8(2), pp. 281-292), whereas specific elongase enzymes of *Trypanosoma brucei* show preference for elongating short and midchain saturated CoA substrates (Lee et al., *Cell*, 2006, Vol 126(4), pp. 691-9).

[0006] The type II fatty acid biosynthetic pathway employs a series of reactions catalyzed by soluble proteins with intermediates shuttled between enzymes as thioesters of acyl carrier protein (ACP). By contrast, the type I fatty acid biosynthetic pathway uses a single, large multifunctional polypeptide.

[0007] The oleaginous, non-photosynthetic alga, *Prototheca moriformis*, stores copious amounts of triacylglyceride oil under conditions when the nutritional carbon supply is in excess, but cell division is inhibited due to limitation of other essential nutrients. Bulk biosynthesis of fatty acids with carbon chain lengths up to C18 occurs in the plastids; fatty acids are then exported to the endoplasmic reticulum where (if it occurs) elongation past C18 and incorporation into triacylglycerides (TAGs) is believed to occur. Lipids are stored in large cytoplasmic organelles called lipid bodies until environmental conditions change to favor growth, whereupon they are mobilized to provide energy and carbon molecules for anabolic metabolism.

SUMMARY

[0008] In one aspect, the present invention refers to an oleaginous eukaryotic microalgal cell that produces a cell oil, the cell optionally of the genus Prototheca, the cell comprising an ablation of one or more alleles of an endogenous polynucleotide encoding a lysophosphatidic acid acyltransferase (LPAAT). In another aspect, the present invention refers to an oil produced by an oleaginous eukaryotic microalgal cell, the cell optionally of the genus Prototheca, the cell comprising an ablation of one or more alleles of an endogenous polynucleotide encoding a lysophosphatidic acid acyltransferase (LPAAT). In still another aspect, the present invention refers to an oleaginous eukaryotic microalgal cell that produces a cell oil, the cell optionally of the genus Prototheca, the cell comprising a first exogenous gene encoding an active enzyme of one of the following types: (a) a lysophosphatidylcholine acyltransferase (LPCAT); (b) a phosphatidylcholine diacylglycerol cholinephosphotransferase (PDCT); or (c) CDP-choline:1,2-sn-diacylglycerol cholinephosphotransferase (DAG-CPT); (d) an LPAAT; (e) and optionally a second exogenous gene encoding (f) a fatty acid elongase (FAE). In one aspect, the present invention refers to a cell, optionally a microalgal cell, that produces at least 20% oil by dry weight, wherein the oil has a fatty acid profile with 5% or less of saturated fatty acids. In another

aspect, the present invention refers to an oleaginous eukaryotic microalgal cell that produces a cell oil, the cell optionally of the genus Prototheca, the cell comprising an exogenous polynucleotide that encodes an active ketoacyl-CoA reductase, hydroxyacyl-CoA dehydratase, or enoyl-CoA reductase. In one aspect, the present invention refers to an oil produced by an oleaginous eukaryotic microalgal cell, the cell optionally of the genus Prototheca, the cell comprising an exogenous polynucleotide that encodes an active ketoacyl-CoA reductase, hydroxyacyl-CoA dehydratase, or enoyl-CoA reductase. In accordance with an example, there is a cell, optionally a microalgal cell, which produces at least 20% oil by dry weight. The oil has a fatty acid profile with 5% or less of saturated fatty acids, optionally less than 4%, less than 3.5%, or less than 3% of saturated fatty acids. The fatty acid profile can have (a) less than 2.0% C16:0; (b) less than 2% C18:0; and/or (c) a C18:1/C18:0 ratio of greater than 20. Alternately, the fatty acid profile can have (a) less than 1.9% C16:0; (b) less than 1% C18:0; and/or (c) a C18:1/C18:0 ratio of greater than 100. The fatty acid profile can have a sum of C16:0 and C18:0 of 2.5% or less, or optionally, 2.2% or less.

[0009] The cell can overexpress both a KASII gene and a SAD gene. Optionally, the KASII gene encodes a mature KASII protein with at least 80, 85, 90, or 95% sequence identity to SEQ ID NO: 18 and/or the SAD gene encodes a mature SAD protein with at least 80, 85, 90, or 95% sequence identity to SEQ ID NO: 65. Optionally, the cell has a disruption of an endogenous FATA gene and/or an endogenous FAD2 gene. In some cases, the cell comprises a nucleic acid encoding an inhibitory RNA to down-regulate the expression of a desaturase. In some cases, the inhibitory RNA is a hairpin RNA that down regulates a FAD2 gene.

