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Comparison of microbial food lipids to common food lipids

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Introduction

Fats and oils widely used in food products face obstacles such as unsustainable production and scarcity of natural resources. A pioneering, sustainable solution is utilising **microbial lipids as equivalents for lipids of plant or animal origin**. Oleaginous microbes can produce lipids up to 90 % (w/w) of dry biomass, and the benefits of fast growth in a bioreactor, and possibility to grow on waste streams, require no deforestation, and lower costs.

This study evaluates the potential of microbial food lipids as replacement for existing food lipids. **Chemical** and **physical properties** of a lipid sample, called yeast lipid (YL), produced by a **novel oleaginous VTT yeast strain**, were analysed and compared to conventional food lipids such as cocoa butter and palm oil. Production process of the yeast lipid is depicted in **Fig 1**.

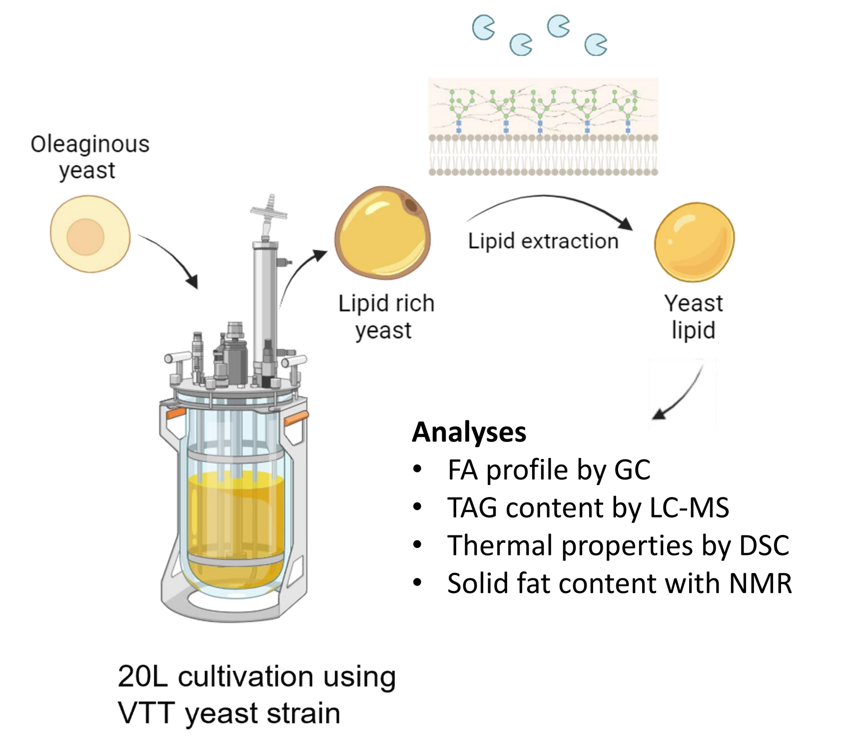

Fig 1. Overview of methods. Cultivation utilized C/N 75 medium with glucose as carbon source and continued for 40h. Created with BioRender.com

Results

Produced YL had a lower saturated fatty acid (FA) content (**Fig 2**) compared to the common food lipids cocoa butter, palm oil, beef fat, milk fat and coconut oil. This led to higher unsaturated triglyceride (TAG) content (**Fig 3, 4**), lower melting and crystallisation temperatures (**Fig 5**), and lower solid fat content at fridge, room, and body temperature (**Fig 6**).

YL melting could be divided into low, medium and high melting fractions, where peak temperatures correspond to their melting points. YL crystallisation curve was similar to the lower melting group of palm oil and beef fat, and contained also a high melting fraction similar to cocoa butter. The chemical and thermal properties differed from milk fat and coconut oil.

