CLAIMS

~~WHAT IS CLAIMED IS:~~

1. A method for concentrating dairy products, comprising a step of performing reverse osmosis concentration treatment on raw milk using a reverse osmosis membrane; the reverse osmosis concentration treatment comprises a low-pressure reverse osmosis membrane concentration treatment and a high-pressure reverse osmosis membrane concentration treatment;

wherein the low-pressure reverse osmosis membrane concentration treatment uses a first predetermined pressure to perform reverse osmosis concentration treatment on feed, and the high-pressure reverse osmosis membrane concentration treatment uses a second predetermined pressure to perform reverse osmosis concentration treatment on feed, wherein the first predetermined pressure is less than the second predetermined pressure.

2. The concentration method according to claim 1, wherein the low-pressure reverse osmosis membrane treatment comprises a multi-stage concentration treatment (preferably a 1- to 14-stage concentration treatment, more preferably a 6- to 11-stage concentration treatment), and/or the high-pressure reverse osmosis membrane treatment comprises a multi-stage concentration treatment (preferably a 1- to 6-stage concentration treatment, more preferably a 2- to 4-stage concentration treatment); preferably, each stage of the low-pressure reverse osmosis membrane treatment and/or each stage of the high-pressure reverse osmosis membrane treatment uses one or more membrane assemblies; more preferably, each membrane assembly comprises one membrane or more membranes which are connected in series, in parallel, or in a combination of series and parallel.

3. The concentration method according to claim 2, wherein the pressure used in each stage of the multi-stage concentration treatment of the low-pressure reverse osmosis membrane treatment is different; preferably, in the low-pressure reverse osmosis membrane treatment, the pressure used in the first three stages is 1 to 50 bar (preferably 1 to 40 bar, more preferably 25 to 35 bar); preferably, in the low-pressure reverse osmosis membrane treatment,

the pressure used in the fourth and subsequent stages is 30 to 60 bar (preferably 40 to 50 bar, more preferably 43 to 47 bar).

~~4. The concentration method according to any one of claims 1 to 3, wherein the high-pressure reverse osmosis membrane treatment comprises a multi-stage concentration treatment (preferably a 1- to 6-stage concentration treatment, more preferably a 2- to 4-stage concentration treatment); preferably, each stage of the high-pressure reverse osmosis membrane treatment uses one or more membrane assemblies; more preferably, each membrane assembly comprises one membrane or more membranes which are connected in series, in parallel, or in a combination of series and parallel.~~

~~5~~4. The concentration method according to ~~claim 4~~any of claims 1-3, wherein the pressure used in each stage of the multi-stage concentration treatment of the high-pressure reverse osmosis membrane treatment is different; preferably, the pressure used in the high-pressure reverse osmosis membrane treatment is 50 to 200 bar (preferably 60 to 80 bar, more preferably 60 to 65 bar).

~~6~~5. The concentration method according to any one of claims 1 to ~~5~~4, wherein the temperature of a feed liquid to be concentrated in the concentration method is 20 °C or lower (preferably 0 to 15 °C, more preferably 7 to 15 °C);
preferably, the temperature of the concentrated feed liquid is maintained below 15 °C (more preferably, maintained at 10 to 14 °C) by a high-pressure radiator; preferably, the high-pressure radiator is arranged at a feed port or a discharge port of the predetermined stage(s) of the high-pressure reverse osmosis membrane treatment unit.

~~7. The concentration method according to any one of claims 1 to 6, wherein before the step of the reverse osmosis concentration treatment, further comprising: i) a temporary storage step; ii) a pretreatment step; and/or iii) a homogenization step.~~

~~8. The concentration method according to claim 7, wherein the temporary storage step~~

~~comprises filtration of the raw milk; preferably, the filtration is two-stage filtration; more preferably, the filtration pore diameter of the first-stage filtration is 0.990 mm to 1.165 mm, and the pore diameter of the second-stage filtration is 0.495 mm to 0.589 mm.~~

~~9. The concentration method according to claim 7, wherein the pretreatment step comprises a low-temperature sterilization and separation treatment; preferably, the low-temperature sterilization and separation uses two-stage filtration; preferably, a temperature of the sterilization and separation is controlled at 45 to 50 °C.~~

~~10. The concentration method according to claim 7, wherein the homogenization step uses two-stage homogenization; preferably, a working temperature of the homogenization step is maintained at 10 to 30 °C (more preferably 15 to 20 °C), more preferably, a pressure of the first-stage homogenization is 100 to 140 bar (more preferably 120 bar), and a pressure of the second-stage homogenization is 40 to 60 bar (more preferably 50 bar).~~

~~11~~6. The concentration method according to any one of claims 1 to ~~10~~5, wherein after the step of the reverse osmosis concentration treatment, further comprising: v) a cooling step; vi) a filling step; vii) a freezing step; and/or viii) cleaning step.

~~12~~7. The concentration method according to claim ~~11~~6, wherein the cooling step uses two-stage cooling; preferably, the first stage of the cooling uses an ice water as a refrigerant; preferably, the second stage of the cooling uses a solution of ethylene glycol in water as a refrigerant.

~~13~~8. The concentration method according to claim ~~11~~6, wherein preferably, the temperature of the first stage of the cooling is maintained at 2 to 10 °C (more preferably 4 to 7 °C); preferably, the temperature of the second stage of the cooling is maintained at -1 to -4 °C (more preferably -2 to -3 °C).

~~14~~9. The concentration method according to claim ~~11~~6, wherein the filling temperature of the

filling step is maintained at 1 to -4 °C, more preferably -2 to -3 °C.

