CLAIMS

1. A method of making a *Yarrowia lipolytica* cell for producing proteins comprising $GlcNAcMan_3GlcNAc_2$ N-glycans, said method comprising:

a) providing a *Yarrowia lipolytica* cell genetically engineered to produce proteins comprising $Man_3GlcNAc_2$ N-glycans;

b) introducing into said cell a nucleic acid encoding a GlcNAc-transferase I, wherein said nucleic acid comprises a nucleotide sequence encoding a targeting sequence to target said encoded GlcNAc-transferase I to an intracellular compartment, wherein expression of said GlcNAc-transferase I in said *Yarrowia lipolytica* cell produces proteins comprising $GlcNAcMan_3GlcNAc_2$ N-glycans.

2. The method of claim 1, said method further comprising introducing into said cell a nucleic acid encoding a target protein, wherein said cell produces said target protein modified to comprise said $GlcNAcMan_3GlcNAc_2$ N-glycans.

3. The method of claim 1, wherein said target protein binds to an Fc receptor.

4. The method of claim 1, wherein said target protein is an antibody or fragment thereof.

5. The method of claim 1, wherein said target protein is a therapeutic glycoprotein.

6. The method of claim 1, wherein said target protein is Interferon-β, GM-CSF, Interferon-γ, or erythropoietin.

7. The method of claim 1, wherein said intracellular compartment is the Golgi apparatus.

8. The method of claim 1, wherein said *Yarrowia lipolytica* cell genetically engineered to produce proteins comprising $Man_3GlcNAc_2$ N-glycans is deficient in ALG3 activity, and comprises a nucleic acid encoding an α-1,2-mannosidase, said nucleic acid comprising a nucleotide sequence encoding a targeting sequence to target the encoded α-1,2-mannosidase to the endoplasmic reticulum.

9. The method of claim 8, wherein said *Yarrowia lipolytica* cell genetically engineered to produce proteins comprising $Man_3GlcNAc_2$ N-glycans further is deficient in OCH1 activity.

10. The method of claim 8 or 9, wherein said *Yarrowia lipolytica* cell genetically engineered to produce proteins comprising $Man_3GlcNAc_2$ N-glycans further comprises a nucleic acid encoding an α-1,3-glucosyltransferase.

11. The method of claim 10, wherein said α-1,3-glucosyltransferase is ALG6.

12. The method of claim 1, said method further comprising introducing into said cell a nucleic acid encoding a GlcNAc-transferase II, wherein said nucleic acid encoding said GlcNAc-transferase II comprises a nucleotide sequence encoding a targeting sequence to target the encoded GlcNAc-transferase II to an intracellular compartment, wherein expression of said GlcNAc-transferase II in said *Yarrowia lipolytica* cell produces proteins comprising $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

13. The method of claim 1 or claim 12, said method further comprising introducing into said cell a nucleic acid encoding a galactosyltransferase, wherein said nucleic acid encoding said galactosyltransferase comprises a nucleotide sequence encoding a targeting sequence to target the encoded galactosyltransferase to the Golgi apparatus, wherein expression of said galactosyltransferase in said *Yarrowia lipolytica* cell produces proteins comprising $GalGlcNAcMan_3GlcNAc_2$ or $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

14. The method of claim 13, said method further comprising introducing into said cell a nucleic acid encoding a target protein, wherein said cell produces said target protein modified to comprise said $GalGlcNAcMan_3GlcNAc_2$ or $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

15. The method of claim 13, wherein said galactosyltransferase is a fusion of a UDP-Glc-4-epimerase and catalytic domain of a β-1,4-galactosyltransferase I.

16. The method of claim 13 said method further comprising introducing into said cell a nucleic acid encoding the α and β subunits of a Glucosidase II, wherein expression of said α and β subunits of said Glucosidase II in said *Yarrowia lipolytica* cell produces proteins comprising $GalGlcNAcMan_3GlcNAc_2$ or $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

17. A method of producing a *Yarrowia lipolytica* cell for producing proteins comprising $GlcNAcMan_5GlcNAc_2$ N-glycans, said method comprising:

a) providing a *Yarrowia lipolytica* cell genetically engineered to produce proteins comprising $Man_5GlcNAc_2$ N-glycans;

b) introducing into said cell a nucleic acid encoding a GlcNAc-transferase I, wherein said nucleic acid comprises a nucleotide sequence encoding a targeting sequence to target the encoded GlcNAc-transferase I to an intracellular compartment, wherein expression of said GlcNAc-transferase I in said *Yarrowia lipolytica* cell produces proteins comprising $GlcNAcMan_5GlcNAc_2$ N-glycans.