[0010] The cell can be a Eukaryotic microalgal cel; the oil has sterols with a sterol profile characterized by an excess of ergosterol over β-sitosterol and/or the presence of 22, 23-dihydrobrassicasterol, poriferasterol or clionasterol.

[0011] In an example, a method includes cultivating the recombinant cell and extracting the oil from the cell. Optionally, the oil is used in a food product with at least one other edible ingredient or subjected to a chemical reaction.

[0012] In one example, an oleaginous eukaryotic microalgal cell that produces a cell oil, the cell comprising an ablation (knock-out) of one or more alleles of an endogenous polynucleotide encoding a lysophosphatidic acid acyltransferase (LPAAT). In some examples, the cell comprises ablation of both alleles of an LPAAT. In some examples, the cell comprises ablation of an allele of an LPAAT identified as LPAAT1 or ablation of an LPAAT identified as LPAAT2. In some examples, the cell comprises ablation of both alleles of LPAAT1 and ablation of both alleles of LPAAT2.

[0013] In some examples, an oleaginous eukaryotic microalgal cell has both an ablation of an endogenous LPAAT and a recombinant nucleic acid that encodes one or more of an active LPCAT, PDCT, DAG-CPT, LPAAT and FAE. The LPCAT has at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 86, 87, 88, 89, 90, 91, or 92 or to the relevant portions of SEQ ID NO: 97, 98, 99, 100, 101, 102, or 103. The PDCT has at least 80, 85, 90 or 95% sequence identity to the relevant portions of SEQ ID NO: 93. The DAG-CPT has at least 80, 85, 90 or 95% sequence identity to the relevant portions of SEQ ID NO: 94, 95, or 96. The LPAAT has at least 80, 85, 90 or 95% sequence identity to the relevant portions of SEQ ID NO: 12, 16, 26, 27, 28, 29, 30, 31, 32, 33, 63, 82, or 83. The FAE has at least 80, 85, 90 or 95% sequence identity to the relevant portions of SEQ ID NO: 19, 20, 84, or 85.

[0014] In some examples, an oleaginous eukaryotic microalgal cell has both an ablation of an endogenous LPAAT and a first recombinant nucleic acid that encodes one or more of an active LPCAT, PDCT, DAG-CPT, and LPAAT and a second recombinant nucleic acid that encodes an active FAE.

[0015] In some examples, an oleaginous eukaryotic microalgal cell has both an ablation of an endogenous LPAAT and a recombinant nucleic acid that encodes one or more of an active LPCAT, PDCT, DAG-CPT, LPAAT and FAE and another recombinant nucleic acid that encodes an active sucrose invertase.

[0016] In some examples, the invention is an oil produced by a eukaryotic microalgal cell, the cell optionally of the genus Prototheca, the cell comprising an ablation of one or more alleles of an endogenous polynucleotide encoding LPAAT.

[0017] In other examples, the invention comprises an oil produced by a eukaryotic microalgal cell tha has both an ablation of an endogenous LPAAT and a recombinant nucleic acid that encodes one or more of an active LPCAT, PDCT, DAG-CPT, LPAAT and FAE.

[0018] In some examples, the invention comprises an oil produced an oleaginous eukaryotic microalgal cell has both an ablation of an endogenous LPAAT and a first recombinant nucleic acid that encodes one or more of an active LPCAT, PDCT, DAG-CPT, and LPAAT and a second recombinant nucleic acid that encodes an active FAE.

[0019] In some examples, the oil comprises at least 10%, at least 15%, at least 20%, or at least 25% or higher C18:2. In other examples the oil comprises at least 5%, at least 10%, at least 20%, or at least 25% or higher C18:3. In some examples, the oil comprises at least 1%, at least 5%, at least 7%, or at least 10% or higher C20:1. In some examples, the oil comprises at least 1%, at least 5%, at least 7%, or at least 10% or higher C22:1.

[0020] In some examples, the oil comprises at least 10%, at least 15%, or at least 20% or higher of the combined amount of C20:1 and C22:1.

