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 about 7% to 20%.

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 about 2% and 18%, or between about 2% and 16%, or between about 2% and 15%,

ii) the level of myristic acid (C14:0) in the total fatty acid content of the extracted lipid is less than 6%, or less than 3% or less than 2%, or less than 1%,

lxvii) the level of oleic acid in the total fatty acid content of the extracted lipid is between about 1% and about 30%, between about 3% and about 30%, or between about 6% and about 30%, or between 1% and about 20%, or between about 30% and about 60%, or about 45% to about 60%, or is about 30%,

lxviii) the level of linoleic acid (LA) in the total fatty acid content of the extracted lipid is between about 4% and about 35%, or between about 4% and about 20%, or between about 4% and 17%,

lxix) the level of α-linolenic acid (ALA) in the total fatty acid content of the extracted lipid is between about 4% and about 40%, between about 7% and about 40%, or between about 10% and about 35%, or between about 20% and about 35%, or between about 4% and 16%, or between about 2% and 16%,

lxx) the level of γ-linolenic acid (GLA) in the total fatty acid content of the extracted lipid is less than 4%, less than about 3%, less than about 2%, less than about 1%, less than about 0.5%, between 0.05% and 7%, between 0.05% and 4%, or between 0.05% and about 3%, or between 0.05% and about 2%,

lxxi) the level of stearidonic acid (SDA) in the total fatty acid content of the extracted lipid is less than about 7%, less than about 6%, less than about

4%, less than about 3%, between about 0.05% and about 7%, between about 0.05% and about 6%, between about 0.05% and about 4%, between about 0.05% and about 3%, or between 0.05% and about 2%,

lxxii) the level of eicosatetraenoic acid (ETA) in the total fatty acid content of the extracted lipid is less than about 6%, less than about 5%, less than about 4%, less than about 1%, less than about 0.5%, between about 0.05% and about 6%, between about 0.05% and about 5%, between about 0.05% and about 4%, between about 0.05% and about 3%, or between about 0.05% and about 2%,

lxxiii) the level of eicosatrienoic acid (ETrA) in the total fatty acid content of the extracted lipid is less than 4%, less than about 2%, less than about 1%, between 0.05% and 4%, between 0.05% and 3%, or between 0.05% and about 2%, or between 0.05% and about 1%,

lxxiv) the level of eicosapentaenoic acid (EPA) in the total fatty acid content of the extracted lipid is less than 4%, less than about 3%, less than about 2%, between 0.05% and 10%, between 0.05% and 5%, or between 0.05% and about 3%, or between 0.05% and about 2%,

lxxv) the level of docosapentaenoic acid (DPA) in the total fatty acid content of the extracted lipid is less than 4%, less than about 3%, less than about 2%, between 0.05% and 8%, between 0.05% and 5%, or between 0.05% and about 3%, or between 0.05% and about 2%,

lxxvi) the level of DHA in the total fatty acid content of the extracted lipid is about 8%, about 9%, about 10%, about 11%, about 12%, about 13%, about 14%, about 15%, about 16%, about 17%, about 18%, between about 8% and 20%, between about 10% and 20%, between about 11% and 20%, between about 10% and about 16%, or between about 14% and 20%,

lxxvii) the lipid comprises ω6-docosapentaenoic acid ($22:5^{\Delta 4,7,10,13,16}$) in its fatty acid content,

lxxviii) the lipid is essentially free of ω6-docosapentaenoic acid ($22:5^{\Delta 4,7,10,13,16}$) in its fatty acid content,

lxxix) the lipid is essentially free of SDA, EPA and ETA in its fatty acid content,

lxxx) the level of total saturated fatty acids in the total fatty acid content of the extracted lipid is between about 4% and about 25%, or between about 4% and about 20%, between about 6% and about 20%, between about

4% and about 60%, between about 30% and about 60%, or between about 45% and about 60%,

lxxxi) the level of total monounsaturated fatty acids in the total fatty acid content of the extracted lipid is between about 4% and about 35%, or between about 8% and about 25%, or between 8% and about 22%,

lxxxii) the level of total polyunsaturated fatty acids in the total fatty acid content of the extracted lipid is between about 20% and about 75%, or between about 50% and about 75%, or between about 60% and about 75%,

lxxxiii) the level of total ω6 fatty acids in the total fatty acid content of the extracted lipid is between about 35% and about 50%, between about 20% and about 35%, between about 6% and 20%, less than 20%, less than about 16%, less than about 10%, between about 1% and about 16%, between about 2% and about 10%, or between about 4% and about 10%,

lxxxiv) the level of new ω6 fatty acids in the total fatty acid content of the extracted lipid is less than about 10%, less than about 8%, less than about 6%, less than 4%, between about 1% and about 20%, between about 1% and about 10%, between about 0.5% and about 8%, or between about 0.5% and 4%,

