

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

رَبِّ اشْرَحْ لِي صَدْرِي ۝ وَيَسِّرْ لِي أَمْرِي ۝
وَاحْلُلْ عُقْدَةً مِّنْ لِّسَانِي ۝ يَفْقَهُوا قَوْلِي ۝

اے میرے رب! میرا سینہ کھول دے اور میرے لیے میرا کام آسان کر دے اور
میری زبان کی گرہ کھول دے تاکہ لوگ میری بات سمجھ سکیں

رَبِّ زِدْنِي عِلْمًا

MY LORD! INCREASE ME IN KNOWLEDGE.

FST- 407. FOOD SAFETY AND LAWS 3(3-0)

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- 1. Food Safety**
- 2. Characterization of food hazards: biological, chemical and physical**
- 3. Hazards from natural origin**
- 4. Hazards produced during food processing, storage and preparation**
- 5. Hazards associated with nutrient fortification**
- 6. Food Safety systems, GMP, TQM**
- 7. HACCP**
- 8. Pakistan Standards and Quality Control Authority**
- 9. Pure Food Rules**
- 10. Punjab Food Authority**
- 11. International Organization for Standardization**
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- 13. Food labeling**
- 14. Concept of Halal, Islamic food laws and regulations**
- 15. Consumer laws in Pakistan**
- 16. The World Trade Organization (WTO)**
- 17. Codex Alimentarius**

FST-407. L # 14. TOXICANTS FORMED DURING FOOD PROCESSING

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- **POLYCYCLIC AROMATIC HYDROCARBONS (PAH)**

FOOD PROCESSING AND PREPARATION

- Conversion of **raw** vegetable, animal, or marine products into **food for consumption**.
- **Preservation** of food is the most important reason
 - Usually by reducing or eliminating **microbial** contamination.
- Can result in **intermediate** or **final** food products.
- Involves **labor, energy, machinery, and knowledge**.
- Can be **commercial** or **consumer** level.

FOOD PROCESSING AND PREPARATION: WHY

- Preservation allows **longer term availability** of food.
 - **Economic** and food availability dimensions: **shelf-life**.
- Major role in establishing and maintaining microbial **food safety** e.g. **pasteurization**
- **Decreases toxicity** of some foods e.g. **lectins** beans
- Conversion into **new foods** e.g. **cheese, beer**
- **Supplementation, fortification** of food e.g. **fortified milk**
- **Sensory, Diversity, Nutrition**

FOOD PROCESSING AND PREPARATION: GENERAL

- **Addition** of **thermal energy** and elevated **temperatures** (e.g. **cooking**, **sterilization**).
- **Removal** of thermal **energy** and reduced **temperatures** (e.g. **frozen** foods).
- **Removal** of **water** and reduced moisture content (e.g. **dried** fruit).
- Use of **packaging** (e.g. **canning**).
- Mixtures of **ingredients** (e.g. **water**).
- Addition of **modifiers** and **additives** (e.g. **salt, sugar, starch**)

NATURAL PROCESSES MODIFYING FOOD

- **Spoilage** and “**available**” **microorganisms** (e.g. **wine yeasts**).
- Atmospheric **O₂** oxidation.
- Atmospheric **CO₂** **pH** buffering.
- Food **enzyme** release (e.g. **cassava**).
- Post-harvest **instability** (e.g. **potato greening/sprouting**).
- Environmental **equilibria**.
 - **Thermal** (ambient temperature).
 - **Moisture** (ambient humidity).
- **Contamination**.
 - **Water, insects, vessels, natural products** (green potatoes, weeds).

FOOD PROCESSING APPROACHES

- Thermal processing.
- Blanching and Pasteurization, Sterilization.
- Refrigerated storage.
- Freezing and frozen food storage.
- Liquid concentration.
- Dehydration.
- Physical processes.
 - Mechanical separation.
 - Extrusion.
- Irradiation.

CHEMISTRY OF PROCESSING TOXICANT FORMATION

- Chemical **thermodynamics** and **kinetics** apply.
- **Non-spontaneous** reactions can occur at higher temperatures.
- **Gibbs free energy** change of a chemical reaction.

$$\Delta G(\text{J/mol}) = \Delta H(\text{J/mol}) - T(\text{K}) \cdot \Delta S(\text{J/molK})$$

- Importance of **enzymes** and **catalysts**.
- Kinetics of quality change are related to **temperature**.
 - **Arrhenius equation**.

FOOD PROCESSING TOXICANTS; PRO-TOXICANTS

- Chemicals added or **created** during food processing can be **anti-nutritive**, **toxicants**, or **pro-toxicants**.
- **Anti-nutritive** chemicals or processes will block, interfere, or destroy **nutrient availability**.
- **Toxic** chemicals formed from food processing will be **dose dependent** and subject to **biotransformation**, **sequestration**, and **elimination**.
- **Pro-toxicants** added or created during food processing can undergo **toxication** during **digestion** or **biotransformation**.

FOOD PROCESSING AND PREPARATION TOXICANTS

- **n-Nitrosamine** formation from **nitrites**.
- **Polycyclic** aromatic hydrocarbons.
- Amino acid **pyrolysates**.
- **Maillard** reaction products.
- **Food irradiation** - unique radiolytic products (URPs) from ionizing radiation.
- **Lipid oxidation** products.
- **Lysinoalanine** cross-linkage from alkali/heat treatment of proteins.
- **Acrylamide** formation in foods prepared at high temperatures.

n-NITROSAMINE FORMATION FROM NITRITES

- **Nitrite** used in **curing meat** and **fish** products.
- Has **antimicrobial** activity, **sensory** attributes, and reacts with **myoglobin** and **hemoglobin** to form **red nitrosyl** compounds.
- Nitrite reacts with **2°**, **3° amines** to form\ stable **nitrosoamines**.
- High temperature processing and protein degradation to **2°**, **3° amines** increase rate of formation.
- **Carcinogenic, mutagenic.**

POLYCYCLIC AROMATIC HYDROCARBONS (PAH)

- Formed in the **high temperature pyrolysis** of **carbohydrates** in **grilling** and **smoking** of meats.
- **Endogenous** food sources and **environmental** contamination are also important.
 - Products of **combustion**.
- **Carcinogenic, mutagenic.**