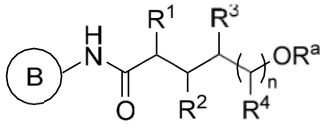
We claim:

1. A compound of Formula A



A

where:

B is phenyl;

phenyl mono- or di-substituted with C_1-C_4-alkyl, C_1-C_4-alkoxy, $-NH_2$, $-NR^5H$, $-N(R^6)_2$ where each R^6 is the same or different, $-C(O)R^7$, -COOH, $-COOR^8$, -CHO or halogen (e.g., Cl, Br, I or F); or an alkyl;

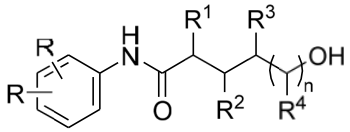
R^a is H when B is phenyl or substituted phenyl, and H or alkyl (e.g., a C_1-C_4 alkyl) when B is alkyl;

R^1, R^2, R^3 and each R^4 are each independently H, -OH, $-OR^9$, $-NHR^{10}$, $-[NH_2R^{11}]^+$, or $-[NH(R^{12})_2]^+$ where each R^{12} is the same or different, wherein at least one of the R^1, R^2, R^3 and R^4 substituents is not OH;

n is an integer from 1 to 7, wherein when n is greater than 1 each R^4 is the same or different; and

each R^5 – R^{12} is independently H, alkyl or aryl.

2. The compound of claim 1, which is compound of Formula I

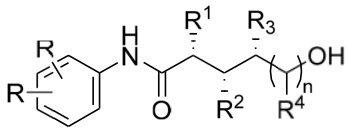


I

wherein:

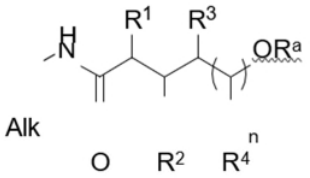
each R is independently hydrogen, C_1-C_4-alkyl, C_1-C_4-alkoxy, $-NH_2$, $-NR^5H$, $-N(R^6)_2$ where each R^6 is the same or different, $-C(O)R^7$, -COOH, $-COOR^8$, -CHO or halogen (e.g., Cl, Br, I or F).

3. The compound of claim 2, wherein the compound has the structure of Formula I'



I' .

4. The compound of claim 1, which is a compound of Formula II

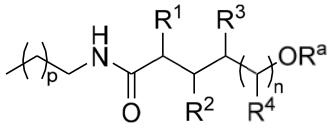


II

wherein:

Alk is a $C_3 – C_9$ linear or branched alkyl or a $C_3 – C_{10}$ mono- or poly-cyclic alkyl.

5. The compound of claim 4, which is a compound of Formula IIa



IIa

where:

p is an integer from 1 to 7, or from 5 to 7, or p is 6.

6. The compound of claim 4, wherein Alk is a C_3-C_8 straight alkyl, a C_3-C_8 branched alkyl (e.g., *t*-butyl), a C_3-C_8 cycloalkyl, or adamantyl.

7. The compound of any one of claims 1 to 6, wherein R^1, R^2, R^3 and each R^4 are independently H, -OH, -OR^9.

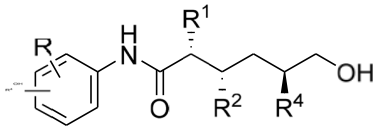
8. The compound of any one of claims 1 to 6, wherein at least one of R^1, R^2, R^3 and each R^4 is H and/or at least one of R^1, R^2, R^3 and each R^4 is OH.