lxxxv) the level of total ω3 fatty acids in the total fatty acid content of the extracted lipid is between 36% and about 65%, between 40% and about 60%, between about 20% and about 35%, between about 10% and about 20%, about 25%, about 30%, about 35% or about 40%,

lxxxvi) the level of new ω3 fatty acids in the total fatty acid content of the extracted lipid is between 9% and about 33%, between about 10% and about 20%, between about 20% and about 30%, between about 12% and about 25%, about 13%, about 15%, about 17% or about 20%,

lxxxvii) the ratio of total ω6 fatty acids: total ω3 fatty acids in the fatty acid content of the extracted lipid is between about 1.0 and about 3.0, between about 0.1 and about 1, between about 0.1 and about 0.5, less than about 0.50, less than about 0.40, less than about 0.30, less than about 0.20, less than about 0.15, about 1.0, about 0.1 or about 0.2,

lxxxviii) the ratio of new ω6 fatty acids: new ω3 fatty acids in the fatty acid content of the extracted lipid is between about 1.0 and about 3.0, between about 0.1 and about 1, between about 0.1 and about 0.5, less than about 0.50, less than about 0.40, less than about 0.30, less than about 0.20, less than about 0.15, about 0.1, about 0.2 or about 1.0,

lxxxix) the fatty acid composition of the lipid is based on an efficiency of conversion of oleic acid to LA by Δ12-desaturase of at least about 60%, at least about 70%, at least about 80%, between about 60% and about 98%, between about 70% and about 95%, or between about 75% and about 90%,

xc) the fatty acid composition of the lipid is based on an efficiency of conversion of ALA to SDA by Δ6-desaturase of at least about 30%, at least about 40%, at least about 50%, at least about 60%, at least about 70%, between about 30% and about 70%, between about 35% and about 60%, or between about 50% and about 70%,

xci) the fatty acid composition of the lipid is based on an efficiency of conversion of SDA to ETA acid by Δ6-elongase of at least about 60%, at least about 70%, at least about 75%, between about 60% and about 95%, between about 70% and about 88%, or between about 75% and about 85%,

xcii) the fatty acid composition of the lipid is based on an efficiency of conversion of ETA to EPA by Δ5-desaturase of at least about 60%, at least about 70%, at least about 75%, between about 60% and about 99%, between about 70% and about 99%, or between about 75% and about 98%,

xciii) the fatty acid composition of the lipid is based on an efficiency of conversion of EPA to DPA by Δ5-elongase of at least about 80%, at least about 85%, at least about 90%, between about 50% and about 95%, or between about 85% and about 95%,

xciv) the fatty acid composition of the lipid is based on an efficiency of conversion of DPA to DHA by Δ4-desaturase of at least about 80%, at least about 90%, at least about 93%, between about 50% and about 95%, between about 80% and about 95%, or between about 85% and about 95%,

xcv) the fatty acid composition of the lipid is based on an efficiency of conversion of oleic acid to DHA of at least about 10%, at least about 15%, at least about 20%, between about 10% and about 50%, between about 10% and about 30%, or between about 10% and about 25%,

xcvi) the fatty acid composition of the lipid is based on an efficiency of conversion of LA to DHA of at least about 15%, at least about 20%, at least about 22%, at least about 25%, between about 15% and about 50%,

between about 20% and about 40%, or between about 20% and about 30%,

xcvii) the fatty acid composition of the lipid is based on an efficiency of conversion of ALA to DHA of at least about 17%, at least about 22%, at least about 24%, between about 17% and about 55%, between about 22% and about 35%, or between about 24% and about 35%,

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

xcix) the triacylglycerol (TAG) content of the lipid is at least about 70%, at least about 80%, at least about 90%, at least 95%, between about 70% and about 99%, or between about 90% and about 99%,

c) the lipid comprises diacylglycerol (DAG),

ci) the lipid comprises less than about 10%, less than about 5%, less than about 1%, or between about 0.001% and about 5%, free (non-esterified) fatty acids and/or phospholipid, or is essentially free thereof,

cii) at least 70%, or at least 80%, of the DHA esterified in the form of TAG is in the *sn*-1 or *sn*-3 position of the TAG,

ciii) the most abundant DHA-containing TAG species in the lipid is DHA/18:3/18:3 (TAG 58:12), and

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

3. The lipid of claim 1 or claim 2 which is in the form of an oil, wherein at least about 90%, or least about 95%, at least about 98%, or between about 95% and about 98%, by weight of the oil is the lipid.

4. The lipid according to any one of claims 1 to 3 which further comprises one or more sterols.

5. The lipid of claim 4 which is in the form of an oil, and which comprises less than about 10 mg of sterols/g of oil, less than about 7 mg of sterols/g of oil, between about 1.5 mg and about 10 mg of sterols/g of oil, or between about 1.5 mg and about 7 mg of sterols/g of oil.

