The Invention urther relates to a method of preparing an aquaporin containing liquid membrane matrix comprising the following steps:

a) in a glass vial or glass separation funnel mix an aqueous solution of nonionic detergent at about 100 mg/mL and an oil component to obtain an oil / water v/v ratio of 0.25 and adding an amount of an aqueous aquaporin protein solution, where the protein may carry a fluorescent label, to obtain a ~~detergent to protein~~ protein to detergent molar ratio of between 1:50 and 1:400,

b) turn the combined mixture from a) in a rolling equipment overnight at room temperature to obtain an emulsion,

c) allow the emulsion from b) to stand for sufficient time to separate into distinct liquid phases including a cream phase or extended oil-water interface which comprises said liquid membrane matrix,

d) take out a matrix sample of the emulsion cream phase with a syringe for injecting into filtration device, e.g. as shown in Fig. 4, and

e) optionally obtain an absorbance spectrum of the matrix formed which is compatible with the fluorescent label used in order to verify correct insertion of the aquaporin protein in the liquid membrane matrix.

More specifically the invention relates to a method of preparing a liquid membrane matrix suitable for extraction of water from a liquid medium using forward osmosis the method comprising combining an aqueous solution of a non-ionic detergent with an aqueous aquaporin protein preparation and an oil followed by gentle mixing and allowing the resulting emulsion to separate and extract the generated extended oil/water interphase which constitutes said liquid membrane matrix. In said method the detergent is preferably an amphiphilic block copolymer selected from ABA type poloxamers, such as those listed in Table X, said aquaporin protein is aquaporin Z solubilised in a buffer containing aqueous solution, and said oil component is squalene. When using AqpZ (aquaporin Z) said buffer preferably having the following composition: 20mMTris pH 8 + 50 mM NaCl + 100mM OG (octyl glucoside) or, alternatively, when sodium or chloride are undesired for the forward osmosis process a 20mMTris pH 8 + 100mM OG buffer combination can be used. In other preferred embodiments using SoPIP2;1 as the aquaporin the buffer may be PBS based, e.g. PBS + 1.0% OG, or PBS + 1.0% OG. Alternatively, yeast aquaporin Aqy1 may be used where a preferred buffer preparation comprises, e.g.: 20 mM Tris pH 8, 300 mM NaCl and 1% beta-OG. About 1 to 10 % of Glycerol is an optional component of these buffer preparations. Since different aquaporin proteins may require different optimal working conditions the skilled person of the art will know how to select a suitable buffer preparation for storage and function of the various aquaporins. Examples of useful non-ionic detergent in the present invention are the compounds disclosed in US patent No. 3,740,421, and the poloxamers sold by BASF under the trade names Pluronic F68, Pluronic F77, Pluronic F87, Pluronic F108, Pluronic F127, Pluronic P81, Pluronic P84, and Pluronic P85, cf. also disclosure in Monica A. James-Smith et al. J Surfact Deterg (2008) 11:237-242.

The liquid membrane matrix of the invention may comprise an aquaglyceroporin thus making the liquid membrane matrix suitable for both water and glycerol filtration. Incorporation of another transmembrane protein than aquaporins will provide a range of possible uses, other than water extraction, in bioreactors, each specific use being dependent on the biophysical properties of the transmembrane protein selected,

**Claims:**

1. A liquid membrane matrix comprising a cellular structure having an internal water phase, an external oil phase~~,~~ and a boundary layer between cells comprising ~~a~~an amphiphilic non-ionic detergent ~~into which transmembrane protein channels have been incorporated~~and one or more amphiphilic lipid components, wherein ~~said protein channels are~~ aquaporin or aquaglyceroporin water channels have been incorporated in the boundary layer between the cells of the liquid membrane matrix and wherein the molar ratio of protein to amphiphilic non-ionic detergent in the boundary layer is between 1: 50 and 1:400.

2. The liquid membrane matrix according to claim 1, wherein said amphiphilic non-ionic detergent is an amphiphilic block copolymer.

