the sensor for determining the state of the mixed solution L).

[0093] The control unit 10 may be provided such that the control unit 10 controls the operation of the biological tissue supply unit 11 based on the signals from the sensor for determining the state of the mixed solution L as described above to supply the biological tissues T. In this case,

it is possible to more suitably process the biological tissues T if the control unit 10 controls the operation state of the agitation device 4 in accordance with the amount of the biological tissues T supplied by the biological tissue supply unit 11.

[0094] (Method for Preparing Solution L1)

In the description of the example above, the solution L1 that has been prepared in advance in a predetermined state is supplied to the housing space 2h of the housing container 2, but the solution L1 may be prepared in a predetermined state in the housing space 2h of the housing container 2.

[0095] For example, as shown in FIG. 1B, providing the electrolytic solution supply device 12 for supplying, to the housing space 2h of the housing container 2, an electrolytic solution prepared to have a predetermined pH and the enzyme addition unit 13 for supplying the enzyme to the housing space 2h of the housing container 2 makes it possible to prepare the solution L1 in a predetermined state in the housing space 2h of the housing container 2. In addition, it is possible to stabilize the state of the mixed solution L if the enzyme and the electrolytic solution are supplied even while the mixed solution L is processed in the biological tissue processing apparatus 1A of this embodiment. In particular, when the biological tissues T are supplied in small portions to the housing space 2h of the housing container 2, the enzyme and the electrolytic solution can be supplied in accordance with the supplied state and the processed state of the biological tissues T, thus making it possible to conduct suitable and effective processing on the biological tissues T.

[0096] In this case, it is desirable that the electrolytic solution supply device 12 is configured to include an electrolyzed water production device 12a for generating an electrolytic solution with a predetermined pH, and a reserve tank 12b for storing the electrolytic solution generated by the electrolyzed water production device 12a. With the configuration above, the electrolytic solution can be stably supplied from the reserve tank 12b to the housing space 2h of the housing container 2. Also, if the reserve tank 12b is provided with a function of adjusting the state of the stored electrolytic solution, it is possible to further stabilize the state of the electrolytic solution supplied to the housing space 2h of the housing container 2. In this case, the reserve tank 12b corresponds to an adjusting unit as described in the claims.

[0097] (Method for Separating Extracellular Matrix M, Etc., and Extract E, Etc., from Each Other)

The extracellular matrix M, etc., the cells C, and the extract E (the cells C and the extract E may be collectively referred to as "extract E, etc." hereinafter) separated by the biological tissue processing apparatus 1A of this embodiment are collected from the mixed solution L. In order to efficiently collect the extracellular matrix M, etc., and the extract E, etc.,

[0117] In the biological tissue processing apparatus 1B of this embodiment having the configuration above, during the circulation between the separation tank 4T and the housing container 2B, the extracellular matrix M, etc., and the extract E, etc., may be separated from each other, or components such as caffeine and catechin may be collected. For example, the return channel 31 is provided with a first return channel 32 for feeding the mixed solution L fed from the separation tank 4T directly to the housing container 2B, a second return channel 33 for feeding the solution to the housing container 2B through the component collection portion 7 made of activated carbon or a solid-liquid separation device 8 such as a cyclone or a filter, and a switching mechanism 31c for switching the channel through which the mixed solution L flows between the first return channel 32 and the second return channel 33. Thus, when the mixed solution L is allowed to flow through the first return channel 32 using the switching mechanism 31c, the regular processing can be continued. Meanwhile, when the mixed solution L is allowed to flow through the second return channel 33 using the switching mechanism 31c, the extracellular matrix M, etc., can be separated from the mixed solution L, and components such as caffeine and catechin can be collected using the component collection portion 7.

[0118] The switching mechanism 31c need only have a function of switching the channel between the first return channel 32 and the second return channel 33, and the mechanism is not particularly limited. For example, a known branched valve or the like can be employed as the switching mechanism 31c.

[0119] Also, the second return channel 33 may be provided with both the component collection portion 7 and the solid-liquid separation device 8, or only one of them. For example, when the component collection portion 7 is provided in the separation tank 4T or the housing container 2B, the second return channel 33 may be provided with only the solid-liquid separation device 8. When the filtration member 6 is provided in the housing container 2B or the separation tank 4T, the second return channel 33 may be provided with only the component collection portion 7. Furthermore, the second return channel 33 may be further provided with branch channels, each of which may be provided with the component collection portion 7 and the solid-liquid separation device 8. In this case, the second return channel 33 may be provided with a switching mechanism for switching channels through which the mixed solution L flows, or the mixed solution L may be allowed to flow through both channels when the mixed solution L is supplied to the second return channel 33.

[0120] The first return channel 32 may be provided with an enzyme supply unit 12 for supplying the enzyme to the housing space 2h of the housing container 2.

[0121] <Consecutive Processing>

homogenization device-side supply channel 21d, and the return-side switching mechanism 35 provides communication between the processing container-side return channel 31b of the same housing container 2B and the homogenization device-side return channel 31d. Thus, the mixed solution L housed in the one housing container 2B can be processed while the mixed solution L is circulated between the one housing container 2B and the homogenization device 40.

