

# Food Information Engineering: A Systematic Literature Review

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## Abstract

In recent years, the research on food information gave rise to the food information engineering domain. The goal of this paper is to provide to the research community with a systematic literature review of methodologies, methods and tools used in this domain.

## Introduction

Food information engineering involves the acquisition, the processing, the diffusion and the use of food information to different stakeholders. These information are compiled from several data sources and used for a variety of purposes such as Question Answering, food image recognition, food recommendation, etc. Many authors have proposed AI technologies for the acquisition, the processing, the diffusion and the use of food information. However, these contributions are scattered in many scientific papers and are difficult to exploit. The goal of this research is to provide to the research community with: (1) a set of resources that will allow them to document this domain and (2) a body of knowledge that will help to reduce the research curve.

## Research Methodology

The research methodology consists of an iterative and incremental process during which Open Research Knowledge Graph (ORKG) is used to create/update templates (used to register researchers contributions), comparison tables of papers and SmartReviews. The idea is to use the experience gained during the creation, use and update of these resources to improve them and create new ones. It was divided into two phases: an exploratory phase and a systematic literature review phase.

The **exploratory phase** took place during a six months (June - November 2022) curation of ORKG with the help of the ORKG team. Thus, we benefit from the training of the ORKG team. The curation meetings allowed us to benefit from the remarks of the other curators and the ORKG team. The overall work was evaluated during this curation. The exploratory phase allowed us to have a global overview of the domain and to create a set of templates and comparisons

tables. The **systematic literature review phase** consists of using these resources to compare more papers and update existing comparisons with new contributions.

## Results

Globally, during the exploratory phase, more than 400 contributions were extracted from 120 papers and ingested in the ORKG platform using 10 templates that we created/updated or that were already created. Using these contributions, 33 comparison tables of papers and 2 SmartReviews were created. The overall results of this work can be found on the ORKG platform: <https://orkg.org/author/R138055>.

Firstly, 5 templates for documenting food composition tables, food ontologies and knowledge graph construction, description and integration were created. Thereafter, we used these templates to review the work in these domains. The comparison tables allowed us to identify structured, unstructured and semi-structured sources used to acquire food knowledge and build food ontologies, food knowledge graphs and food composition tables. On the other hand, we found that Neural Networks were proposed for calorie prediction from food images; knowledge was manually, semi-automatically and automatically extracted from these data sources. Concerning the automatic acquisition of knowledge from data sources, we found that rule-based approaches, machine learning, deep learning and natural language processing techniques were proposed. We also found that on top of food knowledge graphs, Question Answering systems are generally built. Thus, we decided to document it. Other templates for documenting food Question Answering and benchmark were created.

The second phase of this work is ongoing and it consists of a systematic literature review of food information engineering. On the other hand, even if Neurosymbolic AI have shown promising results in many domains, we found that this approach is not yet used in the domain of food information engineering. This research direction has to be considered.

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