Claims

1. A method for producing a hydrophobic compound selected from a fatty alcohol, a fatty alcohol ester, a fatty acyl acetate, a fatty aldehyde and a terpene in a fermentation, said method comprising the step of providing a yeast cell capable of producing said hydrophobic compound and culturing said yeast cell in a culture medium under conditions allowing production of said hydrophobic compound, wherein the culturing step is performed at a cultivation temperature,
wherein the culture medium comprises an extractant in an amount equal to or greater than its cloud concentration measured in an aqueous solution such as the culture medium at the cultivation temperature,
wherein the extractant is a non-ionic ethoxylated surfactant,
the method further comprising the step of recovering the hydrophobic compound.

2. A method for increasing the titer of a hydrophobic compound selected from a fatty alcohol, a fatty alcohol ester, a fatty acyl acetate, a fatty aldehyde and a terpene in a fermentation, said method comprising culturing a yeast cell capable of producing said hydrophobic compound in a culture medium under conditions allowing production of said hydrophobic compound, wherein the culturing step is performed at a cultivation temperature,
wherein the culture medium comprises an extractant in an amount equal to or greater than its cloud concentration measured in an aqueous solution at the cultivation temperature,
wherein the extractant is a non-ionic ethoxylated surfactant,
whereby the titer of the hydrophobic compound is increased compared to a fermentation performed under the same conditions but either in the absence of extractant or in the presence of extractant in an amount lower than its cloud concentration measured in an aqueous solution at the cultivation temperature.

3. A method for increasing the secretion of a hydrophobic compound selected from a fatty alcohol, a fatty alcohol ester, a fatty acyl acetate, a fatty aldehyde and a terpene from a yeast cell capable of producing said hydrophobic compound in a fermentation, said method comprising culturing said yeast cell in a culture medium under conditions allowing production of said hydrophobic compound, wherein the culturing step is performed at a cultivation temperature,

wherein the culture medium comprises an extractant in an amount equal to or greater than its cloud concentration measured in an aqueous solution at the cultivation temperature,
wherein the extractant is a non-ionic ethoxylated surfactant,
whereby the secretion of the hydrophobic compound from the yeast cell is increased compared to a fermentation performed under the same conditions but either in the absence of extractant or in the presence of extractant in an amount lower than its cloud concentration measured in an aqueous solution at the cultivation temperature.

4. The method according to any one of the preceding claims, wherein the non-ionic ethoxylated surfactant is a fatty alcohol alkoxylate or a polyethoxylated surfactant.

5. The method according to any one of the preceding claims, wherein the non-ionic ethoxylated surfactant is selected from: Agnique BP420 (CAS number 68002-96-0), a polyethylene polypropylene glycol, polyethoxylated non-ionic surfactants which comprise or mainly consist of a mixture of polyether dispersions, an antifoaming agent comprising polyethylene glycol monostearate, simethicone, which is a silicone-based emulsion containing also 1.2-1.6% polyethylene glycol monostearate, ethoxylated and propoxylated C_{16}-C_{18} alcohol-based agents and ethoxylated and propoxylated C_{16}-C_{18} alcohol-based antifoaming agents and combinations thereof.

6. The method according to any one of the preceding claims, wherein the fatty alcohols are saturated fatty alcohols, desaturated fatty alcohols, or a mixture thereof, and/or wherein the fatty acyl acetates are saturated fatty acyl acetates, desaturated fatty acyl acetates, or a mixture thereof.

7. The method according to any one of the preceding claims, wherein the fatty aldehydes are saturated fatty aldehydes, desaturated fatty aldehydes, or a mixture thereof.

8. The method according to any one of the preceding claims, wherein the fatty alcohols, fatty acyl acetates and/or fatty aldehydes have a carbon chain length of 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21 or 22.

9. The method according to any one of the preceding claims, wherein the terpene is a sesquiterpene such as a bisabolene.

10. The method according to any one of the preceding claims, wherein the fatty alcohol ester is a fatty alcohol acetate ester.