[0155] Then, when the processing of the mixed solution L housed in the one housing container 2B is finished, the supply-side switching mechanism 25 is used to switch the processing container-side supply channel 21a that is in communication with the homogenization device-side supply channel 21d of the homogenization device 40 from the processing container-side supply channel 21a of the one housing container 2B to the processing container-side supply channel 21a of another housing container 2B. At the same time, the return-side switching mechanism 35 is used to switch the processing container-side return channel 31a that is in communication with the homogenization device-side return channel 31d of the homogenization device 40 from the processing container-side return channel 31a of the one housing container 2B to the processing container-side return channel 31a of another housing container 2B. That is to say, the return-side switching mechanism 35 provides communication between the processing container-side return channel 31a of the housing container 2B whose processing container-side supply channel 21a is in communication with the homogenization device-side supply channel 21d, and the homogenization device-side return channel 31d of the homogenization device 40. Thus, the mixed solution L housed in another housing container 2B can be processed while circulated between the other housing container 2B and the homogenization device 40.

[0156] Successively switching the housing container 2B that is in communication with the homogenization device 40 by repeating the operation above makes it possible to successively process the mixed solutions L housed in the housing containers 2B.

[0157] Meanwhile, if the mixed solution L is processed for a relatively long period of time, the biological tissue processing apparatus 1E of this embodiment may be operated as follows.

[0158] For example, when the processing of the mixed solution L housed in one housing container 2B is finished, the one housing container 2B is separated from the homogenization device 40, and then the mixed solution L is discharged from the outlet 2b provided in the one housing container 2B and is collected. Next, a fresh mixed solution L is supplied to the one housing container 2B from which the processed mixed solution L has been discharged. Thus, when the one housing container 2B is connected to the homogenization device 40 again, the fresh mixed solution L housed in the one housing container 2B can be processed. That is to say, if the processed mixed solutions L are discharged from the plurality of housing containers 2B and then fresh mixed solutions L are supplied thereto, the mixed solution L can be consecutively

processed for a long period of time by using the supply-side switching mechanism 25 and the return-side switching mechanism 35 to successively switch the housing container 2B that is connected to the homogenization device 40, even when the number of the housing containers 2B is limited.

[0159] When each of the housing containers 2B is provided with the filtration member 6, the extracellular matrix M, etc., is collected from the filtration member 6 at the time of collection of the mixed solution L.

[0160] When each of the housing containers 2B is provided with the filtration member 6, the processing container-side supply channel 21a is connected to a position above the filtration member 6. That is to say, the processing container-side supply channel 21a is provided such that the mixed solution L to be supplied from the housing container 2B to the homogenization device 40 is collected from a position above the filtration member 6.

[0161] When the housing container 2B that is connected to the homogenization device 40 is switched, an operator may switch it after confirming the processed states of the mixed solutions L in the housing containers 2B, or an operator may switch it at equal intervals. When the control unit 10 is provided, the control unit 10 may switch the housing container 2B that is connected to the homogenization device 40 after confirming the processed states in the housing containers 2B using sensors, or may switch it at equal intervals.

[0162] <Plurality of Separation Tanks 4T and Plurality of Homogenization Devices 40>

In the descriptions of the examples above, the plurality of housing containers 2B are connected to one separation tank 4T or one homogenization device 40, but a plurality of separation tanks 4T or a plurality of homogenization devices 40 may be provided and configured such that the plurality of housing containers 2B are respectively in communication with the plurality of separation tanks 4T or the plurality of homogenization devices 40. That is to say, the separation tanks 4T or the homogenization devices 40 may be configured to be switchably in communication with the plurality of housing containers 2B via the supply-side switching mechanism 25 and the return-side switching mechanism 35. For example, as shown in FIG. 8, the biological tissue processing apparatus 1C of this embodiment may have a configuration in which a plurality of (two in FIG. 8) separation tanks 4T are provided and a plurality of (two in FIG. 8) housing containers 2B are in communication therewith via the supply-side switching mechanism 25 and the return-side switching mechanism 35. In this case, if the separation tanks 4T or the homogenization devices 40 have the same agitation function, that is, the separation tanks 4T or the homogenization devices 40 are the same, it is also possible to conduct substantially the same processing on the mixed solutions L in the housing containers 2B while simultaneously circulating the mixed solutions L between the housing containers 2B and the

that the agitation blade 4c has such a shape that the leading edge e can form a scratch S such as a cut on the extracellular matrix M, etc., of the biological tissue T when coming into contact with the extracellular matrix M, etc., and can cut the linkage between the extracellular matrix M, etc., and the extract E, etc., when coming into contact with the non-separate-type biological tissue T1. For example, when the leading edge e of the agitation blade 4c has a sharp shape, that is, the surfaces forming the leading edge e of the agitation blade 4c form an acute angle, as shown in FIGs. 1A-1B, the effects as described above can be obtained.

[0168] In order to increase a shearing force applied to the extracellular matrix M, etc., of the biological tissue T, a hood member or the like is provided to cover the agitation blade 4c, and a clearance between the outer edge of the agitation blade 4c and the inner surface of the hood member is reduced. Thus, a shearing force generated between the outer edge of the agitation blade 4c and the inner surface of the hood member can also be applied to the extracellular matrix M, etc., of the biological tissue T in addition to a shearing force by the leading edge e of the agitation blade 4c, thus making it possible to enhance the effects as described above.

[0169] When the hood member is provided, it is desirable that the outer edge ef of the agitation blade 4c also has a shape that can apply a shearing force to the extracellular matrix M, etc., similarly to the leading edge e of the agitation blade 4c. Thus, a shearing force applied to the extracellular matrix M, etc., of the biological tissue T can be further increased due to a shearing force generated between the outer edge of the agitation blade 4c and the inner surface of the hood member. That is to say, a scratch S such as a cut can be effectively formed on the extracellular matrix M, etc., of the biological tissue T when the agitation blade 4c comes into contact with the extracellular matrix M, etc., and the linkage between the extracellular matrix M, etc., and the extract E, etc., can be effectively cut when the agitation blade 4c comes into contact with the non-separate-type biological tissue T1.

