Unusual Hazards to the Food Supply
Lecture 14

Lecture Objectives
• Describe the dangers associated with food allergies.
• List the chemical and physical hazards to the food supply.
• Discuss the use of antibiotics for feed animals.
• Explain the role of growth hormones in growth promotion.
• Determine the most common food additives and their roles in food safety.

Food Allergy
• Hypersensitivity response to foods that is mediated mainly as a result of an immunoglobulin E (IgE) mechanism.
• Usually occurs within the first two years of life.
• Symptoms usually occur within minutes to hours after eating foods and include:
  • Skin rash
  • Respiratory difficulties
  • Vomiting
  • Diarrhea
  • Tingling, swelling in mouth and throat
  • Anaphylactic shock is possible

Food Allergy - Acquisition
• Sensitization usually occurs in the gastrointestinal tract by ingesting foods containing the allergen.
• Interestingly, pollens may be inhaled resulting in IgE which cross-reacts with proteins found in fruits and vegetables.
• Food allergies are usually acquired within the first 2 years of life.
• Previously it was thought that delaying the introduction of solid foods to infants would protect against allergies. We now know that the reverse is true (article at right).

Food Allergy Epidemiology
• 4-6% of children.
• <4% of adults.
• Childhood allergies to milk, egg, wheat, and soy generally disappear during childhood.
• Allergies to peanut, tree nuts, fish, and shellfish are generally lifelong.
• Food allergies are increasing for unknown reasons, but some possible causes are as follows:
  • Hygiene hypothesis – people live in cleaner conditions and the immune system is less likely to tolerate antigens.
  • Better diagnosis – laboratory tests, especially for IgE are available.
  • Processing of foods increases the concentration of allergens.
  • Food proteins are being used in other products (skin creams, etc).

Food Allergy Epidemiology
• The majority of allergies (90%) are caused by 8 foods:
  • Peanut
  • Tree Nuts (Brazil, Cashew, etc.)
  • Soybean
  • Milk
  • Wheat
  • Egg
  • Fish
  • Shellfish
• Peanuts cause more serious reactions that all of the other food allergies combined.
Food Allergy – Milk Allergy vs. Lactose Intolerance

- **Milk Allergy**
  - Symptoms can range from mild (hives, most common) to severe (anaphylactic shock, rare).
  - 0.5% of children <3 years old are allergic to milk.
  - Most outgrow this allergy.
  - Caused by an immune response to milk proteins.
  - Almost always cow’s milk.
  - Prevention is avoiding milk and milk products.

- **Lactose Intolerance**
  - Symptoms involve the GI tract including bloating, nausea, diarrhea.
  - Caused by a lack of the enzyme lactase which breaks down the proteins in milk.
  - Often treated using Lactaid (which contains the enzyme) or probiotics, including yogurt (which contain microorganisms).
  - Does NOT involve the immune system and is NOT a life-threatening condition.

Lactose Intolerance (continued)

- All infants produce lactase and successfully digest lactose in milk or formula.
- However, lactase production decreases in most children after weaning.
- The drop in lactase production results in lactose intolerance.
- Most people can still tolerate lactose in smaller amounts and therefore it is recommended that dairy consumption is managed, not restricted.
- Dietary management also includes consumption of yogurt, use of probiotics, use of dairy products with hydrolyzed lactose (Lactaid).

Food Allergy - Wheat

- Allergies to wheat:
  - Symptoms includes rashes, hives, swelling.
  - Serious reactions are possible but rare.
  - Foods containing wheat are required to be labeled.
  - Preventable by avoiding foods containing wheat.
  - 10% of the population may be sensitive to wheat, however, fully 30% of the population reports reducing or eliminating wheat from their diets.
  - Possible for reasons described on the next slide.

Gluten-related Disorders

- There are two types of conditions which are often related to wheat but are actually caused by gluten (which is present in wheat).
  - Celiac disease – an autoimmune disease which damages the small intestine.
  - Non-celiac gluten sensitivity – most common symptoms are abdominal pain, bloating, diarrhea, or constipation, without small intestine damage.
  - Note: this topic is highly controversial in that many scientists do not believe that non-celiac gluten sensitivity exists.
  - Studies have demonstrated that the symptoms are often the result of lactose, rather than gluten.