6. The lipid of claim 4 or claim 5 which comprises one or more or all of campesterol/24-methylcholesterol, Δ5-stigmasterol, eburicol, β-sitosterol/24-ethylcholesterol, Δ5-avenasterol/isofucosterol, Δ7-stigmasterol/stigmast-7-en-3β-ol, and Δ7-avenasterol.

7. The lipid according to any one of claims 4 to 6 which comprises less than about 0.5 mg of cholesterol/g of oil, less than about 0.25 mg of cholesterol /g of oil, between about 0 mg and about 0.5 mg of cholesterol/g of oil, or between about 0 mg and about 0.25 mg of cholesterol/g of oil, or which is essentially free of cholesterol.

8. The lipid according to any one of claims 1 to 7, wherein the lipid is an oil, preferably oil from an oilseed.

9. The lipid of claim 8, wherein the lipid is *Brassica sp.* oil, *Gossypium hirsutum* oil, *Linum usitatissimum* oil, *Helianthus sp.* oil, *Carthamus tinctorius* oil, *Glycine max* oil, *Zea mays* oil, *Arabidopsis thaliana* oil, *Sorghum bicolor* oil, *Sorghum vulgare* oil, *Avena sativa* oil, *Trifolium sp.* oil, *Elaesis guineenis* oil, *Nicotiana benthamiana* oil, *Hordeum vulgare* oil, *Lupinus angustifolius* oil, *Oryza sativa* oil, *Oryza glaberrima* oil, *Camelina sativa* oil, *Crambe abyssinica* oil, *Miscanthus x giganteus* oil, or *Miscanthus sinensis* oil.

10. 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 about 7% to 20%, and

ii) extracting lipid from the plant part,

wherein the level of DHA in the total fatty acid content of the extracted lipid is about 7% to 20%.

11. The process of claim 10, wherein the extracted lipid has one or more of the features defined in claims 2 to 9.

12. The process of claim 10 or claim 11, wherein the plant part is a seed, preferably an oilseed.

13. The process of claim 12, wherein the seed is *Brassica sp., Gossypium hirsutum, Linum usitatissimum, Helianthus sp., Carthamus tinctorius, Glycine max, Zea mays, Arabidopsis thaliana, Sorghum bicolor, Sorghum vulgare, Avena sativa, Trifolium sp., Elaesis guineenis, Nicotiana benthamiana, Hordeum vulgare, Lupinus angustifolius, Oryza sativa, Oryza glaberrima, Camelina sativa, or Crambe abyssinica*, preferably a *Brassica napus, B juncea* or *C. sativa* seed.

14. The process of claim 12 or claim 13, wherein the seed comprises at least about 18 mg, at least about 22 mg, at least about 26 mg, between about 18 mg and about 100 mg, between about 22 mg and about 70 mg, or between about 24 mg and about 50 mg, of DHA per gram of seed.

15. The process according to any one of claims 10 to 14, wherein the plant part comprises exogenous polynucleotides encoding one of the following sets of enzymes;

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

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

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

iv) 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,

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 a cell of the plant part.

16. The process of claim 15, 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 about 60%, at least about 70%, at least about 80%, between about 60% and about 95%, between about 70% and about 90%, or between about 75% and about 85%,

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 about 65%, at least about 75%, at least about 85%, between about 65% and about 95%, between about 75% and about 91%, or between about 80% and about 91%,

iii) the Δ6-desaturase converts ALA to SDA in one or more cells of the plant with an efficiency of at least about 30%, at least about 40%, at least about 50%, at least about 60%, at least about 70%, between about 30% and about 70%, between about 35% and about 60%, or between about 50% and about 70%,

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 about 5%, less than about 2.5%, less than about 1%, between about 0.1% and about 5%, between about 0.5% and about 2.5%, or between about 0.5% and about 1%,

v) the Δ6-elongase converts SDA to ETA in one or more cells of the plant with an efficiency of at least about 60%, at least about 70%, at least about 75%, between about 60% and about 95%, between about 70% and about 80%, or between about 75% and about 80%,

vi) the Δ5-desaturase converts ETA to EPA in one or more cells of the plant with an efficiency of at least about 60%, at least about 70%, at least about 75%, at least about 80%, at least about 90%, between about 60% and about 95%, between about 70% and about 95%, or between about 75% and about 95%,

vii) the Δ5-elongase converts EPA to DPA in one or more cells of the plant with an efficiency of at least about 80%, at least about 85%, at least about 90%, between about 50% and about 90%, or between about 85% and about 95%,

viii) the Δ4-desaturase converts DPA to DHA in one or more cells of the plant with an efficiency of at least about 80%, at least about 90%, at least about 93%, between about 50% and about 95%, between about 80% and about 95%, or between about 85% and about 95%,

ix) the efficiency of conversion of oleic acid to DHA in one or more cells of the plant part is at least about 10%, at least about 15%, at least about 20%, between about 10% and about 50%, between about 10% and about 30%, or between about 10% and about 25%,

