CLAIMS

1. A method for preparing microcapsule particles, comprising the following steps:

1) Primary core making, which comprises:

1.1) uniformly mixing the embedded substance with the microcapsule core material, and then adding to a container for premixing;

1.2) preparing pellet cores by extrusion spheronization granulation method or centrifugal granulation method, and drying and collecting the obtained pellet cores;

2) secondary fluidization, which comprises:

2.1) preparing water-blocking coating layer solution and hydrophilic coating layer solution;

2.2) using fluidized bed spray granulation method to make the water-blocking coating solution wrap the pellet core prepared by primary core making, and drying in a fluidized bed to form water-blocked coated particles;

2.3) spraying the hydrophilic coating layer solution outside the water-blocked coated particles, and drying and collecting the prepared microcapsule particles.

2. The preparation method according to claim 1, wherein the outer diameter of the pellet core(s) is about 50-500 μm, more preferably about 50 to about 300 μm; the outer diameter of the microcapsule particle(s) is about 200 to about 1000 μm, more preferably about 100 to about 500 μm.

3. The preparation method according to claim 1 or 2, wherein the weight ratio of the embedded substance to the microcapsule core material is 1:6-1:2.5, more preferably 1:5-1:4.

4. The preparation method according to any one of claim 1-3, wherein in step 1), the embedded substance is a functional active substance selected from one or more of functional polysaccharides, functional lipids, functional proteins/peptides/amino acids, micro-ecological regulators, vitamins and minerals.

5. The preparation method according to any one of claim 1-4, wherein, in step 1), a certain

amount of water and dry powder are added; more preferably, the weight ratio of the added water to the dry powder is 1:1.5-1.5:1 (more preferably 1:1.2-1.2:1).

6. The preparation method according to claim 4, wherein the functional polysaccharide is selected from one or more of chitosan, tea polysaccharide, dietary fiber, and dextran; preferably, the functional lipid is selected from one or more of lecithin, EPA and DHA; preferably, the functional protein/peptide/amino acid is selected from one or more of taurine, lactoferrin, immunoglobulin, and whey protein peptide; preferably, the micro-ecological regulator is selected from one or more of probiotics, prebiotics, and synbiotics.

7. The preparation method according to any one of claims 1-6, wherein in step 2), the water-blocking coating layer solution comprises two or more water-blocking coating layer solutions.

8. The preparation method according to any one of claims 1-7, wherein, the main component of the water-blocking coating layer solution includes prolamin; preferably, the main components of the water-blocking coating layer solution are prolamin and oleic acid, or prolamin and glycerin (when the main components of the water-blocking coating layer solution are prolamin and oleic acid, the weight ratio of prolamin and oleic acid is 3:1 to 1:1, more preferably 2.5:1 to 1.2:1; when the main components of the water-blocking coating layer solution are prolamin and glycerin, the weight ratio of prolamin to glycerin is 4.5:1 to 5:1, more preferably 4.5:1 to 4.8:1).

9. The preparation method according to any one of claims 1-8, between steps 2.2) and 2.3), further comprising the step of infiltrating the water-blocked coated particles in medium chain triglycerides (MCT) to form a selectable water-blocking coating layer; preferably, wherein the infiltration time is 12-24 hours (preferably 16 hours).

10. The preparation method according to any one of claims 1-9, wherein in the fluidized bed spray granulation method of step 2.2), the inlet air temperature of the fluidized bed is

50-80°C (preferably 50-70°C, more preferably 55-60°C), and the air flow is 20-100m^3/h (preferably 50-90m^3/h, more preferably 60-80m^3/h).

11. The preparation method according to any one of claims 1-10, wherein the fluidized bed spray granulation method of step 2.2) comprises the following substep:
after each 400 mL of the coating solution is fluidized, particles are passed through a 50-80 mesh screen, and particles larger than 80 mesh and smaller than 50 mesh are discarded.