11. The method according to any one of the preceding claims, whereinthe non-ionic ethoxylated surfactant is selected from C_{16}-C_{18} alkyl alcohol ethoxylate propoxylate (CAS number 68002-96-0), Agnique BP420 (CAS number 68002-96-0), a polyethylene polypropylene glycol, a surfactant comprising polyethylene glycol monostearate, and a fatty alcohol alkoxylate.

12. The method according to any one of the preceding claims, wherein the polyethylene polypropylene glycol is Kolliphor® P407 (CAS number 9003-11-6).

13. The method according to any one of the preceding claims, wherein the non-ionic ethoxylated surfactant is Agnique BP420 (CAS number 68002-96-0).

14. The method according to any one of the preceding claims, wherein the surfactant is simethicone, which is a silicone-based emulsion containing also 1.2-1.6% polyethylene glycol monostearate.

15. The method according to any one of the preceding claims, wherein the fatty alcohol alkoxylate is selected from Plurafac® LF300 (CAS number 196823-11-7), Plurafac® LF1300 (CAS number 68002-96-0), Plurafac® SLF180 (CAS number 196823-11-7), Dehypon® 2574 (CAS number 68154-97-2), and Imbentin SG/251 (CAS number 68002-96-0), preferably Plurafac® LF300 or Dehypon® 2574.

16. The method according to any one of the preceding claims, wherein the culture medium comprises at least 1% vol/vol of the non-ionic ethoxylated surfactant, such as at least 1.5%, such as at least 2%, such as at least 2.5%, such as at least 3%, such as at least 3.5%, such as at least 4%, such as at least 5%, such as at least 6%, such as at least 7%, such as at least 8%, such as at least 9%, such as at least 10%, such as at least 12.5%, such as at least 15%, such as at

least 17.5%, such as at least 20%, such as at least 22.5%, such as at least 25%, such as at least 27.5%, such as at least 30% vol/vol non-ionic ethoxylated surfactant, or more.

17. The method according to any one of the preceding claims, wherein the culture medium comprises the extractant in an amount greater than its cloud concentration by at least 50%, such as at least 100%, such as at least 150%, such as at least 200%, such as at least 250%, such as at least 300%, such as at least 350%, such as at least 400%, such as at least 500%, such as at least 750%, such as at least 1000%, or more.

18. The method according to any one of the preceding claims, wherein the culture medium comprises the extractant in an amount at least 2-fold its cloud concentration, such as at least 3-fold its cloud concentration, such as at least 4-fold its cloud concentration, such as at least 5-fold its cloud concentration, such as at least 6-fold its cloud concentration, such as at least 7-fold its cloud concentration, such as at least 8-fold its cloud concentration, such as at least 9-fold its cloud concentration, such as at least 10-fold its cloud concentration, such as at least 12.5-fold its cloud concentration, such as at least 15-fold its cloud concentration, such as at least 17.5-fold its cloud concentration, such as at least 20-fold its cloud concentration, such as at least 25-fold its cloud concentration, such as at least 30-fold its cloud concentration.

19. The method according to any one of the preceding claims, wherein the hydrophobic compound produced by the microorganism is present in an emulsion in the fermentation broth, the method further comprising a step of breaking said emulsion, thereby obtaining a composition comprising a product phase comprising the extractant and the hydrophobic compound.

20. The method according to claim 19, whereinthe step of breaking the emulsion comprises or consists of a step of phase separation, such as a step of centrifugation, of the fermentation broth, thereby obtaining a composition consisting of three phases: a water phase, a phase comprising cells and cellular debris, and the product phase comprising the extractant and the hydrophobic compound.

21. The method according to any one of claims 19 or 20, wherein the product phase comprises at least 50% of the hydrophobic compound initially present in the fermentation broth, such as at least 55%, such as at least 60%, such as at least 65%, such as at least 70%, such as at least 75%, such as at least 80%, such as at least 85%, such as at least 90%, such as at least 95% or more.

22. The method according to any one of claims 19 to 21, further comprising recovering the product phase comprising the extractant and the hydrophobic compound from the composition.

23. The method according to claim 22, further comprising separating the hydrophobic compound from the extractant, wherein the separation preferably is a distillation such as a distillation under reduced pressure, or a column purification.

