
Green solutions for high quality fish oil for human consumption from Baltic herring

A Data Management Plan created using DMPTuuli

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Project abstract:

Long chain omega-3 polyunsaturated fatty acid eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are essential compounds for human health. Recommended intakes for EPA and DHA are not met by a majority of the population, although, EPA and DHA sources like fish oil supplements (FOS) are widely available. The global demand for EPA and DHA cannot be covered by current fish oil production. Reasons for low use of FOS are mainly costs, but also quality, taste, allergens and ethics play a role. In Finland all FOS on market are produced elsewhere and imported. The most obvious choice of raw material for local fish oil production is Baltic herring because it is the most caught species in commercial fishing and an oily fish with a high EPA and DHA content. Currently more than half of Baltic herring is used as raw material for animal feed. Part of this fish and side-stream material could be used for FOS to highly increase their value. For increasing EPA and DHA availability, it is important to use new sources of raw materials and to decrease losses during production. Most commonly fish oil is extracted by wet and steam rendering using high heat. Afterwards the crude fish oil goes through an intensive refining process with multiple step and is fractionated to concentrate EPA and DHA. In the whole process EPA, DHA and vitamins are lost due to oxidation. In recent years multiple green extraction methods, fulfilling the circular bioeconomy principles, have been developed in lab scale to provide alternatives to traditional processes. However, added research in this field with a focus on reducing oxidation is needed. The objective of this project is to develop a FOS production process from Baltic herring following the concept of green extraction methods. The main aim is to improve the process to have minimal losses of valuable compounds to achieve sustainable use of the raw material. Baltic herring and side-streams from Baltic herring production will be used as raw material for studied FOS production. Raw material, crude, refined and concentrated fish oil will be analyzed for contaminants and lipid oxidation with modern analysis methods to ensure high quality end product. With the multidisciplinary (food chemistry, technology and engineering) and multinational (Finland, Germany and Denmark) network the project creates new openings for value addition to the natural resources in the Baltic Sea using new green technologies and promote the growth of Blue Economy. The project got started efficiently with excellently results obtained using the funding received from the Finnish Cultural Foundation in 2019. Now we are applying for funding for 2020 to continue the research.

Last modified: 30-10-2019

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1. General description of data

The data will consist of laboratory notebooks related to experiments; raw data files containing chromatographic and mass spectrometric measurement data of fish oil, qualitative and quantitative processed chromatographic and mass spectrometric data in proprietary formats (of the instrument software manufacturers), and analyzed tabulated chromatographic and mass spectrometric data in spreadsheet formats. Raw and processed gas chromatographic data will be collected by Shimadzu GC Solution software (.gcd) or Xcalibur software, Thermo Fisher Scientific Inc. (.raw). Raw and processed data will be converted to formats (.csv) suitable for open source software such as cross-platform available OpenChrom. Raw liquid chromatographic and mass spectrometric data is collected by Waters Corporation equipment with Waters MassLynx software (.RAW) and by Bruker Elute HPLC with high resolution TOF-MS impact II with HyStar software (.d). The raw data is then converted to open source format(s) such as mzXML, which can be opened with many open source mass spectrometry software available. Related metadata is stored into the mzXML files and also to ascii files attached to the mass spectrometric data files.

Good practices in writing experimental notes (date, name, all calculations and all necessary experiment details) in laboratory notebooks are followed. Each equipment has a separate notebook for all issues related to the instrumentation. Mass spectrometers are regularly calibrated and sensitivity checks are conducted according to the standard operating procedures so that the instruments are within their manufacturer specifications. Corrective actions are implemented if instrumentation does not meet their specifications. Experimental metadata (experiment conditions, compound concentrations etc.) are always included in data sets. Raw data files cannot be edited. Processed data sets include documentation on how the data has been processed. Internal and external standards are used during analyses when possible. Blank analyses are done to exclude any carry-over, contamination or false positives in sample sets. Sufficient replicate measurements are done and variances between analyses are calculated. Observation of increases in variances will result in confirmation of the instrument performance and in additional replication of analyses.

2. Ethical and legal compliance

The planned project does not involve human or animal studies. Therefore, no sensitive personal information will be collected.

The project is committed to follow the policy and recommendations of the Open Science and Research Initiative (The Ministry of Education and Culture, Finland). IPR policies of University of Turku will be adhered. Copyright and intellectual property rights will be secured before any data is made public. For commercial utilization of results, the UTU legal team and the UTU innovation services, and the corresponding units of other collaborating members will provide support in all intellectual property issues.

3. Documentation & metadata

All collected data will be documented in notebooks and in metadata. All variables will be described and suitable metadata standards will be used, if available. Open data sets stored at Zenodo and IDA will be identified with DOIs (digital object identifiers).

4. Storage and backup during the research project

Paper notebooks will be written with ballpoint pen only. When full, notebooks will be scanned and the resulting pdf-files will be stored as documentation. Instrumental data are collected during the project in the hard drives of the instrument controlling computers. All data is locally mirrored to second hard drives by RAID 1 configuration. Backups of the raw and processed data are then regularly (after each batch of analyses) made to the Department of Biochemistry intranet storage server, which will be regularly backed up by University of Turku IT services.

Instrument control computers are password protected and attached to local intranet. Thus, they can not be accessed from outside of the intranet (no internet access available). Access to intranet is restricted to selected laboratory personnel of Department of Biochemistry. Laboratory doors are locked after office hours and keys are given only to persons in need.

5. Opening, publishing and archiving the data after the research project

Data will be available and cited in peer-reviewed international journals with emphasis on open access (golden open access). Copies of the publications will be stored at the University of Turku publication portal UTUPub. Oral presentations will be held and posters will be shown at conferences to scientific community during and after the project. Researchers will be able to contact the applicant for access to data. Relevant data will be maintained in an open XML format to enable open re-use of the data.

The following services will be used to store research data: Zenodo (<https://zenodo.org>) and IDA (Research Data Storage Service, <http://openscience.fi/ida>). By depositing data with both the IDA and the Zenodo repositories the project will ensure that the research data are migrated to new formats, platforms, and storage media as required by good practice. International scientific publications with DOI's are likely to be available long-term.

6. Data management responsibilities and resources

The project Leader is responsible for execution the data management plan. The key post-doc researcher (in this case Alexis Marsol) working full time for the project is responsible for the management of the data during the life cycle of the project. It is possible that some external support from experts will be needed. The University research support unit will provide guidance for data management and management of IPR rights.

We have allocated time in the proposed budget to cover the costs of preparing data and documentation for archiving and for writing publication. These altogether will take around 6-8 months of a post-doc researcher during the 3-year project. For external service, we have budgeted funding for purchasing assistance in data management. Both the IDA and the Zenodo repositories are free of charge.