[0009] The mixture containing the shear sensitive biopolymer can optionally contain a solution buffer. If the mixture includes a solution buffer, the method can further include displacing a portion of the solution buffer with a dialysis buffer.

[0010] In preferred embodiments, the retentate includes at least about 70 % of the shear sensitive biopolymer in the mixture, preferably at least about 80 % of the shear sensitive biopolymer in the mixture, and more preferably at least about 90 % of the shear sensitive biopolymer in the mixture. The retentate preferably retains at least about 70 % of the activity of the shear sensitive biopolymer in the mixture, and more preferably it retains at least about 80 % of the activity of the shear sensitive biopolymer in the mixture.

[0011] The disclosed method provides a cost-effective process to concentrate shear sensitive biopolymers while avoiding substantial loss of the biopolymer to protein precipitation, membrane fouling, and membrane surface adhesion.

[0011a] In one aspect, there is provided a method for concentrating shear sensitive biopolymers, the method comprising flowing a mixture comprising a shear sensitive biopolymer and a solution buffer into a hollow fiber dialysis module to form a retentate, said retentate having a shear sensitive biopolymer concentration that is greater than that of the mixture, and a filtrate, wherein a transmembrane pressure between the mixture and the filtrate is about 1 mmHg to about 150 mmHg, wherein a membrane thickness of the hollow fiber dialysis module is less than about 200 micrometers, and wherein a wall shear rate in the hollow fiber dialysis module is less than about 2300 s^{-1} wherein the shear sensitive biopolymer present in the retentate retains an activity of at least 70% of the activity of the sensitive biopolymer present in the mixture.

[0012] Additional features of the invention may become apparent to those skilled in the art from a review of the following detailed description, taken in conjunction with the drawings, the examples, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0013] For a more complete understanding of the disclosure, reference should be made to the following detailed description and accompanying drawing wherein:

[0014] Figure 1 is a cross-sectional view of a hollow fiber dialysis module (not to scale);

[0015] Figure 2 is a process flow diagram of a hollow fiber dialysis module with the dialysis buffer being added directly to the retentate;

[0016] Figure 3 is a process flow diagram of a hollow fiber dialysis module with the dialysis buffer introduced counter-current to the feed flow; and,

[0017] Figure 4 is a chart showing process data for Experiment 2-1.

[0018] While the disclosed method for concentrating shear sensitive biopolymers is susceptible of embodiments in various forms, there are illustrated in the drawings (and will hereafter be described) specific embodiments of the invention, with the understanding that the disclosure is intended to be illustrative, and is not intended to limit the invention to the specific embodiments described and illustrated herein.

DETAILED DESCRIPTION OF THE INVENTION

[0019] The invention relates generally to methods of concentrating shear sensitive biopolymers from a mixture containing the same. Known methods of concentrating

What is claimed is:

1. A method for concentrating shear sensitive biopolymers, the method comprising flowing a mixture comprising a shear sensitive biopolymer and a solution buffer into a hollow fiber dialysis module to form a retentate, said retentate having a shear sensitive biopolymer concentration that is greater than that of the mixture, and a filtrate, wherein a transmembrane pressure between the mixture and the filtrate is about 1 mmHg to about 150 mmHg, wherein a membrane thickness of the hollow fiber dialysis module is less than about 200 micrometers, and wherein a wall shear rate in the hollow fiber dialysis module is less than about 2300 s^{-1}~~sec.sup.-1~~ wherein the shear sensitive biopolymer present in the retentate retains an activity of at least 70% of the activity of the sensitive biopolymer present in the mixture.

2. The method of claim 1, wherein the membrane thickness of the hollow fiber dialysis module is about 10 micrometers to about 100 micrometers.

3. The method of claim 1, wherein the membrane thickness of the hollow fiber dialysis module is about 30 micrometers.

4. The method of claim 1, wherein the wall shear rate in the hollow fiber dialysis module is about 50 s^{-1}~~sec-1~~ to about 1800 s^{-1}~~sec-1~~.

5. The method of claim 1, wherein a membrane of the hollow fiber dialysis module comprises a material having protein adsorption below 1 gram per square meter.

6. The method of claim 1, wherein a membrane of the hollow fiber dialysis module comprises a material selected from the group consisting of polysulfone, polyethersulfone, polyvinylidene fluoride, polyimide, ceramic, modified cellulose, aliphatic polyamide, and polyacrylonitrile.

7. The method of claim 1, wherein a membrane of the hollow fiber dialysis module comprises a material selected from the group consisting of polysulfone, polyethersulfone, and modified cellulose.