12. The preparation method according to any one of claims 1-11, wherein the fluidized bed spray granulation method of step 2.2) comprises the following substep:
after the single-layered water-blocked particles are formed, a fluidized bed spray granulation method is used to uniformly spray other water-blocking coating layer solution to form double-layered or multi-layered water-blocked coated particles.

13. The preparation method according to any one of claims 1-12, wherein the fluidized bed spray granulation method is applied in spraying the hydrophilic coating layer solution of 2.3) step, the fluidized bed spray granulation method in step 2.3) comprises the following substep: drying the prepared microcapsule particles in a fluidized bed, and after multiple fluidizations, collecting microcapsule particles.

14. The preparation method according to any one of claims 1-13, wherein when the granulation method in step 1.2) is extrusion spheronization granulation method, the embedded substance is mixed uniformly with the microcapsule core material, and the mixture is added to a wet granulation pot for premixing at a premixing time of 8-15min (more preferably 10 min));
preferably, wherein after spheronization granulation, the obtained particles are dried in a fluidized bed or oven (preferably at a drying temperature of 45-65°C (more preferably 45-50°C));
in the preparation method, preferably, wherein the feeding speed is 25-35 RPM (more preferably 28-32 RPM); preferably, wherein the extrusion speed is 40-50 RPM (more

preferably 45-50 RPM); preferably, wherein the spheronization speed is 350-420 RPM (more preferably 380-420 RPM).

15. The preparation method according to any one of claims 1-13, wherein when the granulation method in step 1.2) is centrifugal granulation method, the embedded substance is mixed uniformly with the microcapsule core material; preferably, wherein a turntable of a centrifugal granulator is used, and the embedded substance and the microcapsule core material are put into the turntable for premixing;
preferably, wherein after centrifugal granulation, the obtained particles are dried in a fluidized bed (at a drying temperature of 40-60°C (more preferably 45-50°C));
preferably, wherein the rotating speed of the centrifuge turntable is 600-800 RPM (more preferably 700-750 RPM).

16. The microcapsule particles prepared by the preparation method according to any one of claims 1-15.

17. A microcapsule particle comprising three parts: a pellet core, a water-blocking coating layer and a hydrophilic coating layer; wherein the pellet core includes an embedded substance and a microcapsule core material; the water-blocking coating layer is one or more coating layers, which include prolamin; the hydrophilic coating layer is one or more coating layers, which include hydrophilic polysaccharide.

18. The microcapsule particle according to claim 17, wherein the outer diameter of the pellet core(s) is about 50-500 μm, more preferably about 50 to about 300 μm; the outer diameter of the microcapsule particle(s) is about 200 to about 1000 μm, more preferably about 100 to about 500 μm.

19. The microcapsule particle according to claim 17 or 18, wherein the weight ratio of the embedded substance to the microcapsule core material is 1:6-1:2.5, more preferably 1:5-1:4.

20. The microcapsule particle according to any one of claims 17-19, wherein the embedded substance is a functional active substance selected from one or more of functional polysaccharides, functional lipids, functional proteins/peptides/amino acids, micro-ecological regulators, vitamins and minerals (preferably one or more of functional protein peptides, micro-ecological regulators and functional greases, more preferably functional protein peptides, polyunsaturated fatty acids, and/or micro-ecological regulators).

21. The microcapsule particle according to claim 20, wherein the functional polysaccharide is selected from one or more of chitosan, tea polysaccharide, dietary fiber, and dextran; preferably, the functional lipid is selected from one or more of lecithin, EPA and DHA; preferably, the functional protein/peptide/amino acid is selected from one or more of taurine, lactoferrin, immunoglobulin, and whey protein peptide; preferably, the micro-ecological regulator is selected from one or more of probiotics, prebiotics, and synbiotics.