x) the efficiency of conversion of LA to DHA in one or more cells of the plant part is at least about 15%, at least about 20%, at least about 22%, at least about 25%, between about 15% and about 50%, between about 20% and about 40%, or between about 20% and about 30%,

xi) the efficiency of conversion of ALA to DHA in one or more cells of the plant part is at least about 17%, at least about 22%, at least about 24%, between about 17% and about 55%, between about 22% and about 35%, or between about 24% and about 35%,

xii) one or more cells of the plant part comprise at least about 15%, at least about 20%, between about 15% and about 30%, or between about 22.5% and about 27.5%, 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 Δ8-desaturase also has Δ6-desaturase activity or does not have Δ6-desaturase activity,

xviii) the Δ15-desaturase also has ω3-desaturase activity on GLA,

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

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

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

xxii) 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 about 10%, at least about 15%, at least about 20%, between about 10% and about 50%, between about 15% and about 30%, or between about 20% and about 25%,

xxiii) 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 about 15%, at least about 20%, at least about 22%, between about 15% and about 60%, between about 20% and about 40%, or between about 22% and about 30%,

xxiv) 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 about 17%, at least about 22%, at least about 24%, between about 17% and about 65%, between about 22% and about 35%, or between about 24% and about 35%

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

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

xxxii) 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,

xxxiii) the Δ6-desaturase has at least about a 2-fold greater Δ6-desaturase activity, at least 3-fold greater activity, at least 4-fold greater activity, or at least 5-fold greater activity, on ALA as a substrate compared to LA,

xxxiv) 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,

xxxv) the Δ6-desaturase has at least about a 5-fold greater Δ6-desaturase activity or at least 10-fold greater activity, on ALA-CoA as fatty acid substrate than on ALA joined to the *sn*-2 position of PC as fatty acid substrate,

xxxvi) the desaturase is a front-end desaturase,

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

17. The process of claim 15 or claim 16, wherein the plant part has one or more or all of the following features

i) the Δ12-desaturase comprises amino acids having a sequence as provided in SEQ ID NO:10, a biologically active fragment thereof, or an amino acid sequence which is at least 50% identical to SEQ ID NO:10,

ii) the ω3-desaturase comprises amino acids having a sequence as provided in SEQ ID NO:12, a biologically active fragment thereof, or an amino acid sequence which is at least 50% identical to SEQ ID NO:12,

iii) the Δ6-desaturase comprises amino acids having a sequence as provided in SEQ ID NO:16, a biologically active fragment thereof, or an amino acid sequence which is at least 50% identical to SEQ ID NO:16,

iv) the Δ6-elongase comprises amino acids having a sequence as provided in SEQ ID NO:25, a biologically active fragment thereof such as SEQ ID NO:26, or an amino acid sequence which is at least 50% identical to SEQ ID NO:25 and/or SEQ ID NO:26,

v) the Δ5-desaturase comprises amino acids having a sequence as provided in SEQ ID NO:30, a biologically active fragment thereof, or an amino acid sequence which is at least 50% identical to SEQ ID NO:30,

vi) the Δ5-elongase comprises amino acids having a sequence as provided in SEQ ID NO:37, a biologically active fragment thereof, or an amino acid sequence which is at least 50% identical to SEQ ID NO:37,

vii) the Δ4-desaturase comprises amino acids having a sequence as provided in SEQ ID NO:41, a biologically active fragment thereof, or an amino acid sequence which is at least 50% identical to SEQ ID NO:41.

18. The process according to any one of claims 15 to 17, wherein the plant part further comprises an exogenous polynucleotide encoding a diacylglycerol acyltransferase (DGAT), monoacylglycerol acyltransferase (MGAT), glycerol-3-phosphate acyltransferase (GPAT), 1-acyl-glycerol-3-phosphate acyltransferase (LPAAT) preferably an LPAAT which can use a C22 polyunsaturated fatty acyl-CoA substrate, acyl-CoA:lysophosphatidylcholine acyltransferase (LPCAT), phospholipase A_2 (PLA_2), phospholipase C (PLC), phospholipase D (PLD), CDP-choline diacylglycerol choline phosphotransferase (CPT), phoshatidylcholine diacylglycerol acyltransferase (PDAT), phosphatidylcholine:diacylglycerol choline phosphotransferase (PDCT), acyl-CoA synthase (ACS), or a combination of two or more thereof.

19. The process according to any one of claim 10 to 18, wherein the plant part further comprises an introduced mutation or an exogenous polynucleotide which down regulates the production and/or activity of an endogenous enzyme in a cell of the plant part selected from FAE1, DGAT, MGAT, GPAT, LPAAT, LPCAT, PLA_2, PLC, PLD, CPT, PDAT, a thioesterase such as FATB, or a Δ12-desaturase, or a combination of two or more thereof.

20. The process according to any one of claims 15 to 19, wherein at least one, or all, of the promoters are seed specific promoters.