3. The liquid membrane matrix according to claim 2, wherein the amphiphilic block copolymer is a poloxamer.

4. The liquid membrane matrix according to claim 3, wherein the poloxamer is a hydrophile-hydrophobe-hydrophile A-B-A type poloxamers.

~~2.~~5. The liquid membrane matrix according to ~~claim 1~~ any one of the preceding claims, wherein said oil phase comprises components selected from the group consisting of a sterol, squalene, squalane, alpha-tocopherol, hopanoids, isoprenes including esterified dolichol, glycerol, ubiquinone, jojoba oil, light mineral oils, linseed oil, soybean oil, ground nut oil, phospholipid stabilized squalene, or an emulsion of soy bean oil, phospholipids and glycerol~~,~~ and alkanes, such as decane, undedane, dodecane~~;~~, and mixtures thereof.

~~3.~~6. The liquid membrane matrix according to ~~claim 1 or claim 2~~any one of the preceding claims, wherein said oil phase comprises a non-polar hydrocarbon ~~solvents, e.g. having unbranched or branched carbon chains of 6 to 12 carbon atoms.~~ solvent.

~~4~~7. The liquid membrane matrix according to any one of the preceding claims ~~1 to 3~~, wherein ~~said non-ionic detergent is selected from hydrophile-hydrophobe-hydrophile (A-B-A) type poloxamers.~~ the one or more amphiphilic lipid components are selected from the group consisting of phospholipids, phosphoglycerides, sphingolipids, cardiolipin, natural lipid extracts, *E. coli* total lipid extract, soybean mixed phospholipids and mixtures thereof.

~~5. The liquid membrane matrix according to any one of claims 1 to 3, wherein said non-ionic detergent is an amphiphilic block copolymer.~~

~~6. The liquid membrane matrix according to any~~ one ~~of claims 1 to 5, further comprising an~~ amphiphilic lipid component.

8. The liquid membrane matrix according to claim 7, wherein the phospholipids are 1,2-dipalmitoyl-sn-phosphatidylcholine (DPPC), DOPC, DPhPC, DOPS or soybean mixed phospholipids.

~~7.~~9. The liquid membrane matrix according to any one of the preceding claims, wherein the aquaporin or aquaglyceroporin water channel is selected from the group consisting of ~~Aqp 4, Aqp 1, Aqp~~AQP4, AQP1, AQP Z, SoPIP2;1 and monomeric, dimeric, tetrameric and higher oligomers as well as functional variants thereof, including mutated, conjugated and truncated versions of the primary sequence.

~~8~~10. The liquid membrane matrix according to any one of claims 1 to ~~7 having~~ 9, wherein the cells ~~with~~ have an approximate maximal diameter of up to 1000 µm ~~and the majority of cells lie preferably in the range of about 20 to about 50 µm.~~

11. The liquid membrane matrix according to claim 10, wherein the majority of cells ~~lie preferably~~have diameters in the range of about 20 to about 50 µm.

12. A supported liquid membrane matrix having a closed sandwich construction, wherein a substantially flat porous filter material provides support on both sides of a layer of a liquid membrane matrix according to any one of claims 1 to 11 thereby immobilising the layer.

13. A supported liquid membrane matrix having an open sandwich construction, wherein a substantially flat porous filter material provides support on one side of a layer of a liquid membrane matrix according to any one of claims 1 to 11 thereby immobilising the layer.

14. An apparatus for pure water extraction from an aqueous liquid media which comprises one or more liquid membrane matrices according to any one of claims 1 to 11.

15. An apparatus for pure water extraction from an aqueous liquid media said apparatus having a filter house comprising one or more aquaporin containing liquid membrane matrices according to any one of claims 1 to 11.

16. The apparatus according to claim 15, wherein the apparatus is a hollow fiber module.

17. The apparatus according to claim 15, wherein the apparatus is a two module hollow fiber liquid - liquid membrane contactor module or a liquid cell extra-flow membrane contactor.