24. The method according to any one of the preceding claims, wherein the hydrophobic compound is one or more fatty alcohols, and wherein the method further comprises the step of recovering said one or more fatty alcohols, preferably by a distillation step such as a distillation under reduced pressure, or by a column purification, thereby obtaining a mixture of fatty alcohols.

25. The method according to claim 24, further comprising the step of chemically converting at least part of the fatty alcohols of said mixture of fatty alcohols to the corresponding fatty acyl acetates.

26. The method according to claim 25, wherein at least part of the fatty alcohols are converted to the corresponding fatty acyl acetates by acetylation.

27. The method according to any one of claims 19 to 26, further comprising the step of chemically converting at least part of the fatty alcohols of said mixture of fatty alcohols to the corresponding fatty aldehydes.

28. The method according to claim 27, wherein at least part of the fatty alcohols are converted to the corresponding fatty aldehydes by oxidation.

29. The method according to any one of claims 25 to 28, further comprising the step of recovering said corresponding fatty acyl acetates and/or said corresponding fatty aldehydes.

30. The method according to any one of the preceding claims, wherein the extractant is recovered from the fermentation broth and optionally recycled to the fermentation broth.

31. The method according to any one of the preceding claims, wherein the titer of the hydrophobic compound is increased by at least 5% compared to the titer obtained in a fermentation performed under the same conditions but either in the absence of extractant or in the presence of extractant in an amount lower than its cloud concentration measured in an aqueous solution such as the culture medium at the cultivation temperature, such as by at least 10%, such as by at least 15%, such as by at least 20%, such as by at least 25%, such as by at least 30%, such as by at least 35%, such as by at least 40%, such as by at least 45%, such as by at least 46%, such as by at least 47%, such as by at least 48%, such as by at least 49%, such as by at least 50%, such as by at least 51%, such as by at least 52%, such as by at least 53%, such as by at least 54%, such as by at least 55% or more.

32. The method according to any one of the preceding claims, wherein the secretion of the hydrophobic compound is increased by at least 5% compared to a fermentation performed under the same conditions but either in the absence of extractant or in the presence of extractant in an amount lower than its cloud concentration measured in an aqueous solution such as the culture medium at the cultivation temperature, such as by at least 7.5%, such as by at least 10%, such as by at least 12.5%, such as by at least 15%, such as by at least 20%, such as by at least 25%, such as by at least 30%, such as by at least 35%, such as by at least 36%, such as by at least 37%, such as by at least 38%, such as by at least 39%, such as by at least 40%, such as by at least or more.

33. The method according to any one of the preceding claims, wherein the yeast is of the genus *Saccharomyces*, *Pichia*, *Yarrowia*, *Kluyveromyces*, *Candida, Rhodotorula, Rhodosporidium, Cryptococcus, Trichosporon* or *Lipomyces*, preferably the genus is *Saccharomyces* or *Yarrowia*.

34. The method according to any one of the preceding claims, wherein the yeast is of a species selected from *Saccharomyces cerevisiae, Pichia pastoris, Kluyveromyces marxianus, Cryptococcus albidus, Lipomyces lipofera, Lipomyces starkeyi, Rhodosporidium toruloides, Rhodotorula glutinis, Trichosporon pullulan* or *Yarrowia lipolytica,* preferably the yeast cell is a *Saccharomyces cerevisiae* cell or a *Yarrowia lipolytica* cell.

35. The method according to any one of the preceding claims, wherein the hydrophobic compound is a desaturated fatty alcohol.

36. The method according to claim 35, wherein the desaturated fatty alcohol is (*Z*)-11-hexadecen-1-ol, (*Z*)9-hexadecen-1-ol, (*Z*)11-tetradecen-1-ol, (*E*)11-tetradecen-1-ol, (*Z*)9-tetradecen-1-ol or *E*8,*E*10-dodecadien-1-ol.

37. The method according to any one of the preceding claims, wherein the hydrophobic compound is an acetate ester of a saturated or desaturated fatty alcohol, preferably wherein the acetate ester is an acetate ester of a desaturated fatty alcohol, such as (*Z*)9-tetradecen-1-yl acetate or *E*8,*E*10-dodecadienyl acetate.