21. The process of claim 20, wherein at least one, or all, of the promoters have been obtained from oil biosynthesis or accumulation genes such as oleosin, or from seed storage protein genes such as conlinin.

22. The process according to any one of claim 15 to 21, wherein the promoter(s) directing expression of the exogenous polynucleotides encoding the Δ4-desaturase and the Δ5-elongase initiate expression of the polynucleotides in developing seed of the

plant part before, or reach peak expression before, the promoter(s) directing expression of the exogenous polynucleotides encoding the Δ12-desaturase and the ω3-desaturase.

23. The process according to any one of claims 15 to 22, wherein the exogenous polynucleotides are covalently linked in a DNA molecule, preferably a T-DNA molecule, integrated into the genome of cells of the plant part and preferably where the number of such DNA molecules integrated into the genome of the cells of the plant part is not more than one, two or three, or is two or three.

24. The process of claim 23, wherein the plant comprises at least two different, exogenous polynucleotides each encoding a Δ6-desaturase which have the same or different amino acid sequences.

25. The process according to any one of claims 15 to 24, wherein the total oil content of the plant part comprising the exogenous polynucleotides is at least about 40%, or at least about 50%, or at least about 60%, or at least about 70%, or between about 50% and about 80% of the total oil content of a corresponding plant part lacking the exogenous polynucleotides.

26. The process according to any one of claims 10 to 25, wherein the lipid is in the form of an oil, preferably a seedoil from an oilseed, and wherein at least about 90%, or about least 95%, at least about 98%, or between about 95% and about 98%, by weight of the lipid is triacylglycerols.

27. The process according to any one of claims 10 to 26 which further comprises treating the lipid to increase the level of DHA as a percentage of the total fatty acid content.

28. The process of claim 27, wherein the treatment is transesterification.

29. Lipid, or oil comprising the lipid, produced using the process according to any one of claims 10 to 28.

30. A chimeric genetic construct comprising in order a first gene, a second gene, a third gene, a fourth gene, a fifth gene and a sixth gene which are all covalently linked on a single DNA molecule,

wherein the first, second and third genes are joined together as a first gene cluster and the fourth, fifth and sixth genes are joined together as a second gene cluster,
wherein each gene comprises a promoter, a coding region and a transcription terminator and/or polyadenylation region such that each promoter is operably linked to the coding region and transcription terminator and/or polyadenylation region,
wherein each promoter is independently identical or different to the other promoters such that the DNA molecule comprises three, four, five or six different promoters,
wherein one or more or all of the promoters are heterologous with respect to the coding region to which it is operably linked,
wherein the direction of transcription of the first gene is away from the third gene and opposite to the direction of transcription of the third gene,
wherein the direction of transcription of the fourth gene is away from the sixth gene and opposite to the direction of transcription of the sixth gene,
wherein the direction of transcription of the second gene is the same as for the first gene or the third gene,
wherein the direction of transcription of the fifth gene is the same as for the fourth gene or the sixth gene,
wherein the transcription terminator and/or polyadenylation region of the second gene is spaced apart from the promoter of the first or third genes, whichever is closer, by a first spacer region of between about 0.2 and about 3.0 kilobases,
wherein the first gene cluster is spaced apart from the second gene cluster by a second spacer region of between about 1.0 and about 10.0 kilobases, and
wherein the transcription terminator and/or polyadenylation region of the fifth gene is spaced apart from the promoter of the fourth or sixth genes, whichever is closer, by a third spacer region of between about 0.2 and about 3.0 kilobases.

31. The genetic construct of claim 30, wherein the DNA molecule comprises a seventh gene which is spaced apart from the first gene cluster or the second gene cluster, whichever is closer, by a spacer region of between about 1.0 and about 10.0 kilobases.

32. The genetic construct of claim 30 or claim 31, wherein the DNA molecule comprises two or more different transcription terminator and/or polyadenylation regions.

33. The genetic construct according to any one of claims 30 to 32, wherein at least one of the spacer regions comprises a matrix attachment region (MAR).

34. The genetic construct according to any one of claims 30 to 33, wherein the DNA molecule comprises right and left border regions flanking the genes and is a T-DNA molecule.

35. The genetic construct according to any one of claims 30 to 34 which is in an *Agrobacterium* cell or is integrated into the genome of a plant cell.

36. The genetic construct according to any one of claims 30 to 35, wherein at least one of the genes encodes a fatty acid desaturase or a fatty acid elongase.

37. The genetic construct of claim 36, comprising genes encoding a set of enzymes as defined in claim 15, and/or wherein one or more of the genes encode an enzyme as defined in claim 16 or claim 17.

38. An isolated and/or exogenous polynucleotide comprising:

i) a sequence of nucleotides selected from any one of SEQ ID NOs: 1 to 9, 11, 14, 18, 22, 23, 28, 34, 35, 39 or 45, and/or

ii) a sequence of nucleotides which are at least 95% identical or 99% identical to one or more of the sequences set forth in SEQ ID NOs: 1 to 9, 11, 14, 18, 22, 23, 28, 34, 35, 39 or 45.