18. The method of claim 17, said method further comprising introducing into said cell a nucleic acid encoding a target protein, wherein said cell produces said target protein modified to comprise said $GlcNAcMan_5GlcNAc_2$ N-glycans.

19. The method of claim 18, wherein said target protein binds to an Fc receptor.

20. The method of claim 19, wherein said target protein is an antibody or fragment thereof.

21. The method of claim 18, wherein said target protein is a therapeutic glycoprotein.

22. The method of claim 18, wherein said target protein is Interferon-β, GM-CSF, Interferon-γ, or erythropoietin.

23. The method of claim 17, wherein said intracellular compartment is the Golgi apparatus.

24. The method of claim 17, wherein said *Yarrowia lipolytica* cell genetically engineered to produce proteins comprising $Man_5GlcNAc_2$ N-glycans is deficient in OCH1 activity and comprises a nucleic acid encoding an α-1,2-mannosidase, wherein said nucleic acid encoding said α-1,2-mannosidase comprises a nucleotide sequence encoding a targeting sequence to target the encoded α-1,2-mannosidase to the endoplasmic reticulum.

25. The method of claim 24, wherein said targeting sequence is an HDEL sequence.

26. The method of claim 17, said method further comprising introducing into said cell a nucleic acid encoding a mannosidase II, wherein said nucleic acid encoding said mannosidase II comprises a nucleotide sequence encoding a targeting sequence to target the encoded mannosidase II to the Golgi apparatus, wherein expression of said mannosidase II in said *Yarrowia lipolytica* cell produces proteins comprising $GlcNAcMan_3GlcNAc_2$ N-glycans.

27. The method of claim 17 or claim 26, said method further comprising introducing into said cell a nucleic acid encoding a galactosyltransferase, wherein said nucleic acid encoding said galactosyltransferase comprises a nucleotide sequence encoding a targeting sequence to target the encoded galactosyltransferase to the Golgi apparatus, wherein expression of said galactosyltransferase in said *Yarrowia lipolytica* cell produces proteins comprising $GalGlcNAcMan_5GlcNAc_2$ or $GalGlcNAcMan_3GlcNAc_2$ N-glycans.

28. The method of claim 27, said method further comprising introducing into said cell a nucleic acid encoding a target protein, wherein said cell produces said target protein modified to comprise said $GalGlcNAcMan_5GlcNAc_2$ or $GalGlcNAcMan_3GlcNAc_2$ N-glycans.

29. The method of claim 27, wherein said galactosyltransferase is a fusion of a UDP-Glc-4-epimerase and the catalytic domain of a β-1,4-galactosyltransferase I.

30. The method of claim 28, further comprising isolating said target protein modified to comprise said $GalGlcNAcMan_5GlcNAc_2$ or $GalGlcNAcMan_3GlcNAc_2$ N-glycans.

31. A method of producing a target protein comprising $GlcNAcMan_3GlcNAc_2$ N-glycans, said method comprising:

a) providing a *Yarrowia lipolytica* cell genetically engineered to comprise a nucleic acid encoding a GlcNAc-transferase I, an α-1,2-mannosidase, and a mannosidase II, wherein said nucleic acid comprises nucleotide sequences encoding targeting sequences to target each encoded protein to an intracellular compartment, wherein said *Yarrowia lipolytica* cell is deficient in OCH1 activity; and

b) introducing into said cell a nucleic acid encoding a target protein, wherein said cell produces said target protein comprising said $GlcNAcMan_3GlcNAc_2$ N-glycans.

32. The method of claim 31, wherein said nucleic acid encoding said α-1,2-mannosidase comprises an endoplasmic reticulum targeting sequence to target the encoded α-1,2-mannosidase to the endoplasmic reticulum.

33. The method of claim 32, wherein said targeting sequence is an HDEL sequence.

34. The method of claim 31, wherein said nucleic acid encoding said GlcNAc-transferase I and said mannosidase II comprises nucleotide sequences encoding Golgi targeting sequences to target the encoded GlcNAc-transferase I and mannosidase II to the Golgi apparatus.

