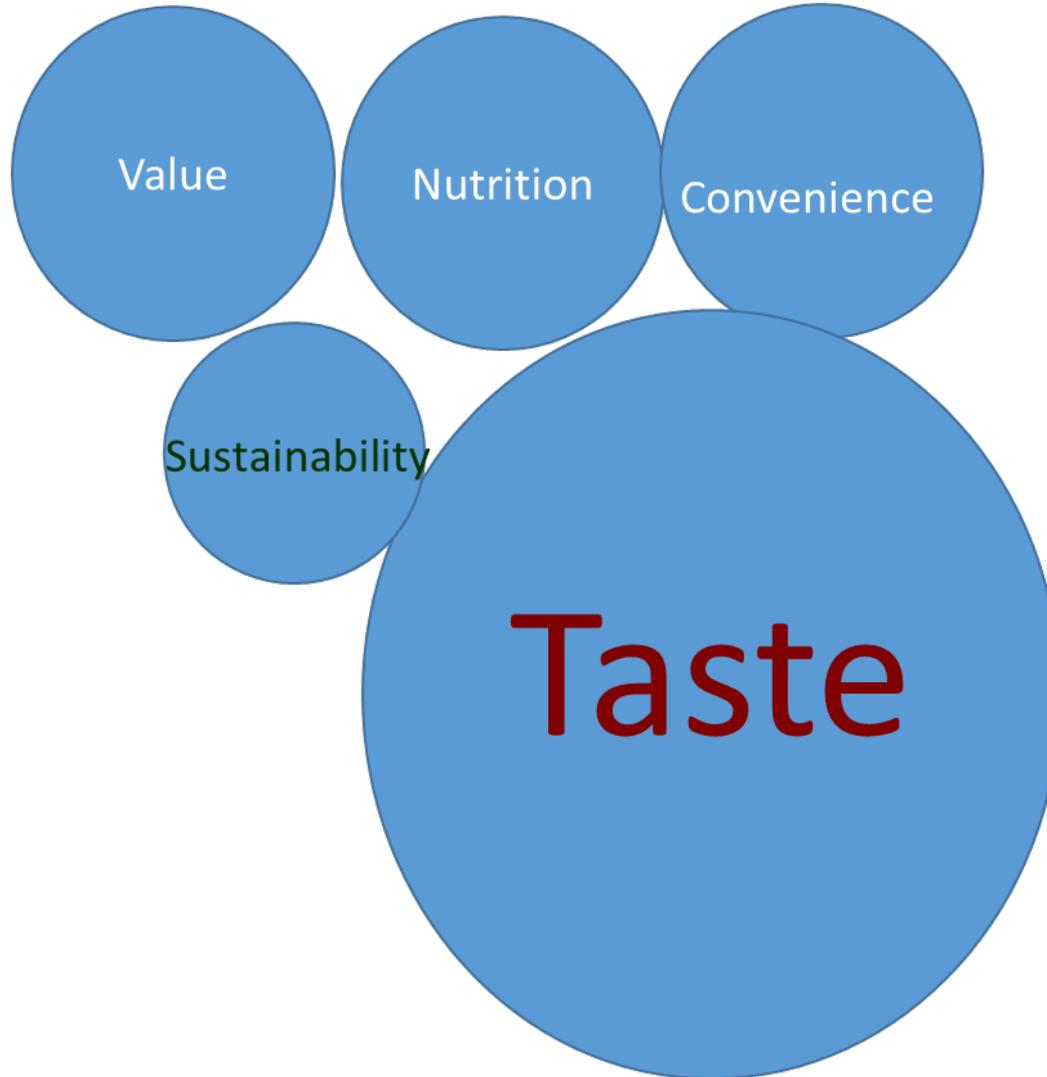


# Disclosures

- Board Member/Advisory Panel – Evaluation of research programs
  - The Cranberry Institute
  - Sensient Technologies
- Consultant – Rancidity Solutions
  - Newlywed Foods
  - Novozymes
  - Ingenuity Foods
  - Kalsec
- Employee
  - University of Massachusetts
- Research Support – Lipid Stability
  - Agriculture and Food Research Initiative
  - DSM

# Drivers of Food Purchases



# Convenience

- 1887: Half of a households labor hours were for preparing foods
- 2014: 37 minutes (Hamrick and McClelland, USDA, Economic Research Service, 2016)
- Preparation time decreases with increasing income
  - Dual working families
  - Long commuting times
  - Family demands
  - Need for quality time