[0021] In some examples, the oil comprises less than 50%, less than 40%, less than 30%, or less than 20% or lower C18:1..

[0022] In some examples, an oleaginous eukaryotic microalgal cell that produces a cell oil, the cell comprising a recombinant nucleic acid that encodes one or more of an active enzymes selected from the group consistion of LPCAT, PDCT, DAG-CPT, LPAAT and FAE. In other examples, the cell comprises a second exogenous gene encoding an active sucrose invertase.

[0023] In an example, an oleaginous eukaryotic microalgal cell produces a cell oil. The cell is optionally of the genus Prototheca and includes an first exogenous gene encoding an active enzyme of one of the following types:

(a) a lysophosphatidylcholine acyltransferase (LPCAT);

(b) a phosphatidylcholine diacylglycerol cholinephosphotransferase (PDCT); or

(c) CDP-choline:1,2-sn- diacylglycerol cholinephosphotransferase (DAG-CPT);

and optionally a second exogenous gene encoding

(d) a fatty acid elongase (FAE) active to increase the amount of C20:1 and/or C22:1 fatty acids in the oil.

[0024] In some examples methods of heterotrophically cultivating recombinant cells of the invention are provided. In some examples methods of cultivating recombinant cells heterotrophically and in the dark are provided. The cultivated cells can be dewatered and/or dried. Oil from the cultivated cells can be extracted by mechanical means. Oil from the

cultivated cells can be extracted by the use of non-polar organic solvents such as hexane, heptane, pentane and the like. Alternatively methanol, ethanol, or other polar organic solvents may be used. When miscible solvents such as ethanol are used, salts such as NaCl may be used to "break" the emulsion between aqueous and organic phase.

[0025] In one example, the present disclosure is directed to an oil produced by an oleaginous eukaryotic microalgal cell as discussed above or herein.

[0026] In some examples, one or more chemical reactions are performed on the oil of the invention to produce a lubricant, fuel, or other useful products. In other examples, a food product is prepared by adding the oil of the invention to another edible food ingredient.

[0027] In one example, the present disclosure is directed to an oleaginous eukaryotic microalgal cell that produces a cell oil, in which the cell is optionally of the genus *Prototheca*, and the cell comprises an exogenous polynucleotide that encodes an active ketoacyl-CoA reductase, hydroxyacyl-CoA dehydratase, or enoyl-CoA reductase. In some examples, the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 144 and encodes an active ketoacyl-CoA reductase. In some examples, the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 143 and encodes an active hydroxyacyl-CoA dehydratase. In some examples, the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to the enoyl-CoA reductase encoding portion of SEQ ID NO: 142 and encodes an active enoyl-CoA reductase.

[0028] In some cases, the cell further comprises an exogenous nucleic acid encoding a lysophosphatidylcholine acyltransferase (LPCAT), a phosphatidylcholine diacylglycerol cholinephosphotransferase (PDCT), CDP-choline:1,2-sn- diacylglycerol cholinephosphotransferase (DAG-CPT), a lysophosphatidic acid acyltransferase (LPAAT) or a fatty acid elongase (FAE). In some cases, the cell further comprises an exogenous nucleic acid encoding an enzyme selected from the group consisting of a sucrose invertase and an alpha galactosidase. In some cases, the cell further comprises an exogenous nucleic acid that encodes a desaturase and/or a ketoacyl synthase. In some cases, the cell further comprises a disruption of an endogenous FATA gene. In some cases, the cell further comprises a disruption of an endogenous or FAD2 gene. In some examples, the cell further comprises a nucleic acid encoding an inhibitory RNA that down-regulates the expression of a desaturase.

[0029] In some examples, the cell oil comprises sterols with a sterol profile characterized by an excess of ergosterol over β-sitosterol and/or the presence of 22, 23-dihydrobrassicasterol, poriferasterol or clionasterol.

[0030] In one example, the present disclosure provides an oil produced by an oleaginous eukaryotic microalgal cell, in which the cell is optionally of the genus *Prototheca*, and the cell comprises an exogenous polynucleotide that encodes an active ketoacyl-CoA reductase, hydroxyacyl-CoA dehydratase, or enoyl-CoA reductase. In some cases, the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 144 and encodes an active ketoacyl-CoA reductase. In some cases, the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 143 and encodes an active hydroxyacyl-CoA dehydratase. In some cases, the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to the enoyl-CoA reductase encoding portion of SEQ ID NO: 142 and encodes an active enoyl-CoA reductase.