~~15~~10. The concentration method according to claim ~~11~~6, wherein the freezing temperature of the freezing step is maintained at -10 to -24 °C, more preferably -18 to -22 °C.

~~16~~11. A concentrated dairy product prepared by the concentration method according to any one of claims 1 to ~~15~~10, wherein the total solid content is 30 to 50%, preferably 35 to 45%, more preferably 40 to 45%;

preferably, after the concentrated dairy product is diluted to the total solid content level of raw milk according to a concentration ratio, the detected furosine content is 4 to 20 mg/100g protein, preferably 8 to 15 mg/100g protein;

preferably, after the concentrated dairy product is diluted to the total solid content level of raw milk according to a concentration ratio, the detected retention amount of IgG (immunoglobulin G) is higher than 95%;

preferably, after the concentrated dairy product is diluted to the total solid content level of raw milk according to a concentration ratio, the detected retention rate of GMP (glycomacropeptide) is 100%.

~~17~~12. A feed liquid concentration device, comprising:

a concentration unit, which is arranged downstream of the homogenization unit and successively comprises a low-pressure concentration unit and a high-pressure concentration unit, wherein the low-pressure concentration unit performs a reverse osmosis concentration treatment on the feed liquids flowing therethrough at a first predetermined pressure, and the high-pressure concentration unit performs a reverse osmosis concentration treatment on the feed liquids flowing therethrough at a second predetermined pressure, wherein the first predetermined pressure is less than the second predetermined pressure.

~~18~~13. The feed liquid concentration device according to claim ~~17~~12, wherein the low-pressure concentration unit and/or the high-pressure concentration unit comprises a plurality of stages, and each stage of the low-pressure concentration unit and/or each stage of

the high-pressure concentration unit comprises one or more membrane assemblies, and each membrane assembly comprises one membrane or more membranes which are connected in series, in parallel, or in a combination of series and parallel.

~~19~~14. The feed liquid concentration device according to claim ~~18~~13, wherein the pressures in various stages of the multi-stage low-pressure concentration unit and/or the multi-stage high-pressure concentration unit are different.

~~20~~15. The feed liquid concentration device according to claim ~~19~~14, wherein the concentration unit further comprises a low-pressure heat exchanger, which is arranged at a feed port or a discharge port of the predetermined stage(s) of the low-pressure concentration unit to maintain the temperature of the concentrated feed liquid below 15 °C; and/or a high-pressure heat exchanger, which is arranged at a feed port or a discharge port of the predetermined stage(s) of the high-pressure concentration unit to maintain the temperature of the concentrated feed liquid below 15 °C.

~~21. The feed liquid concentration device according to any one of claims 17 to 20, wherein the high-pressure concentration unit comprises a plurality of stages, and each stage of the high-pressure concentration unit comprises one or more membrane assemblies, and each membrane assembly comprises one membrane or more membranes which are connected in series, in parallel or in a combination of series and parallel.~~

~~22. The feed liquid concentration device according to claim 21, wherein the pressures in various stages of the multi-stage high-pressure concentration unit are different.~~

~~23. The feed liquid concentration device according to claim 22, wherein the concentration unit further comprises a high-pressure heat exchanger, which is arranged at a feed port or a discharge port of the predetermined stage(s) of the high-pressure concentration unit to maintain the temperature of the concentrated feed liquid below 15 °C.~~

~~24. The feed liquid concentration device according to any of claims 17 to 23, further comprising: a temporary storage unit, which is arranged upstream of the concentration unit and comprises a storage container to store feed liquids to be concentrated.~~

~~25. The feed liquid concentration device according to claim 24, further comprising: a pretreatment unit, which is arranged downstream of the temporary storage unit and upstream of the concentration unit to perform pretreatment of the feed liquid from the temporary storage unit.~~

~~26. The feed liquid concentration device according to claim 25, wherein the pretreatment unit comprises a low-temperature sterilization unit to remove bacteria and/or microbial spores in the feed liquid.~~

~~27. The feed liquid concentration device according to any of claims 24 to 26, further comprising: a homogenization unit, which is arranged downstream of the temporary storage unit and upstream of the concentration unit, and applies a predetermined temperature and pressure to the feed liquids, so that the feed liquids are refined and mixed with each other more uniformly under the action of pressure and impact.~~

~~28~~16. The feed liquid concentration device according to any of claims 12 to 15~~any of claims 17 to 27~~, further comprising: a cooling unit, which is arranged downstream of the concentration unit to cool the feed liquid concentrated by the concentration unit.

~~29~~17. The feed liquid concentration device according to claim ~~28~~16, wherein the cooling unit comprises a first cooling unit and a second cooling unit, wherein the first cooling unit cools the feed liquid to the first cooling temperature, and the second cooling unit further cools the feed liquid cooled by the first cooling unit to a second cooling temperature lower than the first cooling temperature.

~~30. The feed liquid concentration device according to claim 29, wherein the first cooling unit~~

~~comprises a jacketed tank, which comprises a refrigerant liquid chamber to contain a refrigerant liquid.~~

~~31~~18. The feed liquid concentration device according to claim ~~29~~17, wherein the second cooling unit comprises a low-temperature critical tube-type heat exchanger.

~~32. The feed liquid concentration device according to any of claims 17 to 31, further comprising a filling unit, which fills the feed liquid cooled by the cooling unit into a predetermined package.~~

~~33~~19. The feed liquid concentration device according to any of claims 12 to 18~~any of claims 17 to 32~~, further comprising a cleaning unit, which cleans the feed liquid concentration device after the feed liquid concentration is completed.

~~34~~20. The feed liquid concentration device according to any of claims 12 to 19~~any of claims 17 to 33~~, wherein the feed liquid is cow milk.