Nat. Commun. **8**, 1–8 (2017)). However, to date, mechanistic and structural details concerning the iterative shuttling process remain sparse and the structural determinants thereof remain entirely elusive, but are needed to aid in these biotechnological efforts. Finally, fatty acid biosynthesis is also known to be involved in ailments like cancer and obesity, accordingly the ability to directly impact fatty acid synthesis has substantial translational implications (D. Wang, R. N. Dubois, *J. Natl. Cancer Inst.* **104**, 343–5 (2012)).

Summary

In a first aspect, the present disclosure refers to a recombinant polypeptide containing at least parts of the amino acids of SEQ ID No. 1 comprising amino acid (aa) 1 to aa112 of SEQ ID No. 1, an insert located C-terminally to aa112 of SEQ ID No. 1, said insert is at least of 50 amino acids in length, optionally having C-terminally of said insert at least one of the amino acid of from aa113 to aa150 of SEQ ID No. 1.

In a further aspect, the present disclosure refers to a fatty acid synthase protein complex comprising a recombinant polypeptide disclosed herein.

In another aspect, the present disclosure refers to a nucleic acid molecule encoding a polypeptide disclosed herein.

In yet another aspect, the present disclosure refers to a host cell containing a nucleic acid molecule disclosed herein and/or expressing a polypeptide disclosed herein.

Patent Claims

1. A recombinant polypeptide containing at least parts of the amino acids of SEQ ID No. 1 comprising amino acid (aa) 1 to aa112 of SEQ ID No. 1, an insert located C-terminally to aa112 of SEQ ID No. 1, said insert is at least of 50 amino acids in length, optionally having C-terminally of said insert at least one of the amino acid of from aa113 to aa150 of SEQ ID No. 1.

2. The recombinant polypeptide according to claim 1 composed from the N-terminus to the C-terminus of
   - a first unit comprising amino acid 1 to amino acid 112 of SEQ ID No. 1;
   - a second unit composed of amino acids 113 to 132 of Seq. ID No. 1 containing the insert inserted after one of the amino acids 112 to 132 of SEQ ID No. 1; and,
   - optionally a third unit comprising amino acids 133 to 150 of SEQ ID No. 1.

3. The recombinant polypeptide according to any one of claims 1 to 2 consisting from the N-terminus to the C-terminus of the aa1 to aa112 of SEQ ID No. 1, the insert of at least of 50 amino acids and the aa133 to aa150 of SEQ ID No. 1.

4. The recombinant polypeptide of claim 1 or 3 wherein the insert is an enzyme, in particular, wherein the enzyme is selected from a desaturase, thioesterase, oxygenase, hydroxylase, cyclogenase, fatty acid lyase.

5. The recombinant polypeptide of any one of claims 1 to 4 wherein the size of the insert is at most 60 kDa.

6. The recombinant polypeptide of claim 5, wherein the size of the insert is at most 40 kDa.

7. A fatty acid synthase protein complex comprising a recombinant polypeptide according to any one of claims 1 to 6.

8. The fatty acid synthase protein complex of claim 7 containing a recombinant polypeptide of at least one of claim 1 to claim 6 for use in the production of fatty acids and biofuels.

9. The fatty acid synthase protein complex of claim 8 for use in the biological production of free fatty acids, keto-fatty acids, fatty acid alcohols, cyclic fatty acids and elongated fatty acids.

10. A nucleic acid molecule encoding a polypeptide according to any one of claims 1 to 6.

11. A host cell containing a nucleic acid molecule according to claim 10 and/or expressing a polypeptide according to any one claims 1 to 6.

12. The host cell according to claim 11, wherein the host cell is a microorganism containing type I fatty acid synthase.

13. The host cell according to claim 12, wherein the host cell is yeast.