Biotechnology and Allergy

- Biotechnology can be used to remove plant-derived allergens and reduce toxins from foods. Although these foods have been produced in the laboratory, none are currently available in stores (as of late 2015):
  - Rice
  - Soybean
  - Apple
  - Tomato
  - Peanut
  - Cassava (toxins)
  - Wheat
- Peanuts are responsible for approximately 200 deaths per year. These deaths are preventable using the GM peanut. Do you think this peanut should be approved?

Non-Intentionally Added Chemical Hazards

- Some chemicals may contaminate foods unintentionally.
  - These include:
    - Pork
    - Lubricants
    - Sanitizers
    - Cleaners
    - Coatings
    - Metals (from inferior metal food contact surfaces)
  - In the case shown at right, a rodenticide containing barium was accidentally used instead of flour.
Contamination – Gentian Violet

- A recent recall (July 2016) has implicated gentian violet (crystal violet for you microbiologists) in catfish.
- Gentian violet is an antiseptic and may be used for preventing diseases in some animals and is used to treat thrush in humans.
- Carcinogenic and mutagenic potential has been shown in rats. Therefore, exposure should be tightly controlled.

Physical Hazards

- Physical hazards are foreign objects in foods that can cause illness or injury.
- Physical hazards are usually the result of accidental contamination and poor food-handling practices.
- Physical hazards can enter the food supply anywhere from farm to fork.

Preventing Physical Hazards in Foods

- Raw fruits and vegetables must be washed.
- Foods that cannot be washed should be visually inspected for hazards:
  - Many producers use X-rays and/or metal detectors.
  - NOTE: X-rays and all forms of sensing radiation are prohibited in organic foods.
- Safe food handling practices at each step should be used to prevent accidental contamination.
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- Workers should not be allowed to wear jewelry (plain wedding bands are often allowed).

Antimicrobial Use in Feed Animals

- Antimicrobials are delivered to animals for the following reasons:
  - Disease treatment
  - Disease prevention
  - Disease control
  - Growth promotion/feed efficiency:
    - Antibiotics are added to animal feed or drinking water to help them gain weight faster or use less food to gain weight.
Why Oppose Antibiotic Use in Feed Animals?

- The following are the major consumer concerns associated with the use of antibiotics in feed animals:
  - Allergic reactions in persons with sensitivity to the antibiotic.
  - Development of antibiotic-resistant bacteria.
  - Concerns about animal welfare when antibiotics are used for growth.

Use of Antibiotics to Enhance Growth

- The FDA is implementing a plan to phase out the use of MEDICALLY IMPORTANT antibiotics for enhancing food production.
  - Medically important antibiotics are those used to treat, prevent, and control diseases.
  - The FDA guidelines are the result of findings that all uses of antimicrobial drugs in both humans and animals, contribute to the development of antimicrobial resistance.

Why Not Phase Out All Antibiotics in Food?

- Banning the use of all antibiotics on farms would have the following consequences:
  - Unable to treat sick animals.
  - Unable to prevent the spread of diseases.
  - Animal suffering.
  - Animal mortality.
  - Cost – loss of animals would result in a significant profit loss for the farmer.

Are Antibiotics Used in the Production of Organic Foods?

- Antibiotics may not be used in the production of organic foods.
  - As shown in the USDA rule at right, antibiotics MUST be used to treat sick animals, which can no longer be sold as organic.
  - Organic animal handling practices minimize the occurrence and spread of diseases.

Are we Eating Antibiotics?

- Milk is strictly tested for antibiotics and positive samples cannot be sold to the public.
  - Antibiotic residues do exist for a limited time in edible tissues, so the potential for ingestion exists if the producer fails to observe the waiting period or screening fails.

