Plan Overview

A Data Management Plan created using DMPTuuli

Title: SynCap: Design of spray-dried synbiotic microcapsules for healthy, functional, and sustainable powders

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Project abstract:

The SynCap project aims to design new spray-dried synbiotic microcapsule powders, using wood hemicelluloses as wall materials, to support the targeted delivery of probiotics to the colon, and the growth of endogenous colon microbiota. Good emulsifying, and low viscosity and heat transfer of wood hemicelluloses potentially enable them to be superior wall materials in the spray-dried microencapsulation while their proven prebiotic properties enable synbiotics in the produced microcapsule powders. In the spray-dried microencapsulation, understanding wall formation characteristics of the microcapsules being spray-dried, which will provide information necessary for designing stable microcapsule wall and optimising the production process, is still challenging. In the SynCap project, I will design a new optical system including a customised drying chamber and a high-speed camera system to investigate the formation characteristics and structure of probiotic microcapsule wall during spray drying. Further, I will link this information to the ability of the product to enhance probiotic efficiency. This enables the selection of the most suitable wall material and the optimisation of the production process regarding feed concentrations and air drying temperatures. Properties of the designed microcapsule powders including storage stability and *in vitro* digestion simulated conditions in human oral and digestive tract will be executed to understand the survival and release of encapsulated probiotics, and synbiotics of microcapsule powders.

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SynCap: Design of spray-dried synbiotic microcapsules for healthy, functional, and sustainable powders

1. General description of data

1.1 What kinds of data is your research based on? What data will be collected, produced or reused? What file formats will the data be in? Additionally, give a rough estimate of the size of the data produced/collected.

The SynCap project is based on experimental data generated from quantitative analyses including ***(1) recordings/images*** (e.g., high speed cameras, and microscopes - CRM, CLSM, SEM and AFM); ***(2) physical and chemical measurements*** (e.g., hemicellulose properties, probiotic properties, pH and rheological properties of hemicellulose-probiotic mixtures, microcapsule properties (water activity, moisture content, colour, bulk and true densities, thermal properties, particle size, shape, morphology, molecular structure, wall thickness, hemicellulose-probiotic interactions and rehydration properties); ***(3) spectroscopy and chromatography*** (e.g. X-ray mCT, FTIR, DSC, XRD, HPLC); and ***(4) microbial DNA sequences*** (e.g., PCR). The results of these quantitative analyses will generate raw data which will be in the format specific to the equipment. However, the data used to extract the final results will be saved in ASCII format so that they can be opened as text files, which does not require instrument-specific software.

Qualitative data such as technical parameters of designed spray drying chamber, spray drying nozzles and high speed camera systems; preparation conditions of hemicellulose-probiotic mixtures; spray drying conditions (solid concentrations; inlet and outlet air drying temperatures); description of experimental set-ups; and other visual observations will be kept in records, initially in a laboratory notebook, and will also be encoded and saved as text files.

Images will be collected and saved as high quality JPEG or TIFF files (at least 600 dpi). Recordings will be collected, converted and kept as MP4 format. Other data that will be produced by fitting the data extracted from the recordings/images and the data of microcapsule powder properties to various regression models, and the data from survival of probiotics during storage to various kinetic models, will also be collected. The Excel spreadsheets of these data will be saved as comma-separated value (CSV).

Data from the recordings and images will be very large, up to 2TB while the other data need maximum 100 GB.

1.2 How will the consistency and quality of data be controlled?

The plan for organizing, documenting, and using descriptive metadata to assure quality control and reproducibility of these data will conform to best practices and standards of the University of Helsinki. The research group is committed to follow proper documentation at all steps during the implementation of the project. Before performing experiments to collect data, all instruments will be standardized according to supplier suggestions, or analyses with control/standard samples will be performed to make sure the instruments working properly.

2. Ethical and legal compliance

2.1 What legal issues are related to your data management? (For example, GDPR and other legislation affecting data processing.)

The SynCap project will not involve any experiments that are subjected to ethical considerations. No animals and/or humans are involved in this project for any testing, and no personal data will be collected. There are no private partners or concerns about security and/or safety related to the project.