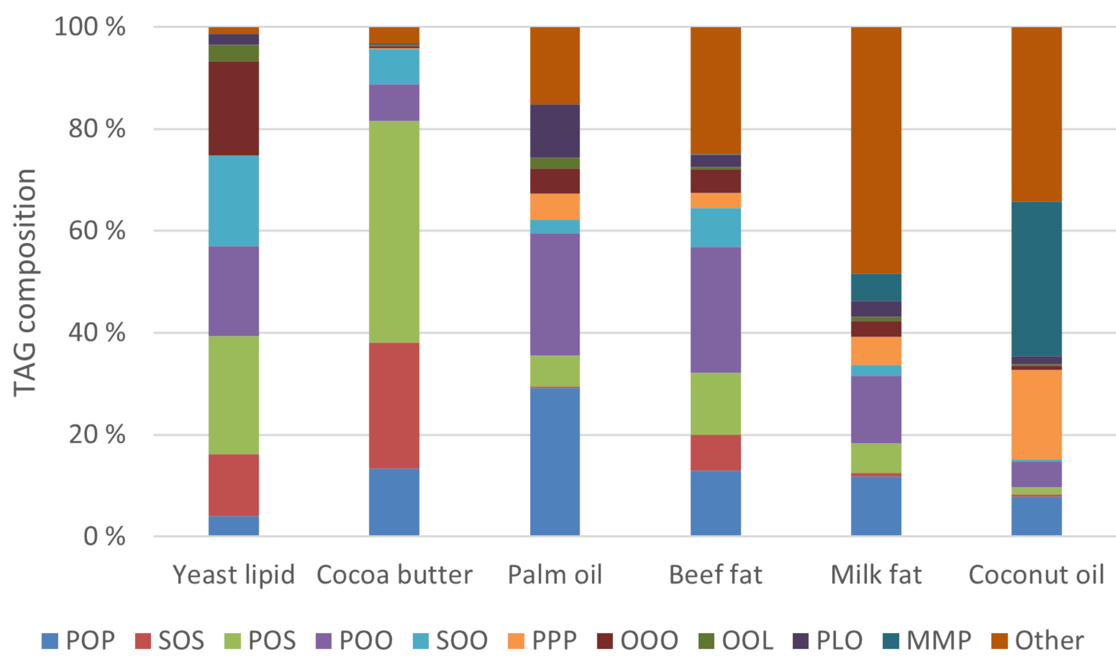

Fig 3. TAG content of microbial food lipid compared to common food lipids. P = C16:0, S = C18:0, O = C18:1, M = C14:0, L = C18:2.

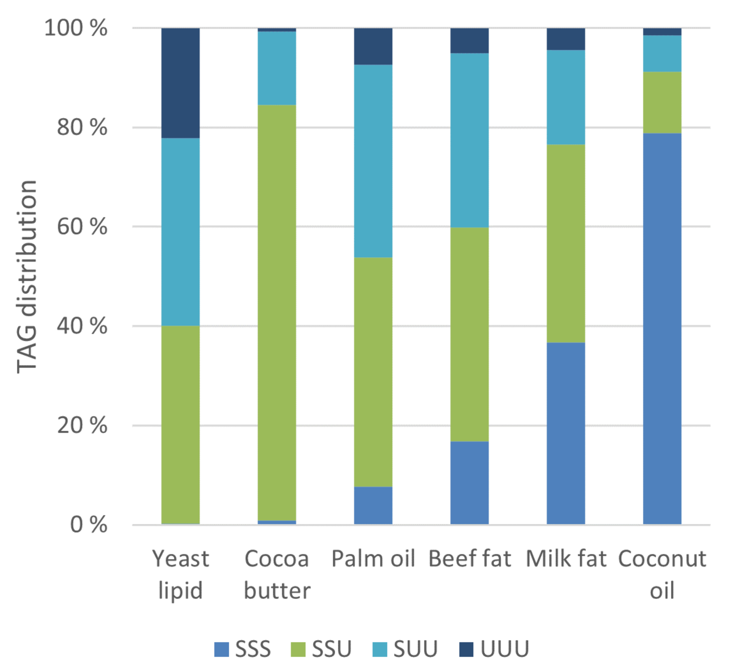

Fig 4. TAG distribution. SSS = fully saturated TAG, SSU = monounsaturated TAG, SUU = diunsaturated TAG, UUU = fully unsaturated TAG.

