CLAIMS:

1. A method of producing sialyloligosaccharides from a liquid source that comprises sialyloligosaccharides, carbohydrates and minerals by subjecting the liquid source to a process comprising

a) heating the liquid source to a temperature of from about 67°C,

b) subjecting the heat-treated liquid source to

i) a filtration step with a heat-resistant filter at a temperature of about 55 to about 90°C to produce a first retentate and first permeate, or

ii) centrifugal separation to produce a light phase and a heavy phase and ultrafiltration of the light phase at a temperature of about 50 to about 70°C to produce a first retentate and first permeate,

c) subjecting the first permeate to nanofiltration, or nanofiltration and diafiltration, to produce a second retentate and second permeate, and

d) concentrating the second retentate,

to produce a sialyloligosaccharide-containing extract.

2. The method of claim 1, wherein the ultrafiltration step of (b)(ii) is carried out at about 55 to about 70°C or at about 60 to about 70°C to produce a first retentate and first permeate, and the ultrafiltration step of (b)(ii) is carried out using a heat resistant filter.

3. The method of claim 1 or 2, wherein the liquid source comprises mother liquor as a by-product of lactose crystallisation, a dairy permeate, whey, whey permeate, or a combination of any two or more thereof.

4. The method of any one of claims 1 to 3, wherein the heat treatment of the liquid source

a) is carried out at a temperature of from about 67 to about 100°C,

b) is carried out for about 2 to about 20 minutes,

c) precipitates about 2% to about 10% of the minerals present in the liquid source, or

d) any combination of any two or more of a) to c).

5. The method of any one of claims 1 to 4, wherein the method comprises at least one glycoside hydrolase or polymerase enzyme reaction.

6. The method of claim 5, wherein

a) the first permeate of the filtration step from the heat-resistant filter,

b) the light phase,

c) the concentrated second retentate, or

d) a combination of any two or more of (a) to (c),

is subjected to the enzyme reaction, optionally wherein the enzyme comprises β-galactosidase.

7. The method of any one of claims 1 to 6, wherein the nanofiltration is conducted at a temperature of from about 25 °C to about 55 °C, optionally about 50 °C.

8. The method of any one of claims 1 to 7, wherein the second retentate is subjected to either nanofiltration or reverse osmosis to produce a third retentate.

9. The method of any one of claims 1 to 8, wherein the sialyloligosaccharide-containing extract comprises, on a dry solids basis

- at least about 7% by weight sialyloligosaccharides,
- at least about 0.2% by weight neutral oligosaccharides,
- less than about 5% by weight protein and non-protein nitrogen,
- less than about 80% by weight non-sialyloligosaccharide sugars, and
- less than about 5% by weight ash.

10. The method of any one of claims 1 to 9, wherein the sialyloligosaccharide-containing extract comprises, on a dry solids basis

- at least about 5% by weight 3'-sialyllactose, and
- at least about 2% by weight 6'-sialyllactose.

11. A sialyloligosaccharide-containing extract produced by the method of any one of claims 1 to 10.

12. A sialyloligosaccharide-enriched composition, comprising on a dry solids basis

- at least about 5% by weight total sialyloligosaccharides comprising
  - i) at least about 5% 3'-sialyllactose by weight of total sialyloligosaccharides,
  - ii) at least about 2% 6'-sialyllactose by weight of total sialyloligosaccharides,
  - iii) at least about 0.01% disialyllactose by weight of total sialyloligosaccharides,
  - iv) at least about 0.01% sialyllactosamine by weight of total sialyloligosaccharides, and
- at least about 0.5% by weight free sialic acid,

- at least about 0.2% by weight neutral oligosaccharides,
- less than about 25% by weight protein and non-protein nitrogen,
- less than about 80% by weight sugars not including sialyllactose, and
- less than about 5% by weight ash.

13. The composition of claim 12 comprising, on a dry solids basis, a greater amount of 3'-sialyllactose relative to the amount of 6'-sialyllactose, optionally comprising 3'-sialyllactose and 6'-sialyllactose in a ratio of from about 65:1 to about 1.5:1, from about 15:1 to about 1.5:1, or from about 8:1 to about 1.5:1.

14. A nutritional formulation comprising a sialyloligosaccharide-containing extract produced by a method of any one of claims 1 to 10, or a sialyloligosaccharide-enriched composition of any one of claims 11 to 13.

