CLAIMS

1. Extracted plant lipid, comprising fatty acids in an esterified form, the fatty acids comprising oleic acid, palmitic acid, ω6 fatty acids which comprise linoleic acid (LA), ω3 fatty acids which comprise α-linolenic acid (ALA) and docosahexaenoic acid (DHA), and optionally one or more of stearidonic acid (SDA), eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and eicosatetraenoic acid (ETA), wherein the level of DHA in the total fatty acid content of the extracted lipid is 7% to 20%, and wherein the level of palmitic acid in the total fatty acid content of the extracted lipid is between 2% and 16%, and wherein the level of myristic acid (C14:0) in the total fatty acid content of the extracted lipid is less than 1%.

2. The lipid of claim 1 which has one or more or all of the following features

i) the level of palmitic acid in the total fatty acid content of the extracted lipid is between 2% and 15%,

ii) the level of oleic acid in the total fatty acid content of the extracted lipid is between 3% and 30%,

iii) the level of linoleic acid (LA) in the total fatty acid content of the extracted lipid is between 4% and 35%,

iv) the level of α-linolenic acid (ALA) in the total fatty acid content of the extracted lipid is between 7% and 40%,

v) the level of γ-linolenic acid (GLA) in the total fatty acid content of the extracted lipid is less than 4%,

vi) the level of stearidonic acid (SDA) in the total fatty acid content of the extracted lipid is less than 4%,

vii) the level of eicosatetraenoic acid (ETA) in the total fatty acid content of the extracted lipid is less than 4%,

viii) the level of eicosatrienoic acid (ETrA) in the total fatty acid content of the extracted lipid is less than 4%,

ix) the level of eicosapentaenoic acid (EPA) in the total fatty acid content of the extracted lipid is less than 4%,

x) the level of docosapentaenoic acid (DPA) in the total fatty acid content of the extracted lipid is less than 4%,

xi) the level of DHA in the total fatty acid content of the extracted lipid is between 11% and 20%,

xii) the level of total saturated fatty acids in the total fatty acid content of the extracted lipid is between 4% and 25%,

xiii) the level of total monounsaturated fatty acids in the total fatty acid content of the extracted lipid is between 4% and 35%,

xiv) the level of total polyunsaturated fatty acids in the total fatty acid content of the extracted lipid is between 20% and 75%,

xv) the level of total ω6 fatty acids in the total fatty acid content of the extracted lipid is less than 20%,

xvi) the level of new ω6 fatty acids in the total fatty acid content of the extracted lipid is less than 10%,

xvii) the level of total ω3 fatty acids in the total fatty acid content of the extracted lipid is between 40% and 60%,

xviii) the level of new ω3 fatty acids in the total fatty acid content of the extracted lipid is between 9% and 33%,

xix) the ratio of total ω6 fatty acids: total ω3 fatty acids in the fatty acid content of the extracted lipid is between 1.0 and 3.0,

xx) the ratio of new ω6 fatty acids: new ω3 fatty acids in the fatty acid content of the extracted lipid is between 1.0 and 3.0,

xxi) the fatty acid composition of the lipid is based on an efficiency of conversion of oleic acid to DHA of at least 10%,

xxii) the fatty acid composition of the lipid is based on an efficiency of conversion of LA to DHA of at least 15%,

xxiii) the fatty acid composition of the lipid is based on an efficiency of conversion of ALA to DHA of at least 17%,

xxiv) the total fatty acid in the extracted lipid has less than 1% C20:1,

xxv) the triacylglycerol (TAG) content of the lipid is at least 70%,

xxvi) the lipid comprises diacylglycerol (DAG),

xxvii) the lipid comprises less than 10%, free (non-esterified) fatty acids and/or phospholipid, or less than 0.5% free (non-esterified) fatty acids and/or phospholipid,

xxviii) at least 70%, of the DHA esterified in the form of TAG is in the sn-1 or sn-3 position of the TAG, and

xxix) the lipid comprises tri-DHA TAG (TAG 66:18).

3. The lipid of claim 1 or claim 2 which further comprises one or more sterols, and/or which is in the form of an oil, and which comprises less than 10 mg of sterols/g

of oil, less than 7 mg of sterols/g of oil, between 1.5 mg and 10 mg of sterols/g of oil, or between 1.5 mg and 7 mg of sterols/g of oil.