35. The method of claim 31, wherein said target protein binds to an Fc receptor.

36. The method of claim 31, wherein said target protein is an antibody or fragment thereof.

37. The method of claim 31, wherein said target protein is a therapeutic glycoprotein.

38. The method of claim 31, wherein said target protein is Interferon-β, GM-CSF, Interferon-γ, or erythropoietin.

39. The method of claim 31, further comprising introducing into said cell a nucleic acid encoding a galactosyltransferase, wherein said nucleic acid encoding said galactosyltransferase comprises a nucleotide sequence encoding a targeting sequence to target the encoded galactosyltransferase to the Golgi apparatus, wherein expression of said galactosyltransferase in said *Yarrowia lipolytica* cell produces said target protein modified to comprise $GalGlcNAcMan_3GlcNAc_2$ N-glycans.

40. The method of claim 39, further comprising isolating said target protein modified to comprise said $GalGlcNAcMan_3GlcNAc_2$ N-glycans.

41. A method of producing a target protein comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans, said method comprising:

a) providing a *Yarrowia lipolytica* cell genetically engineered to be deficient in ALG3 activity and comprising a nucleic acid encoding a GlcNAc-transferase I, a GlcNAc-transferase II, and a galactosyltransferase, wherein said nucleic acid encoding said GlcNAc-transferase I, said

GlcNAc-transferase II, and said galactosyltransferase comprises nucleotide sequences encoding targeting sequences to target each encoded protein to an intracellular compartment;

b) introducing into said cell a nucleic acid encoding a target protein, wherein said cell produces said target protein comprising said $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

42. The method of claim 41, wherein said *Yarrowia lipolytica* cell further is deficient in OCH1 activity.

43. The method of claim 41 or 42, wherein said *Yarrowia lipolytica* cell further comprises a nucleic acid encoding an α-1,3-glucosyltransferase.

44. The method of claim 43, wherein said nucleic acid encoding said α-1,3-glucosyltransferase is ALG6.

45. The method of claim 41, claim 42, or claim 43, wherein said *Yarrowia lipolytica* cell further comprises a nucleic acid encoding the α and β subunits of a Glucosidase II, wherein expression of said α and β subunits of said Glucosidase II in said *Yarrowia lipolytica* cell produces said target protein comprising said $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

46. An isolated *Yarrowia lipolytica* cell genetically engineered to produce proteins comprising $GlcNAcMan_3GlcNAc_2$ N-glycans, wherein said *Yarrowia lipolytica* cell is deficient in OCH1 activity and comprises a nucleic acid encoding an α-1,2-mannosidase, a GlcNAc-transferase I, and a mannosidase II, wherein said nucleic acid encoding said α-1,2-mannosidase, said GlcNAc-transferase I, and said mannosidase II comprises nucleotide sequences encoding targeting sequences to target each encoded protein to an intracellular compartment, wherein expression of said α-1,2-mannosidase, said GlcNAc-transferase I, and said mannosidase II in said *Yarrowia lipolytica* cell produces proteins comprising $GlcNAcMan_3GlcNAc_2$ N-glycans.

47. The *Yarrowia lipolytica* cell of claim 46, wherein said genetically engineered *Yarrowia lipolytica* cell further comprises a nucleic acid encoding a target protein, wherein said cell produces said target protein modified to comprise said $GlcNAcMan_3GlcNAc_2$ N-glycans.

48. The *Yarrowia lipolytica* cell of claim 46 or claim 47, wherein said genetically engineered *Yarrowia lipolytica* cell further comprises a nucleic acid encoding a GlcNAc-transferase II, wherein said nucleic acid encoding said GlcNAc-transferase II comprises a nucleotide sequence encoding a targeting sequence to target the encoded GlcNAc-transferase II to an intracellular compartment, wherein expression of said GlcNAc-transferase II in said *Yarrowia lipolytica* cell produces proteins comprising $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

49. The *Yarrowia lipolytica* cell of claim 48, wherein at least 50%, at least 70%, or at least 85% of the N-glycans on said glycoprotein are $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

50. The *Yarrowia lipolytica* cell of claim 48 or 49, said *Yarrowia lipolytica* cell further comprising a nucleic acid encoding a galactosyltransferase, wherein said nucleic acid encoding said galactosyltransferase comprises a nucleotide sequence encoding a targeting sequence to target the encoded galactosyltransferase to the Golgi apparatus, wherein expression of said galactosyltransferase in said *Yarrowia lipolytica* cell produces proteins comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