[0170] For example, assume that the agitation blade 4c is constituted by a cylindrical hub b fixed to the rotating shaft 4b, and a plurality of (four in FIGs. 6A-6B) blades f provided on the outer circumferential surface of the hub b as being rotationally symmetric around the rotating shaft 4b, as shown in FIGs. 6A-6B. Note that in FIGs. 6A-6B, surfaces of the hub b located at an upper position and a lower position when the agitation blade 4c is placed in the housing space 2h of the housing container 2 as shown in FIG. 7 are defined as a surface b1 and a surface b2, respectively.

[0171] An upper surface f1 of each of the blades f faces upward when the agitation blade 4c is placed in the housing space 2h of the housing container 2, and the outer edge ef formed by the upper surface f1 and an outer end surface f2 of the blade f has a sharp shape. In addition, the blade f is long to some extent in a direction in which the rotating shaft 4b extends, and the width

of the upper portion (i.e., the width near the surface b1 of the hub b) is larger than the width of the lower portion (i.e., the width near the surface b2 of the hub b). That is, the agitation blade 4c has a substantially trapezoidal shape in a side view due to the shape of the blade f.

[0172] As shown in FIGs. 5A-5B, a hood member 4f for covering the agitation blade 4c (housing the agitation blade 4c thereinside) has a bottomed cylindrical shape that has a space capable of housing the agitation blade 4c thereinside, an open lower end, and a blocked upper end. Also, the upper end surface of the hood member 4f is provided with a shaft space sh through which the space and the outside are in communication with each other and the rotating shaft 4b is to be inserted, and a plurality of (six in FIGs. 5A-5B) through holes Lf through which streams of the mixed solution L generated by the agitation blade 4c can pass. Furthermore, the inner surface of the hood member 4f is provided with a shearing surface sf such that the clearance between the inner surface of the hood member 4f and the outer end surface f2 of the agitation blade 4c is reduced. The shearing surface sf has a shape that is substantially similar to the shape of the agitation blade 4c in a cross-sectional view (see FIG. 7). That is to say, the shearing surface sf is formed such that distances between the shearing surface sf and the outer end surface f2 of the agitation blade 4c at any positions corresponding to the outer end surface f2 are substantially the same. Note that in FIGs. 5A-5B, the hood member 4f and the agitation blade 4c are expressed such that the sizes on a side away from the viewpoint are reduced.

[0173] When the agitation blade 4c as described above is placed in the housing space 2h of the housing container 2 in a state of being housed in the hood member 4f, and then the agitation blade 4c is rotated, it is possible to generate a stream of the mixed solution L as shown in FIG. 7. Moreover, when the agitation blade 4c is rotated, a shearing force generated due to the biological tissue T caught between the outer edge ef and the shearing surface sf can also be applied to the biological tissue T or the non-separate-type biological tissue T1 in addition to a shearing force by the leading edge e or the outer edge ef of the agitation blade 4c alone. Thus, a scratch such as a cut can be effectively formed on the extracellular matrix M, etc., of the biological tissue T when the agitation blade 4c comes into contact with the extracellular matrix M, etc., and the linkage between the extracellular matrix M, etc., and the extract E, etc., can be effectively cut when the agitation blade 4c comes into contact with the non-separate-type biological tissue T1.

[0174] Similarly to the leading edge e of the agitation blade 4c, the outer edge ef of the agitation blade 4c also corresponds to a shearing blade as described in the claims.

[0175] [Second Biological Tissue Processing Apparatus]

An aspect of the present disclosure provides a second biological tissue processing apparatus with improved extraction efficiency. The processing apparatus of the present disclosure includes: a first housing container that is capable of housing a mixed solution obtained

the processing method of this embodiment returns to the process S1. Specifically, when the decomposition of the mixed solution progresses, the state of the mixed solution becomes constant. Therefore, a change in the state of the mixed solution can be evaluated based on, for example, the rate of change in or the derivative value of the measurement value. In an example in which the predetermined condition is a condition related to the rate of change in or the derivative value of the measurement value, when the rate of change or the derivative value is, for example, smaller than or equal to a certain value or substantially zero, it is determined in the process S3 that the decomposition of the biological tissue in the first housing container 50 is finished, and the processing method of this embodiment proceeds to the process S4. On the other hand, when the rate of change or the derivative value is not smaller than or equal to a certain value or substantially zero, it is determined in the process S3 that the decomposition of the biological tissue in the first housing container 50 has not been finished yet, and the processing method of this embodiment returns to the process S1.

[0194] In the process S4, the first control device 53 controls the separation device 51 to allow the motor 51b to start the rotation of the agitation blade 51a and to increase the rotation rate of the agitation blade 51a, thereby increasing the frequency of contact between the agitation blade 51a and the biological tissue in the mixed solution, and thus the decomposition product of the biological tissue is separated in the first housing container 50.

[0195] The processing method of this embodiment prevents the decomposition in the first housing container 50 from being continued for an unnecessarily long period of time, and the decomposition product of the biological tissue can be separated by the separation device 51 at an appropriate timing. Accordingly, with the processing method of this embodiment, it is possible to efficiently process a biological tissue to produce an extract of a component derived from the biological tissue.