2.2 How will you manage the rights of the data you use, produce and share?

Before the project is commenced, an Undertaking on Transfer of Rights to the University of Helsinki will be signed. The ownership, copyright and Intellectual Property Right (IPR) will be agreed in writing within the research group, which will adhere to the University of Helsinki Research Data Policy and Terms of Use and Privacy Policies for IT Services. The guidelines for ethical principles of research as well as the guidelines for responsible conduct of research will be followed at all times. Patenting of the results will be considered prior to publishing, when appropriate, and of patenting, the IPR will remain with the University of Helsinki. All research results coming from the project will be published in accordance with Plan S principles and Finland's national policy for open access to scholarly publications so that the project outcomes will be available to all readers. The research data meant for reuse will be available under CC-BY licence.

3. Documentation and metadata

3. How will you document your data in order to make the data findable, accessible, interoperable and re-usable for you and others? What kind of metadata standards, README files or other documentation will you use to help others to understand and use your data?

Hierarchical directory structure (folders) will be used to store separately for experimental procedures, notes, protocols, raw data, cleaned data, documentation, manuscripts, or presentations with properly name. The data collected in this project will be documented and described with appropriate metadata as a Readme file. At the beginning of the project, appropriate metadata as a Readme file will be created for each folder, and this list will be added/updated during project life-cycle. Specifically, the following information will be included in the metadata: title of the dataset, creator of the dataset, digital identifier, dates associated with the data and project, keywords describing the dataset, funding organization of the project, short description on how the data was generated such as equipment name and model, experiment title, and software used. The description of all abbreviations that will be used in creating the metadata as well as in naming the documents will also be documented in the Readme file. Variables and parameters will be also explained as data dictionaries in the Readme file.

4. Storage and backup during the research project

4.1 Where will your data be stored, and how will the data be backed up?

The primary data are stored on UH group folders for personal storage hosted by the University of Helsinki, with backups and version controls provided by the University IT Services. Soon after the data are collected, they will be uploaded to the folders.

4.2 Who will be responsible for controlling access to your data, and how will secured access be controlled?

The PI will control the access to raw experimental data stored in the UH group folders. The PI will share the data to team members via sharing the folders. University of Helsinki network is protected from outsiders keeping the data secure.

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

5.1 What part of the data can be made openly available or published? Where and when will the data, or its metadata, be made available?

Results of the SynCap project will be disseminated by publications in scholarly journals as openly as possible in accordance with Plan S principles and Finland's national policy for open access. The publications will be available in a freely accessible format (open access journal or as self-archived copies in the personal web-pages of the applicant). Preliminary experimental data and those supporting for the publications will be published as supplementary files along with the publications. After published in scientific journals, the data on which the results are based and any potentially useful other data, will be made openly accessible via Zenodo.

The publications are expected to be published during the project or at maximum one year after it has finished. For publishing and storing data not published together with a journal article, Zenodo will be used to make the data available preferably under the CC-BY license.

5.2 Where will data with long-term value be archived, and for how long?

The data collected during the project will be managed and stored using the services provided or recommended by the University Helsinki IT Center.

After completion of this research project, the appropriate data will be deposited to the open repository provided by the University of Helsinki or Zenodo, EUDAT etc. repositories which enable open access to the data via a persistent identifier.

All data will be backed up and kept in hard-drives for at least 5 years after project is ended.

6. Data management responsibilities and resources

6.1 Who (for example role, position, and institution) will be responsible for data management?

The PI will be responsible for implementing and scheduling regular updates of the data management plan. External researchers will be able to contact the PI for access to the raw data stored in UH group folders.

6.2 What resources will be required for your data management procedures to ensure that the data can be opened and preserved according to FAIR principles (Findable, Accessible, Interoperable, Re-usable)?

Preparing the data for preservation and sharing will require some work, but when it is done systematically every time after collecting a set of experimental data, the workload will not become overwhelming. Costs for memory ticks to storage data are estimated in the budget.