Nutriknow: a comprehensive foods-for-health knowledge repository

Author **Matthew C. Lange**

Supervisors J. Bruce German

Studies/Stage PhD Candidate

Affiliation UC Davis Food Science Department

E-Mail mclange@ucdavis.edu

Aims and Objectives of the Research

There are two main objectives of this project. First, is to outline a multi-ontology framework for a Foods-for-Health knowledge system. This knowledge system begins as a framework for linking multiple ontologies on the Agriculture—Food—Diet—Health knowledge spectrum. A brief overview of the necessary knowledge domains and their respective information sources is presented. Second, is to outline a more in-depth focus on the nutrigenomics knowledge domain—highlighting available ontologies and databases that can be utilized to grow this knowledge space.

Justification for the Research Topic

Many of the top ten killers listed by the World Health Organization and the United States Center for Disease Control have some form of dietary component. The public health implications of diet-related illnesses could not be more clear. Unfortunately, because diet-related illnesses are typically the consequence of long-term recurring lifestyle patterns that interact with genetic predispositions, clinicians rarely have opportunity to intervene to improve health until signs of a disease state emerge. As a result, the vast majority of "health" knowledge, even as reflected in biomedical ontologies, is actually disease-based. That is to say, clinicians rarely intervene to make healthy people healthier. Yet intervening to improve people's health before a disease state occurs is precisely what enables disease prevention.

Traditionally, the food production system has been driven largely by the local availability of inputs—including seed, soil, water and infrastructure. These inputs provide commodities and products for processing which is based largely on demand based on consumers' organoleptic delight. The hope is that we can move from this process-based food production and delivery system, to a knowledge based system capable of guiding individuals in the acquisition and delivery of personalized nutrition and foods that will make them healthier and more long-lived.

Research Questions

Is it possible develop a comprehensive Agriculture—Food—Diet—Health knowledge infrastructure whereby markets for food products can be restratified according to the health needs and organoleptic desires of individuals?

Who would be the users of such a large scale system, and what would their use cases look like?

What are the various data, information, and knowledge sources required for such a system?

In what formats do these sources currently exist?

What are the determinants of health (as opposed to disease)? How do we measure and manage these variables and their outcomes?

How might the integration of individual health data, information, knowledge—including nutrigenomics, guide population-level nutrition advice and food processing and production methods?

Research Methodology

Because most existing ontology creation software has a rather steep learning curve, we have chosen to use concept maps as our preferred curation software. As the informaiton becomes more complex, this could change.
Methods for developing overall framework include:

1) Identify the most essential knowledge domains along the Agriculture—Food—Diet—Health knowledge spectrum.
2) Identify the data, information, and knowledge systems that exist in each of these knowledge domains and review their structures, capabilities, and shortcomings.
3) Identify the data, information, and knowledge systems that intersect these knowledge domains.
4) Develop an infrastructure capable of storing and querying these data and their relationships.

Our methods for developing specific knowledge domains within the framework are as follows:

1) After having identified and reviewed the structures, capabilities, relationships and shortcoming of information systems within a knowledge domain—decide and prioritize elements from each system and/or knowledge source (literature) to be included.
2) When no suitable information repository exists, students are encouraged to create a new conceptual map that bridges these information gaps.
3) Once initial concept maps are in place, appropriate people are chosen for an editorial/curatorial workflow as follows:

   Senior Undergrad-->early Grad Student-->PhD Candidate/
   Post Doctoral Scholar-->Local Expert--> National/Global Expert
4) Information with a high degree of structure (ontologies and databases) is extracted, transformed, and loaded into a repository capable of generating CMAPS
5) Manually created concept maps are submitted into a relational database and combined with the digitized resources from #4.
6) New concept maps are created from the combined repository—centered around a query of a users interest.

Research Results to Date

Preliminary results will be shown for concept maps that include information across several knowledge domains including:

Nutrigenoimics, nutrients, food-nutrient composition, herbs, herbal aromas and bioactive components, known thresholds for detecting specific aromatic compounds, genetics of the olfactory bulb its impact on these thresholds, beer, mouthfeel characteristics of specific beers, aroma qualities of specific hops used within beers, beef slaughter, hazard analysis at critical control points of the slaughter process, Halaal and the beef slaughter process.