[0196] In the processing method of this embodiment, the first control device 53 controls the separation device 51 to separate the decomposition product of the biological tissue in the first housing container 50 in the process S4, but the present disclosure is not limited thereto, and the first control device 53 may control the separation device 51 to finish the separation of the decomposition product of the biological tissue in the first housing container 50. When the agitation blade 51a is provided with a shearing blade, the first control device 53 may control the separation device 51 to allow the motor 51b to change the rotational direction of the agitation blade 51a in the process S4. In this case, changing the rotational direction makes it possible to bring the shearing blade into contact with the biological tissue when the agitation blade 51a is rotated.

[0197] In the processing method of this embodiment, a certain threshold may be used instead of

The channel 56 is configured to be capable of circulating the mixed solution in the first housing container 50. The channel 56 may be, for example, a channel (e.g., a tube), etc., made of a metal, plastic, resin, or the like.

[0222] (Liquid Feeding Device)

The liquid feeding device 57 is configured to be capable of feeding the mixed solution in the first housing container 50 via the channel 56. The liquid feeding device 57 includes the pump 57a and the motor (driving unit) 57b. The pump 57a may be, for example, a shear pump, a homogenization pump, or the like. Note that when the pump 57a is a shear pump, a homogenization pump, or the like, the liquid feeding device 57 may, for example, also serve as the separation device 51. In this case, the first housing container 50 may optionally include an agitation device instead of the separation device 51 and be configured to be capable of agitating a content. The agitation device need only be configured to be capable of agitating a content (mixed solution), and can be configured using, for example, an agitation blade provided with no shearing blade, which will be described below.

[0223] (Third Measurement Device)

The third measurement device 58 is configured to be capable of measuring the state of the mixed solution in the channel 56 over time. The state of the mixed solution in the channel 56 means a state that can be evaluated based on the physical properties of the mixed solution, and examples thereof include the flow rate, flow speed, viscosity, and/or turbidity of the mixed solution. The setting of the third measurement device 58 can be determined as appropriate in accordance with the state of the mixed solution in the channel 56 to be measured, and the third measurement device 58 may be, for example, a flow meter, a current meter, a viscometer, a turbidimeter, or the like.

[0224] (Third Control Device)

The third control device 59 is configured to be capable of controlling the liquid feeding by the liquid feeding device 57 based on the state of the mixed solution in the channel 56 obtained in the measurement above. For example, a controller such as an analog control device (e.g., a microcomputer, an operational amplifier, or the like) or a digital control device that includes a logical circuit can be used as the third control device 59. The third control device 59 can control the liquid feeding by the liquid feeding device 57 based on, for example, a change in the state of the mixed solution in the channel 56 over time. The third control device 59 can control the liquid feeding by the liquid feeding device 57 by controlling the liquid feeding amount (ejection amount), the rotation rate, and/or the rotational torque of the pump 57a of the liquid feeding device 57 via the rotation (driving) of the motor 57b of the liquid feeding device 57. Note that the liquid feeding by the liquid feeding device 57 may be controlled by changing

the biological tissue may be, for example, a processing operation for homogenizing the biological tissue using a Waring blender, a mixer, ultrasonic homogenization, or the like. When the biological tissue is a plant tissue, the processing operation for mechanically shearing the extracellular matrix of the biological tissue may be, for example, a processing operation for homogenizing the biological tissue under agitation using a homogenizer or the like. Also, the shearing machine or the homogenization machine may include, for example, a homogenizer, a shear pump, an in-line mixer, a homogenization pump, or the like. The operational manner of the shearing machine or the homogenization machine can be selected as appropriate in accordance with, for example, the origin of the biological tissue, and examples thereof include those using ultrasonic homogenization, pressurization, agitation, and the like.

[0279] When the biological tissue is a tissue of a tea plant (tea) or a coffee plant (coffee), the mechanical shearing may be shearing conducted using any device with a blade capable of effectively shearing the tissue of the tea plant (tea) or the coffee plant (coffee).

[0280] The temperature during the processing operation for mechanically shearing or homogenizing the extracellular matrix of the biological tissue can be set as appropriate in accordance with, for example, an enzyme used in the decomposition step. The temperature is, for example, a temperature at which the enzyme exhibits enzymatic activity, and is specifically 20°C to 70°C, 25°C to 65°C, 35°C to 60°C, 40°C to 60°C, or 45°C to 55°C.

[0281] The decomposition step and/or the separation step may be independently conducted once or a plurality of times. The number of times of conducting the decomposition step and the number of times of conducting the separation step may be the same or different. The decomposition step and the separation step may be conducted separately, and parts or all of the decomposition step and the separation step may be conducted simultaneously.

[0282] (Measurement Step)

The measurement step is a step of measuring a state of the mixed solution containing the biological tissue and the enzyme over time in the decomposition step. The state of the mixed solution may be, for example, the viscosity, pH, temperature, turbidity, color, and/or air bubble density of the mixed solution. In the measurement step, the setting of the measurement device can be selected as appropriate in accordance with the state of the mixed solution to be measured. The measurement device may be, for example, a viscometer, a pH meter, a thermometer, a turbidimeter, a colorimeter (color-difference meter), an air-bubble detector, or the like.

[0283] The separation of the decomposition product of the biological tissue is conducted based on the state of the mixed solution obtained in the measurement step. When the shearing machine or homogenization machine includes an agitation blade configured to be capable of agitating the mixed solution, the separation can be conducted by controlling the rotation rate

the solid-liquid separation (1) to the total protein amount was 1.60%.

[0324] The total protein amount in the tea-leaf slurry and the tea-leaf extract solution obtained through the solid-liquid separation (5) was 5.12 g. Meanwhile, the protein amount in the tea leaves (25 g) used in this example was 6.35 g. Accordingly, it was found that 80.69% of the proteins obtained from the entire tea leaves could be collected by conducting the solid-liquid separation (5). It was also found that most of the proteins contained in the tea leaves could be collected using filters with apertures in a range of about 1.00 μm to 100 μm, and most of the other components such as fibers and dietary fibers could be removed using a filter with apertures of 100 μm or greater.