[0031] In some examples, the oil is produced by a cell that further comprises an exogenous nucleic acid encoding a lysophosphatidylcholine acyltransferase (LPCAT), a phosphatidylcholine diacylglycerol cholinephosphotransferase (PDCT), CDP-choline:1,2-sn-diacylglycerol cholinephosphotransferase (DAG-CPT), a lysophosphatidic acid acyltransferase (LPAAT) or a fatty acid elongase (FAE). In some cases, the cell further comprises and exogenous nucleic acid encoding an enzyme selected from the group consisting of a sucrose invertase and an alpha galactosidase.

[0032] In some cases, the oil comprises at least 10% C18:2. In some cases, the oil comprises at least 15% C18:2. In some cases, the oil comprises at least 1% C18:3. In some cases, the oil comprises at least 5% C18:3. In some cases, the oil comprises at least 10% C18:3. In some cases, the oil comprises at least 1% C20:1. In some cases, the oil comprises at least 5% C20:1. In some cases, the oil comprises at least 7% C20:1. In some cases, the oil comprises at least 1% C22:1. In some cases, the oil comprises at least 5% C22:1. In some cases, the oil comprises at least 7% C22:1. In some examples, the oil comprises sterols with a sterol profile characterized by an excess of ergosterol over β-sitosterol and/or the presence of 22, 23-dihydrobrassicasterol, poriferasterol or clionasterol.

[0033] In one example, the present disclosure is directed to a cell of the genera *Prototheca* or *Chlorella* that produces a cell oil, wherein the cell comprises an exogenous polynucleotide that replaces an endogenous regulatory element of an endogenous gene. In some cases, the cell is a *Prototheca* cell. In some cases, the cell is a *Prototheca moriformis* cell.

[0034] In some examples, the endogenous regulatory element is a promoter that controls the expression of an endogenous acetyl-CoA carboxylase. In some cases, the exogenous polynucleotide is a *Prototheca moriformis* AMT03 promoter.

[0035] In some cases, the cell further comprises an exogenous nucleic acid that encodes an active ketoacyl-CoA reductase, hydroxyacyl-CoA dehydratase, or enoyl-CoA reductase. In some examples, the exogenous nucleic acid has at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 144 and encodes an active ketoacyl-CoA reductase. In some examples, the exogenous nucleic acid has at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 143 and encodes an active hydroxyacyl-CoA dehydratase. In some examples, the exogenous nucleic acid has at least 80, 85, 90 or 95% sequence identity to the enoyl-CoA reductase encoding portion of SEQ ID NO: 142 and encodes an active enoyl-CoA reductase.

[0036] In some cases, the cell further comprises an exogenous nucleic acid encoding a lysophosphatidylcholine acyltransferase (LPCAT), a phosphatidylcholine diacylglycerol cholinephosphotransferase (PDCT), CDP-choline:1,2-sn- diacylglycerol cholinephosphotransferase (DAG-CPT), a lysophosphatidic acid acyltransferase (LPAAT) or a fatty acid elongase (FAE). In some cases, the cell further comprises an exogenous nucleic acid that encodes a desaturase and/or a ketoacyl synthase. In some cases, the cell further comprises a disruption of an endogenous FATA gene. In some cases, the cell further comprises a disruption of an endogenous or FAD2 gene. In some cases, the cell further comprises a nucleic acid encoding an inhibitory RNA that down-regulates the expression of a desaturase.

[0037] In some examples, the cell oil comprises sterols with a sterol profile characterized by an excess of ergosterol over β-sitosterol and/or the presence of 22, 23-dihydrobrassicasterol, poriferasterol or clionasterol.

[0038] In one example, the present disclosure provides an oil produced by any one of the cells discussed above or herein.

[0039] In one example, the present disclosure provides a method comprising (a) cultivating a cell as discussed above or herein to produce an oil, and (b) extracting the oil from the cell.

[0040] In one example, the present disclosure provides a method of preparing a composition comprising subjecting the oil discussed above or herein to a chemical reaction.

[0041] In one example, the present disclosure provides a method of preparing a food product comprising adding the oil discussed above or herein to another edible ingredient.

