

Jonhnathan Napier¹, Eric Maréchal², Ivo Feussner³, Jean-Denis Faure⁴, Douglas Tocher⁵, Richard Haslam⁶, Monica Venegas Caleron⁷

1: johnathan.napier@rothamsted.ac.uk (Rothamsted Research, UK); 2: eric.marechal@cea.fr (Laboratoire de Physiologie Cellulaire & Végétale, CNRS-CEA-INRAE-Univ. Grenoble Alpes, Grenoble, FR); 3: ifeussn@gwdg.de (Georg-August-University Goettingen, Albrecht-von-Haller-Institute for Plant Sciences, Dept. for Plant Biochemistry, Goettingen, GER); 4: jean-denis.faure@agroparistech.fr (Institut Jean-Pierre Bourgin, INRAE-AgroParisTech, INRAE-Versailles, FR); 5: d.r.tocher@stir.ac.uk (Institute of Aquaculture, University of Stirling, Stirling, UK); 6: richard.haslam@rothamsted.ac.uk (Plant Sciences, Rothamsted Research, Harpenden, UK); 7: mvc@ig.csic.es (Instituto de la Grasa (CSIC), Campus Universitario Pablo de Olavide, Sevilla, Spain).



Professor Johnathan Napier, Rothamsted Research Johnathan.napier@rothamsted.ac.uk





Not all omega-3 (n-3) fatty acids are the same

Fish oils vs Vegetable oils



*** Importantly, only the omega-3s EPA and DHA found in fish oils have validated health claims ***







SALAR

Obesity is now prevalent throughout much of the Western world. This and associated diseases such as CVD and type 2 diabetes represent an imminent public health crisis.

Moderate consumption (0.5-2g/day) of omega-3 long chain polyunsaturated fatty acids found in fish oils can help avert this problem

You only get this benefit with EPA and DHA, but not ALA



Biotechnology and Biological Sciences Research Council

Farm to Fork



Aquaculture – vital for sustainably feeding the world now and in the future





World fish production











All marine and salmonid species require diets containing omega-3 fish oils. As the industry expanded, the finite & expensive fish oil was diluted with cheaper plant oils. Although this keep the costs low, it reduced the EPA & DHA levels in the fillet, meaning the consumer got reduced nutrition



The declining USP of salmon

EPA+DHA Scottish farmed salmon fillet















Regenerate transgenic plants with novel fatty acid traits



Biotechnology and Biological Sciences Research Council

Efficient metabolic engineering is challenging but possible







Unexpected asymmetry in the accumulation of fatty acids reveals by MALDI-MS imaging





Marmon et al 2017

Metabolic imaging reveals previously unknown additional complexities in the biosynthesis & accumulation of seed oils



Biotechnology and Biological Sciences Research Council





The UK's most comprehensive GM field trials – and all that entails...



Omega-3 Flagship – Recent Milestones







STIRLING Southampton

Omega-3 Research – Challenges & Future Impacts





Understanding complex systems

- Metabolic flux through lipid metabolism
- Impact of transgenesis on the genome
- Spatial separation of oil synthesis

Fit for purpose

- Addressing the oil yield penalty
- De-risking feeding studies
- Evidence base for GM regulation



Discovery programme programme

Novel products; flexible platform





Biotechnology and Biological Sciences Research Council

Data science

•

• Genetic, epigenetic, RNA, & metabolic networks