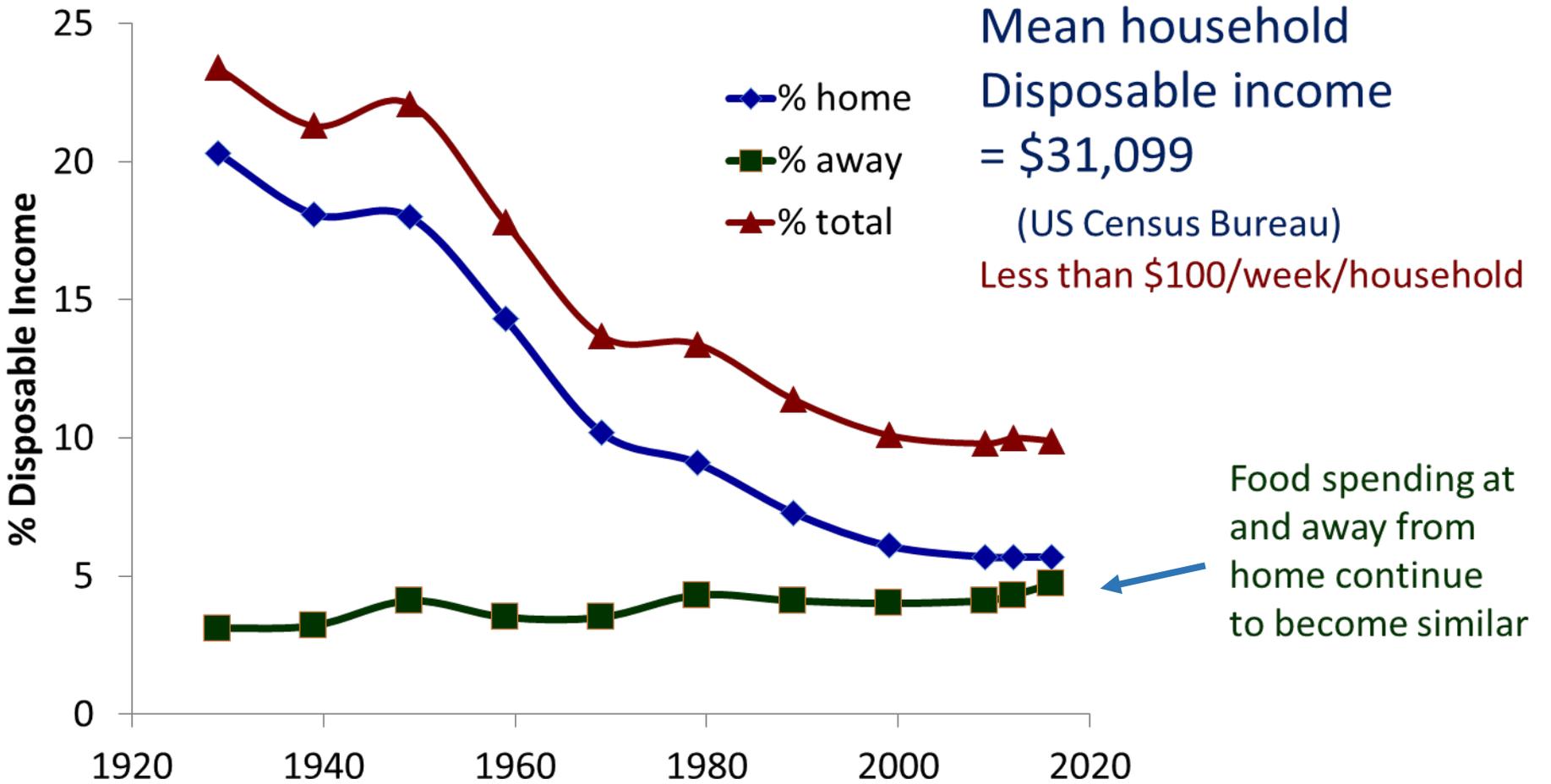


# Producing Convenient Processed Foods

- Pre-cleaned and processed produce
  - Bagged vegetables, carrots, guacamole, fruit slices,
- Ready to eat foods
  - Breakfast Cereals, breads, yogurts, cheeses, frozen, dried and canned fruits, roasted nuts, deli meats, crackers, salad dressings
- Quick cooking foods
  - Pregelatinized whole grains, frozen vegetables, refrigerated potatoes, microwavable meals, canned sauces, canned and frozen seafood, flexible/microwavable packaged foods

