Acrylamide-related Research and Information Brought to OEHHA’s Attention

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Sources of Information

• Public submissions to OEHHA
• U.S. Food and Drug Administration (FDA)
  – compiled internet links for FDA activities and information
• World Health Organization and the Food and Agriculture Organization (WHO/FAO) Infonet
• European Commission Database of Activities
• Published literature
Acrylamide Levels in Foods

- **FDA - extensive testing of U.S. food supply**
  - 2 interim reports to date, JIFSAN contract for private lab testing, Total Diet Study planned (hundreds of samples)

- **Environmental World Watch, Inc – California foods**

- **Measurements in foods from other countries:**
  - Sweden, UK, Germany, Canada, Norway, Switzerland, Japan, Jordan, Korea, Australia, Italy, Belgium, Finland, Ireland, Netherlands, Denmark, Austria, France

- **Extensive worldwide effort to develop and standardize methods of analysis**
Food stock, food storage and modulation of acrylamide through cooking practices and processes

- **FDA**
  - NCFST – acrylamide formation, including home cooking.
  - JIFSAN consortium-sponsored academic research

- **Private industry**
  - Procter and Gamble (mechanisms of formation)
  - Frito Lay (reaction variables in food preparation)
  - Nestle Research Center (Maillard reaction)
Acrylamide Formation and Reduction (continued)

- **Academic research**
  - Univ. Madison-Wisconsin -- compilation of studies regarding asparagine levels in various food stocks and changes in asparagine levels from storage, irradiation, and other process variables (Env. World Watch submission).
  - Univ. Madison-Wisconsin - mechanisms of formation, food engineering
  - Univ. Reading, UK – Maillard reaction/acrylamide formation.
  - Stockholm Univ. – acrylamide formation, reaction variables
  - McGill Univ. -- asparagine conversion to acrylamide
  - Univ. Arkansas - effect of frying on food quality and safety
  - Instituto del Frio – reduce acrylamide in cooking and processing
Acrylamide Formation and Reduction (continued)

• Ongoing research at other governmental organizations
  – Health Canada
  – Finland
  – Germany
  – Norway (several groups)
  – Sweden
  – U.K. (several projects)
Food Consumption Amounts and Patterns (Dietary Assessment)

• FDA
  – CFSAN researchers estimating U.S. intake of acrylamide (distributional analyses, and by age)
  – Apply acrylamide residue data to existing food consumption databases developed by U.S. Department of Agriculture and others.

• Intake assessments in other countries
  – Norway
  – Sweden
  – Denmark
  – Ireland
  – Belgium (probabilistic exposure assessment)
  – France
Assessing Acrylamide Cancer Potency and Risk (e.g., bioavailability, sensitive populations, and biomarkers)

- **FDA – NCTR - NTP**
  - extensive toxicology testing, including cancer studies in mice and rats, neonatal exposure cancer studies, mechanistic and toxicokinetic studies, bioavailability, DNA and protein adducts, developmental neurotox testing, *in vivo* mutagenicity, CYP2E1-knockout mouse studies.
  - study of background acrylamide adducts in rats and humans – food, smoking
  - human volunteer studies of acrylamide and glycidamide Hb-adduct formation
  - investigating the feasibility of large epidemiological study using stored biological samples (i.e., nested case-control study).
  - FDA risk assessment planned
Assessing Acrylamide Cancer Potency and Risk (continued)

• **U.S. Centers for Disease Control (CDC)**
  – NHANES – Hb adducts to be measured in U.S. pop.
  – Possible NIOSH worker study

• **Private Industry**
  – Research Triangle Institute -- Hb adducts, interspecies metabolism
  – SNF-Floerger -- toxicokinetics and Hb adducts of acrylamide following ingested by human volunteers
  – CIIT -- PBPK model (rat) and CYP2E1 knockout mouse study
  – DNA adduct studies (cited by S. Olin, ILSI)
  – Mechanisms of acrylamide carcinogenicity (reviews: KS Crump, Inc, 1999a,b;2000a,b; SNF Flocare, 2001) (several studies ongoing, sponsored by SNF-Floerger).
Assessing Acrylamide Cancer Potency (continued)

- **Academia**
  - Cohort worker study (Marsh et al., 1999)
  - Case-control dietary study (Mucci et al. 2003)
  - Bioavailability, kinetics, and breastmilk and urinary levels among human volunteers (Sorgel et al., 2002)
  - Bioavailability of acrylamide from food (rodents) (Tareke et al., 2000).
  - Dose-response of *in vivo* micronuclei formation (Paulsson et al., 2002; 2003; Abramsson-Zetterberg, 2003)
  - Mechanisms of acrylamide carcinogenicity or genotoxicity (Segerback 1995; Damjanov and Friedman, 1998; Khan et al., 1999; Park et al., 2002, others).
  - Biomarker data from Germany, Sweden, Korea (Schettgen, 2002; 2003; Perez, 1999; Hagmar 2001, Tareke 2000).
  - Metabolism and kinetics studies in humans (Stockholm University)
Assessing Acrylamide Cancer Potency and Risk (continued)

• **Governmental organizations in other countries**
  – evaluation of acrylamide toxicity (Australia, 2002).
  – bioavailability studies (Netherlands, France, Germany, Sweden).
  – transgenic mouse mutagenicicity and carcinogenicity study planned (Netherlands)
  – low dose toxicology studies (Germany)
  – in vivo and in vitro DNA damage studies planned (France)
  – consumption habits of adolescents (Germany).
  – risk assessment (Germany).
California’s Current Cancer Potency Estimate for Acrylamide

- Cancer potency: $4.5 \ (mg/kg-d)^{-1}$
- NSRL ($10^{-5}$ lifetime risk) = $0.2 \ \mu g \ per \ day$
- FDA estimate of mean U.S. intake = $26 \ \mu g \ per \ day$

- CA Potency estimate adopted in 1990
  - Adopted a 1989 U.S. EPA assessment (IRIS)
  - Based on multiple acrylamide-responding sites in a 2-year drinking water study in female rats.

- Considerable amount of new data since 1989
Risk Communication

• FDA and WHO/FAO
  – multiple scientific and public meetings
  – posted informational items on Websites
  – dietary advisories (which say: eat a balanced diet, don’t overcook food, don’t undercook food).