9. The compound of any one of claims 1 to 8, wherein R^3 is H.

10. The compound of any one of claims 1 to 9, wherein at least one of R^1, R^2, R^3 and each R^4 are OH.

11. The compound of any one of claims 1 to 10, wherein n is 1, 2 or 3.

12. The compound of claim 11, wherein the compound has the structure of Formula Ia

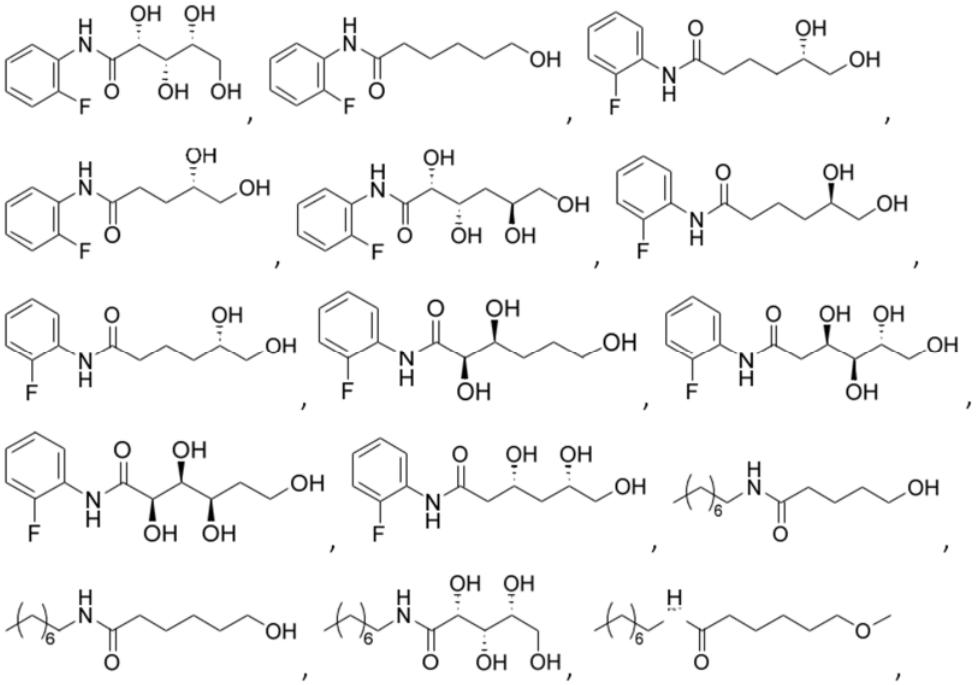


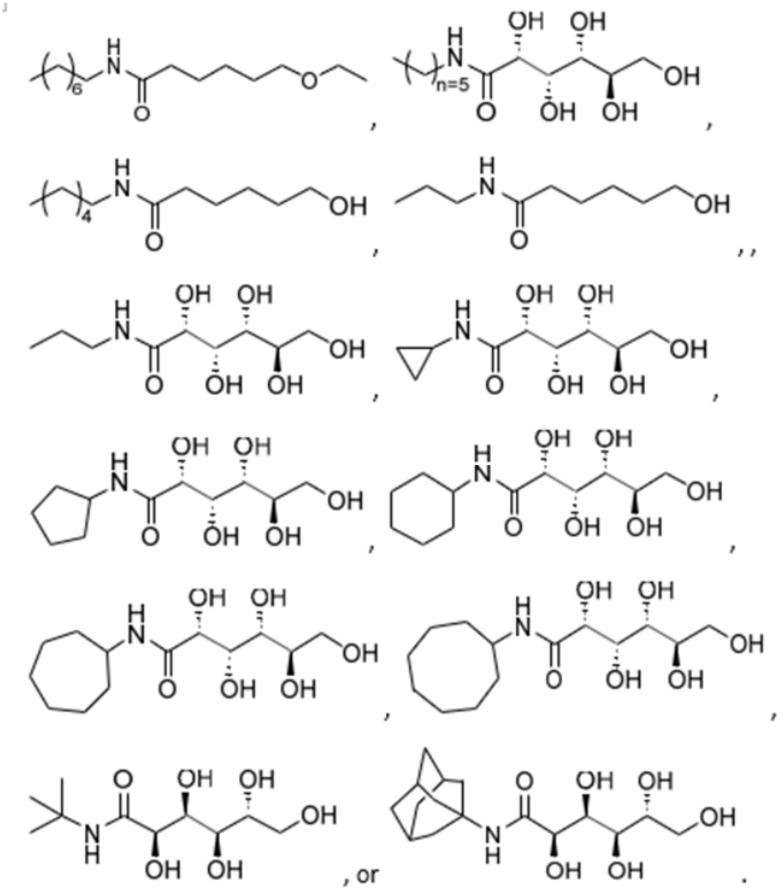
Ia .

