

What is claimed is:

1. A method for preparing a pulse protein isolate, comprising:
obtaining a milled composition;
extracting protein from the milled composition comprising pulse proteins in an aqueous solution at a pH of from about 1 to about 9 to produce a protein rich fraction containing extracted pulse proteins;
applying the protein rich fraction to an ultrafiltration process comprising a semi-permeable membrane to separate a retentate fraction from a permeate fraction based on molecular size at a temperature of from 2°C to 60°C; and
collecting the retentate fraction containing the pulse protein isolate.
2. The method of claim 1, further comprising adjusting the pH of the retentate fraction to a first pH of from 4.0 to 7.0, optionally followed by a further pH adjustment to a second pH of from 5.0 to 6.6.
3. The method of claim 2, wherein the first pH or the second pH of the retentate fraction is adjusted to a pH of from 5.8 to 6.6.
4. The method of claim 2, wherein the first pH or the second pH of the retentate fraction is adjusted to a pH of from 6.0 to 6.2.
5. The method of any one of claims 1-4, further comprising heating the retentate fraction to a temperature of from 60°C to 80°C for a period of time from 10 seconds to 10 minutes.
6. The method of claim 5, wherein the retentate fraction is heated to a temperature of from 65°C to 80°C.
7. The method of claim 5, wherein the retentate fraction is heated to a temperature of from 70°C to 80°C.
8. The method of claim 5, wherein the retentate fraction is heated to a temperature of from 70°C to 75°C.
9. The method of any one of claims 5-8, wherein the retentate fraction is heated for a period of from 10 seconds to 5 minutes.

10. The method of any one of claims 5-8, wherein the retentate fraction is heated for a period of from 10 seconds to 1 minute.
11. The method of any one of claims 5-8, wherein the retentate fraction is heated for a period of from 10 seconds to 30 seconds.
12. The method of any one of claims 1-11, further comprising removing water from the retentate fraction to produce a concentrated pulse protein isolate.
13. The method of claim 12, wherein removing water from the retentate fraction is performed by spray drying, drum drying, tray drying, flash drying, or freeze drying.
14. The method of any one of claims 1-13, wherein the milled composition comprising pulse proteins is a milled composition of dry beans, lentils, faba beans, dry peas, chickpeas, cowpeas, bambara beans, pigeon peas, lupins, vetches, adzuki, common beans, fenugreek, long beans, lima beans, runner beans, tepary beans.
15. The method of any one of claims 1-13, wherein the milled composition comprising pulse proteins is a milled composition of mung beans.
16. The method of any one of claims 1-15, further comprising dehulling pulses, milling pulses, or dehulling and milling pulses to produce the milled composition comprising pulse proteins.
17. The method of claim 16, wherein the pulse is dry-milled or wet-milled.
18. The method of claim 16 or 17, further comprising drying the pulses prior to milling.
19. The method of any one of claims 1-18, further comprising air classifying the milled composition prior to extracting protein.
20. The method of any one of claims 1-19, further comprising applying the protein rich fraction to a pre-filtration process before applying the protein rich fraction to the ultrafiltration process.
21. The method of any one of claims 1-20, wherein the pulse proteins are not precipitated from the protein rich fraction at a pH of from 4 to 6.

22. The method of any one of claims 1-21, wherein the retentate fraction comprises pulse proteins enriched in proteins having a molecular size of greater than 5 kilodaltons (kDa), 10 kDa, 20 kDa, 50 kDa or 75 kDa, but less than 100 kDa.

23. The method of any one of claims 1-21, wherein the permeate fraction comprises pulse proteins depleted in proteins having a molecular size of less than 5 kilodaltons (kDa), 10 kDa, 20 kDa, 50 kDa or 75 kDa.

24. The method of any one of claims 1-21, wherein the retentate fraction comprises pulse proteins having a molecular size of less than 100 kilodaltons (kDa).

25. The method of any one of claims 1-21, wherein the retentate fraction comprises pulse proteins having a molecular size of less than 50 kDa.

26. The method of any one of claims 1-21, wherein the retentate fraction comprises pulse proteins having a molecular size of less than 25 kDa.

27. The method of any one of claims 1-21, wherein the retentate fraction comprises pulse proteins having a molecular size of less than 15 kDa.

28. The method of any one of claims 1-21, wherein the semi-permeable membrane excludes molecules having a size of 1 kDa or larger.