# Value

## Decreased Food Cost



# The food industry is critical in decreasing food costs



- Buy raw materials in large quantities
- Use energy efficient processing steps
- Maximize yield to decrease waste
- Utilize food waste products to offset costs
- Utilize food processing operations, packaging technologies and food ingredients to maximize shelf-life



Homemade tomato paste = \$9.90+/pound  
Industrial tomato paste = \$2.00/pound

# Future of a Healthy Food Supply

How likely is it to expect consumers to adapt a diet that meets public health goals that requires them to:

- Spend more time cooking
- Pay more for foods
- Sacrifice taste

## Realistic Goal

- Provide a healthy, convenient, affordable, sustainable and great tasting food supply that is accessible to all

# Unintended Consequences at the Interface between Nutritional Recommendations and the Food Supply

- The industry can reformulate foods to meet public health goals
- Because of the size of the industry this can rapidly change the food supply
  - No Cholesterol
- Rule of substitution: How is the “bad” nutrient replaced?
  - Low Fat Foods: Replacement of fat with carbohydrates
    - Thus nutritional recommendations can have huge impacts on the population which sometimes do not have expected outcomes

# Unintended Consequences of Dietary Fat Recommendations

Before 1920's most fats were animal derived



- Decrease Dietary Cholesterol (late 50s, early 60s)
  - Replace animal fats with tropical oils



- Decrease Dietary Saturated Fatty Acids (early 80s)
  - Replace tropical oils with hydrogenated fats



- Decrease *trans* Fatty Acids (late 90s, early 2000s)
  - High Oleic Vegetable Oils

# Challenges to changing the food supply so that it positively impacts health

No matter how nutritious the food is, it does not improve health if it is not consistently incorporated into the diet

# 1. Eat more fruits and vegetable

Both nutritional and sustainability benefits

- Most purchased vegetables

1. Potato
2. Tomato
3. Onion
4. Corn
5. Green beans

- 18 Asparagus
30. Kale

- Value- Cost/serving

\$0.06/serving

\$0.21/serving

\$0.12/serving

\$0.21/serving

\$0.13/serving

\$0.66/serving

\$0.19/serving

# Plant Foods Convenience

- Challenges

- Short shelf-life – more shopping
- Preparation time – washing, peeling, seeding, juicing  
portioning and cooking

