

CLAIMS

1. A thawing solution, characterized by comprising, per 100 mL: 0.1–50 g of a biomimetic ice growth inhibition material, a water-soluble saccharide at 0–1.0 mol L⁻¹ and the balance of a buffer, wherein the biomimetic ice growth inhibition material is an atactic polyvinyl alcohol (PVA) having a syndiotacticity of 15%–65%, a molecular weight of 10 kDa–500 kDa and a degree of hydrolysis of 80%–99%, or the biomimetic ice growth inhibition material is a combination of said atactic polyvinyl alcohol (PVA) and an amino acid, a polypeptide and/or a polyamino acid;~~an ice growth inhibition material with an ice-philic group and a hydrophilic group; the hydrophilic group is a functional group or molecule capable of forming a non-covalent interaction with water molecules, and the ice-philic group is a functional group or molecule capable of forming a non-covalent interaction with ice.~~

2. ~~The thawing solution according to claim 1, characterized in that, the hydrophilic group forms a hydrogen bond, a van der Waals interaction, an electrostatic interaction, a hydrophobic interaction or a π - π interaction with water; illustratively, the hydrophilic group is selected from at least one of hydroxyl (-OH), amino (-NH₂), carboxyl (-COOH) and acylamino (-CONH₂), or from a compound molecule, such as proline (L-Pro), arginine (L-Arg), lysine (L-Lys), gluconolactone (GDL) and a saccharide, or a molecular fragment thereof; preferably, the ice-philic group forms a hydrogen bond, a van der Waals interaction, an electrostatic interaction, a hydrophobic interaction or a π - π interaction with ice; illustratively, the ice-philic group is selected from hydroxyl (-OH), amino (-NH₂), phenyl (-C₆H₅) and pyrrolidinyl (-C₄H₈N), or from a compound molecule, such as glutamine (L-Gln), threonine (L-Thr), aspartic acid (L-Asn), histidine (L-His), glycine (L-Gly), benzene (C₆H₆) and pyrrolidine (C₄H₉N), or a molecular fragment thereof.~~

3. ~~The thawing solution according to claim 1 or 2, characterized in that, the biomimetic ice growth inhibition material is selected from at least one of or a combination of two or more of a polyvinyl alcohol (PVA), an amino acid, a polypeptide and a polyamino acid; preferably, the amino acid is selected from one of or a combination of two or more of arginine, threonine, proline, lysine, histidine, glutamine, aspartic acid, and glycine and the like; the polyamino acid is a homopolymer (with a degree of polymerization ≥ 2 , preferably 2–40,~~

for example, 6, 8, 15 and 20) of at least one selected from lysine, arginine, proline, threonine, histidine, glutamic acid, aspartic acid, and glycine and the like; and

~~preferably, the polypeptide consists of two or more amino acids or is a glycopeptide derivative consisting of an amino acid and a saccharide, for example, consists of 2–8 different amino acids, and preferably the polypeptide is one or two or more of L-Thr-L-Arg (TR), L-Thr-L-Pro (TP), L-Arg-L-Thr (RT), L-Pro-L-Thr (PT), L-Thr-L-Arg-L-Thr (TRT), L-Thr-L-Pro-L-Thr (TPT), L-Ala-L-Ala-L-Thr (AAT) or L-Thr-L-Cys-L-Thr (TCT);~~

3. The thawing solution according to claim 1~~preferably, characterized in that the PVA is selected from one of or a combination of two or more of an isotactic PVA, a syndiotactic PVA and an atactic PVA, for example,~~

~~the PVA has a syndiotacticity of 15%–65%, preferably a syndiotacticity 45%–65%; or preferably, the PVA is selected from a PVA having a molecular weight of 10 kDa–500 kDa or higher; and preferably, the PVA has a degree of hydrolysis of 80%–99%, 82%–87%, 87%–89%, 89%–99% or 98%–99%.~~

4. The thawing solution according to any of claims 1–3, characterized in that, –the content of the biomimetic ice growth inhibition material is 1.0–30 g;

preferably, the biomimetic ice growth inhibition material comprises 1.0–6.0 g of the PVA;

preferably, the biomimetic ice growth inhibition material comprises 1.0–30 g of the amino acid, and more preferably, the amino acid is a combination of arginine and threonine;

preferably, the biomimetic ice growth inhibition material comprises 0.1–9.0 g of the polyamino acid;

preferably, the biomimetic ice growth inhibition material comprises 1.0–50 g of the polypeptide;

preferably, the biomimetic ice growth inhibition material is a combination of the PVA and the amino acid, the polypeptide and/or the polyamino acid.