39. A vector or genetic construct comprising the polynucleotide according to claim 38 and/or the genetic construct according to any one of claims 30 to 37.

40. The vector or genetic construct of claim 39, wherein the sequence of nucleotides selected from any one of SEQ ID NOs: 11, 14, 18, 22, 23, 28, 34, 35, 39 or 45, or the sequence of nucleotides which is at least 95% identical or 99% identical to one or more of the sequences set forth in SEQ ID NOs: 11, 14, 18, 22, 23, 28, 34, 35, 39 or 45, is operably linked to a promoter.

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

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

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

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

iv) 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,

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.

42. The cell of claim 41, comprising lipid as defined in any one of claims 1 to 9, or wherein one or more or all of the desaturases or elongases have one or more of the features as defined in claim 16 or claim 17.

43. A host cell comprising

i) a first exogenous polynucleotide encoding a Δ12-desaturase which comprises amino acids having a sequence as provided in SEQ ID NO:10, a biologically active fragment thereof, or an amino acid sequence which is at least 50% identical to SEQ ID NO:10, and

ii) a second exogenous polynucleotide encoding a ω3-desaturase which comprises amino acids having a sequence as provided in SEQ ID NO:12, a biologically active fragment thereof, or an amino acid sequence which is at least 50% identical to SEQ ID NO:12,

wherein each polynucleotide is operably linked to one or more promoters that are capable of directing expression of said polynucleotides in the cell.

44. A host cell comprising one or more of the polynucleotide according to claim 38, the genetic construct according to any one of claims 30 to 37, or the vector or genetic construct of claim 39 or claim 40.

45. The cell according to any one of claim 41 to 44 which is in a plant, in a plant part and/or is a mature plant seed cell.

46. The cell of claim 45, wherein the plant or plant seed is an oilseed plant or an oilseed, respectively.

47. A transgenic non-human organism comprising a cell according to any one of claims 41 to 46.

48. The transgenic non-human organism of claim 47 which is a transgenic plant.

49. 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 about 7% to 20%.

50. The plant of claim 49, wherein the plant is a canola, *Glycine max*, *Camelina sativa* or *Arabidopsis thaliana* plant.

51. The plant of claim 49 or claim 50, wherein one or more of the desaturases is capable of using an acyl-CoA substrate.

52. The plant of claim 51, wherein one or more of the Δ6-desaturase, Δ5-desaturase, Δ4-desaturase and Δ8-desaturase, if present, is capable of using an acyl-CoA substrate, preferably each of the i) Δ6-desaturase, Δ5-desaturase and Δ4-desaturase or ii) Δ5-desaturase, Δ4-desaturase and Δ8-desaturase is capable of using an acyl-CoA substrate.

53. The plant according to any one of claims 49 to 52, wherein mature, harvested seed of the plant has a DHA content of at least about 28mg per gram seed, preferably at least about 32mg per gram seed, at least about 36mg per gram seed, at least about 40mg per gram seed, more preferably at least about 44mg per gram seed or at least about 48mg per gram seed.

54. A *Brassica napus, B. juncea* or *Camelina sativa* plant which is capable of producing seed comprising DHA, wherein mature, harvested seed of the plant has a DHA content of at least about 28mg per gram seed, preferably at least about 32mg per gram seed, at least about 36mg per gram seed, at least about 40mg per gram seed, more preferably at least about 44mg per gram seed or at least about 48mg per gram seed.

55. A plant cell of a plant according to any one of claims 49 to 54 comprising the exogenous polynucleotides.

56. A plant part, preferably a seed, which has one or more of the following features
i) is from a plant according to any one of claims 48 to 54,
ii) comprises lipid as defined in any one of claims 1 to 9,
iii) can be used in a process according to any one of claims 10 to 28,
iv) comprises a genetic construct according to any one of claims 30 to 37, or
v) comprises a set of exogenous polynucleotides defined in any one of claims 14, 41 or 48 to 52.

57. Mature, harvested *Brassica napus, B. juncea* or *Camelina sativa* seed comprising DHA and a moisture content of between about 4% and about 15% by weight, wherein the DHA content of the seed at least about 28mg per gram seed, preferably at least about 32mg per gram seed, at least about 36mg per gram seed, at

least about 40mg per gram seed, more preferably at least about 44mg per gram seed or at least about 48mg per gram seed.

58. The cell according to any one of claims 41 to 46 or 55, the transgenic organism of claim 47 or claim 48, the oilseed plant according to any one or claims 49 to 53, the *Brassica napus*, *B. juncea* or *Camelina sativa* plant of claim 54, the plant part of claim 49 or claim 56 or the seed of claim 57, which can be used to produce extracted lipid comprising one or more or all of the features defined in any one of claims 1 to 9.