38. The method according to any one of the preceding claims, wherein the hydrophobic compound is a fatty aldehyde, preferably an unsaturated fatty aldehyde such as (*Z*)11-hexadecen-1-al or *E*8,*E*10-dodecadienal.

39. The method according to any one of the preceding claims, wherein the yeast cell is capable of producing the hydrophobic compound with a titer of at least 0.2 mg/L.

40. The method according to any one of the preceding claims, wherein the yeast cell expresses:

- a Δ11-desaturase selected from the group consisting of the *Amyelois transitella* Δ11-desaturase (Atr_Δ11; SEQ ID NO: 1), the *Spodoptera littoralis* Δ11-desaturase (Sl_Δ11; SEQ ID NO: 2), the *Agrotis segetum* Δ11-desaturase (As_Δ11; SEQ ID NO: 3), the desaturase from *Lobesia botrana* (Lbo_PPTQ; SEQ ID NO: 43), the desaturase from *Drosophila grimshawi* (Dgd9; SEQ ID NO: 44), the desaturase from *Drosophila virilis* (Dvd9; SEQ ID NO: 45) and the *Trichoplusia ni*

Δ11-desaturase (Tni_Δ11; SEQ ID NO: 4) or a functional variant thereof having at least 65% homology to Atr_Δ11 (SEQ ID NO: 1), Sl_Δ11 (SEQ ID NO: 2), As_Δ11 (SEQ ID NO: 3), Lbop_PPTQ (SEQ ID NO: 43), Dgd9 (SEQ ID NO: 44), Dvd9 (SEQ ID NO: 45) or Tni_Δ11 (SEQ ID NO: 4), and

- an alcohol-forming fatty acyl-CoA reductase (FAR) selected from the group consisting of Har_FAR (SEQ ID NO: 5), Hs_FAR (SEQ ID NO: 6), and Has_FAR (SEQ ID NO: 7), or a functional variant thereof having at least 80% homology to Har_FAR (SEQ ID NO: 5), Hs_FAR (SEQ ID NO: 6), or Has_FAR (SEQ ID NO: 7);

whereby

- the Δ11-desaturase is capable of converting at least part of said hexadecanoyl-CoA to (*Z*)11-hexadecenoyl-CoA; and
- the FAR is capable of converting at least part of said (*Z*)11-hexadecenoyl-CoA to (*Z*)-11-hexadecenol.

41. The method according to claim 40, wherein the yeast cell further expresses a fatty acyl synthetase.

42. The method according to claim 41, wherein the fatty acyl synthetase is selected from the group consisting of Sc_FAA1 (SEQ ID NO: 8), Yl_FAA (SEQ ID NO: 9) and functional variants thereof having at least 75% homology to Sc_FAA1 (SEQ ID NO: 8) or Yl_FAA (SEQ ID NO: 9).

43. The method according to any one of claims 41 to 42, further comprising the step of converting at least part of the (*Z*)-11-hexadecen-1-ol into (*Z*)-11-hexadecen-1-yl acetate by chemical conversion or by expression of an acetyltransferase such as a heterologous acetyltransferase (AcT) from said yeast cell or by overexpression of a native acetyltransferase from said yeast cell, wherein said acetyltransferase is capable of converting at least part of the (*Z*)-11-hexadecen-1-ol into (*Z*)11-hexadecen-1-yl acetate.

44. The method according to claim 43, wherein the acetyltransferase is Sc_Atf1 (SEQ ID NO: 10) or a functional variant thereof having at least 75% homology to Sc_Atf1 (SEQ ID NO: 10).

45. The method according to any one of the preceding claims, wherein the hydrophobic compound is a desaturated fatty alcohol and the yeast is an oleaginous yeast cell such as a *Yarrowia* cell, for example a *Yarrowia lipolytica* cell, capable of producing said desaturated fatty alcohol, said oleaginous yeast cell:

- expressing at least one heterologous desaturase capable of introducing at least one double bond in a fatty acyl-CoA; and
- expressing at least one heterologous fatty acyl-CoA reductase, capable of converting at least part of said desaturated fatty acyl-CoA to a desaturated fatty alcohol; and
- having a mutation resulting in reduced activity of Fao1 and a mutation resulting in reduced activity of at least one of Hfd1, Hfd4, Pex10 and GPAT or having a mutation resulting in reduced activity of at least one protein having at least 90% homology to Fao1 as set forth in SEQ ID NO: 11 and a mutation resulting in reduced activity of at least one of Hfd1 as set forth in SEQ ID NO: 12, Hfd4 as set forth in SEQ ID NO: 13, Pex10 as set forth in SEQ ID NO: 14 and GPAT as set forth in SEQ ID NO: 15.