13. The compound of claim 11 or 12, wherein each of R^1 and R^2 are OH.

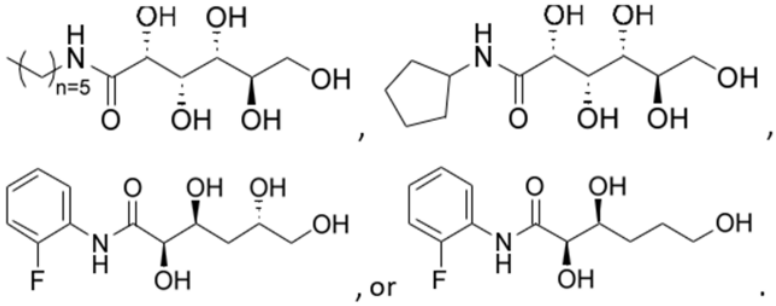
14. The compound of claim 13, wherein one R is H and one R is F.

15. The compound of claim 1, having the structure of:





16. The compound of claim 1, having the structure of:



17. The compound of any one of claims 1 to 3, wherein at least one of R^1, R^2, R^3 and the R^4 groups is $-NHR^{10}$, $-[NH_2R^{11}]^+$, or $-[NH(R^{12})_2]^+$.

18. The compound of claim 17, wherein at least two of R^1, R^2, R^3 and R^4 groups are independently $-NHR^{10}$, $-[NH_2R^{11}]^+$, or $-[NH(R^{12})_2]^+$.

19. A composition comprising the compound of any one of claims 1 – 18 and a solvent (e.g., water) or a buffer.

20. The composition of claim 19, further comprising a cryopreservation agent.

21. The composition of claim 20, wherein the cryopreservation agent comprises DMSO, lactobionate, glycerol, polyvinylalcohol, hydroxyethyl starch (HES), ethylene glycol (EG), propylene glycol (PG), trehalose, mannitol, or a combination of two or more thereof.

22. The composition of any one of claims 19 to 21, further comprising a biological material from a human, an animal, a plant, a fungus or a microorganism.

23. The composition of claim 22, wherein the biological material is an organ, a tissue, cells or platelets.

24. The composition of claim 23, wherein the cells comprise stem cells, T cells (including CAR-T cells), peripheral blood mononuclear cells (PMBCs), neurons, progenitor cells, liver cells, red blood cells, immune cells (including natural killer (NK) cells), endothelial cells, pancreatic cells (e.g., pancreatic islet cells), dendritic cells, fibroblasts or cells from a cell line, preferably the cells comprise stem cells, T cells, red blood cells, progenitor cells, or liver cells.

25. The composition of any one of claims 19 to 24, further comprising a cell culture medium.

26. The composition of claim 25, wherein the cell culture medium is phosphate buffered saline.

27. The composition of claim 26, wherein the cell culture medium comprises albumin, Eagle's minimum essential medium, Dulbecco's modified Eagle's medium, RPMI, fetal bovine serum, fetal calf serum, Ham's F-10, Ham's F-12, Medium 199, Hank's Buffered Salt Solution, Hank's Buffered Salt Solution and dextrose, or a combination thereof.

28. A method for cryopreserving a biological material comprising:

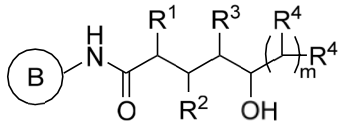
a. combining the biological material with a solution comprising at least one compound according to any one of claims 1 to 18;

b. cooling the combination from step a) to a storage temperature at or below the freezing point of the solution; and

c. storing the cooled combination at the storage temperature.

29. The method of claim 28, wherein the cooling comprises performing a rate-controlled cooling of about 1°C per minute over about 16 hours.