[0325] The total protein amount in the tea-leaf slurries obtained through the solid-liquid separation (1) to (4) was 1.22 g, and the protein amount in the tea-leaf slurry obtained through the solid-liquid separation (5) was 1.86 g. Meanwhile, the protein amount in the tea leaves (25 g) used in this example was 6.35 g. Accordingly, relative to the protein amount in the tea leaves (25 g) used in this example, the total protein amount in the tea-leaf slurries obtained through the solid-liquid separation (1) to (4) was 19.31%, and the protein amount in the tea-leaf slurry obtained through the solid-liquid separation (5) was 48.59%. Accordingly, it was found that 29.28% of the proteins obtained from the entire tea leaves could be collected by conducting the solid-liquid separation (5) subsequently to the solid-liquid separation (1) to (4).

[0326] The protein content rate in the dry tea-leaf slurry obtained through the solid-liquid separation (5) was 45.50%. A dry powder solid in which proteins are concentrated is obtained by drying the dry tea-leaf slurry shown in FIG. 15E using a hot-air dryer. Therefore, it was found that a dry solid in which proteins are concentrated can be obtained through the solid-liquid separation as described above.

[0327] FIG. 19 shows the results of the concentrations of the components obtained in Example 3 and Comparative Example 2. In FIG. 19, the horizontal axis indicates the components, and the vertical axis indicates the concentrations of the components. The catechin amount and the caffeine amount obtained in Example 3 were 1868.62 mg and 512.66 mg, respectively. The amount of the tea-leaf extract solution obtained in Example 3 was 416.62 g, and therefore, the concentrations of the catechin and the caffeine obtained in Example 3 were 4485.20 mg/L and 1230.52 mg/L, respectively.

[0328] Meanwhile, the catechin amount and the caffeine amount obtained in Comparative Example 2 were 1523.84 mg and 377.23 mg, respectively. The amount of the tea obtained in Comparative Example 2 was 328 g, and therefore, the concentrations of the catechin and the caffeine obtained in Comparative Example 2 were 4650.59 mg/L and 1151.26 mg/L, respectively. Accordingly, it was found that the concentrations of the caffeine and the catechin

used in this example, the protein amount in the tea-leaf extract solution obtained through the solid-liquid separation (5) was 42.59%. Relative to the protein amount in the tea leaves (25 g) used in this example, the total protein amount in the tea-leaf slurry and the tea-leaf extract solution obtained through the solid-liquid separation (5) was 91.36%.

[0341] The protein content rate in the dry tea-leaf slurry obtained through the solid-liquid separation (5) was 60.25%. Therefore, it was found that a dry solid in which proteins are concentrated can be obtained through the solid-liquid separation as described above.

[0342] FIG. 25 shows the results of the concentrations of the components obtained in Example 4 and Comparative Example 3. In FIG. 25, the horizontal axis indicates the components, and the vertical axis indicates the concentrations of the components (component concentrations). In FIG. 25, the bars on the left indicate the results from Comparative Example 3, and the bars on the right indicate the results from Example 4. EGCG, EC, ECG, and EGC in the diagram represent epigallocatechin gallate, epicatechin, epicatechin gallate, and epigallocatechin, respectively. The catechin amount and the caffeine amount obtained in Example 4 were 23.61 mg and 147.69 mg, respectively. The amount of the tea-leaf extract solution obtained in Example 4 was 457.75 g, and therefore, the concentrations of the catechin and the caffeine obtained in Example 4 were 51.67 mg/L and 323.17 mg/L, respectively.

[0343] Meanwhile, the catechin amount and the caffeine amount obtained in Comparative Example 3 were 383.90 mg and 145.83 mg, respectively. The amount of the tea obtained in Comparative Example 3 was 439 g, and therefore, the concentrations of the catechin and the caffeine obtained in Comparative Example 3 were 874.49 mg/L and 332.19 mg/L, respectively.

[0344] Accordingly, it was found that the concentration of the caffeine obtained in Example 4 was similar to that in Comparative Example 3. Meanwhile, the concentration of the catechin obtained in Example 4 was less than 1/10 of the concentration of the catechin obtained in Comparative Example 3, and it was thus found that compared with caffeine, catechin did not move to the solutions and remained in the solid (tea-leaf slurries) during the solid-liquid separation processes in Example 4. Catechin could be moved to the solution by immersing the tea leaves in water at 80°C in Comparative Example 3, and therefore, it is considered that in Example 4, catechin could be moved to the solution by immersing the solid (tea-leaf slurry) in water at 80°C, whereas catechin could be allowed to remain in the solid fraction by setting the temperature to be lower than or equal to a certain temperature (e.g., a temperature lower than a temperature of 50°C or lower (30°C in this example)).

[0345] It was found from the results above that fibers derived from tea leaves, dietary fibers, proteins derived from tea leaves, a solid containing components derived from tea leaves, an

strawberry-leaf slurry and the dry strawberry-leaf slurry were 0.28% and 3.20%, respectively. Also, the strawberry-leaf slurry was rich in strawberry-leaf fibers, dietary fibers, and the like.

