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Representing Foods Potentially Involved in Food-Drug Interactions using FoodOn

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Motivation

- Certain foods contain chemical substances that may interact with drugs
- Unexpected consequences
 - Increasing or reducing the effect of a drug
 - Treatment failure
 - Toxicity
 - Higher risk of side-effects
- Similar to drug interactions but there is limited research on extracting and representing these interactions

Food-Drug Interaction Examples

- Altered absorption of drugs by **fatty, high protein and fiber diets**
- **Grapefruit juice** drug interactions - inhibition of CYP3A enzymes
- **Milk products** with antibiotics
- Food containing **tyramine** (matured cheese, red wine, ripped bananas, yogurt, shrimp paste and salami) with Monoamine Oxidase Inhibitors
- Vegetables high in **vitamin K** (broccoli, Brussels sprouts, kale, parsley, spinach) with warfarin

FIDEO Ontology: Core concepts

- Object Drug
- Precipitant Food
- Food-Drug Interaction
- Interaction mechanism
- Related Evidence

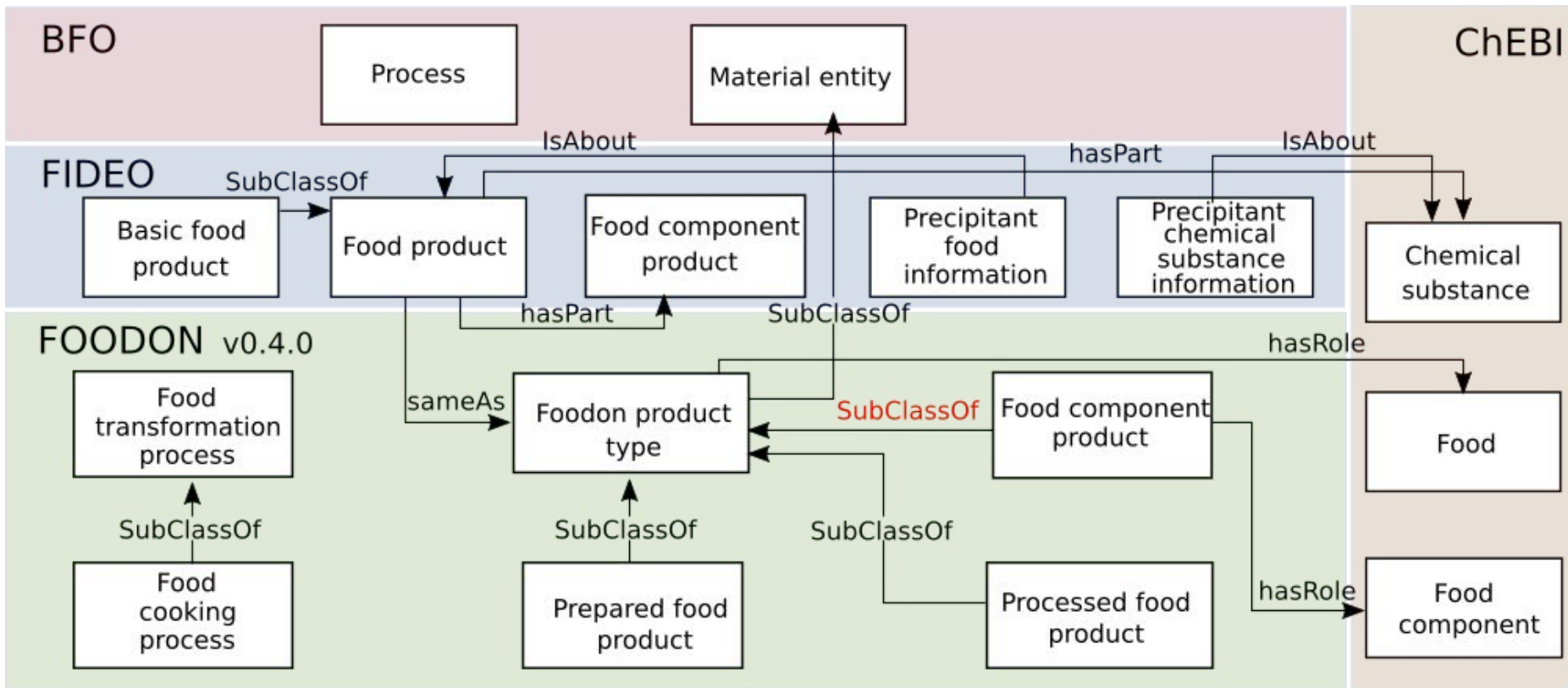
Modeling the Food Domain



LOD Food Resources

- **ChEBI** (additives and nutrients)
- **Open Food Facts Food Ontology** (Food nutrients, Food product data)
- **FoodOn** (food cooking methods, preservation methods, food classifications, food treatments, physical state)

Grounding food concepts on BFO



Annotated corpora about Food-Drug Interactions

- Stockley compendium (2008, 2016)
- POMELO 2017
 - Limited coverage of food-drug interactions
 - Large number of articles with incomplete information
 - Annotations done by one expert
 - No annotation guide
- 20 articles selected by hand
 - Annotation guide
 - Corpus annotated by two groups of experts (CNIM, CRPV)

Entity linking approach

- Exact string match on labels (rdfs:label)
- UMLS synonyms
- Exact string match of synonyms
 - obo:IAO_0000118 alternative term
 - obolnOwl:hasSynonym
 - obolnOwl:hasExactSynonym
 - obolnOwl:hasRelatedSynonym
- Generate concept name variants
 - Composed phrases (*food product, ratio, of material*)
 - Plurals
 - Upper/lower casing
 - Removing special characters

Linking foods and food components with Foodon and ChEBI

- 20 articles: 62% of foods and 76% of food components
- Error analysis
 - Missing food categories: *Green vegetables*
 - *Food product* vs. *whole, raw, cooked, processed, maturing*
 - *Juice* - available for *lemon, orange* and *grape* but not for *pomegranate*
 - *Green tea* as beverage - *green tea leaf (dry), green tea leaf (powdered)*
 - More specific labels - *skipjack* vs. *skipjack tuna fish*
 - Scientific names missing - *Amblygaster, Sardinella, Citrus grandis*
 - Composed phrases - *frozen grapefruit juice, brewed tea, purple grape juice*

Extracting food categories from Wikipedia

- Application-specific taxonomies from the category hierarchy
- Approach
 - Pruning algorithm
 - Iterative manual filtering methodology
 - Sampling strategies to reduce the amount of manual work
- Examples of missing categories in FoodOn
 - Regional cuisines, regional drinks
 - *Charcuterie, Vegan cuisine*

Conclusions

- **Ontology design**

FIDEO extends drug interaction ontologies for food-drug interactions by modeling foods using FoodOn

- **Entity Linking**

FoodOn inconsistencies and incomplete coverage of foods involved in food-drug interactions

- **Future work**

Interaction mechanisms represented using the Interaction Network Ontology (INO)

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