46. The method according to claim 45, wherein the at least one heterologous desaturase is selected from the group consisting of a Δ3 desaturase, a Δ5 desaturase, a Δ6 desaturase, a Δ7 desaturase, a Δ8 desaturase, a Δ9 desaturase, a Δ10 desaturase, a Δ11 desaturase, a Δ12 desaturase, a Δ13 desaturase and a Δ14 desaturase, preferably wherein the desaturase is derived from an insect, such as from the *Lepidoptera* order.

47. The method according to claim 46, wherein the desaturase is a Δ11 desaturase having at least 60% homology to the Δ11 desaturase from *Amyelois transitella* as set forth in SEQ ID NO: 1, a Δ9 desaturase having at least 60% homology to the Δ9 desaturase from *Drosophila melanogaster* as set forth in SEQ ID NO: 16, a desaturase having at least 60% homology to the desaturase from *Lobesia botrana* as set forth in SEQ ID NO: 43, a desaturase having at least 60% homology to the desaturase from *Drosophila grimshawi* as set forth in SEQ ID NO: 44 and a desaturase having at least 60% homology to the desaturase from *Drosophila virilis* as set forth in SEQ ID NO: 45.

48. The method according to any one of the preceding claims, wherein the hydrophobic compound is a desaturated fatty alcohol, preferably wherein the yeast

cell is a *Yarrowia* cell, for example a *Yarrowia lipolytica* cell, capable of producing said desaturated fatty alcohol, said yeast cell expressing:

- at least one heterologous desaturase capable of introducing at least one double bond in a fatty acyl-CoA having a carbon chain length of 14; and
- at least one heterologous fatty acyl-CoA reductase (FAR), capable of converting at least part of said desaturated fatty acyl-CoA to a desaturated fatty alcohol.

49. The method according to claim 48, wherein the at least one heterologous desaturase is derived from an organism selected from *Pelargonium hortorum, Ricinus communis, Drosophila melanogaster, Spodoptera litura* and *Tribolium castaneum,* preferably the desaturase is derived from *Drosophila melanogaster*, preferably wherein the at least one heterologous desaturase is selected from the group consisting of:
    i) a Δ9 desaturase having at least 60% homology to the Δ9 desaturase from *Drosophila melanogaster* as set forth in SEQ ID NO: 16;
    ii) a Δ9 desaturase having at least 60% homology to the Δ9 desaturase from *Spodoptera litura* as set forth in SEQ ID NO: 18;
    iii) a desaturase having at least 60% homology to the desaturase from *Lobesia botrana* as set forth in SEQ ID NO: 43;
    iv) a desaturase having at least 60% homology to the desaturase from *Drosophila grimshawi* as set forth in SEQ ID NO: 44; and
    v) a desaturase having at least 60% homology to the desaturase from *Drosophila virilis* as set forth in SEQ ID NO: 45.

50. The method according to any one of the preceding claims, wherein the hydrophobic compound is codlemone (*E*8,*E*10-dodecadien-1-ol), or one or more of its derivatives *E*8,*E*10-dodecadienyl acetate and/or *E*8,*E*10-dodecadienal, and wherein the yeat cell expresses at least one heterologous desaturase capable of introducing one or more double bonds in a fatty acyl-CoA having a carbon chain length of 12, thereby converting said fatty acyl-CoA to a desaturated fatty acyl-CoA, wherein at least part of said desaturated fatty acyl-CoA is *E*8,*E*10-dodecadienyl coenzyme A (*E*8,*E*10-C12:CoA), and further expresses at least one heterologous fatty acyl-CoA reductase (EC 1.2.1.84) capable of converting at least part of said desaturated fatty acyl-CoA to a desaturated fatty alcohol, wherein the fatty acyl-CoA reductase is capable of converting at least part of

said *E*8,*E*10-dodecadienyl coenzyme A (*E*8,*E*10-C12:CoA) to *E*8,*E*10-dodecadien-1-ol.

