ASTA 2009
Annual Meeting and Trade Show
April 26-29, 2009
Loews Ventana Canyon Resort
Tucson, Arizona

Irradiation of Herbs & Spices
A Safe Alternative in the USA

Lorraine Tam, Ph.D.
Director Innovation and Corporate Quality Systems
Griffith Laboratories US

Overview

- Herbs and spices are sterilized to protect both the consumer and food manufacturer
  - Reduce microbial load
  - Reduce the incidence of food borne illness
  - Maintain reputation
  - Expand trading

Overview

- The optimal sterilization method
  - Maximizes microbial kill
  - Minimizes residues
  - Maintains organoleptic & visual properties

Approved Sterilization Methods

- Ethylene oxide (ETO)
- Propylene oxide (PPO)
- Irradiation
- Steam

Presentation Outline

- Compare approved sterilization methods
  - Mechanism by which microbial inactivation and destruction occurs
  - Communicate the effectiveness of each method
  - Outline factors influencing
    - Microbial reduction
    - Consumer and industry acceptance

US Industry Standard

- Prior to December 2008, ethylene oxide was the established industry standard

‘Sterilizing Foodstuffs’
US Patent #2,107,697
2/8/1938

US Industry Standard

- Concerns surrounding ethylene oxide's safety and impact on the environment drove the development of a new EPA standard and the industry to consider alternate methods for spice sterilization

Ethylene Oxide Sterilization of Herbs and Spices

	Prior to 12/31/08	After 12/31/08
Phase cycles	40 - 50	96
Steam	Non	21 washes
Cycle time	6 – 10 hrs	16 – 20 hrs
Concentration	300 - 500	300 -375
Ethylene oxide level	50 PPM	7 PPM
Ethylene chlorohydrin level (residue) - Canada	1500 PPM	940 PPM

Microbial Inactivation & Destruction

Treatment Method	Mechanism
Ethylene oxide	Alkylation of amino, sulphydryl and hydroxyl groups in proteins and nucleic acids; target areas include DNA & Enzymes
Propylene oxide	Alkylation of amino, sulphydryl and hydroxyl groups in proteins and nucleic acids; target areas include DNA & Enzymes
Irradiation (Ionizing energy)	DNA disruption at the base, single & double strand levels by free radicals; DNA cleavage
Steam	Denaturation & coagulation of nucleic acids, structural proteins and enzymes

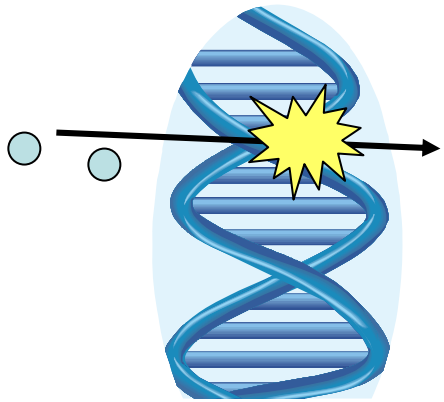
Alkylation

Amino Group

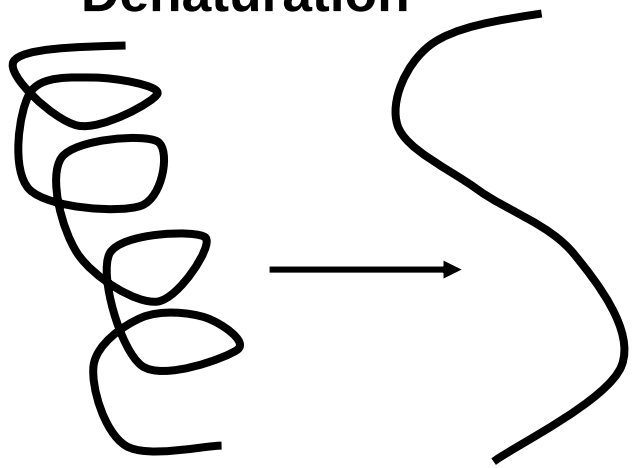
Protein or Nucleic Acid-N^{2+} + **$R\text{-}CH_2\text{-}X$**

Protein or Nucleic Acid-N-**$CH_2\text{-}R$**

Ionizing Energy



Denaturation



Effectiveness

Highly Effective Microbial Reduction

Irradiation

Ethylene Oxide (Standard)

Propylene Oxide

Steam

Less Effective Microbial Reduction

Other Factors Influencing Microbial Reduction

Treatment	Microbial Reduction	Uniformity of treatment	Containment
Ethylene oxide	Effective (New ETO process will yield product with increased micro counts)	Hot spots are frequent	Packaging must be porous to allow penetration of gas
Propylene oxide	More effective than steam	Hot spots are frequent	Packaging must be porous to allow penetration of gas
Steam	Less effective than PPO and IRR		Packaged after processing
Irradiation (Ionizing energy)	Highly effective; 100% kill of known pathogens	Effective penetration	Packaging does not need to be porous

Factors Influencing Consumer/Industry Acceptance

Treatment	Residue & By-products	Organoleptic Changes	Visual Changes
Ethylene oxide	Ethylene chlorohydrin	Minimal impact on flavor and aroma (New ETO process may affect flavor & aroma and volatile oil concentration)	Minimal impact (New ETO process may affect color)
Propylene oxide	Propylene chlorohydrin	Minimal impact on flavor and aroma	Minimal impact
Steam	None	Alter aroma and flavor; some loss of volatile oil	Darken the color
Irradiation (Ionizing energy)	None	Minimal impact on flavor and aroma	Minimal impact

Summary

- Choice of sterilizing agent will impact the level of microbial inactivation and destruction
  - IRR>>> ETO>>PPO> Steam
- Irradiation is recognized as a process to improve food safety and approved for spices and dehydrated vegetables since 1986 at 30kGy
- Supported by the FDA, USDA, WHO, CDC, ASTA and CODEX

THANK YOU