51. An isolated *Yarrowia lipolytica* cell genetically engineered to produce proteins comprising $GlcNAc_2Man_3GlcNAc_2$ N-glycans, wherein said *Yarrowia lipolytica* cell is genetically engineered to be deficient in ALG3 activity and comprises a nucleic acid encoding a GlcNAc-transferase I and a GlcNAc-transferase II, wherein said nucleic acid encoding said GlcNAc-transferase I and said GlcNAc-transferase II comprises nucleotide sequences encoding targeting sequences to target each encoded protein to an intracellular compartment, wherein expression of said GlcNAc-transferase I, and said GlcNAc-transferase II in said *Yarrowia lipolytica* cell produces proteins comprising $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

52. The *Yarrowia lipolytica* cell of claim 51, wherein said genetically engineered *Yarrowia lipolytica* cell further is deficient in OCH1 activity.

53. The *Yarrowia lipolytica* cell of claim 51 or claim 52, wherein said genetically engineered *Yarrowia lipolytica* cell further comprises a nucleic acid encoding an α-1,3-glucosyltransferase.

54. The *Yarrowia lipolytica* cell of claim 51, claim 52, or claim 53, wherein said genetically engineered *Yarrowia lipolytica* cell further comprises a nucleic acid encoding a target protein, wherein said cell produces said target protein modified to comprise said $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

55. The *Yarrowia lipolytica* cell of any one of claims 51-54, said *Yarrowia lipolytica* cell further comprising a nucleic acid encoding the α and β subunits of a Glucosidase II, wherein expression of said α and β subunits of said Glucosidase II in said *Yarrowia lipolytica* cell produces said protein comprising said $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

56. The *Yarrowia lipolytica* cell of any one of claims 51-55, wherein at least 50%, at least 70%, or at least 85% of the N-glycans on said glycoprotein are $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

57. The *Yarrowia lipolytica* cell of claim 55 or 56, said *Yarrowia lipolytica* cell further comprising a nucleic acid encoding a galactosyltransferase, wherein said nucleic acid encoding said galactosyltransferase comprises a nucleotide sequence encoding a targeting sequence to target the encoded galactosyltransferase to the Golgi apparatus, wherein expression of said galactosyltransferase in said *Yarrowia lipolytica* cell produces proteins comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

58. A substantially pure culture of *Yarrowia lipolytica* cells, a substantial number of which are genetically engineered to produce glycoproteins comprising $Gal_2GlcNac_2Man_3GlcNAc_2$ N-glycans, wherein said cells are genetically engineered to be deficient in ALG3 activity and comprise a nucleic acid encoding a GlcNAc-transferase I, a GlcNAc-transferase II, and a galactosyltransferase, wherein said nucleic acid encoding said GlcNAc-transferase I, said GlcNAc-transferase II, and said galactosyltransferase comprises nucleotide sequences encoding targeting sequences to target each encoded protein to an intracellular compartment, wherein expression of said GlcNAc-transferase I, said GlcNAc-transferase II, and said galactosyltransferase in said cell produces proteins comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

59. The substantially pure culture of claim 58, wherein said cells further are deficient in OCH1 activity.

60. The substantially pure culture of claim 58 or claim 59, wherein said cells further comprise a nucleic acid encoding an α-1,3-glucosyltransferase.

61. The substantially pure culture of claim 58, claim 59, or claim 60, wherein said cells further comprise a nucleic acid encoding the α and β subunits of a Glucosidase II, wherein expression of said α and β subunits of said Glucosidase II in said *Yarrowia lipolytica* cell produces said target protein comprising said $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

62. A substantially pure culture of *Yarrowia lipolytica* cells, a substantial number of which are genetically engineered to produce glycoproteins comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans, wherein said cells are genetically engineered to be deficient in OCH1 activity and comprise a nucleic acid encoding an α-1,2-mannosidase, a GlcNAc-transferase I, a mannosidase II, a GlcNAc-transferase II, and a galactosyltransferase, wherein said nucleic acid encoding said α-1,2-mannosidase, said GlcNAc-transferase I, said mannosidase II, said GlcNAc-transferase II, and said galactosyltransferase comprises nucleotide sequences encoding targeting sequences to target each encoded protein to an intracellular compartment, wherein expression of said α-1,2-mannosidase, said GlcNAc-transferase I, said mannosidase II, said GlcNAc-transferase II, and a galactosyltransferase in said cells produces proteins comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

63. A composition comprising a glycoprotein, wherein at least 50% of the N-glycans on said glycoprotein are $GlcNAc_2Man_3GlcNAc_2$ N-glycans; and wherein the glycoprotein has been produced using a genetically engineered *Yarrowia lipolytica* cell.