- Technology solutions

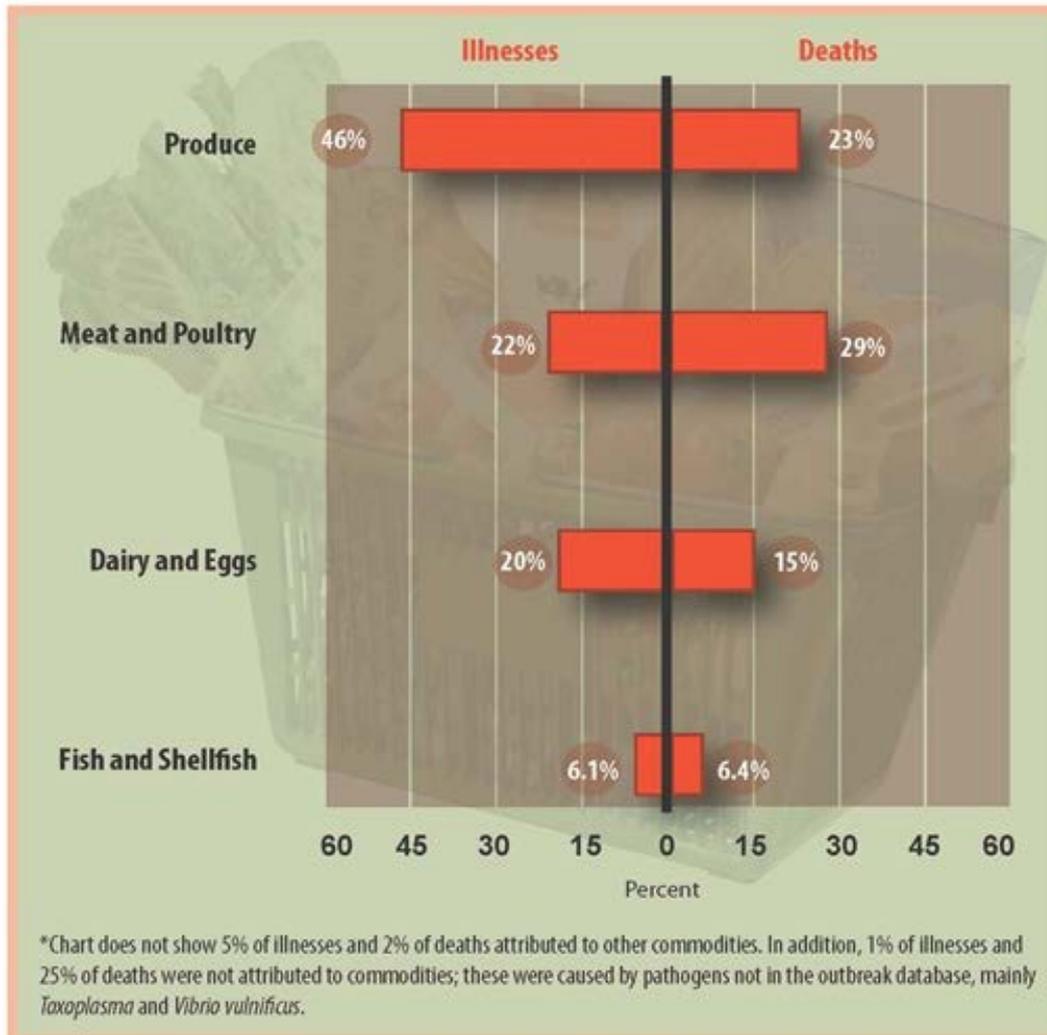
- Prewashing
- Packaging
- Preserving

- Convenience = Increases cost?



# Plant Foods - Safety

Figure 1. Contribution of different food categories to estimated domestically-acquired illnesses and deaths, 1998-2008\*



# Produce Safety

## Plants Contaminated with enteric bacteria

- Animals in fields
  - Deer and apple cider
- Contaminated irrigation water
  - Romaine lettuce
- Improper handling procedures
  - Salmonella in cantaloupe
- Contaminated raw material
  - Seeds for sprouts

Many of these issues are being addressed by the food safety modernization act

# Produce Safety Challenge/Solutions

- Inability to heat process fruits and vegetable without negatively impacting quality
  - Change flavor and texture
- Non-thermal processing
  - High Pressure
  - Ultraviolet
  - Pulse electric field processing