22. The microcapsule particle according to any one of claims 17-21, wherein the microcapsule core material comprises one or a combination of more of:
vegetable protein, such as soy protein, rice protein, wheat protein, corn protein, etc.; preferably corn protein, or
animal protein, such as whey protein, casein, etc.; preferably whey protein concentrate (WPC), whey protein isolate (WPI) or whey protein peptide, especially preferably whey protein isolate (WPI); or
greases, such as greases with a melting point of 40°C or higher, preferably with a melting point of 40-50°C, particularly preferably palm oil, medium chain glycerides, hydrogenated greases (e.g., hydrogenated palm oil, hardened oil, hydrogenated soybean oil), lecithin, cocoa butter substitutes, palm oil monoglycerides, coconut oil, soybean oil, peanut oil, sunflower oil, or
other materials, such as microcrystalline cellulose (MCC), glycerin, oleic acid, sodium alginate, shellac, CMC-Na, gellan, xanthan gum, k-carrageenan, cellulose acetate phthalate, Maltodextrin, starch, dextrin, sucrose, lactose, dextran, corn syrup, pectin, gum arabic, chitosan, acetylated mono- or di-glyceride fatty acid esters, konjac gum, carrageenan, wax or

gelatin, etc.;
preferably, the main component of the microcapsule core material is microcrystalline cellulose (MCC).

23. The microcapsule particle according to any one of claims 17-22, wherein the water-blocking coating layer further comprises one or a combination of more of:
vegetable protein, such as soy protein, rice protein, wheat protein, corn protein, etc.; preferably corn protein, or
animal protein, such as whey protein, casein, etc.; preferably whey protein concentrate (WPC), whey protein isolate (WPI) or whey protein peptide, especially preferably whey protein isolate (WPI); or
greases, such as greases with a melting point of 40°C or higher, preferably with a melting point of 40-50°C, particularly preferably palm oil, medium chain glycerides, hydrogenated greases (e.g., hydrogenated palm oil, hardened oil, hydrogenated soybean oil), lecithin, cocoa butter substitutes, palm oil monoglycerides, coconut oil, soybean oil, peanut oil, sunflower oil, or
other materials, such as one or more of glycerin, oleic acid, sodium alginate, shellac, CMC-Na, gellan, xanthan gum, k-carrageenan, cellulose acetate phthalate, maltodextrin, starch, dextrin, sucrose, lactose, dextran, corn syrup, pectin, gum arabic, chitosan, acetylated mono- or di-glyceride fatty acid esters, konjac gum, carrageenan, wax or gelatin; preferably, wherein the prolamin is selected from one or more of zein prolamin and/or glutinous rice prolamin.

24. The microcapsule particle according to any one of claims 17-23, wherein the water-blocking coating layer has one or more layers (more preferably 2-4 layers, most preferably 2-3 layers).

25. The microcapsule particle according to any one of claims 17-24, wherein the main components of the hydrophilic coating layer include pectin, soybean polysaccharide, and/or whey protein isolate; preferably, wherein the hydrophilic coating layer has one layer.

26. A food or health product containing the microcapsule particle according to any one of claims 17-25, the food or health product is selected from one or more of milk and dairy products, fermented flavored foods, beverages, chocolates, candies, baked foods or fruit and vegetable juice foods, the microcapsule particle is the probiotic microcapsule particle;

wherein based on the total weight of the food or health product, the weight percentage of the probiotic microcapsule particle is about 0.02 to 1%, preferably about 0.04 to 0.5%, more preferably, about 0.06-0.15%;

optionally, the food or health product further contains honey, syrup, and/or fruit juice;

when the food or health product is yogurt, the yogurt comprises: based on the total weight of the food or health product, about 89-94% of raw milk/reconstituted milk, about 5.5-10.9% of white granulated sugar, about 0.1-0.5% of stabilizer, about 30-100 U/ton of leavening agent, and about 0.02-0.5%, preferably about 0.06-0.15% of probiotic microcapsules;