[0361] (Solid-Liquid Separation (3))

The strawberry-leaf extract solution obtained through the solid-liquid separation (2) was poured onto a commercially available sieving net (mesh: 1.00 mm square). A strawberry-leaf slurry remained on the net (FIG. 32C), and a strawberry-leaf extract solution passed through the net and fell into a receiving container. Thus, the strawberry-leaf slurry (wet) and the strawberry-leaf extract solution were separated and obtained. The weight of the strawberry-leaf slurry (wet) was 23.77 g and was 2.11 g in terms of the weight of the strawberry-leaf slurry (dry). The protein amount in the strawberry-leaf slurry was 0.08 g. The protein content rates in the wet strawberry-leaf slurry and the dry strawberry-leaf slurry were 0.35% and 3.89%, respectively.

[0362] (Solid-Liquid Separation (4))

The strawberry-leaf extract solution obtained through the solid-liquid separation (3) was poured onto a commercially available filter (aperture: 100 μm). A strawberry-leaf slurry remained on the filter (FIG. 32D), and a strawberry-leaf extract solution passed through the filter and fell into a receiving container. Thus, the strawberry-leaf slurry (wet) and the strawberry-leaf extract solution were separated and obtained. The weight of the strawberry-leaf slurry (wet) was 55.58 g, and was 4.94 g in terms of the weight of the strawberry-leaf slurry (dry). The protein amount in the strawberry-leaf slurry was 0.17 g. The protein content rates in the wet strawberry-leaf slurry and the dry strawberry-leaf slurry were 0.30% and 3.39%, respectively.

[0363] (Solid-Liquid Separation (5))

The strawberry-leaf extract solution obtained through the solid-liquid separation (4) was poured onto commercially available filter paper (aperture: 1.00 μm). A strawberry-leaf slurry remained on the filter paper (FIG. 32E), and a strawberry-leaf extract solution passed through the filter paper and fell into a receiving container (FIG. 32F). Thus, the strawberry-leaf slurry (wet) and the strawberry-leaf extract solution were separated and obtained. The weight of the strawberry-leaf slurry (wet) was 6.98 g, and was 0.62 g in terms of the weight of the strawberry-leaf slurry (dry). The protein amount in the strawberry-leaf slurry was 0.21 g. The protein content rates in the wet strawberry-leaf slurry and the dry strawberry-leaf slurry were 3.02% and 33.95%, respectively. The weight of the strawberry-leaf extract solution obtained after the solid-liquid separation (5) was 218.57 g. The protein amount in the strawberry-leaf extract solution was 0.16 g. The protein content rate in the strawberry-leaf extract solution was 0.07%.

[0364] (Results and Discussion)

(Supplementary Note 21)

A biological tissue processing apparatus for processing a mixed solution obtained by mixing a biological tissue and a solution containing an enzyme, including:

a housing container in which the mixed solution is housed and decomposition is conducted for decomposing the extracellular matrix of the biological tissue in the mixed solution with the enzyme; and

a separation device for separating cells of the biological tissue and/or an extract of the biological tissue from the extracellular matrix by applying a force to the biological tissue in the mixed solution.

(Supplementary Note 22)

The biological tissue processing apparatus according to Supplementary Note 21,

wherein the separation device includes an agitation blade that is disposed in the housing container and is configured to agitate the mixed solution in the housing container, and

the agitation blade includes a shearing blade that comes into contact with the biological tissue subjected to the decomposition and applies a shearing force to the extracellular matrix of the biological tissue and/or the cells of the biological tissue.

(Supplementary Note 23)

The biological tissue processing apparatus according to Supplementary Note 21, further including a separation tank provided with the separation device,

wherein the separation tank includes:

a supply channel to which the mixed solution subjected to the decomposition is supplied from the housing container; and

a return channel through which the mixed solution subjected to the separation in the separation tank is returned to the housing container,

the separation device includes an agitation blade that is disposed in the separation tank and is configured to agitate the mixed solution in the separation tank, and

the agitation blade includes a shearing blade that comes into contact with the biological tissue subjected to the decomposition in the housing container and applies a shearing force to the extracellular matrix of the biological tissue and/or the cells of the biological tissue.

(Supplementary Note 24)

The biological tissue processing apparatus according to Supplementary Note 23, including a plurality of the housing containers,

wherein between the housing containers and the separation tank, provided are

a plurality of the supply channels through which the housing containers and the separation tank are in communication,

a supply-side switching mechanism for switching any of the plurality of the supply channels to a channel for supplying the mixed solution to the separation tank,

a plurality of the return channels through which the housing containers and the separation tank are in communication, and

a return-side switching mechanism for switching any of the plurality of the return channels to a channel for returning the mixed solution from the separation tank.

(Supplementary Note 25)

The biological tissue processing apparatus according to any one of Supplementary Notes 22 to 24, further including:

a driving source for driving the agitation blade;

a sensor for detecting a state of the mixed solution in the housing container and/or a state of the mixed solution in the separation tank; and

a control unit for controlling an operation of the driving source based on a signal from the sensor.

(Supplementary Note 26)

The biological tissue processing apparatus according to Supplementary Note 21, further including a circulation channel that is disposed outside the housing container and through which the mixed solution subjected to the decomposition in the housing container is circulated,

wherein the separation device is provided at an intermediate portion of the circulation channel, and

the separation device includes a shearing blade that comes into contact with the biological tissue flowing in the circulation channel and applies a shearing force to the extracellular matrix of the biological tissue and/or the cells of the biological tissue.

(Supplementary Note 27)

The biological tissue processing apparatus according to Supplementary Note 26, including a plurality of the housing containers,

wherein the circulation channel includes:

a plurality of supply channels through which the housing containers and the separation tank are in communication,

a supply-side switching mechanism for switching any of the plurality of supply channels to a channel for supplying the mixed solution to the separation device,

a plurality of return channels through which the separation device and the housing containers are in communication, and

a return-side switching mechanism for switching any of the plurality of return channels to a channel that is in communication with the separation device.