29. The method of claim 28, wherein the semi-permeable membrane excludes molecules having a size of 3 kDa or larger.

30. The method of claim 28, wherein the semi-permeable membrane excludes molecules having a size of 5 kDa or larger.

31. The method of claim 28, wherein the semi-permeable membrane excludes molecules having a size of 7.5 kDa or larger.

32. The method of claim 28, wherein the semi-permeable membrane excludes molecules having a size of 10 kDa or larger.

33. The method of claim 28, wherein the semi-permeable membrane excludes molecules having a size of 20 kDa or larger.

34. The method of claim 28, wherein the semi-permeable membrane excludes molecules having a size of 30 kDa or larger.

35. The method of claim 28, wherein the semi-permeable membrane excludes molecules having a size of 50 kDa or larger.

36. The method of claim 28, wherein the semi-permeable membrane excludes molecules having a size of 70, 80, 90 or 95 kDa or larger.

37. The method of any one of claims 1-21, wherein the semi-permeable membrane has a pore size of from 0.001 to 0.1 micron.

38. The method of claim 37, wherein the semi-permeable membrane has a pore size of from 0.001 to 0.006 micron.

39. The method of claim 38, wherein the semi-permeable membrane has a pore size of from 0.001 to 0.005 micron.

40. The method of claim 38, wherein the semi-permeable membrane has a pore size of from 0.0025 to 0.005 micron.

41. The method of claim 38, wherein the semi-permeable membrane has a pore size of about 0.003 micron.

42. The method of any one of claims 1-41, wherein the semi-permeable membrane is a polymeric membrane, a ceramic membrane, or a metallic membrane.

43. The method of any one of claims 1-42, wherein the semi-permeable membrane is made from polyvinylidene fluoride (PVDF), polyether sulfone (PES), polyacrylonitrile (PAN), polytetrafluoroethylene (PTFE), polyamide-imide (PAI), a natural polymer, rubber, wool, cellulose, stainless steel, tungsten, palladium, an oxide, a nitride, a metallic carbide, aluminum carbide, titanium carbide, or a hydrated aluminosilicate mineral containing an alkali and alkaline-earth metal.

44. The method of any one of claims 1-43, wherein the ultrafiltration process is performed at a pressure of from about 20 to about 500 psig.

45. The method of any one of claims 1-44, wherein the aqueous solution comprises a salt.

46. The method of claim 45, wherein the aqueous solution comprises a salt at a concentration of from 0.01% w/v to 5% w/v.

47. The method of claim 45, wherein the aqueous solution comprises a salt at a concentration of from 0.001% w/v to 0.1% w/v, 0.001% w/v to 0.2% w/v, 0.001% w/v to 0.3% w/v, or 0.001% w/v to 0.4% w/v.

48. The method of claim 45, wherein the aqueous solution comprises a salt at a concentration of from 0.1% w/v to 0.5% w/v, 0.1% w/v to 1% w/v, 1.0% w/v to 2.5% w/v, or 2.5% w/v to 5% w/v.

49. The method of any one of claims 45-48, wherein the salt is selected from sodium chloride, sodium sulfate, sodium phosphate, ammonium sulfate, ammonium phosphate, ammonium chloride, potassium chloride, potassium sulfate, or potassium phosphate.

50. The method of claim 49, wherein the salt is NaCl.

51. The method of any one of claims 1-44, wherein the aqueous solution does not comprise a salt.

52. The method of any one of claims 1-51, wherein the density of the pulse protein isolate is less than 0.6 g/ml.

53. The method of claim 52, wherein the density of the pulse protein isolate is less than 0.5 g/ml or 0.4 g/ml.

54. The method of claim 52, wherein the density of the pulse protein isolate is less than 0.3 g/ml.

55. The method of claim 52, wherein the density of the pulse protein isolate is less than 0.2 g/ml or 0.1 g/ml.

56. The method of any one of claims 1-55, wherein a homogenized protein dispersion consisting of 12% w/w pulse protein isolate, 0.35% w/w NaCl, and water has a separation ratio of less than 30% after 48 hours of storage at 4°C.

57. The method of claim 56, wherein the separation ratio is less than 25% after 48 hours of storage at 4°C.

58. The method of claim 57, wherein the separation ratio is less than 20% after 48 hours of storage at 4°C.

59. The method of any one of claims 1-58, wherein the pulse protein isolate has a storage modulus of less than 50 Pa at a temperature between 90°C and 95°C, as measured by dynamic oscillatory rheology using a rheometer equipped with a flat parallel plate geometry of 40 mm in which the measured pulse protein isolate comprises 12% w/w protein and the storage modulus is recorded under 0.1% strain conditions at a constant angular frequency of 10 rad/s.

