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 aa1 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 25 amino acids in length, optionally having C-terminally of said insert at least one of the aa of from aa113 to aa 150 of SEQ ID No. 1.

In another aspect, the present disclosure refers to a recombinant polypeptide comprising the amino acids of amino acids 1 to amino acids 112 of Seq ID No. 1 further containing an insert of at least 25 amino acids, or a functional fragment of said recombinant polypeptide, or a homolog thereof.

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.

Brief description of the present invention

In an aspect, the present invention relates to a recombinant polypeptide of amino acids 1 to 132 of SEQ ID No. 1 or a functional fragment thereof, or a homolog thereof. Further, a recombinant polypeptide is provided comprising the amino acids of SEQ ID No. 1 containing further an insert of at least 20 amino acids, like 25 amino acids or a functional fragment thereof, or a homolog thereof.

Moreover, a polypeptide is provided consisting of

i.) at least 6 consecutive amino acids of Seq ID No. 2, like at least 8 consecutive amino acids, e.g. at least 10 consecutive amino acids or a functional fragment thereof, or a homolog thereof; or

ii.) at least 5 consecutive amino acids of Seq ID No. 3, like at least 6 consecutive amino acids, e.g. at least 8 consecutive amino acids or a functional fragment thereof, or a homolog thereof; or

iii.) at least 6 consecutive amino acids of Seq ID No. 4, like at least 8 consecutive amino acids, e.g at least 10, 12 or 14 consecutive amino acids of Seq ID No. 4, or a functional fragment thereof, or a homolog thereof.

Said polypeptides have altering activity on enzymes, like enzyme present in the FAS complex.

Further, a fatty acid synthase protein complex comprising the recombinant polypeptide as described herein is disclosed.

In addition, nucleic acid molecules encoding the polypeptides according to the present invention as well as host cells containing said nucleic acid molecules and/or expressing the polypeptides according to the present invention are described.

Further, an isolated fatty acid synthase protein complex containing the described α-

Patent Claims

1. A recombinant polypeptide containing at least parts of the amino acids of SEQ ID No. 1, comprising aa1 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 25 amino acids in length, optionally having C-terminally of said insert at least one of the aa of from aa113 to aa 150 of SEQ ID No. 1.

2. A recombinant polypeptide comprising the amino acids of amino acids 1 to amino acids 112 of Seq ID No. 1 further containing an insert of at least 25 amino acids, or a functional fragment of said recombinant polypeptide, or a homolog thereof.

3. A recombinant polypeptide according to anyone of claim 1 to 2 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 an 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;

   or a functional fragment of said polypeptide, or a homolog thereof.

4. The recombinant polypeptide according to any one of the preceding claims consisting from the N-terminus to the C-terminus of the aa1 to aa112 of SEQ ID No. 1, an insert of at least of 25 amino acids and the aa133 to aa150 of SEQ ID No. 2.

5. The recombinant polypeptide according to claim 4, wherein the insert has at least 50 amino acids.

6. The recombinant polypeptide of claim 1 or 5 wherein the insert is an enzyme, in particular, wherein the enzyme is selected from a desaturase, thioesterase, oxygenase, hydroxylase, cyclogenase, fatty acid lyase.

7. The recombinant polypeptide of any one of claims 1 to 6 wherein the size of the insert is at most 60 kDa.

8. The recombinant polypeptide of claim 7, wherein the size of the insert is at most 40 kDa.

9. A fatty acid synthase protein complex comprising a recombinant polypeptide according to any one of claims 1 to 8.

10. The fatty acid synthase protein complex of claim 9 containing a recombinant polypeptide of at least one of claim 1 to claim 8 for use in the production of fatty acids and biofuels.

11. The fatty acid synthase protein complex of claim 10 for use in the biological production of free fatty acids, keto-fatty acids, fatty acid alcohols, cyclic fatty acids and elongated fatty acids.

12. A nucleic acid molecule encoding a polypeptide according to any one of claims 1 to 8.

13. A host cell containing a nucleic acid molecule according to claim 12 and/or expressing a polypeptide according to any one claims 1 to 8.

14. The host cell according to claim 13, wherein the host cell is a microorganism containing type I fatty acid synthase.

15. The host cell according to claim 14, wherein the host cell is yeast.