In Europe, the General Food Law Regulation serves to ensure that all food placed on the European market is safe. For food manufacturers, this implies that they should have a food safety plan to safeguard the consumer health. This requires information on the food safety hazards that may occur in their food production chain and operations, and the knowledge on the effect of different preservation hurdles and processing intensities to reduce and control the hazard. Another challenge is the reintroduction of side streams in the food production chain in circular food production systems. For food producers, this requires continuous monitoring and assessment of the safety of their food production processes.

Wageningen University & Research (WUR) has performed extensive literature-based reviews on the microbiological and chemical hazards of many food chains, of animal and plant origin. This knowledge will be extended with hazards specific for side streams. Furthermore, knowledge rules will be gathered on processes and how this will affect certain hazards. This knowledge will come from different sources and will be made available in a platform that can be used by the food industry.

To accommodate the information from different sources, the Food Safety Hazards and Processes ontology will be developed to gather this data in a knowledge graph. The ontology will be reusing classes and data from already existing ontologies such as FoodOn, Chebi, PO2, OM and the NCBI Taxon ontologies. Last year we presented the first version of the ontology. We talked about the classes for food ingredients, hazards, hazard types and processes.

We also need to store information on how a process influences the elimination of a hazard. We have a set of processes that can be applied to food ingredients in preparation to form a food product. Depending on the parameters of a process, hazards can be introduced or eliminated in the food process. This information for these knowledge rules is based on scientific research (either through literature research or in consultation with experts. Last year we talked about ways to store information on these knowledge rules. We explored using SHACL as a tool, but this proved to be inconvenient. It is certainly possible to define knowledge rules with SHACL, but we found that rules can only be applied on direct relation with a certain instance of a class (i.e. if the instance has a direct connection to a numerical value of a quantity, the SHACL rule could be applied, but since we make use of the ontology of units of measure, some data digging is required). It might still be possible to apply SHACL rules on indirect relations, but we did not explore this further. Therefore we decided to include a 'Process Effect' class in the ontology. With this 'Process Effect' class we aim to store knowledge rules on the formation or elimination of hazards for a specific process under certain conditions. The 'Process Effect' class has a relation with a hazard to indicate on which hazard the effect applies and a relation to indicate whether the effect results in formation or elimination. Furthermore, there are a number of conditions that can be linked to the process effect. The first is the process condition to indicate which process must be used for the process effect to apply. This relation should be filled in for every process effect. There is also the possibility to indicate that the process effect applies only for specific ingredient(s). Lastly it is also possible to connect it to a process quantity and indicate whether this quantity should require a minimum or maximum value for the process effect to occur (e.g. the temperature should be at least 120 degrees for the process effect to happen (see figure 2 and 3). We were able to store knowledge rules for heating, storage, high pressure and freezing this way.

The Knowledge Graph containing more detailed information on the specific process effects, hazards and ingredients will be made available in 2025.