64. The composition of claim 63, wherein at least 70% of the N-glycans on said glycoprotein are $GlcNAc_2Man_3GlcNAc_2$ N-glycans; and wherein the glycoprotein has been produced using a genetically engineered *Yarrowia lipolytica* cell.

65. The composition of claim 63, wherein at least 85% of the N-glycans on said glycoprotein are $GlcNAc_2Man_3GlcNAc_2$ N-glycans; and wherein the glycoprotein has been produced using a genetically engineered *Yarrowia lipolytica* cell.

WHAT IS CLAIMED IS:

1. A method of producing a fungal cell capable of producing proteins comprising $GlcNAcMan_5GlcNAc_2$ N-glycans, said method comprising:

a) providing a fungal cell genetically engineered to produce proteins comprising $Man_5GlcNAc_2$ N-glycans;

b) introducing into said cell a nucleic acid encoding a GlcNAc-transferase I, wherein said nucleic acid comprises a nucleotide sequence encoding a targeting sequence to target the encoded GlcNAc-transferase I to an intracellular compartment, wherein expression of said GlcNAc-transferase I in said fungal cell produces proteins comprising $GlcNAcMan_5GlcNAc_2$ N-glycans.

2. The method of claim 1, said method further comprising introducing into said cell a nucleic acid encoding a target protein, wherein said cell produces said target protein modified to comprise said $GlcNAcMan_5GlcNAc_2$ N-glycans.

3. The method of claim 2, wherein said target protein binds to an Fc receptor.

4. The method of claim 3, wherein said target protein is an antibody or fragment thereof.

5. The method of claim 2, wherein said target protein is a therapeutic glycoprotein.

6. The method of claim 2, wherein said target protein is Interferon-β, GM-CSF, Interferon γ, or erythropoietin.

7. The method of claim 1, wherein said intracellular compartment is the Golgi apparatus.

8. The method of claim 1, wherein said fungal cell genetically engineered to produce proteins comprising $Man_5GlcNAc_2$ N-glycans is deficient in OCH1 activity and comprises a nucleic acid encoding an α-1,2-mannosidase, wherein said nucleic acid encoding said α-1,2-mannosidase comprises a nucleotide sequence encoding a targeting sequence to target the encoded α-1,2-mannosidase to the endoplasmic reticulum.

9. The method of claim 8, wherein said targeting sequence is an HDEL sequence.

10. The method of claim 1, wherein said fungal cell is *Yarrowia lipolytica* or *Arxula adeninivorans*.

11. The method of claim 1, said method further comprising introducing into said cell a nucleic acid encoding a mannosidase II, wherein said nucleic acid encoding said mannosidase II comprises a nucleotide sequence encoding a targeting sequence to target the encoded mannosidase II to the Golgi apparatus, wherein expression of said mannosidase II in said fungal cell produces proteins comprising $GlcNAcMan_3GlcNAc_2$ N-glycans.

12. The method of claim 1 or claim 11, said method further comprising introducing into said cell a nucleic acid encoding a galactosyltransferase, wherein said nucleic acid encoding said galactosyltransferase comprises a nucleotide sequence encoding a targeting sequence to target the encoded galactosyltransferase to the Golgi apparatus, wherein expression of said galactosyltransferase in said fungal cell produces proteins comprising $GalGlcNAcMan_5GlcNAc_2$ or $GalGlcNAcMan_3GlcNAc_2$ N-glycans.

13. The method of claim 12, said method further comprising introducing into said cell a nucleic acid encoding a target protein, wherein said cell produces said target protein modified to comprise said $GalGlcNAcMan_5GlcNAc_2$ or $GalGlcNAcMan_3GlcNAc_2$ N-glycans.

14. The method of claim 12, wherein said galactosyltransferase is a fusion of a UDP-Glc-4-epimerase and the catalytic domain of a β-1,4-galactosyltransferase I.

15. The method of claim 13, further comprising isolating said target protein modified to comprise said $GalGlcNAcMan_5GlcNAc_2$ or $GalGlcNAcMan_3GlcNAc_2$ N-glycans.