[0042] In one example, the present disclosure provides a polynucleotide with at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 144. In some cases, the polynucleotide comprises the nucleotide sequence of SEQ ID NO: 144.

[0043] In one example, the present disclosure provides a polynucleotide with at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 143. In some cases, the polynucleotide comprises the nucleotide sequence of SEQ ID NO: 143.

[0044] In one example, the present disclosure provides a polynucleotide with at least 80, 85, 90 or 95% sequence identity to nucletoides 4884 to 5816 of SEQ ID NO: 142. In some cases, the polynucleotide comprises the nucleotide sequence of nucleotides 4884 to 5816 of SEQ ID NO: 142.

[0045] In one example, the present disclosure provides a ketoacyl-CoA reductase (KCR) encoded by the nucleotide sequence of SEQ ID NO: 144. In some cases, the KCR is encoded by a polynucleotide with at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 144.

[0046] In one example, the present disclosure provides a hydroxylacyl-CoA dehydratase (HACD) encoded by the nucleotide sequence of SEQ ID NO: 143. In some cases, the HACD is encoded by a polynucleotide with at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 143.

[0047] In one example, the present disclosure provides an enoyl-CoA reductase (ECR) encoded by the nucleotide sequence of nucleotides 4884 to 5816 of SEQ ID NO: 142. In some cases, the ECR is encoded by a polynucleotide with at least 80, 85, 90 or 95% sequence identity to nucletoides 4884 to 5816 of SEQ ID NO: 142.

[0048] In various embodiments of the invention, two or more features discussed above or herein can be combined together.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049] **Figure 1** shows the total saturated fatty acid levels of S8188 in 15-L fed-batch fermentation runs 140558F22 and 140574F24.

[0050] **Figure 2** shows the percent saturates produced from various cell lines discussed in Example 17. "MCB" refers to the master cell bank, and "WCB" refers to the working cell bank. Strains S8695 and S8696, when cultivated in liquid culture media, had total saturates of about 3.6% and 3.75%, respectively.

[0051] **Figure 3** shows the alignment of the amino acid sequences of *P. morformis* and plant ketoacyl-CoA reductase proteins.

[0052] **Figure 4** shows the alignment of the amino acid sequences of *P. morformis* and plant hydroxyacyl-CoA dehydratase proteins.

[0053] **Figure 5** shows the alignment of the amino acid sequences of *P. morformis* and plant enoyl-CoA reductase proteins.

WHAT IS CLAIMED IS:

1. An oleaginous eukaryotic microalgal cell that produces a cell oil, the cell optionally of the genus *Prototheca*, the cell comprising an ablation of one or more alleles of an endogenous polynucleotide encoding a lysophosphatidic acid acyltransferase (LPAAT).

2. The cell of claim 1, wherein the endogenous polynucleotide encoding the LPAAT has at least 80, 85, 90 or 95% sequence identity to SEQ ID NOs: 105 or 106.

3. The cell of claim 1 or 2, further comprising an exogenous gene encoding an active enzyme selected from the group consisting of

(a) a lysophosphatidylcholine acyltransferase (LPCAT);

(b) a phosphatidylcholine diacylglycerol cholinephosphotransferase (PDCT);

(c) CDP-choline:1,2-sn- diacylglycerol cholinephosphotransferase (DAG-CPT);

(d) a lysophosphatidic acid acyltransferase LPAAT; and

(e) a fatty acid elongase (FAE).

4. The cell of claim 3, wherein the exogenous gene encodes a lysophosphatidylcholine acyltransferase having at least 80, 85, 90 or 95% sequence identity to SEQ ID NOs: 98, 99, 100, 101, 102, or 108.

5. The cell of claim 3, wherein the exogenous gene encodes a phosphatidylcholine diacylglycerol cholinephosphotransferase having at least 80, 85, 90 or 95% sequence identity to the phosphatidylcholine diacylglycerol cholinephosphotransferase encoding portion of SEQ ID NO: 93.

6. The cell of claim 3, wherein the exogenous gene encodes a (c) CDP-choline:1,2-sn- diacylglycerol cholinephosphotransferase having at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 95 or 96.

7. The cell of claim 3, wherein the exogenous gene encodes lysophosphatidic acid acyltransferase having at least 80, 85, 90 or 95% sequence identity to SEQ ID NOs: 12, 29, 30, 32, 33, or 34.