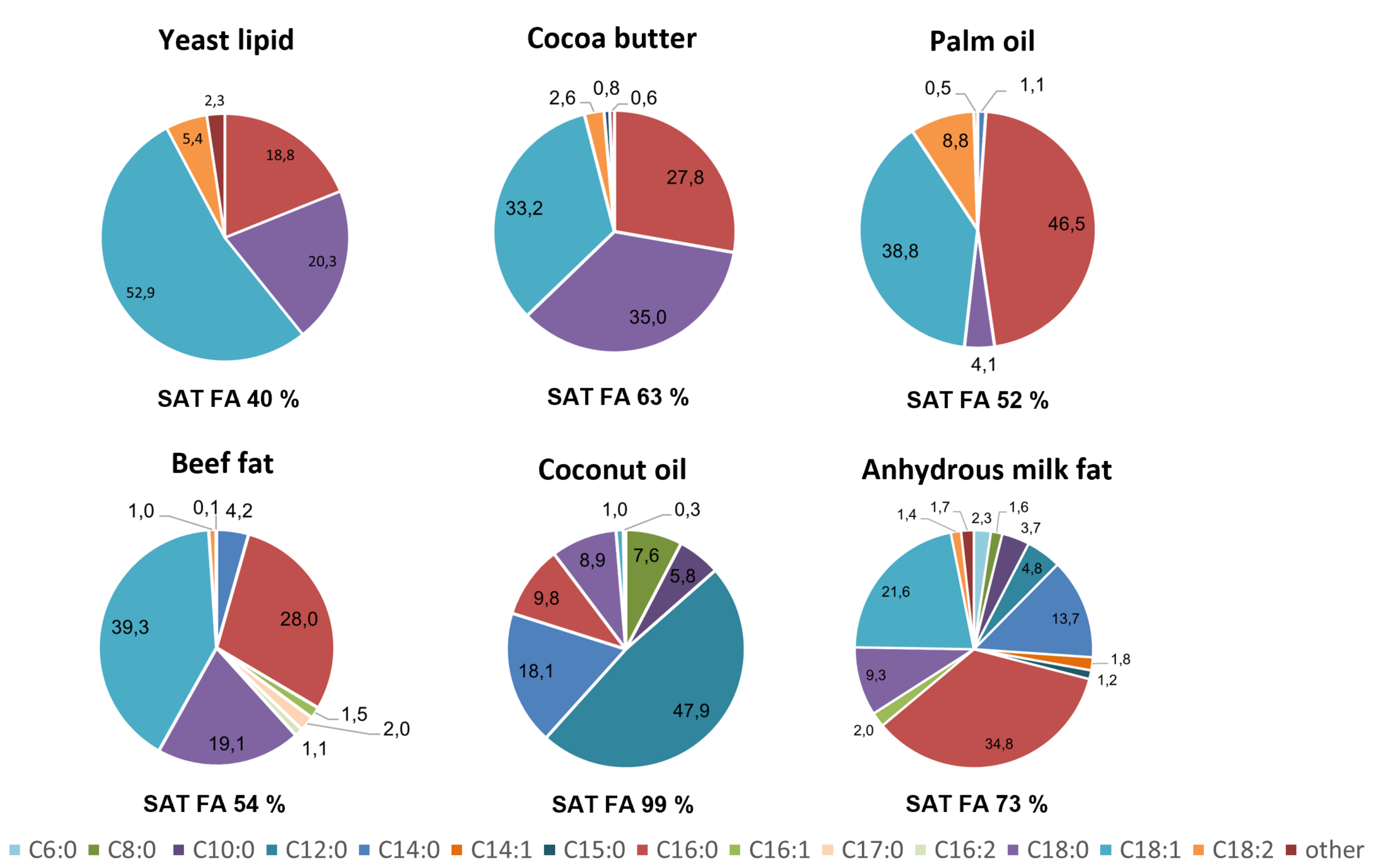

Fig 2. Fatty acid profile and distribution of microbial food lipid compared to common food lipids.

