INNOVECTIS
Ein Unternehmen der
Johann Wolfgang Goethe-Universität
Frankfurt am Main

Collaboration & Licensing Offer
Engineered Fatty Acid Synthase for chain-length controlled Fatty Acid Synthesis

Benefits

- Precision Fatty Acid Chain-Length Control (C6-C16)
- Modular and Programmable Platform
- Product Diversity from Free fatty acids (C6-C18), Fatty aldehydes or alcohols
- Transferable to Yeast or Bacteria

Technology Stage

- Pilot Scale Validation
- Characterization of 24+ designer FAS variants
  Successful expression and production in multiple yeast platforms
- Optimized fed-batch titers

Patents

- WO2016156548 "MICROBIOLOGICAL PRODUCTION OF SHORT FATTY ACIDS AND USES THEREOF", US15/561,201 (issued), CA2,980,391 (pending), EP3277803 (issued),
- EP 25157462,0 (filed 02/12/2025) "Variants of Metazoan Fatty Acid Synthase for the Production of Fatty Acids, Aldehydes, and Alcohols"

Publications:

- Ludig, D.L., Zhai, X., Rittner, A. *et al.* Engineering metazoan fatty acid synthase to control chain length applied in yeast. *Nat Chem Biol* (2026). https://doi.org/10.1038/s41589-025-02105-w.
- Gusenda, C., Calixto, A.R., Da Silva, J.R., Fernandes, P.A., Grininger, M. *Angew Chem Int Ed* 64, e202412195 (2025). https://doi.org/10.1002/anie.202412195
- Gajewski, J., Pavlovic, R., Fischer, M. et al. Engineering fungal de novo fatty acid synthesis for short chain fatty acid production. Nat Commun 8, 14650 (2017). https://doi.org/10.1038/ncomms14650

Partnership Opportunities

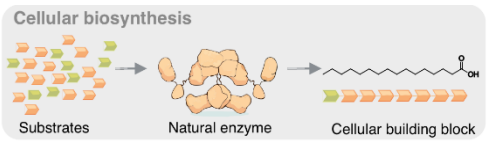
Technology licensing and/or Collaboration development:

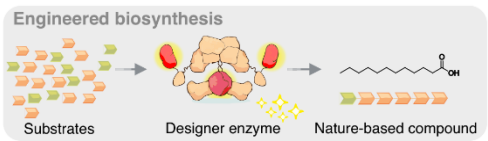
- Joint optimization for specific MCFA targets (e.g. lauric acid production)
- Scale-up to pilot scale (10-1000 L) Process integration with downstream purification

Summary

Scientists at Goethe-University Frankfurt am Main (Germany) have developed a breakthrough biotechnology platform that enables the precise, sustainable production of short- and medium-chain fatty acids (C6-C16) through protein engineering of fatty acid synthase (FAS) enzyme. This technology offers a viable alternative, e. g. to palm oil and coconut oil extraction or for production of precursors for food additives or cosmetics.

Through targeted molecular engineering and yeast-based production, the Designer-FAS platform overcomes the intrinsic C16 chain-length constraint of natural fatty acid synthesis, enabling access to industrially relevant titers of tailored fatty acids.





Market Need and Applications

Short-Medium-Chain Fatty Acids (C6-C8):

- Food industry: Flavoring agents, preservatives
- Pharmaceuticals: Drug delivery systems,
- immune health supplements
- Cosmetics: Antimicrobial and moisturizing
- ingredients

Medium-Long-Chain Fatty Acids (C10-C16):

- Lubricants and industrial chemistry
- Fragrances and perfumery
- Paint additives and coatings
- Pharmaceutical intermediates
- Surfactants and detergents
- Cosmetics & Personal Care

Engineering Approach:

1. Chain-Length Control via KS Domain Modification: Single amino acid substitutions in the ketoacyl synthase active site modulate substrate binding pocket dimensions and elongation efficiency: Strategic mutations (G113S, G113M, G113F, G113W) introduce steric constraints that reduce elongation efficiency for longer acyl chains; Additional hotspots: S117, T196 provide fine-tuning of chain-length specificity at shorter lengths.

2. Product Release Engineering via Termination Domain Replacement:

Substitution of the mammalian thioesterase domain with bacterial 'TesA from *Escherichia coli* broadens substrate acceptance across C8-C18 range. TesA Optimization: Mutations at positions L109, M141, E142, Y145, L146 tune release specificity for short/medium chains.

Alternative TR Pathway: Integration of thioreductase (TR) domains enables direct production of fatty aldehydes and alcohols instead of free fatty acids

3. Combinatorial Library Generation:

Systematic combination of KS and TE/TR variants creates a focused library of FAS variants with distinct chain-length profiles, collectively spanning C8-C18 products with high specificity.

4. Yeast Cell Factory Integration:

The engineered FAS systems have been successfully implemented in industrial yeast platforms, e.g. *Oogataea polymorpha*

5. Production Performance:

Shake flask cultivation: 90.8 mg/L medium-chain length FAs (MCFAs) (83% of total free FAs), Fed-batch fermentation: 674-708.6 mg/L MCFAs depending on strain and conditions, Product composition: C12-FA up to 48% of total fatty acids, matching natural coconut oil profiles.

Technology Transfer:
INNOVECTIS GmbH
Altenhöferallee 5
60438 Frankfurt am Main, Germany
Phone: +49 69 25 61 632-0
Kirstin.schilling@innovectis.de
www.innovectis.de

Principal Investigator:
Prof. Dr. Martin Grininger
Buchmann Institute for Molecular Life Sciences
Goethe University Frankfurt
Phone: +49 (0)69 798 42705
grininger@chemie.uni-frankfurt.de
www.greeninger-chemistry.com