16. A method of producing a target protein comprising $GlcNAcMan_3GlcNAc_2$ N-glycans, said method comprising:

a) providing a fungal cell genetically engineered to comprise a nucleic acid encoding a GlcNAc-transferase I, an α-1,2-mannosidase, and a mannosidase II, wherein said nucleic acid comprises nucleotide sequences encoding targeting sequences to target each encoded protein to an intracellular compartment, wherein said fungal cell is deficient in OCH1 activity; and

b) introducing into said cell a nucleic acid encoding a target protein, wherein said cell produces said target protein comprising said $GlcNAcMan_3GlcNAc_2$ N-glycans.

17. The method of claim 16, wherein said fungal cell is *Yarrowia lipolytica* or *Arxula adeninivorans*.

18. The method of claim 16, wherein said nucleic acid encoding said α-1,2-mannosidase comprises an endoplasmic reticulum targeting sequence to target the encoded α-1,2-mannosidase to the endoplasmic reticulum.

19. The method of claim 18, wherein said targeting sequence is an HDEL sequence.

20. The method of claim 16, wherein said nucleic acid encoding said GlcNAc-transferase I and said mannosidase II comprises nucleotide sequences encoding Golgi targeting sequences to target the encoded GlcNAc-transferase I and mannosidase II to the Golgi apparatus.

21. The method of claim 16, wherein said target protein binds to an Fc receptor.

22. The method of claim 16, wherein said target protein is an antibody or fragment thereof.

23. The method of claim 16, wherein said target protein is a therapeutic glycoprotein.

24. The method of claim 16, wherein said target protein is Interferon-β, GM-CSF, Interferon γ, or erythropoietin.

25. The method of claim 16, further comprising introducing into said cell a nucleic acid encoding a galactosyltransferase, wherein said nucleic acid encoding said galactosyltransferase comprises a nucleotide sequence encoding a targeting sequence to target the encoded galactosyltransferase to the Golgi apparatus, wherein expression of said galactosyltransferase in said fungal cell produces said target protein modified to comprise $GalGlcNAcMan_3GlcNAc_2$ N-glycans.

26. The method of claim 25, further comprising isolating said target protein modified to comprise said $GalGlcNAcMan_3GlcNAc_2$ N-glycans.

27. A method of making a fungal cell capable of producing proteins comprising $GlcNAcMan_3GlcNAc_2$ N-glycans, said method comprising:

a) providing a fungal cell genetically engineered to produce proteins comprising $Man_3GlcNAc_2$ N-glycans;

b) introducing into said cell a nucleic acid encoding a GlcNAc-transferase I, wherein said nucleic acid comprises a nucleotide sequence encoding a targeting sequence to target said encoded GlcNAc-transferase I to an intracellular compartment, wherein expression of said GlcNAc-transferase I in said fungal cell produces proteins comprising $GlcNAcMan_3GlcNAc_2$ N-glycans.

28. The method of claim 27, said method further comprising introducing into said cell a nucleic acid encoding a target protein, wherein said cell produces said target protein modified to comprise said $GlcNAcMan_3GlcNAc_2$ N-glycans.

29. The method of claim 27, wherein said target protein binds to an Fc receptor.

30. The method of claim 27, wherein said target protein is an antibody or fragment thereof.

31. The method of claim 27, wherein said target protein is a therapeutic glycoprotein.

32. The method of claim 27, wherein said target protein is Interferon-β, GM-CSF, Interferon γ, or erythropoietin.

33. The method of claim 27, wherein said intracellular compartment is the Golgi apparatus.

34. The method of claim 27, wherein said fungal cell genetically engineered to produce proteins comprising $Man_3GlcNAc_2$ N-glycans is deficient in ALG3 activity, and comprises a nucleic acid encoding an α-1,2-mannosidase, said nucleic acid comprising a nucleotide sequence encoding a targeting sequence to target the encoded α-1,2-mannosidase to the endoplasmic reticulum.

35. The method of claim 34, wherein said fungal cell genetically engineered to produce proteins comprising $Man_3GlcNAc_2$ N-glycans further is deficient in OCH1 activity.

36. The method of claim 34 or 35, wherein said fungal cell genetically engineered to produce proteins comprising $Man_3GlcNAc_2$ N-glycans further comprises a nucleic acid encoding an α-1,3-glucosyltransferase.