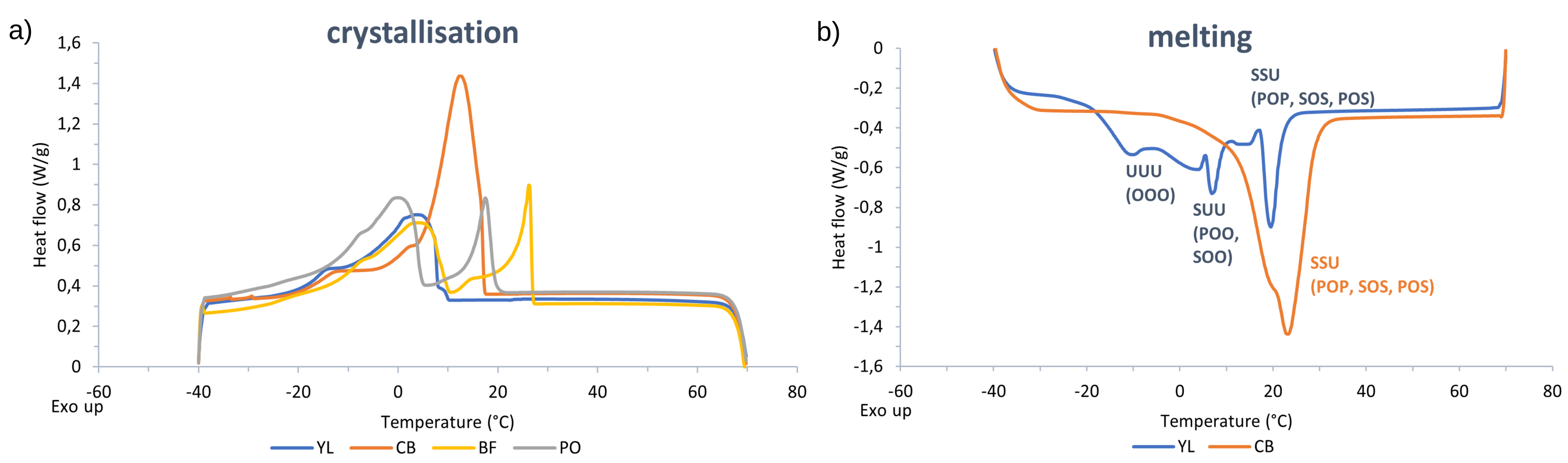

Fig 5. Differential scanning calorimetry (DSC) thermogram of crystallisation and melting of samples with 10 °C/min. a) YL crystallization compared to non tempered CB, PO, and BF, and b) melting of YL compared to CB, where peaks indicate possible TAG groups melting. Only thermograms with similar curves or melting points are shown.
S = saturated, U = unsaturated. YL = yeast lipid, CB = cocoa butter, PO = palm oil, BF = beef fat.

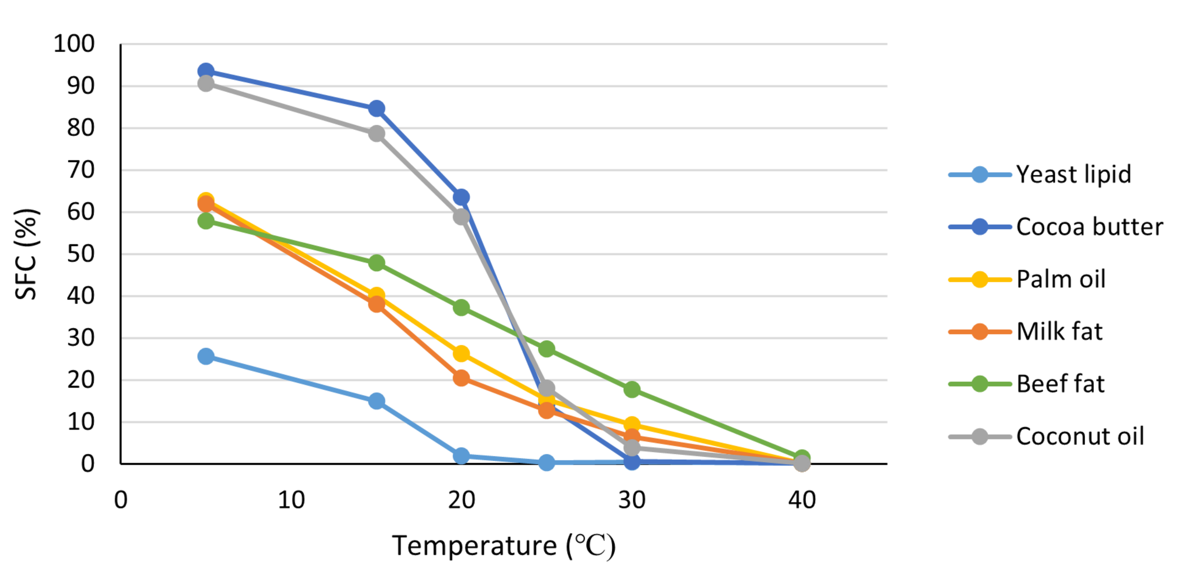

Fig 6. Solid fat content (SFC) measured by NMR. All samples were prepared as non-stabilizing fats.

Conclusion

- **Yeast lipid produced by novel VTT strain had high content of palmitic, stearic, and oleic acid.**
- **Sample showed similarities to cocoa butter, palm oil and beef fat.**
- **Possible to produce common food lipids by further altering yeast fatty acid profile by changing growth parameters, or through strain engineering. Another promising alternative would be fractionation of desired melting fractions.**

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