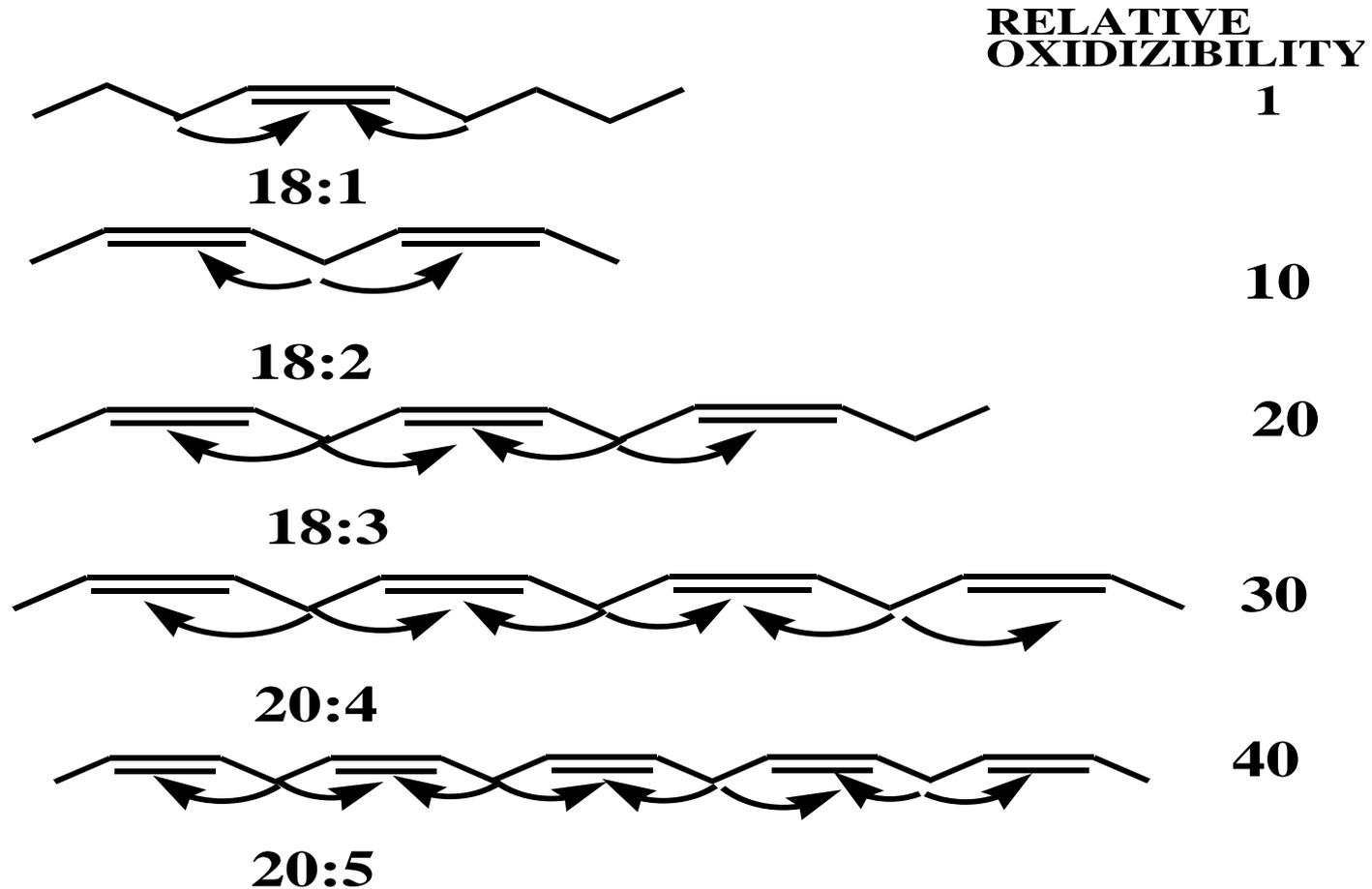


## 2. Eat Less Solid Fat

Solid Fat is important in foods for structure (baked goods) and oxidative stability

- Technology exists for making solid fats high in unsaturated fatty acids
  - **Interesterification**
- Challenge is to prevent rancidity when increasing unsaturation
  - **Packaging**
  - **Antioxidants**
  - **High oleic oils**
- Many antioxidants are not used or allowed in retail stores due to clean label/organic trends
- Increased prevalence of rancid foods

# Impact of Unsaturation on Susceptibility to Lipid Oxidation

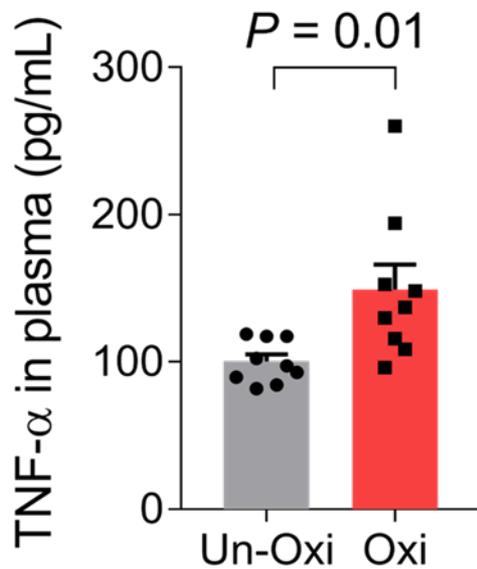


# Newspapers soaked in linseed oil caused fire due to spontaneous combustion

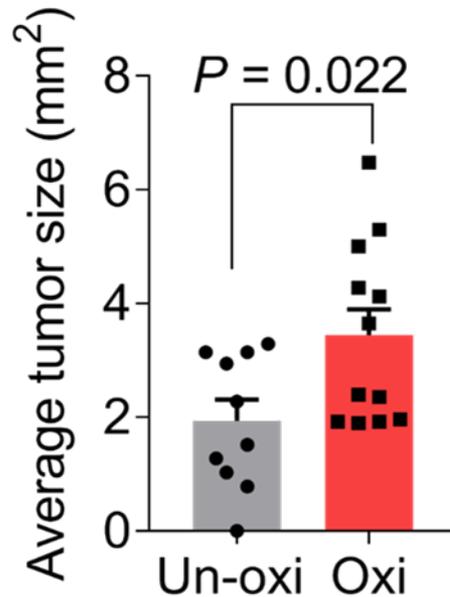
(Hampshire Gazette; Northampton, MA)