37. The method of claim 36, wherein said α-1,3-glucosyltransferase is ALG6.

38. The method of claim 27, wherein said fungal cell is *Yarrowia lipolytica* or *Arxula adeninivorans*.

39. The method of claim 27, said method further comprising introducing into said cell a nucleic acid encoding a GlcNAc-transferase II, wherein said nucleic acid encoding said GlcNAc-transferase II comprises a nucleotide sequence encoding a targeting sequence to target the encoded GlcNAc-transferase II to an intracellular compartment, wherein

155 expression of said GlcNAc-transferase II in said fungal cell produces proteins comprising
156 $GlcNAc_2Man_3GlcNAc_2$ N-glycans.
157
158 40. The method of claim 27 or claim 39, said method further comprising introducing into
159 said cell a nucleic acid encoding a galactosyltransferase, wherein said nucleic acid
160 encoding said galactosyltransferase comprises a nucleotide sequence encoding a targeting
161 sequence to target the encoded galactosyltransferase to the Golgi apparatus, wherein
162 expression of said galactosyltransferase in said fungal cell produces proteins comprising
163 $GalGlcNAcMan_3GlcNAc_2$ or $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.
164
165 41. The method of claim 40, said method further comprising introducing into said cell a
166 nucleic acid encoding a target protein, wherein said cell produces said target protein
167 modified to comprise said $GalGlcNAcMan_3GlcNAc_2$ or $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-
168 glycans.
169
170 42. The method of claim 40, wherein said galactosyltransferase is a fusion of a UDP-
171 Glc-4-epimerase and catalytic domain of a β-1,4-galactosyltransferase I.
172
173 43. The method of claim 40 said method further comprising introducing into said cell a
174 nucleic acid encoding the α and β subunits of a Glucosidase II, wherein expression of
175 said α and β subunits of said Glucosidase II in said fungal cell produces proteins
176 comprising $GalGlcNAcMan_3GlcNAc_2$ or $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.
177
178 44. A method of producing a target protein comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-
179 glycans, said method comprising:
180 a) providing a fungal cell genetically engineered to be deficient in ALG3 activity
181 and comprising a nucleic acid encoding a GlcNAc-transferase I, a GlcNAc-transferase II,
182 and a galactosyltransferase, wherein said nucleic acid encoding said GlcNAc-transferase
183 I, said GlcNAc-transferase II, and said galactosyltransferase comprises nucleotide
184 sequences encoding targeting sequences to target each encoded protein to an intracellular
185 compartment;

b) introducing into said cell a nucleic acid encoding a target protein, wherein said cell produces said target protein comprising said $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

45. The method of claim 44, wherein said fungal cell further is deficient in OCH1 activity.

46. The method of claim 44 or 45, wherein said fungal cell further comprises a nucleic acid encoding an α-1,3-glucosyltransferase.

47. The method of claim 46, wherein said nucleic acid encoding said α-1,3-glucosyltransferase is ALG6.

48. The method of claim 44, claim 45, or claim 46, wherein said fungal cell further comprises a nucleic acid encoding the α and β subunits of a Glucosidase II, wherein expression of said α and β subunits of said Glucosidase II in said fungal cell produces said target protein comprising said $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

49. An isolated fungal cell genetically engineered to produce proteins comprising $GlcNAcMan_3GlcNAc_2$ N-glycans, wherein said fungal cell is deficient in OCH1 activity and comprises a nucleic acid encoding an α-1,2-mannosidase, a GlcNAc-transferase I, and a mannosidase II, wherein said nucleic acid encoding said α-1,2-mannosidase, said GlcNAc-transferase I, and said mannosidase II comprises nucleotide sequences encoding targeting sequences to target each encoded protein to an intracellular compartment, wherein expression of said α-1,2-mannosidase, said GlcNAc-transferase I, and said mannosidase II in said fungal cell produces proteins comprising $GlcNAcMan_3GlcNAc_2$ N-glycans.

50. The fungal cell of claim 49, wherein said genetically engineered fungal cell further comprises a nucleic acid encoding a target protein, wherein said cell produces said target protein modified to comprise said $GlcNAcMan_3GlcNAc_2$ N-glycans.

51. The fungal cell of claim 49 or claim 50, wherein said genetically engineered fungal cell further comprises a nucleic acid encoding a GlcNAc-transferase II, wherein said nucleic acid encoding said GlcNAc-transferase II comprises a nucleotide sequence encoding a targeting sequence to target the encoded GlcNAc-transferase II to an intracellular compartment, wherein expression of said GlcNAc-transferase II in said fungal cell produces proteins comprising $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

52. The fungal cell of claim 51, said fungal cell further comprising a nucleic acid encoding a galactosyltransferase, wherein said nucleic acid encoding said galactosyltransferase comprises a nucleotide sequence encoding a targeting sequence to target the encoded galactosyltransferase to the Golgi apparatus, wherein expression of said galactosyltransferase in said fungal cell produces proteins comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