4. The lipid according to any one of claims 1 to 3, wherein the lipid is *Brassica sp.* oil or *Camelina sativa* oil.

5. A process for producing extracted plant lipid, comprising the steps of

i) obtaining a plant part comprising lipid, the lipid comprising fatty acids in an esterified form, the fatty acids comprising oleic acid, palmitic acid, ω6 fatty acids which comprise linoleic acid (LA) and γ-linolenic acid (GLA), ω3 fatty acids which comprise α-linolenic acid (ALA), stearidonic acid (SDA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA), and optionally one or more of eicosapentaenoic acid (EPA) and eicosatetraenoic acid (ETA), wherein the level of DHA in the total fatty acid content of extractable lipid in the plant part is 7% to 20%, and wherein the level of palmitic acid in the total fatty acid content of the extractable lipid is between 2% and 16%, and wherein the level of myristic acid (C14:0) in the total fatty acid content of the extractable lipid is less than 1%, and

ii) extracting lipid from the plant part,

wherein the level of DHA in the total fatty acid content of the extracted lipid is 7% to 20%, and wherein the level of palmitic acid in the total fatty acid content of the extracted lipid is between 2% and 16%, and wherein the level of myristic acid (C14:0) in the total fatty acid content of the extracted lipid is less than 1%.

6. The process of claim 5, wherein the extracted lipid has one or more of the features defined in claims 2 to 4.

7. The process of claim 5 or claim 6, wherein the plant part comprises exogenous polynucleotides encoding a Δ12-desaturase, a ω3-desaturase or a Δ15-desaturase, a Δ6-desaturase, a Δ5-desaturase, a Δ4-desaturase, a Δ6-elongase and an Δ5-elongase, and wherein each polynucleotide is operably linked to one or more promoters that are capable of directing expression of said polynucleotides in a cell of the plant part.

8. The process of claim 7, wherein the plant part has one or more or all of the following features

i) the Δ12-desaturase converts oleic acid to linoleic acid in one or more cells of the plant with an efficiency of at least 60%,

ii) the ω3-desaturase converts ω6 fatty acids to ω3 fatty acids in one or more cells of the plant with an efficiency of at least 65%,

iii) the Δ6-desaturase converts ALA to SDA in one or more cells of the plant with an efficiency of at least 30%,

iv) the Δ6-desaturase converts linoleic acid to γ-linolenic acid in one or more cells of the plant with an efficiency of less than 5%,

v) the Δ6-elongase converts SDA to ETA in one or more cells of the plant with an efficiency of at least 60%,

vi) the Δ5-desaturase converts ETA to EPA in one or more cells of the plant with an efficiency of at least 60

vii) the Δ5-elongase converts EPA to DPA in one or more cells of the plant with an efficiency of at least 80%,

viii) the Δ4-desaturase converts DPA to DHA in one or more cells of the plant with an efficiency of at least 80%,

ix) the efficiency of conversion of oleic acid to DHA in one or more cells of the plant part is at least 10%,

x) the efficiency of conversion of LA to DHA in one or more cells of the plant part is at least 15%,

xi) the efficiency of conversion of ALA to DHA in one or more cells of the plant part is at least 17%,

xii) one or more cells of the plant part comprise at least 15% more ω3 fatty acids than corresponding cells lacking the exogenous polynucleotides,

xiii) the Δ6-desaturase preferentially desaturates α-linolenic acid (ALA) relative to linoleic acid (LA),

xiv) the Δ6-elongase also has Δ9-elongase activity,

xv) the Δ12-desaturase also has Δ15-desaturase activity,

xvi) the Δ6-desaturase also has Δ8-desaturase activity,

xvii) the ω3-desaturase also has Δ15-desaturase activity on LA,

xviii) the ω3-desaturase desaturates both LA and/or GLA,

xix) the ω3-desaturase preferentially desaturates GLA relative to LA,

xx) the level of DHA in the plant part is based on an efficiency of conversion of oleic acid to DHA in the plant part of at least 10%,

xxi) the level of DHA in the plant part is based on an efficiency of conversion of LA to DHA in the plant part of at least 15%,

xxii) the level of DHA in the plant part is based on an efficiency of conversion of ALA to DHA in the plant part of at least 17%,

xxiii) one or more or all of the desaturases have greater activity on an acyl-CoA substrate than a corresponding acyl-PC substrate,

xxiv) the Δ6-desaturase has greater Δ6-desaturase activity on ALA than LA as fatty acid substrate,