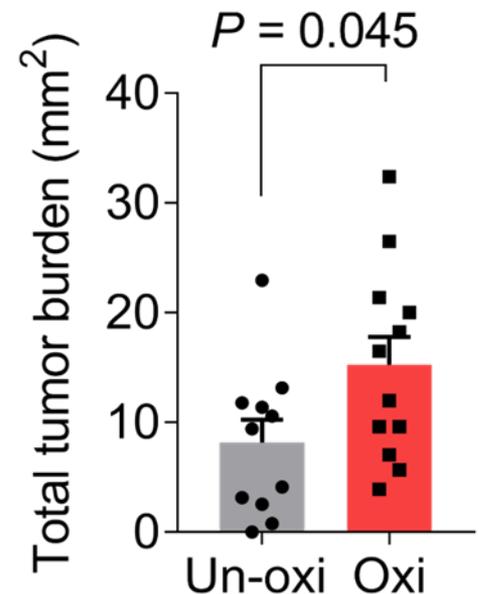
# Impact of Mildly Oxidized Oil on Mouse Model of Inflammatory Bowel Disease



Increased Gut Inflammation



Increased tumor size and number



# 3. Sodium

- Reduction of dietary sodium continues to be a challenge

	2003-04	2005-06	2007-08	2009-10
All males	1653 mg/1000 kcal	1666 mg/1000 kcal	1697 mg/1000 kcal	1689 mg/1000 kcal
All females	1669 mg/1000 kcal	1719 mg/1000 kcal	1698 mg/1000 kcal	1688 mg/1000 kcal

**National Health and Nutrition Examination Survey, 2003–2010**

- Sodium plays multiple roles in foods
  - Flavor
  - Protein functionality
  - Fermentation control
  - Water control agent
  - Preservative

# Sodium



- Because of its multiple roles, it's difficult to make major salt reductions in certain foods and maintain quality and safety
- This makes across the board sodium reduction plans difficult if not impossible to implement with current technology
- It would be easier to achieve sodium reduction in foods where technologies exist for sodium replacement

# Where does dietary sodium come from?

## NHANES Dietary Sodium Ranking

1. Breads and rolls
  2. Pizza
  3. Sandwiches
  4. Cold cuts and cured meats
  5. Soups
  6. Burritos and tacos
  7. Savory snacks\*
  8. Chicken
  9. Cheese
  10. Eggs and Omelets
- Cheese



\*Chips, popcorn, pretzels, snack mixes, and crackers

# Removal of Salt from Cheese

- Role of Salt in Cheese
  - Fermentation aid
  - Water control
  - Protein functionality
  - Flavor
  - Preservative
- Reduction of salt from cheese will change
  - Salty and fermentation derived flavors
  - Shelf-life
  - Safety
  - Texture – creaminess, elasticity and melting properties
- Technologies do not currently exist to replace salt and maintain quality, safety and sustainability across all types of cheeses

# Targeted Salt Removal

- Tools do exist to decrease the sodium content of foods when salt is used primarily as flavor
- These tools are based on traditional culinary methods to enhance flavor (Umami)
  - Seaweed and mushrooms in soups
  - Parmesan and pasta
  - Anchovies and vegetables
  - Tomato paste and sauces and stews

These all enhance flavor by similar mechanisms = Glutamate



# Umami Ingredients for Cooking



	Glutamate	Inosinate	Guanylate
Seaweed (Nori)	950	20	40
Dried tomatoes	900		10
Dried mushrooms (shitake)	1060		150
Anchovies	630		
Parmigiano	1440		
Soy Sauce	1050		

Clinical trials have shown that glutamate is not harmful yet this sodium reducing tool (up to 30% reduction) is still not accepted by many health professionals and consumers

# Conclusions

- Dietary recommendations are unlikely to be successful if healthy foods are not incorporated into a daily diet
- Consumer food choices are largely driven by taste, value and convenience
- The food industry can improve the nutritional profile of foods if the resulting products are accepted by consumers
- Nutritional recommendations might be more effective if they are focused on foods where the tools exist to maintain acceptable taste, value and convenience
- This will require both health professionals and consumers to accept science and technology in their foods