59. A method of producing a cell according any one of claims 41 to 45, the method comprising

a) introducing into the cell, preferably a cell which is not capable of synthesising a LC-PUFA, the gene construct according to any one of claims 30 to 37, the isolated and/or exogenous polynucleotide of claim 38, the vector or genetic construct of claim 39 or claim 40, one or more of the combinations of exogenous polynucleotides defined in any one of claims 14, 41 to 43 or 48 to 52,

b) optionally, expressing the genes or polynucleotide(s) in the cell;

c) optionally, analysing the fatty acid composition of the cell, and

d) optionally, selecting a cell which express the genes or polynucleotide(s).

60. The method of claim 59, wherein lipid in the cell has one or more of the features defined in claims 1 to 9.

61. The method of claim 59 or claim 60, wherein the gene construct, the isolated and/or exogenous polynucleotide, the vector, the genetic construct or combinations of exogenous polynucleotides, become stably integrated into the genome of the cell.

62. The method according to any one of claims 59 to 61, wherein the cell is a plant cell, and the method further comprises the step of regenerating a transformed plant from the cell of step a).

63. The method of claim 62, wherein the genes and/or exogenous polynucleotide(s) are expressed transiently in the cell.

64. A cell produced using the method according to any one of claims 59 to 63.

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

a) growing a plant according to any one of claims 48 to 54, or a plant which produces a part as defined in any one of claims 10 to 28, 56 or 57, preferably in a field as part of a population of at least 1000 such plants or in an area of at least 1 hectare planted at a standard planting density,

b) harvesting seed from the plant or plants, and

c) optionally, extracting lipid from the seed, preferably to produce oil with a total DHA yield of at least 60kg DHA/hectare.

66. The plant, plant cell, plant part or seed of any one of claims 48 to 57, which has one or more of the following features

i) the oil is as defined in any one of claims 2, or 4 to 7,

ii) the plant part or seed is capable of being used in a process according to any one of claims 14, 16 to 19, 21 to 28,

iii) the exogenous polynucleotides are comprised in a genetic construct according to any one of claims 30 to 35,

iv) the exogenous polynucleotides comprise an exogenous polynucleotide of claim 38,

v) the plant cell is a cell according to claim 43, and

vi) the seed was produced according to the method of claim 65.

67. A method of producing one or more fatty acid desaturases and/or fatty acid elongases, or one or more fatty acid desaturases and one or more fatty acid elongases, the method comprising expressing in a cell or cell free expression system the gene construct of claim 36 or claim 37, the isolated and/or exogenous polynucleotide of claim 38, the vector or genetic construct of claim 39 or claim 40, one or more of the combinations of exogenous polynucleotides defined in any one of claims 14, 41 to 43 or 48 to 52.

68. Lipid, or oil, produced by, or obtained from, using the process accoding to any one of claims 10 to 28, the cell according to any one of claims 41 to 46 or 55, the transgenic organism of claim 47 or claim 48, the oilseed plant according to any one or claims 49 to 53, the *Brassica napus, B. juncea* or *Camelina sativa* plant of claim 54, the plant part of claim 49 or claim 56, the seed of claim 57, or the plant, plant cell, plant part or seed of claim 66.

69. The lipid or oil of claim 29 or claim 68, which is obtained by extraction of oil from an oilseed.

70. The lipid or oil of claim 29, 68 or 69 which is canola oil (*Brassica napus, Brassica rapa* ssp.), mustard oil (*Brassica juncea*), other Brassica oil, sunflower oil (*Helianthus annus*), linseed oil (*Linum usitatissimum*), soybean oil (*Glycine max*), safflower oil (*Carthamus tinctorius*), corn oil (*Zea mays*), tobacco oil (*Nicotiana tabacum*), peanut oil (*Arachis hypogaea*), palm oil, cottonseed oil (*Gossypium hirsutum*), coconut oil (*Cocos nucifera*), avocado oil (*Persea americana*), olive oil (*Olea europaea*), cashew oil (*Anacardium occidentale*), macadamia oil (*Macadamia intergrifolia*), almond oil (*Prunus amygdalus*) or Arabidopsis seed oil (*Arabidopsis thaliana*).

71. A fatty acid produced by, or obtained from, using the process accoding to any one of claims 10 to 28, the cell according to any one of claims 41 to 46 or 55, the transgenic organism of claim 47 or claim 48, the oilseed plant according to any one or claims 49 to 53, the *Brassica napus, B. juncea* or *Camelina sativa* plant of claim 54, the plant part of claim 49 or claim 56, the seed of claim 57, or the plant, plant cell, plant part or seed of claim 66.