51. The method according to claim 50, wherein the at least one desaturase is Cpo_CPRQ (SEQ ID NO: 48), or a functional variant thereof having at least 65% homology, such as at least 70% homology, such as at least 71% homology, such as at least 72%, such as at least 73%, such as at least 74%, such as at least 75%, such as at least 80%, such as at least 81%, such as at least 82%, such as at least 83%, such as at least 84%, such as at least 85%, such as at least 86%, such as at least 87%, such as at least 88%, such as at least 89%, such as at least 90%, such as at least 91%, such as at least 92%, such as at least 93%, such as at least 94%, such as at least 95%, such as at least 96%, such as at least 97%, such as at least 98%, such as at least 99% homology to SEQ ID NO: 48, or wherein the at least one desaturase is at least two desaturases, wherein at least one of said two desaturases is Cpo_CPRQ (SEQ ID NO: 48), or a functional variant thereof having at least 65% homology, such as at least 70% homology, such as at least 71% homology, such as at least 72%, such as at least 73%, such as at least 74%, such as at least 75%, such as at least 80%, such as at least 81%, such as at least 82%, such as at least 83%, such as at least 84%, such as at least 85%, such as at least 86%, such as at least 87%, such as at least 88%, such as at least 89%, such as at least 90%, such as at least 91%, such as at least 92%, such as at least 93%, such as at least 94%, such as at least 95%, such as at least 96%, such as at least 97%, such as at least 98%, such as at least 99% homology to SEQ ID NO: 48, and the other desaturase is a desaturase capable of introducing at least one double bond in a fatty acyl-CoA having a carbon chain length of 12, such as a *Z*9-12 desaturase, preferably Cpo_NPVE (SEQ ID NO: 49) or Cpo_SPTQ (SEQ ID NO: 50) or a functional variant thereof having at least 65% homology, such as at least 70% homology, such as at least 71% homology, such as at least 72%, such as at least 73%, such as at least 74%, such as at least 75%, such as at least 80%, such as at least 81%, such as at least 82%, such as at least 83%, such as at least 84%, such as at least 85%, such as at least 86%, such as at least 87%, such as at least 88%, such as at least 89%, such as at least 90%, such as at least 91%, such as at least 92%, such as at least 93%, such as at least 94%, such as at least 95%, such as at least 96%, such as at least 97%,

such as at least 98%, such as at least 99% homology to SEQ ID NO: 49 or SEQ ID NO: 50,
optionally wherein the desaturase is a mutant of Cpo_CPRQ having a mutation at position 85, such as an S85A mutation, and/or wherein the at least one heterologous desaturase is at least two different heterologous desaturases, such as Cpo_CPRQ as set forth in SEQ ID NO: 48 and a mutant of Cpo_CPRQ having a mutation at position 85 such as an S85A mutation.

52. The method according to any one of the preceding claims, wherein the hydrophobic compound is a desaturated fatty alcohol and the yeast cell:
- has one or more mutations resulting in reduced activity of one or more native acyl-CoA oxidases; and
- expresses at least one first group of enzymes comprising at least one acyl-CoA oxidase capable of oxidising a fatty acyl-CoA, wherein the first group of enzymes is capable of shortening a fatty acyl-CoA of a first carbon chain length X to a shortened fatty acyl-CoA having a second carbon chain length X', wherein X´ ≤ X-2; and
- expresses at least one heterologous desaturase capable of introducing at least one double bond in said fatty acyl-CoA and/or in said shortened fatty acyl-CoA; and
- expresses at least one heterologous fatty acyl-CoA reductase, capable of converting at least part of said desaturated fatty acyl-CoA to a desaturated fatty alcohol.

53. The method according to claim 52, wherein the native acyl-CoA oxidase and/or the heterologous acyl-CoA oxidase is a peroxisomal acyl-CoA oxidase.