30. A method for synthesizing a compound of Formula XII



XII

wherein:

B is phenyl; phenyl mono- or di-substituted with C_1-C_4-alkyl, C_1-C_4-alkoxy, $-NH_2$, $-NR^5H$, $-N(R^6)_2$ where each R^6 is the same or different, $-C(O)R^7$, - COOH, $-COOR^8$, -CHO or halogen (e.g., Cl, Br, I or F); or an alkyl;

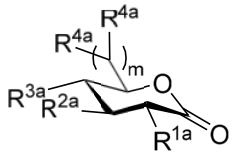
R^1, R^2, R^3 and each R^4 are each independently H, -OH, $-OR^9$, $-NHR^{10}$, $-[NH_2R^{11}]^+$ or $-[NH(R^{12})_2]^+$ where each R^{12} is the same or different, wherein the terminal R^4 is OH;

m is an integer from 1 to 6; and

each R^5 – R^{12} is independently H, alkyl or aryl,

said method comprising:

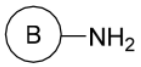
(a) providing a lactone of Formula VIII



VIII

wherein R^{1a}, R^{2a}, R^{3a} and each R^{4a} are independently H, -OH, -OR^9, -NHR^{10}, -$[NH_2R^{11}]^+$, -$[NH(R^{12})_2]^+$ where each R^{12} is the same or different, a protected alcohol, or a protected amine, wherein the terminal R^{4a} is OH; and

(b) ring opening the compound of Formula VIII with an aryl or alkyl amine of Formula VII

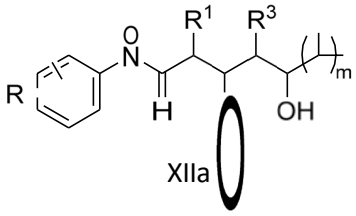


VII .

31. The method according to claim 30, further comprising deprotecting the product of step (b).

32. The method according to claim 30 or 31, wherein:

a) the compound of Formula XII has the structure of Formula XIIa:

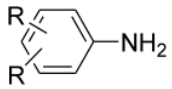


wherein:

each R is independently hydrogen, C_1-C_4-alkyl, C_1-C_4-alkoxy, -NH_2, -NR^5H, -$N(R^6)_2$ where each R^6 is the same or different, -$C(O)R^7$, - COOH, -$COOR^8$, -CHO, haloalkyl or halogen (e.g., Cl, Br, I or F), and

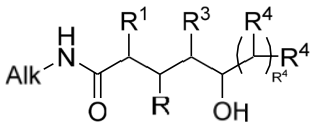
each R^8 – R^{12} is independently H, alkyl or aryl; and

wherein the compound of Formula VII is an aryl amine having the structure of Formula VIIa:



VIIa; or

b) the compound of Formula XII has the structure of Formula XIIb:

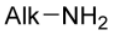


XIIb

wherein:

Alk is a C_3 – C_9 linear or branched alkyl or a C_3 – C_{10} mono- or poly-cyclic alkyl; and

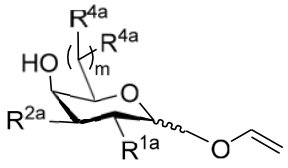
wherein the compound Formula VII is an alkyl amine having the structure of Formula VIIb:



VIIb.

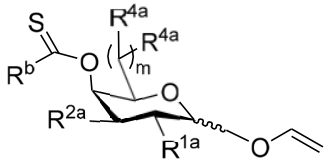
33. The method synthesizing a compound of Formula III according to any one of claims 30 to 32, wherein R^3 is H, and wherein prior to step (a), a compound of Formula VIII, in which R^{3a} is H, is first produced by steps comprising:

(i) providing a protected O-allyl pyranose of Formula IX



IX ;

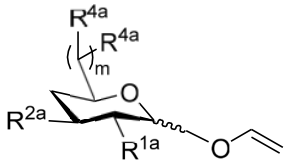
(ii) converting the protected O-allyl pyranose of Formula IX to a thiocarbonyl derivative of Formula X



