administration. Particularly useful formulations may display or attain gel consistency upon administration, whereby pharmaceutical active ingredients included in the formulations are retained in the gel *in situ* and are gradually released from the gel, i.e., sustained or slow release. Also, where the formulations contain therapeutic cells, gel consistency may provide cell-supportive environment and may ensure proximity of the cells and optional beneficial substances, such as growth factors that stimulate survival, proliferation (propagation) and/or differentiation of the cells. Fresh frozen plasma (FFP) is prepared in blood banks worldwide mainly as a by-product of red blood cell concentrate preparation. With view of improving safety of FFP, solvent/detergent (S/D) treatment of plasma has been developed in the course of 1980's, resulting in a manufactured product in 1992. S/D treatment and S/D-treated plasma are described *inter alia* in Horowitz et al. 1992; US 4,764,369; EP 0 322 786; and US 2002/018777. S/D treatment of plasma disrupts the membranes of lipid-enveloped viruses, cells and most protozoa, while leaving the labile coagulation factors intact. The treatment has variable efficacy against bacteria and is substantially ineffective against non-lipid-enveloped viruses. Compared to FFP, S/D-treated plasma displays extremely high safety with respect to transfusion related acute lung injury (TRALI), significantly lower likelihood of provoking allergic reactions, and low batch to batch variation in plasma level coagulation factors. JP2011229508 (abstract) concerns a cell composition comprising skeleton myoblasts embedded in gel including plasma.
WO 2009/016451 concerns the use of a homologous or autologous blood derived substance alone or in combination with hyaluronic acid to treat an articular disease, articular pain or skin. Park et al. 2009 concerns the combination of fibrin and hyaluronic acid as a cell delivery vehicle for rabbit chondrocytes with applications in cartilage repair.

Summary

The present inventors have found pharmaceutical formulations addressing one or more of the above-mentioned problems in the art.

~~An aspect of t~~The present disclosure relates to a pharmaceutical formulation comprising solvent/detergent-treated plasma (S/D plasma) and a glycosaminoglycan.

In one aspect of the present disclosure, there is provided a pharmaceutical formulation comprising solvent/detergent-treated plasma (S/D plasma) and hyaluronic acid or a derivative thereof, wherein the pharmaceutical formulation comprises the hyaluronic acid or derivative thereof in a concentration ranging from about 0.10 mg/ml to about 200 mg/ml.

A further aspect of the present disclosure relates to the pharmaceutical formulation as described above for use in the treatment of a musculoskeletal disease, preferably wherein the musculoskeletal disease is a bone disease or a joint disease.

Another aspect of the present disclosure relates to the use of a formulation comprising S/D plasma and ~~a glycosaminoglycan~~hyaluronic acid or a derivative thereof as a pharmaceutical excipient, wherein the formulation comprises the hyaluronic acid or derivative thereof in a concentration ranging from about 0.10 mg/ml to about 200 mg/ml.

As evidenced in the Examples section, formulations applying the principles of the present disclosure have the advantageous property to gelify *in vitro* in contact with body fluids of subjects, such as

Claims

1. A pharmaceutical formulation comprising solvent/detergent-treated plasma (S/D plasma) and ~~a glycosaminoglycan.~~hyaluronic acid or a derivative thereof

~~2. The pharmaceutical formulation according to claim 1~~, wherein the pharmaceutical formulation comprises the ~~glycosaminoglycan~~ hyaluronic acid or derivative thereof in a concentration ranging from about 0.10 mg/ml to about 200 mg/ml.

~~3~~2. The pharmaceutical formulation according to claim 1, wherein the pharmaceutical formulation is produced by a method comprising combining the S/D-plasma and the ~~glycosaminoglycan~~hyaluronic acid or derivative thereof.

~~4~~3. The pharmaceutical formulation according to ~~any one of claims 1 to 3~~claim 1 or 2, wherein the S/D plasma is human S/D plasma.

