BaGaTel: an ontology driven database to ecodesign food products taking into account their nutritional and sensory qualities

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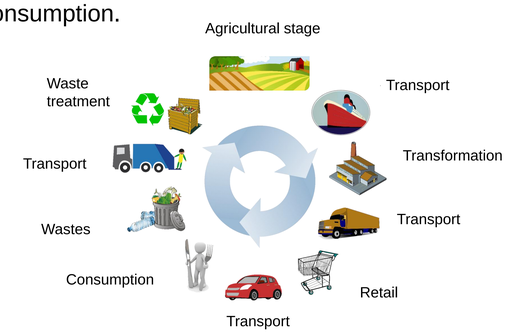
LCA FOOD 2020

Introduction

Agrifood systems cover all the activities of agricultural production, trade, transformation of agricultural products into food products, retail and consumption.



In order to conclude about the relevance of actions which aim at improving sustainability of food value chains, **multicriteria assessment** of these agrifood systems is essential. To perform such assessment, **collection and management of data** on the whole range of agrifood system activities are of primary importance.

Many efforts have been performed to collect and structure data on the agricultural stage, especially with regards to their environmental impact. Description of activities related to **transformation of agricultural products into food products** has not been investigated in such an extent. There is now a real need of tools to structure, store and share these data. Data can be heterogeneous: they describe the food products through the key criteria of composition, nutritional and sensory properties; together with the processes used to obtain them but also more systemic data and especially environmental impact data.

Methodology

A process and observation ontology in food science, **PO² ontology** [1], has been built to structure relational **BaGaTel database** in order to integrate data in the field of dairy products taking into account their environmental impact computed by LCA as well as their nutritional and sensory properties, using a consensual model and a shared structured vocabulary.

Data from a total of **40 different projects** (collaborative national/ European, publications, PhD theses, reports) have been integrated with their **associated metadata** (project information, link to publications, nature of the data, incertitude, process steps, materials, methods…).

The metadata associated to each project, the list of the terms used in BaGaTel and a video tutorial, which presents the data entry interface and the visualization of data, are available on the BaGaTel portal [2].

Results

The interest of BaGaTel database for Life Cycle Assessment has been demonstrated in the case of Comté cheese assessment.

First, BaGaTel database was shown to be very useful **to support Life Cycle Inventories**. Several projects which include inventory data are already in the database, and by querying them it is possible for a new LCA practitioner to identify which kind of data are necessary for the inventory. In other words, BaGaTel database can provide **guidance to data collection**.

=> Which are the steps involved in the production process of hard cheese TF24 ?

Table | Raw Response | Pivot Table | Google Chart — Download as ...

Filter query results — Showing results from 1 to 9 of 9. Query took 0.3s, today at 17:46.

	stepType
1	Cheese ripening
2	Demoulding
3	Skimming
4	Moulding
5	Cooling
6	Milk reception
7	Brining
8	Milk standardization
9	Step in the vat

9 different production steps found for TF24

Results

Thanks to this information, a detailed process chart could be built, and BaGaTel database could then be queried on **available data for LCA**.

Available data to estimate environmental impact of TF24 production (Ingredients used)

Step	Characteristic	Object	Value	Unit
Step in the vat	Quantity	Milk	100	L
Step in the vat	Quantity	Sodium metasilicate	200	g
Step in the vat	Quantity	Sodium carbonate	200	g
Step in the vat	Quantity	Phosphoric acid	250	g
Step in the vat	Quantity	Ethaneperoxoic acid	250	g
Step in the vat	Quantity	Hydrogen peroxide	250	g
Step in the vat	Quantity	Ethanoic acid	250	g
Brining	Quantity	Brine	200	L

Available data to estimate environmental impact of TF24 production (Electricity consumption)

Step	Characteristic	Object	Value	Unit
Skimming	Electricity consumption	Cream separator	0.065	kWh
Cooling	Electricity consumption	Refrigerated tank	29.04	kWh
Step in the vat	Electricity consumption	Heating unit for the vat (1st heating)	6.75	kWh
Step in the vat	Electricity consumption	Heating unit for the vat (2nd heating)	11.97	kWh
Cheese ripening	Electricity consumption	Maturing cellar 1	900	kWh
Cheese ripening	Electricity consumption	Maturing cellar 2	1350	kWh
Cheese ripening	Electricity consumption	Maturing cellar 3	2250	kWh

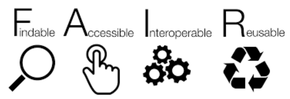
For **missing data**, BaGaTel database was also successfully used to estimate quantified data on electrical consumptions, by querying the data available for the materials and methods used.

When the inventory is completed, LCA can be computed thanks to a LCA software.

When LCA has been computed, the second main interest of BaGatel database is that **inventory data and LCA results can be stored in the database, together with all the corresponding metadata necessary to eventually re-use them**. Thanks to the fact that data on cheese quality, process and eco-design are in the same database, and that many projects and data are available, it is possible to estimate missing data on the environmental impact of products described in projects only focused on food quality. Such an approach is very useful for knowledge and data capitalization, as well as to produce new knowledge and data by combining and integrating existing resources.

Perspectives

Our objective is now to combine the database with adequate tools to deliver open access data in accordance with FAIR principles: data have to be Findable, Accessible, Interoperable and Reusable.



We are also working on the interoperability between BaGaTel and MEANS platform, which focuses on providing tools and database for LCA practitioners.

MEANS

MEANS-InOut software currently allows the description of farming practices for crop and livestock productions. Inclusion of food processing will provide a major step towards sustainability assessment of agrifood systems.

These works are currently performed in the framework of the DataSusFood project [4].

DataSusFood
Structuring and Opening Data to improve Sustainability of Food Systems

References

[1] Ibanescu, Dibie, Dervaux, Guichard, Raad (2016). PO2-A Process and Observation Ontology in Food Science. Application to Dairy Gels. In: Metadata and Semantics Research, MTSR pp.155-165. Göttingen, Germany. (http://agroportal.lirmm.fr/ontologies/PO2_DG)
[2] ANR-IC-Qualiment-NutriSensAl (http://plasticnet.grignon.inra.fr/portailbagatel)
[3] Pénicaud, Ibanescu, Allard, Fonseca, Dervaux, Perret, Guillemin, Buchin, Salles, Dibie, Guichard (2019). Relating transformation process, eco-design, composition and sensory quality in cheeses using PO2 ontology. International Dairy Journal, 92, 1-10.
[4] ANR-19-DATA-0016 DataSusFood (https://www6.inrae.fr/datasusfood)

Funding

Qualiment — Label Carnot — Réseau de recherche pour l'innovation alimentaire
ANR Agence Nationale de la Recherche