X

wherein R^b is H, CH_3, SCH_3, OCH_3, phenyl (Ph), OPh or imidazolyl, preferably imidazolyl;

(iii) treating the thiocarbonyl derivative of Formula X with a radical reducing agent to produce a C4-deoxy pyranose derivative of Formula XI



XI ;

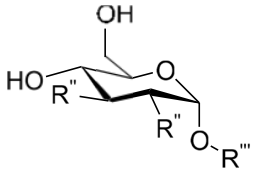
(iv) converting the C1 allyl group in the compound of Formula XI to a C1 hydroxyl group; and

(v) oxidizing the C1 hydroxyl group to form the lactone of Formula VIII.

34. The method of any one of claims 30 to 33, wherein R^{1a}, R^{2a}, R^{3a} and each R^{4a} are independently H or a protected alcohol and/or wherein m is 1.

35. A method for synthesizing a compound of Formula I, I as defined in claim 2, wherein n is 2, R^3 is H and R^4 is OH, comprising the steps of:

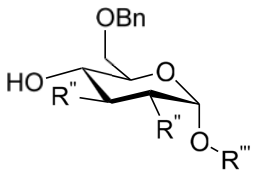
(i) converting a protected D-pyranose of Formula III to a benzylidene acetal



III

where each R" is independently H or OH and O-R"' is a hydroxyl protecting group, such as methoxy or silyl ether (e.g., a bulky silyl ether);

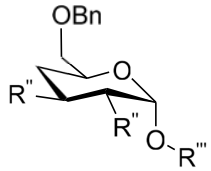
(ii) when one or both of the R" groups are OH, protecting the OH group or groups, and subsequently performing a selective ring opening of the benzylidene acetal to form a C4 acceptor compound of Formula IV



IV

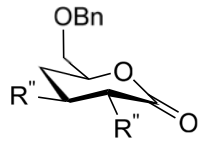
wherein each R" is independently H or OPr^1, where Pr^1 is a hydroxyl protecting group (such as, but not limited to, a benzyl group);

(iii) converting the C4 hydroxyl group of the compound of Formula IV into a triflate and displacing the triflate to produce a C4 deoxy pyranose derivative of Formula V



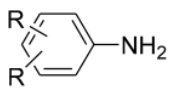
V ;

(iv) deprotecting the anomeric protected group and oxidizing the resultant hydroxyl to produce the lactone of Formula VI



VI ; and

(v) ring opening the lactone of Formula VI with an aryl amine of Formula VIIa

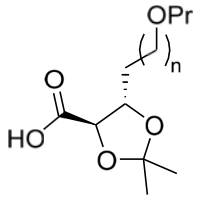


VIIa

wherein each R is independently hydrogen, C_1-C_4-alkyl, C_1-C_4-alkoxy, $-NH_2$, $-NR^5H$, $-N(R^6)_2$ where each R^6 is the same or different, $-C(O)R^7$, -COOH, $-COOR^8$, -CHO or halogen (e.g., Cl, Br, I or F), and removing the hydroxyl protecting group(s) to form the compound of Formula I as defined above, wherein n is 2, R^3 is H and R^4 is OH.

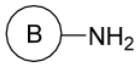
36. A method of synthesizing a compound of Formula I, as defined in claim 1, wherein R^1 and R^2 are both OH, R^3 and R^4 are H and R^a is H , said method comprising the steps of:

(a) providing a carboxylic acid of Formula XX



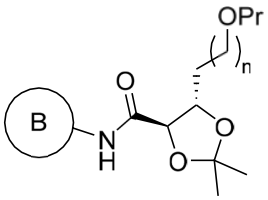
XX ;

(b) coupling the carboxylic acid of Formula XX with an alkyl or aryl amine of Formula VII



VII

in the presence of a coupling agent (e.g., EDC) to form a protected amide of Formula XXI



XXI ; and

(c) deprotecting of the protected amide to form the compound of Formula I in which R^1 and R^2 are both OH, R^3 and R^4 are H and R^a is H.