Numerical exploration of non-standard methods for filtrating fatty acids

replacing *removal of crystals from liquids* ***with*** *removal of liquids from crystals* ***applying high G-force***

Innolipid AS, based in Ålesund, Norway, is an innovative company with its own testing and analysis laboratory that specializes in the blue sector and provides analyses and contract research on request. The company focuses on innovations in two key areas: (1) Better utilization and development of higher value products from resources extracted from the sea; (2) Analysis technology for improving fish welfare.

Task: to separate fatty acid A (in crystallized form) from fatty acids B,C and D (in liquid form)

Fatty acid	**A**	**B**	**C**	**D**
Rel. content%	50	20	15	15
mp. °C	25	-35	-45	-55

Current art and practice - and the innovation.

Blend is cooled down to as low as possible temperature where it still exists as a liquid and can be pumped into a filter press for retaining crystals.

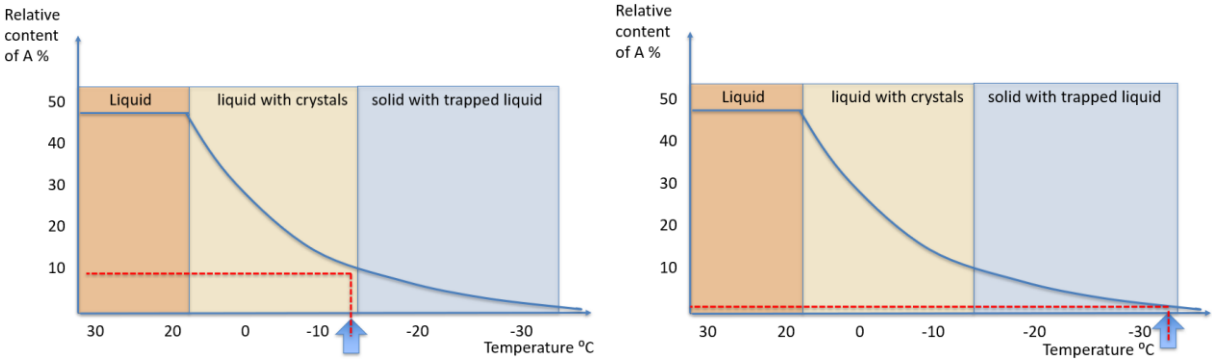

Fig. 1. Current practice (left) on removal of dispersed crystals from lipids by cooling down the blend to a point where the blend still can be handled as a liquid, for transfer to a filter press. In the model blend, the component desired to be removed still represents about 10% (@ - 12 °C).
-Innovation (right): The blend is cooled to a point where <u>all</u> of A (component to be removed) is crystallized, which occur well below solidifying point of the entire blend. Components B,C and D, still fluids but now trapped in a solid matrix, are expelled by high centrifugal forces at – 35C.

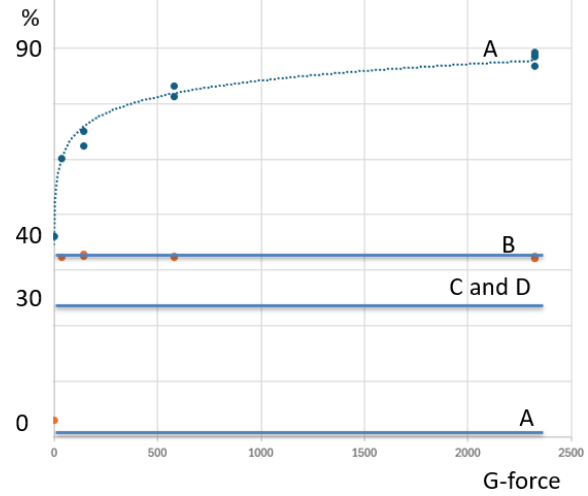

Fig. 2 Composition of components A,B, C and D in the olein part (blue lines) expelled from centrifuge operation at – 35°C. Dotted line; content of A in the retained solid stearin. The degree of removal of B,C and D depends on the G-force, but the relative composition of the olein is constant.
Conclusion: B,C and D can be removed virtually completely from a solid block of fat. There is no demand for a filter cloth/membrane. The solid lipid material is itself a tridimensional «filter» or grid.

Development and design tasks: Use mathematical modelling and simulation tools to:

- create a digital twin of the current (laboratory-scale) filtration setup.
- explore if scale-up data can be obtained and if it is comparable to obtained large laboratory scale data (TRL 5);
- design an efficient system to feed a frozen block of lipids into a centifuge, and to remove the solid stearin (peeler centrifuge would work). The olein is discarged as pr. current practice.

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