when the food or health product is native cheese or processed cheese, the native cheese or processed cheese also includes raw milk, edible salt, leavening agent or chymosin; more preferably, based on the total weight of the food or health product, the native cheese or processed cheese contains about 0.8-1.8% of edible salt, about 0.001-0.005% of leavening agent, about 0.001-0.005% of chymosin, and about 0.02-0.5% of probiotic microcapsules (preferably about 0.06-0.15%), and the rest is raw milk;

when the food or health product is a milk beverage, the milk beverage contains about 0.02-1% (preferably about 0.04-0.5%) of probiotic microcapsules;

when the food or health product is ice cream, the ice cream contains about 0.02 to 1% (preferably about 0.04 to 0.5%) of probiotic microcapsules.

27. A preparation method of probiotic microcapsules having more layers of embedding structure, comprising the following steps:

(1) coating of the first layer of microcapsules, it comprises the following substeps:

a. adding a binder to probiotic mud or probiotic powder for granulation;

b. pre-treating the first wall material:

the first wall material is mixed with water, fully dissolved, and then alternately heated and

cooled to form a stable gel;

c. uniformly wrapping droplets of the first wall material on probiotic powder, probiotic mud, or the particles obtained in step a described above;

d. curing: uniformly wrapping droplets of a curing solution on the particles obtained in step c described above;

e. drying;

(2) coating of the second layer of microcapsule, it comprises the following substeps:

f. the dry particles of single-layered microcapsule obtained in step (1) are used as probiotic core particles and mixed with the second layer of wall material to prepare double-layered microcapsules;

g. drying the microcapsules prepared in step f and collecting dry particles of double-layered microcapsule;

(3) coating of the third or more layer of microcapsule, it comprises the following substeps:

j. the double-layered microcapsules obtained in step (2) are further coated for the third or more times according to the aforementioned method;

wherein the wet particles prepared in the step of (1) coating of the first layer of microcapsules have a particle size of ≤400um, preferably 50-300um, after being dried.

28. The preparation method according to claim 27, wherein the first wall material is WPI, the second wall material is grease (preferably grease with a melting point of 40-50°C, especially preferably palm oil or MCT) or whey protein.

29. The preparation method according to claim 27 or 28, wherein in the step (1) of coating of the first layer of microcapsules, the extrusion granulation method or fluidized bed spray granulation method is used, more preferably, acute angle extrusion granulation method is used;

preferably, in the step (2) of coating of the second layer of microcapsule and/or the step (3) of coating of the third or more layer of microcapsule, the fluidized bed spray granulation method is used;

preferably, pre-treating the first wall material comprises the following substeps:

(i) the first wall material is mixed with water, and stirred at a low temperature of about 2 to 8°C for about 4 to 16 hours;
(ii) the first wall material is further heated at about 75 to about 96°C for about 30 to about 180 minutes;
(iii) the first wall material is cooled immediately at a cooling temperature of about -20 to about 4°C, and stored at about 4°C for about 12 to about 60 hours to obtain a gel solution of the first wall material.

30. The probiotic microcapsule prepared by the preparation method according to any one of claims 27-29, preferably, the probiotic microcapsule has four layers of embedding structure; more preferably, wherein based on 1000 parts by weight of dry microcapsule particles, the weight ratio of the composition of the probiotic microcapsule is: about 50 to 500 parts by weight of probiotic mud or probiotic powder; about 150-950 parts by weight of the first layer of wall material; about 0-350 parts by weight of the second layer of wall material; about 0 to 350 parts by weight of the third layer of wall material; and about 0 to 260 parts by weight of the fourth layer of wall material.

31. Use of the microcapsule particle according to any one of claims 17-25, or use of the probiotic microcapsule according to any one of claims 26-30, as food and health products, such as heat-processed foods or frozen foods (preferably used in dairy products (e.g., milk, yogurt, cheese, ice cream, milk powder, milk beverage), fermented flavored foods, beverages, chocolates, candies such as chewing gum, baked foods such as pudding, or fruit and vegetable juices).