54. The method according to any one of claims 52 to 53, wherein the at least one acyl-CoA oxidase of the first group of enzymes is a native acyl-CoA oxidase or a heterologous acyl-CoA oxidase, which is optionally overexpressed compared to a reference yeast strain not expressing said at least one first group of enzymes, preferably the at least one acyl-CoA oxidase of the first group of enzymes is a heterologous acyl-CoA oxidase.

55. The method according to claim 54, wherein the at least one first group of enzymes comprises an acyl-CoA oxidase selected from the group consisting of

Yli_POX1 (SEQ ID NO: 19), Yli_POX2 (SEQ ID NO: 20), Yli_POX3 (SEQ ID NO: 21), Yli_POX4 (SEQ ID NO: 22), Yli_POX5 (SEQ ID NO: 23), Yli_POX6 (SEQ ID NO: 24), Ase_POX (SEQ ID NO: 25), Ath_POX1 (SEQ ID NO: 26), Ath_POX2 (SEQ ID NO: 27), Ani_POX (SEQ ID NO: 28), Cma_POX (SEQ ID NO: 29), Hsa_POX1-2 (SEQ ID NO: 30), Pur_POX (SEQ ID NO: 31), and Rno_POX2 (SEQ ID NO: 32), and functional variants thereof having at least 60% homology thereto.

56. The method according to any one of claims 50 to 55, wherein the at least one heterologous desaturase is selected from the group consisting of a Δ_{Z9}-desaturase such as Sce_OLE1 (SEQ ID NO: 33), Yli_OLE1 (SEQ ID NO: 34) or Dme_D9 (SEQ ID NO: 16), a Δ_{Z11}-desaturase such as Atr_D11 (SEQ ID NO: 1), Cro_Z11 (SEQ ID NO: 35), Onu_11 (SEQ ID NO: 36), Tpi_D13 (SEQ ID NO: 37), a Δ_{E9}-desaturase such as Dpu_E9-14 (SEQ ID NO: 38), a $\Delta_{Z/E10}$-desaturase such as Gmo_CPRQ (SEQ ID NO: 39), or a desaturase such as Epo_E11 (SEQ ID NO: 40), Sls_ZE11 (SEQ ID NO: 41), Lbo_PPTQ (SEQ ID NO: 43), Dgd9 (SEQ ID NO: 44), Dvd9 (SEQ ID NO: 45) or Cpa_E11 (SEQ ID NO: 42), or a functional variant thereof having at least 60% homology thereto.

57. The method according to any one of claims 46 to 56, wherein the fatty acyl-CoA reductase is selected from the group consisting of a fatty acyl-CoA reductase having at least 80% homology to Har_FAR (SEQ ID NO: 5), Has_FAR (SEQ ID NO: 7), Ban_FAR (SEQ ID NO: 17) or Hs_FAR (SEQ ID NO: 6).

58. The method according to any one of claims 46 to 57, further comprising the step of converting at least part of the desaturated fatty alcohol to a fatty acyl acetate by chemical conversion or by expression of an acetyltransferase such as a heterologous acetyltransferase (AcT) from said yeast cell or by overexpression of a native acetyltransferase from said yeast cell, wherein said acetyltransferase is capable of converting at least part of the desaturated fatty alcohol to a desaturated fatty acyl acetate.

59. The method according to claim 58, wherein the acetyltransferase is Sc_Atf1 (SEQ ID NO: 10) or a functional variant thereof having at least 75% homology to Sc_Atf1 (SEQ ID NO: 10).

60. The method according to any one of claims 46 to 59, further comprising the step of converting at least part of the desaturated fatty alcohol to a desaturated fatty aldehyde by expression of at least one alcohol dehydrogenase and/or at least one fatty alcohol oxidase from said yeast cell.

61. A method of monitoring the presence of pest or disrupting the mating of pest, said method comprising the steps of:

i) producing a hydrophobic compound by the method of any of claims 1 to 60, wherein the hydrophobic compound is as defined in any one of the preceding claims,
ii) formulating said hydrophobic compound as a pheromone composition, and
iii) employing said pheromone composition as an integrated pest management composition.

62. The method according to claim 61, wherein the hydrophobic compound is selected from a fatty alcohol, a fatty alcohol ester, a fatty acyl acetate, a fatty aldehyde and a terpene.