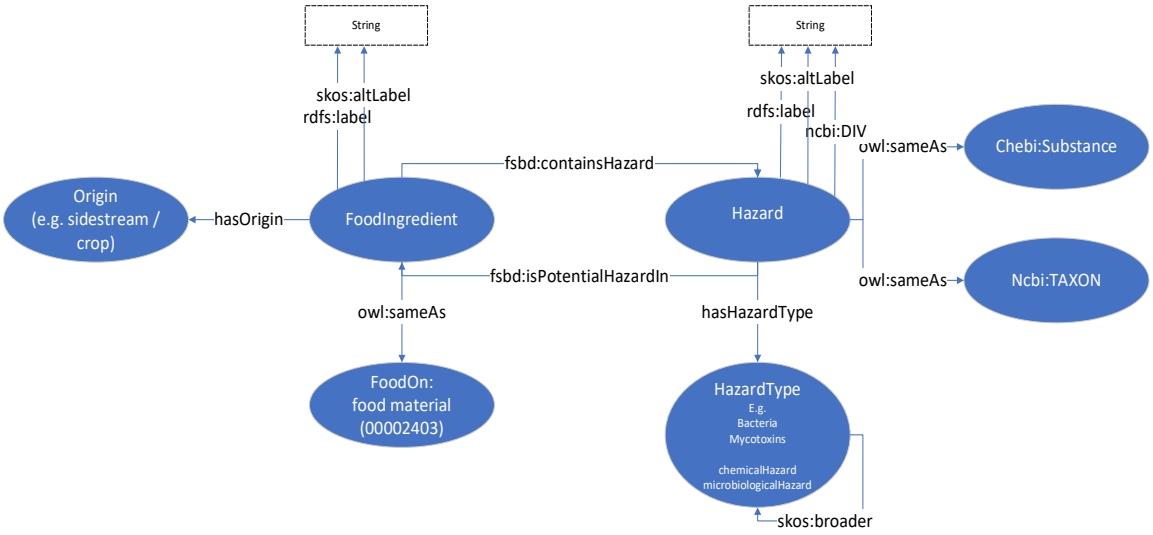

Figure 1 Overview of Food Ingredient and Hazard class

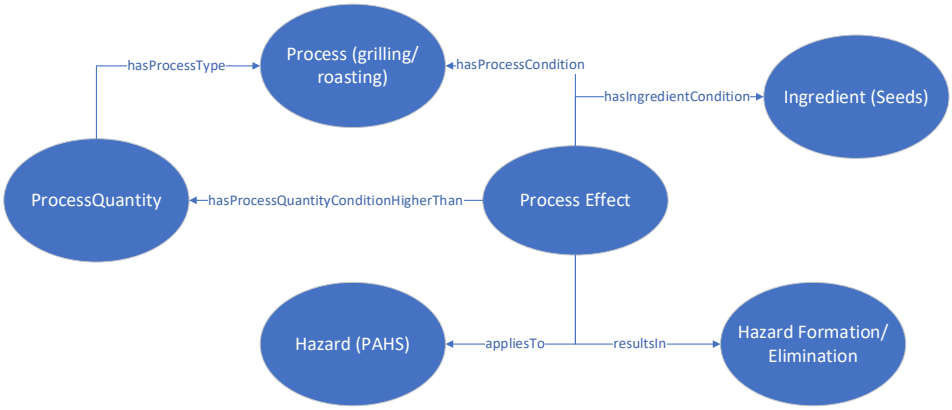

Figure 2 Overview of the process effect class and its relations

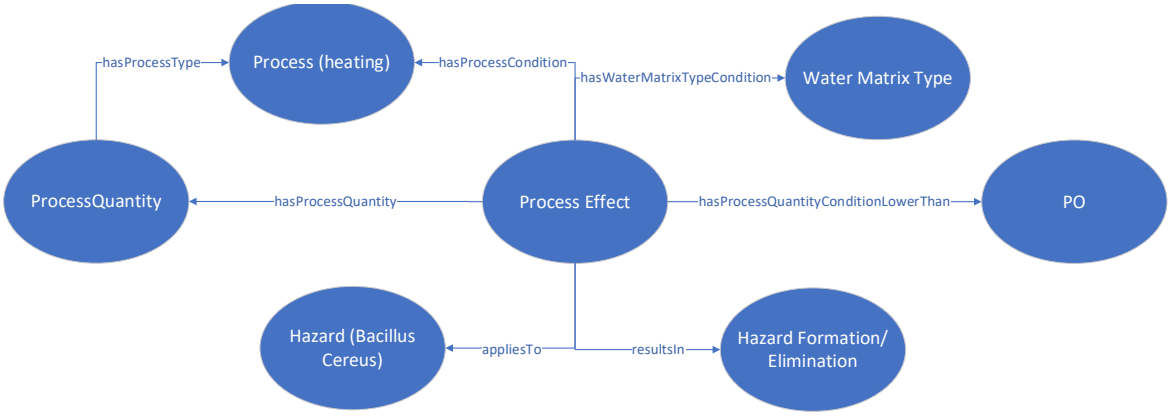

Figure 3 Overview if the process effect class and its relations with heating as an example