53. An isolated fungal cell genetically engineered to produce proteins comprising $GlcNAc_2Man_3GlcNAc_2$ N-glycans, wherein said fungal cell is genetically engineered to be deficient in ALG3 activity and comprises a nucleic acid encoding a GlcNAc-transferase I and a GlcNAc-transferase II, wherein said nucleic acid encoding said GlcNAc-transferase I and said GlcNAc-transferase II comprises nucleotide sequences encoding targeting sequences to target each encoded protein to an intracellular compartment, wherein expression of said GlcNAc-transferase I, and said GlcNAc-transferase II in said fungal cell produces proteins comprising $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

54. The fungal cell of claim 53, wherein said genetically engineered fungal cell further is deficient in OCH1 activity.

55. The fungal cell of claim 53 or claim 54, wherein said genetically engineered fungal cell further comprises a nucleic acid encoding an α-1,3-glucosyltransferase.

56. The fungal cell of claim 53, claim 54, or claim 55, wherein said genetically engineered fungal cell further comprises a nucleic acid encoding a target protein, wherein said cell produces said target protein modified to comprise said $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

57. The fungal cell of any one of claims 53-56, said fungal cell further comprising a nucleic acid encoding the α and β subunits of a Glucosidase II, wherein expression of said α and β subunits of said Glucosidase II in said fungal cell produces said protein comprising said $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

58. The fungal cell of claim 57, said fungal cell further comprising a nucleic acid encoding a galactosyltransferase, wherein said nucleic acid encoding said galactosyltransferase comprises a nucleotide sequence encoding a targeting sequence to target the encoded galactosyltransferase to the Golgi apparatus, wherein expression of said galactosyltransferase in said fungal cell produces proteins comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

59. A substantially pure culture of *Yarrowia lipolytica* cells, a substantial number of which are genetically engineered to produce glycoproteins comprising $Gal_2GlcNac_2Man_3GlcNAc_2$ N-glycans, wherein said cells are genetically engineered to be deficient in ALG3 activity and comprise a nucleic acid encoding a GlcNAc-transferase I, a GlcNAc-transferase II, and a galactosyltransferase, wherein said nucleic acid encoding said GlcNAc-transferase I, said GlcNAc-transferase II, and said galactosyltransferase comprises nucleotide sequences encoding targeting sequences to target each encoded protein to an intracellular compartment, wherein expression of said GlcNAc-transferase I, said GlcNAc-transferase II, and said galactosyltransferase in said cell produces proteins comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

60. The substantially pure culture of claim 49, wherein said cells further are deficient in OCH1 activity.

61. The substantially pure culture of claim 59 or claim 60, wherein said cells further comprise a nucleic acid encoding an α-1,3-glucosyltransferase.

62. The substantially pure culture of claim 59, claim 60, or claim 61, wherein said cells further comprise a nucleic acid encoding the α and β subunits of a Glucosidase II, wherein expression of said α and β subunits of said Glucosidase II in said fungal cell produces said target protein comprising said $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

63. A substantially pure culture of *Yarrowia lipolytica* cells, a substantial number of which are genetically engineered to produce glycoproteins comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans, wherein said cells are genetically engineered to be deficient in OCH1 activity and comprise a nucleic acid encoding an α-1,2-mannosidase, a GlcNAc-transferase I, a mannosidase II, a GlcNAc-transferase II, and a galactosyltransferase, wherein said nucleic acid encoding said α-1,2-mannosidase, said GlcNAc-transferase I, said mannosidase II, said GlcNAc-transferase II, and said galactosyltransferase comprises nucleotide sequences encoding targeting sequences to target each encoded protein to an intracellular compartment, wherein expression of said α-1,2-mannosidase, said GlcNAc-transferase I, said mannosidase II, said GlcNAc-transferase II, and a galactosyltransferase in said cells produces proteins comprising $Gal_2GlcNAc_2Man_3GlcNAc_2$ N-glycans.

64. A composition comprising a glycoprotein, wherein at least 50% of the N-glycans on said glycoprotein are $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

65. The composition of claim 64, wherein at least 70% of the N-glycans on said glycoprotein are $GlcNAc_2Man_3GlcNAc_2$ N-glycans.

66. The composition of claim 64, wherein at least 85% of the N-glycans on said glycoprotein are $GlcNAc_2Man_3GlcNAc_2$ N-glycans.