8. The cell of claim 3, wherein the exogenous gene encodes a fatty acid elongase having at least 80, 85, 90 or 95% sequence that encodes the amino acid of SEQ ID NO: 19, 20, 84 or 85.

9. The cell of claim 1 or 2, wherein the cell comprises a first exogenous gene encoding an active enzyme selected from the group consisting of

(a) a lysophosphatidylcholine acyltransferase (LPCAT);

(b) a phosphatidylcholine diacylglycerol cholinephosphotransferase (PDCT);

(c) CDP-choline:1,2-sn- diacylglycerol cholinephosphotransferase (DAG-CPT); and

(d) a lysophosphatidic acid acyltransferase LPAAT; and

(e) a second exogenous gene encoding an active fatty acid elongase (FAE) .

10. The cell of any of claims 1 to 9, wherein the cell further comprises an exogenous gene encoding an active sucrose invertase or an alpha galactosidase.

11. An oil produced by an oleaginous eukaryotic microalgal cell, the cell optionally of the genus *Prototheca*, the cell comprising an ablation of one or more alleles of an endogenous polynucleotide encoding a lysophosphatidic acid acyltransferase (LPAAT).

12. The oil of claim 11, wherein the endogenous polynucleotide encoding the LPAAT has at least 80, 85, 90 or 95% sequence identity to SEQ ID NOs: 105or 106.

13. The oil of claim 11 or 12, further comprising an exogenous gene encoding an active enzyme selected from the group consisting of

(a) a lysophosphatidylcholine acyltransferase (LPCAT);

(b) a phosphatidylcholine diacylglycerol cholinephosphotransferase (PDCT);

(c) CDP-choline:1,2-sn- diacylglycerol cholinephosphotransferase (DAG-CPT);

(d) a lysophosphatidic acid acyltransferase (LPAAT); and

(e) a fatty acid elongase (FAE).

14. An oleaginous eukaryotic microalgal cell that produces a cell oil, the cell optionally of the genus *Prototheca*, the cell comprising a first exogenous gene encoding an active enzyme of one of the following types:

(a) a lysophosphatidylcholine acyltransferase (LPCAT);

(b) a phosphatidylcholine diacylglycerol cholinephosphotransferase (PDCT); or

(c) CDP-choline:1,2-sn- diacylglycerol cholinephosphotransferase (DAG-CPT);

(d) an LPAAT;

(e) and optionally a second exogenous gene encoding

(f) a fatty acid elongase (FAE).

15. A cell, optionally a microalgal cell, that produces at least 20% oil by dry weight, wherein the oil has a fatty acid profile with 5% or less of saturated fatty acids.

16. An oleaginous eukaryotic microalgal cell that produces a cell oil, the cell optionally of the genus *Prototheca*, the cell comprising an exogenous polynucleotide that encodes an active ketoacyl-CoA reductase, hydroxyacyl-CoA dehydratase, or enoyl-CoA reductase.

17. The oleaginous eukaryotic microalgal cell of claim 16, wherein the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 144 and encodes an active ketoacyl-CoA reductase.

18. The oleaginous eukaryotic microalgal cell of claim 16, wherein the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 143 and encodes an active hydroxyacyl-CoA dehydratase.

19. The oleaginous eukaryotic microalgal cell of claim 16, wherein the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to the enoyl-CoA reductase encoding portion of SEQ ID NO: 142 and encodes an active enoyl-CoA reductase.

20. An oil produced by an oleaginous eukaryotic microalgal cell, the cell optionally of the genus *Prototheca*, the cell comprising an exogenous polynucleotide that encodes an active ketoacyl-CoA reductase, hydroxyacyl-CoA dehydratase, or enoyl-CoA reductase.

21. The oil of claim 20, wherein the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 144 and encodes an active ketoacyl-CoA reductase.

22. The oil of claim 20, wherein the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to SEQ ID NO: 143 and encodes an active hydroxyacyl-CoA dehydratase.

23. The oil of claim 20, wherein the exogenous polynucleotide has at least 80, 85, 90 or 95% sequence identity to the enoyl-CoA reductase encoding portion of SEQ ID NO: 142 and encodes an active enoyl-CoA reductase.