Characterizing pathways of exposure for risk-based chemical prioritization

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Overview

Manual mapping of chemical exposure data to broad exposure pathway categories to categorize 62,692 chemicals by exposure pathway

Scientific Impact & Potential Applications

- Pathways can be used to inform rapid exposure models for use in risk-based chemical prioritization [1], e.g.:
  - as a training set for automated read-across of exposure pathways based on chemical structure
  - as features (predictor variables) for machine-learning models of exposure [2]

Methods

Data streams

Large public inventories, reporting chemical use and/or occurrence:

- ACToR USEdb [3]: manually-curated pathways database (2015)
- CompTox Chemicals Dashboard (CCD) chemical lists [4] (https://comptox.epa.gov/dashboard/chemical-lists)
- Chemical Data Reporting 2016-2020 [5]
- CPDat (Chemical & Products Database) [6-11] via ChemExpo (see poster P284/abstract 3795)
  - Chemical-Product Composition data
  - Functional Use categories
  - Chemical List Presence (curated tags)

Data streams include 62,692 unique DSSTox Substance IDs

Pathway classifications

- Consumer
  - Fragrance
  - Personal care
  - Cosmetic
- Pesticide
  - active
  - inert
- Industrial
- Pharmaceutical
- Food/Dietary
- Other
  - Flame retardant
  - Tobacco
  - Colorant
  - Commercial
  - Agricultural
    - Fertilizer
  - Biocide
    - Herbicide
    - Antimicrobial

Chemical may be positive, negative, or unclassified (no data, NA) for each pathway.

Negative = ChemExpo Chemical List Presence tags "prohibited", "restricted", "not used", "non_food_use", "nondetect"

Classifications from each data stream may disagree. Here:

- Any positive = positive overall.
- No positive & any negative = negative overall.
- All NA = NA overall.

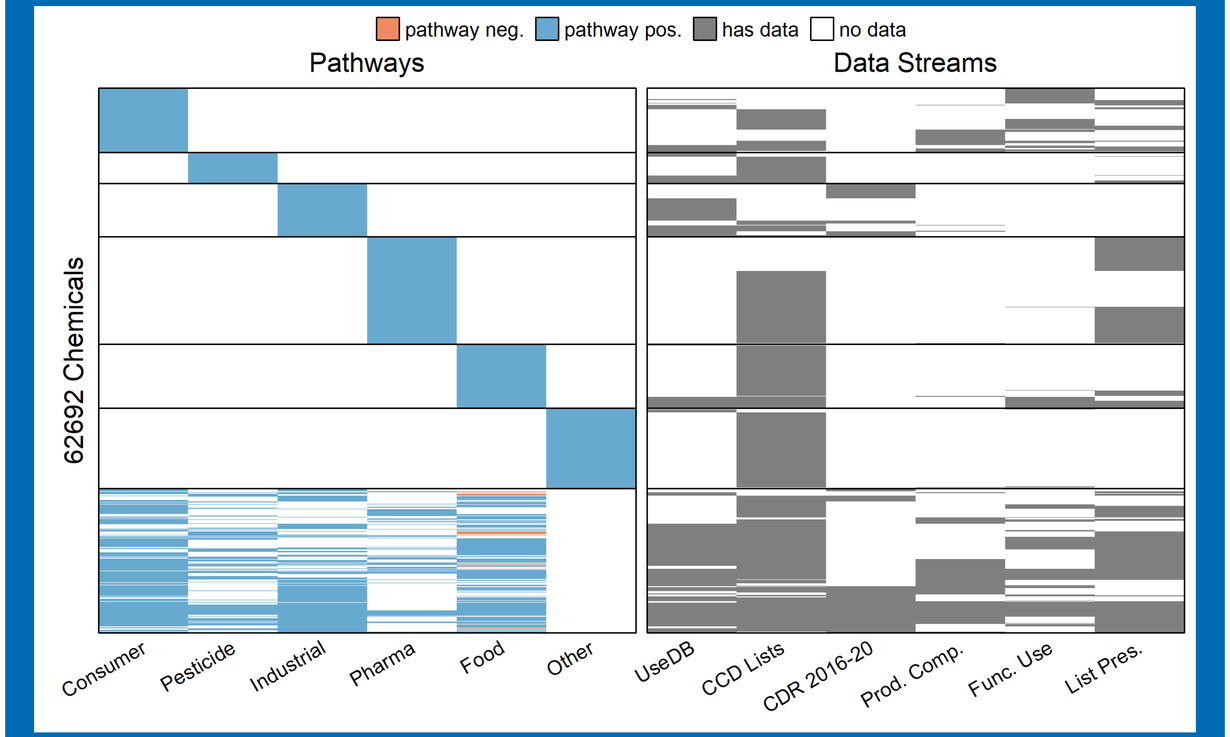

Figure 1. Heatmap of pathway classifications (left panel) and data stream sources (right panel) for 62,692 unique DTXSIDs.

United States Environmental Protection Agency

For references or copy of poster: Scan QR code or https://github.com/carolinering/pathwaysSOT2023

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Case Study: Food-Only Chemicals

6583 chemicals positive for the Food pathway and negative or NA for all other pathways

Case Study Summary

- Transparent, granular sourcing for pathway categorization
- Majority of food-only chemicals rely on data from 1-2 lists
- Food-only chemical classes are consistent with source lists (e.g. flavors)

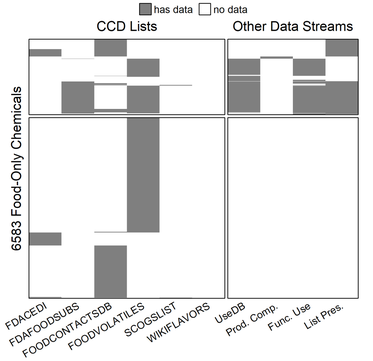

Figure 2. Data streams for food-only chemicals. Left panels: Specific CCD lists. Upper/lower panels: Chemicals with multiple/single data streams. Many chemicals have info only from CCD lists of food volatiles or food contact substances. https://comptox.epa.gov/dashboard/chemical-lists

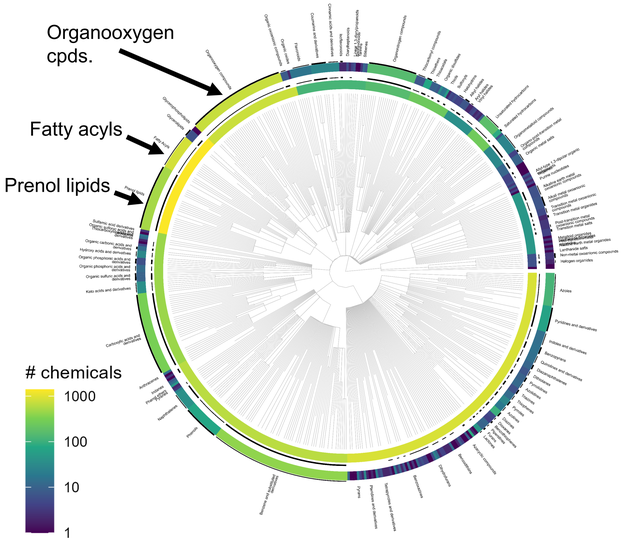

Figure 3. ClassyFire classifications for food-only chemicals. Colored rings: # of food-only chemicals in each superclass (inner ring) and class (outer ring, labels). Most frequent classes: Prenol lipids; Fatty acyls; Organooxygen compounds. Visualized using ClassyFire [12] & treecompareR package (see poster P160/abstract 3675).