xxv) the Δ6-desaturase has greater Δ6-desaturase activity on ALA-CoA as fatty acid substrate than on ALA joined to the *sn*-2 position of PC as fatty acid substrate,

xxvi) the Δ6-desaturase has at least a 2-fold greater Δ6-desaturase activity on ALA as a substrate compared to LA,

xxvii) the Δ6-desaturase has greater activity on ALA-CoA as fatty acid substrate than on ALA joined to the *sn*-2 position of PC as fatty acid substrate,

xxviii) the Δ6-desaturase has at least a 5-fold greater Δ6-desaturase activity on ALA-CoA as fatty acid substrate than on ALA joined to the *sn*-2 position of PC as fatty acid substrate,

xxix) the desaturase is a front-end desaturase, and

xxx) the Δ6-desaturase has no detectable Δ5-desaturase activity on ETA.

9. The process according to any one of claims 5 to 8, wherein one or more of the following features apply;

i) the exogenous polynucleotides are covalently linked in a DNA molecule, such as a T-DNA molecule, integrated into the genome of cells of the plant part,

ii) the total oil content of the plant part comprising the exogenous polynucleotides is at least 40% of the total oil content of a corresponding plant part lacking the exogenous polynucleotides,

iii) the lipid is in the form of an oil, such as a seedoil from an oilseed, and wherein at least 90% by weight of the lipid is triacylglycerols,

iv) which further comprises treating the lipid to increase the level of DHA as a percentage of the total fatty acid content.

10. A host cell comprising exogenous polynucleotides encoding one of the following sets of enzymes;

i) a Δ12-desaturase, a ω3-desaturase or a Δ15-desaturase, a Δ6-desaturase, a Δ5-desaturase, a Δ4-desaturase, a Δ6-elongase and an Δ5-elongase,

ii) an ω3-desaturase, a Δ6-desaturase, a Δ5-desaturase, a Δ4-desaturase, a Δ6-elongase and a Δ5-elongase,

iii) a Δ15-desaturase, a Δ6-desaturase, a Δ5-desaturase, a Δ4-desaturase, a Δ6-elongase and a Δ5-elongase,

iv) a Δ12-desaturase, a Δ6-desaturase, a Δ5-desaturase, a Δ4-desaturase, a Δ6-elongase and an Δ5-elongase,

v) an ω3-desaturase, a Δ8-desaturase, a Δ5-desaturase, a Δ4-desaturase, a Δ9-elongase and an Δ5-elongase,

vi) a Δ15-desaturase, a Δ8-desaturase, a Δ5-desaturase, a Δ4-desaturase, a Δ9-elongase and a Δ5-elongase,

vii) a Δ12-desaturase, a Δ8-desaturase, a Δ5-desaturase, a Δ4-desaturase, a Δ9-elongase and an Δ5-elongase, or

viii) a Δ12-desaturase, a ω3-desaturase or a Δ15-desaturase, a Δ8-desaturase, a Δ5-desaturase, a Δ4-desaturase, a Δ9-elongase and an Δ5-elongase,

and wherein each polynucleotide is operably linked to one or more promoters that are capable of directing expression of said polynucleotides in the cell, wherein the cell comprises lipid as defined in any one of claims 1 to 4.

11. A transgenic plant comprising a cell of claim 10.

12. An oilseed plant comprising

a) lipid in its seed, the lipid comprising fatty acids in an esterified form, and

b) exogenous polynucleotides encoding one of the following sets of enzymes;

i) a Δ12-desaturase, a fungal ω3-desaturase and/or fungal Δ15-desaturase, a Δ6-desaturase, a Δ5-desaturase, a Δ4-desaturase, a Δ6-elongase and an Δ5-elongase, or

ii) a Δ12-desaturase, a fungal ω3-desaturase and/or fungal Δ15-desaturase, a Δ8-desaturase, a Δ5-desaturase, a Δ4-desaturase, a Δ9-elongase and an Δ5-elongase,

wherein each polynucleotide is operably linked to one or more seed-specific promoters that are capable of directing expression of said polynucleotides in developing seed of the plant, wherein the fatty acids comprise oleic acid, palmitic acid, ω6 fatty acids which comprise linoleic acid (LA) and γ-linolenic acid (GLA), ω3 fatty acids which comprise α-linolenic acid (ALA), stearidonic acid (SDA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA), and optionally eicosapentaenoic acid (EPA) and/or eicosatetraenoic acid (ETA), and wherein the level of DHA in the total fatty acid content of the lipid is 7% to 20%, and wherein the level of palmitic acid in the total fatty acid content of the lipid is between 2% and 16%, and wherein the level of myristic acid (C14:0) in the total fatty acid content of the lipid is less than 1%.