5. The thawing solution according to any of claims 1–4, characterized in that, –the content of the water-soluble saccharide per 100 mL of the thawing solution is 0.1–1.0 mol L⁻¹;

preferably, the water-soluble saccharide can be at least one of a non-reducing disaccharide, a water-soluble polysaccharide and a glycoside, for example, selected from sucrose, trehalose, a water-soluble cellulose (e.g., hydroxypropyl methyl cellulose) and a polysucrose;

preferably, the buffer can be selected from at least one of DPBS, hepes-buffered HTF buffer

and other cell buffers.

6. A thawing reagent, comprising a thawing solution I, a thawing solution II, a thawing solution III and a thawing solution IV, wherein the thawing solutions I–IV have compositions of the thawing solution according to any of claims 1–5.

7. The thawing reagent according to claim 6, characterized in that, ~~preferably~~, the concentration of the water-soluble saccharide in the thawing solution II is 50%–100% of that in the thawing solution I, the concentration of the water-soluble saccharide in the thawing solution III is 50%–100% of that in the thawing solution II, and the concentration of the water-soluble saccharide in the thawing solution IV is 0; preferably, in the thawing solutions I–IV, for example, the concentrations of the biomimetic ice growth inhibition material are the same or different, for example, the concentration of the biomimetic ice growth inhibition material in the thawing solution II is 50%–100% of that in the thawing solution I, the concentration of the biomimetic ice growth inhibition material in the thawing solution III is 50%–100% of that in the thawing solution II, and the concentration of the biomimetic ice growth inhibition material in the thawing solution IV is 0;

preferably, the thawing solutions I–IV comprise 1.0–6.0 g of the PVA; and preferably, the concentrations of the PVA in the thawing solutions I–IV are the same.

8. The thawing reagent according to claim 6 or 7, characterized in that, in the thawing reagent, the thawing solution I comprises, per 100 mL: 1.0–50 g of at least one of the amino acid and the polypeptide, 1.0–5.0 g of the PVA, the water-soluble saccharide at 1.0 mol L⁻¹ and the balance of the buffer;

the thawing solution II comprises, per 100 mL: 1.0–25 g of at least one of the amino acid and the polypeptide, 1.0–5.0 g of the PVA, the water-soluble saccharide at 0.5 mol L⁻¹ and the balance of the buffer;

the thawing solution III comprises, per 100 mL: 1.0–12.5 g of at least one of the amino acid and the polypeptide, 1.0–5.0 g of the PVA, the water-soluble saccharide at 0.25 mol L⁻¹ and the balance of the buffer;

the thawing solution IV comprises, per 100 mL: 0–6.25 g of at least one of the amino acid and the polypeptide, 1.0–5.0 g of the PVA and the balance of the buffer.

9. The thawing reagent according to claim 6 or 7, characterized in that, –the thawing solution I comprises, per 100 mL: 1.0–5.0 g of the PVA, the water-soluble saccharide at 1.0 mol L⁻¹ and the balance of the buffer;

the thawing solution II comprises, per 100 mL: 1.0–5.0 g of the PVA, the water-soluble saccharide at 0.5 mol L⁻¹ and the balance of the buffer;

the thawing solution III comprises, per 100 mL: 1.0–5.0 g of the PVA, the water-soluble saccharide at 0.25 mol L⁻¹ and the balance of the buffer;

the thawing solution IV comprises, per 100 mL: 1.0–5.0 g of the PVA and the balance of the buffer;

preferably, the thawing solution I comprises, per 100 mL: 0.1–9.0 g of the polyamino acid, 1.0–5.0 g of the PVA, the water-soluble saccharide at 1.0 mol L⁻¹ and the balance of the buffer;

the thawing solution II comprises, per 100 mL: 0.1–4.5 g of the polyamino acid, 1.0–5.0 g of the PVA, the water-soluble saccharide at 0.5 mol L⁻¹ and the balance of the buffer;

the thawing solution III comprises, per 100 mL: 0.1–2.3 g of the polyamino acid, 1.0–5.0 g of the PVA, the water-soluble saccharide at 0.25 mol L⁻¹ and the balance of the buffer; or

the thawing solution IV comprises, per 100 mL: 0–1.2 g of the polyamino acid, 1.0–5.0 g of the PVA and the balance of the buffer.

10. A method for thawing a cryopreserved cell or tissue, comprising:

thawing the cryopreserved cell or tissue in the thawing solution I according to any of claims 6–9 at 37 °C for 3–5 minutes, and then sequentially thawing the cryopreserved cells or tissues in the thawing solution II, the thawing solution III and the thawing solution IV according to any of claims 6–9 for 3–5 minutes at room temperature.

11. Use of the thawing solution according to any of claims 1–5 or the thawing reagent according to any of claims 6–9 in thawing a cryopreserved oocyte, embryo, tissue or organ, wherein, for example, the tissue or the organ is an ovarian tissue or an ovarian organ.