18. A method of preparing a liquid membrane matrix suitable for extraction of water from a liquid medium using forward osmosis liquid membrane matrix comprising a cellular structure having an internal water phase, an external oil phase and a boundary layer between cells comprising an amphiphilic non-ionic detergent and one or more amphiphilic lipid components, wherein aquaporin or aquaglyceroporin water channels have been incorporated in the boundary layer between the cells of the liquid membrane matrix, the method comprising:

combining an aqueous solution of the amphiphilic non-ionic detergent with a buffered aqueous aquaporin protein preparation and an oil followed by end-over-end mixing and

allowing the resulting emulsion to separate and extract the generated extended oil/water interphase which constitutes said liquid membrane matrix,

wherein the molar ratio of protein to amphiphilic non-ionic detergent in the boundary layer is between 1: 50 and 1:400.

19. Use of the liquid membrane matrix according to any one of claims 1 to 11 for extraction of pure water through forward osmosis.

20. Use of the liquid membrane matrix prepared according to any one of claims 1 to 11 for re-extraction of pure water from a patient's plasma lost through hemodialysis.

~~9.~~21. A method of extracting water from an aqueous liquid comprising the following steps:

a) placing an amount of the liquid membrane matrix according to any one of claims 1 to ~~8~~11 into a filter chamber which is in ~~controlled~~ connection with a first aqueous liquid (feed solution) having an osmotic pressure which is lower than or equal to that of the liquid membrane matrix, and which is further in ~~controlled~~ connection with a second aqueous liquid (draw solution) having an osmotic pressure which is higher than that of the matrix to create an osmotic pressure potential between said first and said second liquid,

b) allowing the matrix to absorb pure water from said first liquid and to mediate a pure water flux into said second liquid as long as an osmotic pressure gradient exists,

c) optionally separating the extracted pure water from said second liquid.

~~10~~22. The method according to claim ~~9~~21, wherein said first aqueous liquid is selected from the group consisting of any type of natural water source, such as sea water, river water, lake water, brackish water, rain water, waste water which is not toxic to the aquaporin water channels, biological fluids including wine, fruit and vegetable juice, milk, whole blood, plasma, urine, saliva, sweat~~,~~ and homogenized tissue ~~etc~~.

11. An apparatus for pure water extraction from an aqueous liquid media which comprises one or more liquid membrane matrices according to any one of claims 1 to 8.

12. An apparatus for pure water extraction from an aqueous liquid media said apparatus having a filter house comprising one or more aquaporin containing liquid membrane matrices according to any one of claims 1 to 8.

13. The apparatus according to claim 12, wherein the apparatus is a hollow fiber module.

14. The apparatus according to claim 12, wherein the apparatus is a two module hollow fiber liquid - liquid membrane contactor module or a liquid cell extra-flow membrane contactor.

15. A method of preparing a liquid membrane matrix suitable for extraction of water from a liquid medium using forward osmosis the method comprising combining an aqueous solution of a non-ionic detergent with a buffered aqueous aquaporin protein preparation and an oil followed by end-over-end mixing and allowing the resulting emulsion to separate and extract the generated extended oil/water interphase which constitutes said liquid membrane matrix.

16. Use of the liquid membrane matrix prepared according to any one of claims 1 to 8 for extraction of pure water through forward osmosis.

17. Use of the liquid membrane matrix prepared according to any one of claims 1 to 8 for re-extraction of pure water from a patient's plasma lost through hemodialysis.

18. A supported liquid membrane matrix having a closed sandwich construction, wherein a substantially flat porous filter material provides support on both sides of a layer of a liquid membrane matrix according to any one of claims 1 to 8 thereby immobilising the layer.

19. A supported liquid membrane matrix having an open sandwich construction, wherein a substantially flat porous filter material provides support on one side of a layer of a liquid membrane matrix according to any one of claims 1 to 8 thereby immobilising the layer.