13. The plant of claim 12, wherein one or more of the following features apply;

i) the plant is a canola, *Glycine max*, *Camelina sativa* or *Arabidopsis thaliana* plant,

ii) one or more of the desaturases is capable of using an acyl-CoA substrate,

iii) mature, harvested seed of the plant has a DHA content of at least 28mg per gram seed.

14. A plant part, which has one or more of the following features

i) comprises lipid as defined in any one of claims 1 to 4,

ii) is from a plant according to any one of claims 11 to 13, or

iii) can be used in a process according to any one of claims 5 to 8.

15. The plant part of claim 14 which is a seed.

16. A method of producing seed, the method comprising,

a) growing a plant which produces a part as defined in claim 14 or claim 15, or a plant according to any one of claims 11 to 13,

b) harvesting seed from the plant or plants, and

c) optionally, extracting lipid from the seed.

17. Seedmeal obtained from the seed of 15.

18. A method of producing a foodstuff for human or animal consumption, the method comprising mixing one or more of the lipid or oil according to any one of claims 1 to 4, the cell of claim 10, the transgenic plant of claim 11, the oilseed plant of claim 12 or claim 13, the plant part of claim 14 or claim 15, or the seedmeal of claim 17, with at least one other food ingredient.

19. Use of one or more of the lipid or oil according to any one of claims 1 to 4, the cell of claim 10, the transgenic plant of claim 11, the oilseed plant of claim 12 or claim 13, or the plant part of claim 14 or claim 15 for the manufacture of a medicament for treating or preventing a medical condition which would benefit from a PUFA, wherein the medical condition is selected from the group consisting of cardiac arrhythmia's, angioplasty, inflammation, asthma, psoriasis, osteoporosis, kidney stones, AIDS, multiple sclerosis, rheumatoid arthritis, Crohn's disease, schizophrenia, cancer, foetal alcohol syndrome, attention deficient hyperactivity disorder, cystic fibrosis,

phenylketonuria, unipolar depression, aggressive hostility, adrenoleukodystophy, coronary heart disease, hypertension, diabetes, obesity, Alzheimer's disease, chronic obstructive pulmonary disease, ulcerative colitis, restenosis after angioplasty, eczema, high blood pressure, platelet aggregation, gastrointestinal bleeding, endometriosis, premenstrual syndrome, myalgic encephalomyelitis, chronic fatigue after viral infections or an ocular diseasecardiac arrhythmia's, angioplasty, inflammation, asthma, psoriasis, osteoporosis, kidney stones, AIDS, multiple sclerosis, rheumatoid arthritis, Crohn's disease, schizophrenia, cancer, foetal alcohol syndrome, attention deficient hyperactivity disorder, cystic fibrosis, phenylketonuria, unipolar depression, aggressive hostility, adrenoleukodystophy, coronary heart disease, hypertension, diabetes, obesity, Alzheimer's disease, chronic obstructive pulmonary disease, ulcerative colitis, restenosis after angioplasty, eczema, high blood pressure, platelet aggregation, gastrointestinal bleeding, endometriosis, premenstrual syndrome, myalgic encephalomyelitis, chronic fatigue after viral infections or an ocular disease.

20. A process for producing ethyl esters of polyunsaturated fatty acids, the process comprising transesterifying triacylglycerols in extracted plant lipid, wherein the extracted plant lipid comprises fatty acids esterified in the form, the fatty acids comprising oleic acid, palmitic acid, ω6 fatty acids which comprise linoleic acid (LA), ω3 fatty acids which comprise α-linolenic acid (ALA), and docosahexaenoic acid (DHA), and optionally one or more of stearidonic acid (SDA), eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and eicosatetraenoic acid (ETA), wherein the level of DHA in the total fatty acid content of the extracted lipid is 7% to 20%, and wherein the level of palmitic acid in the total fatty acid content of the extracted lipid is between 2% and 16%, and wherein the level of myristic acid (C14:0) in the total fatty acid content of the extracted lipid is less than 1%, thereby producing the ethyl esters.