# CLAIMS

1. A method for producing an extract of a biological tissue, comprising:

a step of decomposing extracellular matrix of the biological tissue with an enzyme; and

a step of separating cells of the biological tissue and/or an extract of the biological tissue from the extracellular matrix by subjecting the biological tissue to separation.

2. The production method according to claim 1, wherein the separation includes a processing operation for mechanically shearing the extracellular matrix of the biological tissue, preferably, the separation includes a processing operation for mechanically shearing the extracellular matrix of the biological tissue by bringing the biological tissue into contact with an agitation blade having a shearing blade.

3. The production method according to claim 1 or 2, wherein the extracellular matrix includes a cell wall, collagen, and/or proteoglycan;

the extract includes a cellular component of the biological tissue;

the cellular component is a low-molecular-weight compound, a nucleic acid, a peptide, a protein, and/or extracellular matrix;

the extract is a liquid or a solid;

the separation includes a processing operation for separating a liquid and a solid of the biological tissue from each other;

at least portions of the decomposition and the separation are simultaneously conducted;

the decomposition and/or the separation is conducted a plurality of times;

the decomposition includes a processing operation for decomposing the extracellular matrix of the biological tissue with a microbial culture solution containing the enzyme;

the enzyme is a protease, a cellulase, a hemicellulase, and/or a pectinase; and/or

the biological tissue is a plant tissue, preferably, the plant is a tea plant (tea), a coffee plant (coffee), a moringa, a Brussels sprout, and/or a cabbage.

4. The production method according to claim 3, wherein the plant tissue is a leaf, a stem, a flower, a seed, a root, a trunk, a skin (e.g., a bark, an epidermis, and a bast), sap, and/or a fruit, or a processed product thereof, preferably, the plant tissue is a tissue of a tea leaf or a used tea leaf.

5. An extract of a biological tissue produced using the production method according to any one of claims 1 to 4.

6. The extract according to claim 5, comprising a cellulose fiber.

7. A food composition comprising the extract according to claim 5 or 6.

8. A method for extracting an extract of a biological tissue, comprising:

a step of decomposing extracellular matrix of the biological tissue with an enzyme; and

a step of separating cells of the biological tissue and/or an extract of the biological tissue from the extracellular matrix by subjecting the biological tissue to separation.

9. A biological tissue processing apparatus for processing a mixed solution obtained by mixing a biological tissue and a solution containing an enzyme, comprising:

a housing container in which the mixed solution is housed and decomposition is conducted for decomposing extracellular matrix of the biological tissue in the mixed solution with the enzyme; and

a separation device for separating cells of the biological tissue and/or an extract of the biological tissue from the extracellular matrix by applying a force to the biological tissue in the mixed solution.

10. The biological tissue processing apparatus according to claim 9,

wherein the separation device includes an agitation blade that is disposed in the housing container and is configured to agitate the mixed solution in the housing container, and

the agitation blade includes a shearing blade that comes into contact with the biological tissue subjected to the decomposition and applies a shearing force to the extracellular matrix of the biological tissue and/or the cells of the biological tissue; or

further comprising a separation tank provided with the separation device,

wherein the separation tank includes:

a supply channel to which the mixed solution subjected to the decomposition is supplied from the housing container; and

a return channel through which the mixed solution subjected to the separation in the separation tank is returned to the housing container,

the separation device includes an agitation blade that is disposed in the separation tank and is configured to agitate the mixed solution in the separation tank, and

the agitation blade includes a shearing blade that comes into contact with the biological tissue subjected to the decomposition in the housing container and applies a shearing force to the extracellular matrix of the biological tissue and/or the cells of the biological tissue, preferably, comprising a plurality of the housing containers,

wherein between the housing containers and the separation tank, provided are

a plurality of the supply channels through which the housing containers and the separation tank are in communication,

a supply-side switching mechanism for switching any of the plurality of the supply channels to a channel for supplying the mixed solution to the separation tank,

a plurality of the return channels through which the housing containers and the separation tank are in communication, and

a return-side switching mechanism for switching any of the plurality of the return channels to a channel for returning the mixed solution from the separation tank, more preferably further comprising:

a driving source for driving the agitation blade;

a sensor for detecting a state of the mixed solution in the housing container and/or a state of the mixed solution in the separation tank; and

a control unit for controlling an operation of the driving source based on a signal from the sensor.

11. The biological tissue processing apparatus according to claim 9, further including a circulation channel that is disposed outside the housing container and through which the mixed solution subjected to the decomposition in the housing container is circulated,

wherein the separation device is provided at an intermediate portion of the circulation channel, and

the separation device includes a shearing blade that comes into contact with the biological tissue flowing in the circulation channel and applies a shearing force to the extracellular matrix of the biological tissue and/or the cells of the biological tissue, preferably comprising a plurality of the housing containers,

wherein the circulation channel includes:

a plurality of supply channels through which the housing containers and the separation tank are in communication,

a supply-side switching mechanism for switching any of the plurality of supply channels to a channel for supplying the mixed solution to the separation device,

a plurality of return channels through which separation device and the housing

containers are in communication, and

a return-side switching mechanism for switching any of the plurality of return channels to a channel that is in communication with the separation device, more preferably, the circulation channel includes:

first and second return channels for returning the mixed solution passing through the separation device to the housing container; and

a switching mechanism that is provided between the separation device and the first and second return channels and is configured to switch a channel for supplying the mixed solution from the separation device between the first and second return channels,

the first return channel includes an enzyme addition unit for adding an enzyme to the mixed solution, and

the second return channel includes a solid-liquid separation device for separating a solid from the mixed solution and/or a component collection portion for collecting a component contained in the cells of the biological tissue from the mixed solution.