15. The nutritional formulation of claim 14, further comprising one or more dairy lipids, one or more galactooligosaccharides, one or more probiotic strains, one or more protein hydrolysates, lactoferrin, a milk fat globular membrane (MFGM) formulation, or a combination of any two or more thereof.

16. The nutritional formulation of claim 14 or 15, wherein the one or more probiotic strains comprises a *Bifidobacterium lactis* or a *Lactobacillus rhamnosus* strain, or a combination of both *Bifidobacterium lactis* and *Lactobacillus rhamnosus*, optionally wherein the *Bifidobacterium lactis* strain comprises *Bifidobacterium lactis* HN019 (DR10™), and/or optionally wherein the *Lactobacillus rhamnosus* strain comprises *Lactobacillus rhamnosus* HN001 (DR20™).

17. A composition for providing nutrition to an infant of less than 6 months of age, an infant of from about 6 months to about 12 months of age, or an infant of 12 months of age or over, wherein the composition is formulated to comprise 3'-sialyllactose and 6'-sialyllactose in a ratio of from 10:1 to about 1.5:1 3'-sialyllactose to 6'-sialyllactose, and at least about 0.001% sialyllactosamine on a dry solids basis.

18. The nutritional formulation of any one of claims 14 to 16 or the composition of claim 17, wherein the nutritional formulation or composition comprises

- at least about 0.005% or 0.01% sialyllactosamine on a dry solids basis, and/or
- 3'-sialyllactose, 6'-sialyllactose and sialyllactosamine in a ratio of from about 10:1:0.5 to about 1.5:1:0.03.

19. Use of a sialyloligosaccharide-enriched extract produced by the method of any one of claims 1 to 10, a sialyloligosaccharide-enriched composition of any one of claims 11 to 13 or 17, a nutritional formulation of any one of claims 14 to 17 or 18 or a composition of claim 17 or 18 in the manufacture of a medicament for

- maintaining or increasing brain function or brain development in an otherwise healthy subject, or

- treating mild cognitive impairment associated with any one or more of age-related cognitive decline, dementia, Alzheimer's disease, vascular disease, frontotemporal lobar degeneration (FTLD), dementia with Lewy bodies, Parkinson's disease, amyotrophic lateral sclerosis, Huntington's disease, cognitive impairment associated with schizophrenia, chemotherapy-induced neuropathy, Down's syndrome, Korsakoff's disease, cerebral palsy, epilepsy, neuronal ischemia, neuronal reperfusion injury, neuronal trauma, neuronal haemorrhage, neuronal infection, stroke, neuronal exposure to a toxic substance, age-related mental disorders, anxiety disorders, age-related depression, dementia associated with microvascular disorders (such as diabetes, hypotension, stroke induced vascular dementia, and obesity), dementia associated with a disorder of the immune system, dementia associated with a central nervous system (CNS) disorder, dementia associated with hypotension, dementia associated with obesity or vascular dementia in a subject in need thereof.

20. The use of claim 19, wherein the extract, composition or nutritional formulation is to be administered to

a) treat or prevent delayed brain development,
b) maintain the viability or function of neuronal cells,
c) maintain or increase cognitive development,
d) prevent delayed cognitive development,
e) maintain or increase cognitive performance,
f) prevent cognitive decline,
g) maintain or increase learning, memory or attention span,
h) prevent decline of learning ability, memory or attention span,
i) maintain or increase ability to cope with stress,
j) prevent decline in brain function,
k) maintain or increase the level of gangliosides in the brain,
l) maintain or increase the level of neural cell adhesion molecule (NCAM),

m) maintain or increase blood, nutrient or oxygen flow to the brain,
n) maintain or increase synaptogenesis,
o) maintain or increase the activity of the gut/brain axis,
p) maintain or increase neurogenesis in an older brain,
q) maintain or increase white matter volume, or
r) a combination of any two or more of a) to q).

21. The use of claim 19 or 20, wherein

- the subject is a foetal, infant or child subject,

- the extract, composition or nutritional formulation is to be administered to a mother during gestation to maintain or increase brain function or development in a foetal subject, or

- the extract, composition or formulation is to be administered to a breastfeeding mother to maintain or increase brain function or development in an infant subject.

22. A sialyloligosaccharide-enriched extract produced by the method of any one of claims 1 to 10, a sialyloligosaccharide-enriched composition of any one of claims 11 to 13 or 17, a nutritional formulation of any one of claims 14 to 17 or 18 or a composition of claim 17 or 18 for use in therapy.