60. The method of any one of claims 1-59, wherein the pulse protein isolate has a linear viscoelastic region of less than 1000 Pa at up to 10% strain, as measured by dynamic oscillatory rheology using a rheometer equipped with a flat parallel plate geometry of 40 mm in which the measured pulse protein isolate comprises 12% w/w protein and the strain is carried out at a constant frequency of 10 rad/s at 50°C.

61. The method of claim 60, wherein the pulse protein isolate has a linear viscoelastic region of less than 500 Pa at up to 10% strain, or a linear viscoelastic region of less than 200 Pa at up to 10% strain.

62. A pulse protein isolate prepared by the method of any one of claims 1-61.

63. A food composition comprising the pulse protein isolate of claim 62, and one or more edible ingredients.

64. An isolated pulse protein having a density of less than 0.6 g/ml.

65. The isolated pulse protein of claim 64, wherein the density is less than 0.5 g/ml or 0.4 g/ml.

66. The isolated pulse protein of claim 64, wherein the density is less than 0.3 g/ml.

67. The isolated pulse protein of claim 64, wherein the density is less than 0.2 g/ml or 0.1 g/ml.

68. The isolated pulse protein of any one of claims 64-67, wherein the pulse protein has a storage modulus of less than 50 Pa at a temperature between 90°C and 95°C, as measured by dynamic oscillatory rheology using a rheometer equipped with a flat parallel plate geometry of 40

mm in which the measured pulse protein isolate comprises 12% w/w protein and the storage modulus is recorded under 0.1% strain conditions at a constant angular frequency of 10 rad/s.

69. The isolated pulse protein of any one of claims 64-68, wherein the pulse protein has a linear viscoelastic region of less than 1000 Pa at up to 10% strain, as measured by dynamic oscillatory rheology using a rheometer equipped with a flat parallel plate geometry of 40 mm in which the measured pulse protein isolate comprises 12% w/w protein and the strain is carried out at a constant frequency of 10 rad/s at 50°C.

70. The isolated pulse protein of claim 69, wherein the pulse protein has a linear viscoelastic region of less than 500 Pa at up to 10% strain, or a linear viscoelastic region of less than 200 Pa at up to 10% strain.

71. The isolated pulse protein of any one of claims 64-70, wherein pulse protein is isolated from dry beans, lentils, faba beans, dry peas, chickpeas, cowpeas, bambara beans, pigeon peas, lupins, vetches, adzuki, common beans, fenugreek, long beans, lima beans, runner beans, or tepary beans.

72. The isolated pulse protein of any one of claims 64-70, wherein the pulse protein is isolated from mung beans.

73. The isolated pulse protein of any one of claims 64-72, wherein the pulse protein is enriched in proteins having a molecular size of greater than 5 kilodaltons (kDa), 10 kDa, 20 kDa, 50 kDa or 75 kDa, but less than 100 kDa.

74. The isolated pulse protein of any one of claims 64-72, wherein the pulse protein is depleted in proteins having a molecular size of less than 5 kilodaltons (kDa), 10 kDa, 20 kDa, 50 kDa or 75 kDa.

75. The isolated pulse protein of any one of claims 64-72, wherein the pulse protein includes proteins having a molecular size of less than 100 kDa.

76. The isolated pulse protein of any one of claims 64-72, wherein the pulse protein includes proteins having a molecular size of less than 50 kDa.

77. The isolated pulse protein of any one of claims 64-72, wherein the pulse protein includes proteins having a molecular size of less than 25 kDa.

78. The isolated pulse protein of any one of claims 64-72, wherein the pulse protein includes proteins having a molecular size of less than 15 kDa.

79. The isolated pulse protein of any one of claims 64-72, wherein the pulse protein includes proteins having a molecular size of from 1 kDa to 99 kDa.

80. A food composition comprising a pulse protein isolate of any one of claims 64-79, and one or more edible ingredients.

81. The food composition of claim 80, wherein the composition has a viscosity of less than 500 cP after storage for thirty days at 4°C.

82. The food composition of claim 80, wherein the composition has a viscosity of less than 500 cP after storage for sixty days at 4°C.

83. The food composition of claim 81, wherein the composition has a viscosity of less than 450 cP after storage for thirty days at 4°C.

84. The food composition of claim 81, wherein the composition has a viscosity of less than 450 cP after storage for sixty days at 4°C.

85. A food composition of any one of claims 80-84 comprising pulse proteins that are depleted in proteins having a molecular size of less than 10 kilodaltons (kDa) or 20 kDa, wherein the food composition has improved texture as compared to a reference food composition comprising proteins depleted in proteins having a molecular size of less than 50 kilodaltons (kDa), 75 kDa, or 100 kDa.