72. Seedmeal obtained from seed according to any one of claims 56, 57 or 66.

73. A composition comprising one or more of the lipid or oil according to any one of claims 29 or 59 to 51, the fatty acid of claim 62, the genetic construct according to any one of claims 30 to 37, the isolated and/or exogenous polynucleotide of claim 38, the vector or genetic construct of claim 39 or claim 40, the cell according to any one of claims 41 to 46 or 55, the transgenic organism of claim 47 or claim 48, the oilseed plant according to any one or claims 49 to 53, the *Brassica napus, B. juncea* or *Camelina sativa* plant of claim 54, the plant part of claim 49 or claim 56, the seed of claim 57, the plant, plant cell, plant part or seed of claim 66, or the seedmeal of claim 72.

74. Feedstuffs, cosmetics or chemicals comprising one or more of the lipid or oil according to any one of claims 1 to 9, 29 or 59, the fatty acid of claim 62, the gene construct according to any one of claims 30 to 37, the isolated and/or exogenous polynucleotide of claim 38, the vector or genetic construct of claim 39 or claim 40, the cell according to any one of claims 41 to 46 or 55, the transgenic organism of claim 47

or claim 48, the oilseed plant according to any one or claims 49 to 53, the *Brassica napus, B. juncea* or *Camelina sativa* plant of claim 54, the plant part of claim 49 or claim 56, the seed of claim 57, the plant, plant cell, plant part or seed of claim 66, the seedmeal of claim 72, or the composition of claim 73.

75. A method of producing a feedstuff, the method comprising mixing one or more of the lipid or oil according to any one of claims 1 to 9, 29 or 59, the fatty acid of claim 62, the gene construct according to any one of claims 30 to 37, the isolated and/or exogenous polynucleotide of claim 38, the vector or genetic construct of claim 39 or claim 40, the cell according to any one of claims 41 to 46 or 55, the transgenic organism of claim 47 or claim 48, the oilseed plant according to any one or claims 49 to 53, the *Brassica napus, B. juncea* or *Camelina sativa* plant of claim 54, the plant part of claim 49 or claim 56, the seed of claim 57, the plant, plant cell, plant part or seed of claim 66, the seedmeal of claim 72, or the composition of claim 73, with at least one other food ingredient.

76. A method of treating or preventing a condition which would benefit from a PUFA, the method comprising administering to a subject one or more of the lipid or oil according to any one of claims 1 to 9, 29 or 59, the fatty acid of claim 62, the gene construct according to any one of claims 30 to 37, the isolated and/or exogenous polynucleotide of claim 38, the vector or genetic construct of claim 39 or claim 40, the cell according to any one of claims 41 to 46 or 55, the transgenic organism of claim 47 or claim 48, the oilseed plant according to any one or claims 49 to 53, the *Brassica napus, B. juncea* or *Camelina sativa* plant of claim 54, the plant part of claim 49 or claim 56, the seed of claim 57, the plant, plant cell, plant part or seed of claim 66, the seedmeal of claim 72, the composition of claim 73, or the feedstuff of claim 74.

77. The method of claim 76, wherein the condition is 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 disease.

78. Use of one or more of the lipid or oil according to any one of claims 1 to 9, 29 or 59, the fatty acid of claim 62, the gene construct according to any one of claims 30 to 37, the isolated and/or exogenous polynucleotide of claim 38, the vector or genetic construct of claim 39 or claim 40 the cell according to any one of claims 41 to 46 or 55, the transgenic organism of claim 47 or claim 48, the oilseed plant according to any one or claims 49 to 53, the *Brassica napus, B. juncea* or *Camelina sativa* plant of claim 54, the plant part of claim 49 or claim 56, the seed of claim 57, the plant, plant cell, plant part or seed of claim 66, the seedmeal of claim 72, the composition of claim 73, or the feedstuff of claim 74 for the manufacture of a medicament for treating or preventing a condition which would benefit from a PUFA.

79. A method of trading seed, comprising obtaining seed of any one of claims 56, 57 or 66, and trading the obtained seed for pecuniary gain.

80. The method of claim 79, wherein obtaining the seed comprises cultivating the plant according to any one of claims 48 to 54 or 66, and/or harvesting the seed from the plants.

81. The method of claim 80, wherein obtaining the seed further comprises placing the seed in a container and/or storing the seed.

82. The method of claim according to any one of claims 79 to 81, wherein obtaining the seed further comprises transporting the seed to a different location.

83. The method of claim according to any one of claims 79 to 82, wherein the trading is conducted using electronic means such as a computer.

84. A process of producing bins of seed comprising:

a) swathing, windrowing and/or or reaping above-ground parts of plants comprising seed as defined in any one of claims 56, 57 or 66,

b) threshing and/or winnowing the parts of the plants to separate the seed from the remainder of the plant parts, and

c) sifting and/or sorting the seed separated in step b), and loading the sifted and/or sorted seed into bins, thereby producing bins of seed.

85. 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 about 7% to 20%, thereby producing the ethyl esters.

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, the plant part of claim 14 or claim 15, the seedmeal of claim 17, or the foodstuff of claim 18 for the manufacture of a medicament for treating or preventing a medical condition which would benefit from a PUFA.

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.