~~5~~4. The pharmaceutical formulation according to any one of claims 1 to ~~4~~3, ~~wherein the glycosaminoglycan is hyaluronic acid or a derivative thereof~~further comprising one or more additional glycosaminoglycans.

~~6~~5. The pharmaceutical formulation according to any one of claims 1 to ~~5~~4, further comprising one or more pharmaceutical active ingredients.

~~7~~6. The pharmaceutical formulation according to any one of claims 1 to ~~6~~5, further comprising serum, preferably human serum.

~~8~~7. The pharmaceutical formulation according to any one of claims 1 to ~~6~~5, further comprising whole blood or a fractionated component of whole blood, preferably wherein the whole blood is human whole blood.

~~9~~8. The pharmaceutical formulation according to any one of claims ~~6~~ 5 to ~~8~~7, wherein the one or more pharmaceutical active ingredient is, each independently, selected from the group consisting of: a cell composition, a pharmaceutical active compound, a protein, a peptide, and a small organic molecule.

~~10~~9. The pharmaceutical formulation according to claim ~~9~~8, wherein the cell composition comprises mesenchymal stem cells (MSC), osteoprogenitors, osteoblastic cells, osteocytes, chondroblastic cells, and/or chondrocytes.

~~11~~10. The pharmaceutical formulation according to claim ~~9~~8, wherein the pharmaceutical active compound is an alpha-2 adrenergic receptor agonist, preferably the alpha-2 adrenergic receptor agonist is selected from the group consisting of clonidine and derivatives thereof.

~~12~~11. The pharmaceutical formulation according to claim ~~9~~8, wherein the pharmaceutical active protein or peptide is a growth factor, preferably a growth factor selected from the group consisting of a fibroblast growth factor (FGF), a transforming growth factor beta (TGFB), platelet-derived growth factor (PDGF), interleukin-8 (IL-8), a bone morphogenetic protein (BMP), parathyroid hormone (PTH), parathyroid hormone-related protein (PTHrp), and stem cell factor (SCF); more preferably a growth

factor selected from the group consisting of FGF-2, TGFB-1, PDGF, IL-8, BMP-2, BMP-4, BMP-6, BMP-7, PTH, PTHrp, and SCF.

~~13~~12. The pharmaceutical formulation according to any one of claims 1 to ~~12~~11, which is configured for parenteral administration, preferably for intra-osseous, peri-osseous, intra-articular, or peri-articular administration, or for intra-tendon, peri-tendon, intra-ligament or peri-ligament administration.

~~14~~13. The pharmaceutical formulation according to any one of claims 1 to ~~13~~ 12, for use in the treatment of a musculoskeletal disease, preferably wherein the musculoskeletal disease is a bone disease or a joint disease.

~~15~~14. The use of a formulation comprising S/D plasma and ~~a glycosaminoglycan~~hyaluronic acid or a derivative thereof as a pharmaceutical excipient.

~~16. The use according to claim 15~~, wherein the formulation comprises the ~~glycosaminoglycan~~ hyaluronic acid or derivative thereof in a concentration ranging from about 0.10 mg/ml to about 200 mg/ml.

~~17~~15. The use according to claim ~~15~~14, wherein the formulation is produced by a method comprising combining the S/D-plasma and the ~~glycosaminoglycan~~hyaluronic acid or derivative thereof.

~~18~~16. The use according to ~~any one of claims 15 to 17~~claim 14 or 15, wherein the S/D plasma is human S/D plasma.

17. The use according to any one of claims 14 to 16, wherein the formulation further comprises one or more additional glycosaminoglycans.

~~19~~18. The use according to any one of claims ~~15~~ 14 to ~~18~~17, wherein the pharmaceutical formulation is configured for parenteral administration, preferably for intra-osseous, peri-osseous, intra-articular, or peri-articular administration, or for intra-tendon, peri-tendon, intra-ligament or peri-ligament administration.