Claims

[Claim 1]

A method for filtering a protein-containing liquid containing protein at a concentration of 20 mg/mL or more and 100 mg/mL or less, the method comprising:

a prefiltration step of filtering the protein-containing liquid by a prefilter having a pore size of 0.08 μm to 0.25 μm and comprising a hydrophobic resin; and

a virus removal step of filtering the protein-containing liquid by a virus removal membrane comprising a synthetic polymer, after the prefiltration step, wherein

the protein-containing liquid before conducting the prefiltration step comprises 0.25 g or more of a trimer or higher multimer of the proteins having an average diameter of less than 100 nm, per 1 m^2 of the virus removal membrane.

[Claim 2]

The method according to claim 1, wherein the prefilter comprises a material selected from the group consisting of a polyamide resin, a polysulfone-based resin and a fluororesin.

[Claim 3]

The method according to claim 2, wherein the prefilter comprises polyether sulfone or polyvinylidene fluoride.

[Claim 4]

The method according to any one of claims 1 to 3, wherein the protein-containing liquid before the prefiltration step further comprises a particulate substance which is a multimer of the proteins and which has an average diameter of 100 nm or more.

[Claim 5]

The method according to any one of claims 1 to 3, further comprising a diafiltration step of conducting diafiltration of the protein-containing liquid, before the prefiltration step.

[Claim 6]

The method according to any one of claims 1 to 3, further comprising an ultrafiltration step of conducting ultrafiltration of the protein-containing liquid, before the prefiltration step.

[Claim 7]

The method according to claim 5, not further comprising ultrafiltration step and diafiltration step, after the diafiltration step.

[Claim 8]

The method according to any one of claims 1 to 3, further comprising a tangential flow filtration step of conducting filtration by use of a tangential flow filtration apparatus, before the prefiltration step.

[Claim 9]

The method according to any one of claims 1 to 3, further comprising a stirring step of stirring the protein-containing liquid for two hours or more, before the prefiltration step.

[Claim 10]

The method according to any one of claims 1 to 3, comprising no other step between the prefiltration step and the virus removal step.

[Claim 11]

The method according to any one of claims 1 to 3, wherein the prefiltration step and the virus removal step are successively performed.

[Claim 12]

The method according to any one of claims 1 to 3, wherein the prefilter is a sheet-shaped filter.

[Claim 13]

The method according to any one of claims 1 to 3, wherein the prefilter comprises a multi-layer membrane.

[Claim 14]

The method according to any one of claims 1 to 3, wherein the prefilter comprises a multi-layer membrane where each layer is different in filter pore size.

[Claim 15]

The method according to any one of claims 1 to 3, wherein a viscosity of the protein-containing liquid filtered by the prefilter is lower than a viscosity of the protein-containing liquid before filtration by the prefilter.

[Claim 16]

The method according to any one of claims 1 to 3, wherein the protein comprises an antibody.

[Claim 17]

The method according to any one of claims 1 to 3, wherein the protein comprises a monoclonal antibody.

[Claim 18]

The method according to any one of claims 1 to 3, wherein the virus removal membrane comprises a fluororesin.

[Claim 19]

The method according to claim 18, wherein the virus removal membrane comprises polyvinylidene fluoride.

[Claim 20]

The method according to any one of claims 1 to 3, wherein a logarithmic removal rate (LRV) for parvovirus by the virus removal membrane is 4.0 or more.

[Claim 21]

The method according to any one of claims 1 to 3,

wherein the virus removal membrane comprises:

a primary surface to which the protein-containing liquid filtered by the prefilter is supplied; and

a secondary surface from which a permeation liquid that permeated through the virus removal membrane is discharged,

wherein, in the case where a solution containing gold colloids having a diameter of 20 nm is supplied through the primary surface side to the virus removal membrane to allow the virus removal membrane to capture the gold colloid for measurement of brightness in a cross section of the virus removal membrane, a value obtained by dividing a standard deviation of a value of an area of a spectrum of variation in the brightness by an average of the value of the area of the spectrum of variation in the brightness is 0.01 or more and 1.50 or less, and

wherein a thickness of a portion where gold colloids having a diameter of 20 nm or more and 30 nm or less are captured in the cross section of the virus removal membrane in a wet state is 10 μm or more and 30 μm or less.

[Claim 22]

The method according to any one of claims 1 to 3, wherein the protein-containing liquid before conducting the prefiltration step has a hydrogen-ion exponent of 4.0 or more and 8.0 or less.

[Claim 23]

The method according to any one of claims 1 to 3, wherein the protein-containing liquid before conducting the prefiltration step has an ionic strength of 0 mmol/L or more and 300 mmol/L or less.

[Claim 24]

The method according to any one of claims 1 to 3, wherein the protein-

containing liquid before conducting the prefiltration step comprises an additive comprising at least one selected from the group consisting of a sugar and a basic amino acid.

[Claim 25]

The method according to any one of claims 1 to 3, wherein the prefilter is sterilizable-in-place.