12. The biological tissue processing apparatus according to any one of claims 9 to 11, further comprising:

an enzyme supply unit for supplying a solution containing an enzyme to a solution in the housing container; and

an electrolyzed water supply unit for supplying electrolyzed water to the solution in the housing container,

wherein the electrolyzed water supply unit includes:

an electrolyzed water production device for generating the electrolyzed water; and

an adjusting unit to which the electrolyzed water is supplied from the electrolyzed water production device and that is configured to adjust a state of the electrolyzed water;

further comprising an adsorption portion for adsorbing a component contained in the cells of the biological tissue contained in the solution in the housing container; and/or

further comprising a biological tissue supply unit for supplying the biological tissue to the solution in the housing container.

13. A biological tissue processing apparatus comprising:

a first housing container that is capable of housing a mixed solution obtained by mixing a biological tissue and a solution containing an enzyme and is configured to be capable of

decomposing extracellular matrix of the biological tissue in the mixed solution with the enzyme;

a separation device that is configured to be capable of applying a force to the biological tissue in the mixed solution and separating cells of the biological tissue and/or an extract of the biological tissue from the extracellular matrix;

a first measurement device that is configured to be capable of measuring a state of the mixed solution over time; and

a first control device that is configured to be capable of controlling separation of a decomposition product of the biological tissue by the separation device based on the state of the mixed solution obtained in the measurement.

14. A biological tissue processing apparatus comprising:

a first housing container that is capable of housing a mixed solution obtained by mixing a biological tissue and a solution containing an enzyme and is configured to be capable of decomposing extracellular matrix of the biological tissue in the mixed solution with the enzyme;

a separation device that is configured to be capable of applying a force to the biological tissue in the mixed solution and separating cells of the biological tissue and/or an extract of the biological tissue from the extracellular matrix;

a second measurement device that is configured to be capable of measuring a state of the separation device over time; and

a second control device that is configured to be capable of controlling separation of a decomposition product of the biological tissue by the separation device based on the state of the separation device obtained in the measurement.

15. A biological tissue processing apparatus comprising:

a first housing container that is capable of housing a mixed solution obtained by mixing a biological tissue and a solution containing an enzyme and is configured to be capable of decomposing extracellular matrix of the biological tissue in the mixed solution with the enzyme;

a separation device that is configured to be capable of applying a force to the biological tissue in the mixed solution and separating cells of the biological tissue and/or an extract of the biological tissue from the extracellular matrix;

a channel that is configured to allow the mixed solution in the first housing container to be circulated therethrough;

a liquid feeding device that is configured to be capable of feeding the mixed solution in the first housing container via the channel;

a third measurement device that is configured to be capable of measuring a state of the

mixed solution in the channel over time; and

a third control device that is configured to be capable of controlling liquid feeding by the liquid feeding device based on the state of the mixed solution in the channel obtained in the measurement.

16. A biological tissue processing apparatus comprising:

a first housing container that is capable of housing a mixed solution obtained by mixing a biological tissue and a solution containing an enzyme and is configured to be capable of decomposing extracellular matrix of the biological tissue in the mixed solution with the enzyme;

a separation device that is configured to be capable of applying a force to the biological tissue in the mixed solution and separating cells of the biological tissue and/or an extract of the biological tissue from the extracellular matrix;

a solid-liquid separation device that is configured to be capable of conducting solid-liquid separation of the extract;

a second housing container that is configured to be capable of housing a solid fraction obtained through the solid-liquid separation of the extract;

a fourth measurement device that is configured to be capable of measuring a state of the solid fraction in the second housing container over time; and

a fourth control device that is configured to be capable of controlling the solid-liquid separation of the extract by the solid-liquid separation device based on the state of the solid fraction obtained in the measurement.

17. A biological tissue processing apparatus comprising:

a first housing container that is capable of housing a mixed solution obtained by mixing a biological tissue and a solution containing an enzyme and is configured to be capable of decomposing extracellular matrix of the biological tissue in the mixed solution with the enzyme;

a separation device that is configured to be capable of applying a force to the biological tissue in the mixed solution and separating cells of the biological tissue and/or an extract of the biological tissue from the extracellular matrix;

a solid-liquid separation device that is configured to be capable of conducting solid-liquid separation of the extract;

a second housing container that is configured to be capable of housing a solid fraction obtained through the solid-liquid separation of the extract;

a channel that is configured to allow the extract to be circulated therethrough via the solid-liquid separation device;

a liquid feeding device that is configured to be capable of feeding the extract via the channel;

a fourth measurement device that is configured to be capable of measuring a state of the solid fraction in the second housing container over time; and

a fifth control device that is configured to be capable of controlling supply of the extract to the solid-liquid separation device via the channel based on the state of the solid fraction obtained in the measurement.

18. A method for processing a biological tissue, comprising:

a decomposition step of decomposing extracellular matrix of a biological tissue in a mixed solution containing the biological tissue and an enzyme;

a measurement step of measuring a state of the mixed solution containing the biological tissue and the enzyme over time in the decomposition step; and

a separation step of separating cells of the biological tissue and/or an extract of the biological tissue from a decomposition product of the biological tissue,

wherein the separation of the decomposition product of the biological tissue is conducted based on the state of the mixed solution obtained in the measurement step.