Addressing Consumer’s Concerns on Antibiotics in Foods

- The following are the major consumer concerns associated with the use of antibiotics in feed animals:
  - Allergic reactions in persons with sensitivity to the antibiotic.
    - Do not support any role for antibiotics in enhancing food production.
    - Allergies are not caused by the antibiotic itself but by the immune system's reaction to it.
  - Development of antibiotic-resistant bacteria.
    - Overuse of antibiotics to both humans and animals results in resistant organisms. Antibiotics should not be used as feed additives.
  - Concerns about animal welfare when antibiotics are used for growth.
    - The FDA is in the process of banning the use of antibiotics for growth promotion.
Growth Hormones

- Growth hormones have been approved for use in the food industry since the 1950s.
- Hormones are used to promote growth and to increase the leanness of meats.
- Includes naturally-occurring hormones such as estrogen and testosterone, and synthetic compounds.
- Note: Hormones are drugs and are therefore subject to FDA testing and approval.

What are the Concerns with Growth Hormones?

- There are two main concerns regarding growth hormones:
  - Concerns that trace amounts of hormones remaining in meat may lead to early puberty.
  - Concerns that trace amounts of hormones remaining in milk may lead to increased production of IGF-1.
  - IGF-1 has been linked to several human diseases.

Growth Hormones in Meat

- Growth hormones are only approved for use in cattle (as of 2014)!
- The use of growth hormone can increase the food yield of single head of cattle by 10-15%.
- Estimates of the amount of hormone in meat due to treatment are unreliable as the hormones occur naturally.
  - Overall, the hormones are present in extremely low concentration.
  - Despite concerns, no health risks have yet been linked to the use of growth hormones in cattle.

Growth Hormones in Milk

- Recombinant bovine growth hormone (rbGH) is given to dairy cows to increase milk production.
- rbGH use increases the concentration of IGF-1 (insulin-like growth factor 1) in cow’s milk.
- Both rbGH and IGF-1 are present in cow’s milk.
  - However, humans do not possess receptors for rbGH.
  - IGF-1 is present in concentrations naturally found in humans.
  - IGF-1 may play a role in the development of diseases in humans, complex pathway, not completely understood (see right).

Growth Hormones in Milk (Continued)

- No studies have demonstrated a link between rbGH milk and adverse human health.
- The following however may be consequences of using rbGH:
  - Higher incidence of mastitis in cows.
  - Required treatment with antibiotics and therefore contributes to overuse of antibiotics.

Growth Hormones Summary

- Growth hormones are used to increase profits.
- No known health effects occur in humans (despite the picture at right, a good illustration of why science information on the Internet is not always reliable).
- Animals may suffer from the use of growth hormones.
- rbGH, growth hormones will be the next target of elimination due to consumer concerns.
  - Less than 20% of all milk producers use rbGH due to consumer concerns.
  - Check your milk, is it rbGH free?
Food Additives

- Several things may be added to foods:
  - Preservatives – resist spoiling
  - Colors – including artificial
  - Flavors – including artificial
  - Nutrients – fortified foods
  - Sweeteners
  - Others

- NOTE: 1000s of additives are used in the food industry and due to time, only a few can be covered in this lecture.

Food Additives - Preservatives

- Most food additives are preservatives, they are added to help food resist spoilage.
- Sugar and salt and compounds containing each resist the growth of bacteria by withdrawing water from food.
- These are added sugars and salts which have nutritional consequences which are beyond the scope of this course.

- List of common preservatives:
  - Citric acid
  - Ascorbic acid
  - Sodium benzoate
  - Sodium nitrite
  - Calcium nitrate
  - Potassium sorbate
  - BHA
  - BHT
  - EDTA
  - Tocopherols (Vitamin E)

Preservatives – BHA and BHT

- BHA and BHT are added to foods to prevent rancidity.
- Consumers have raised concerns because studies have predicted that both may be human carcinogens.
- Conversely, some studies suggest they may protect against cancer.
- FDA has approved the use of both at current levels because no health effects are seen at low levels of exposure.

Colors

- Colors are added to offset the loss of colors due to light and air exposure, to change colorless items, to add "fun" colors, and to alert the customer to the taste (for example, the yellow ones taste like banana).
- Very few artificial colors are FDA approved.
- Survived extensive safety testing.
- Use is strictly controlled.
- Some colors such as beta-carotene are added to deepen existing colors:
  - Adds a deep pink hue to salmon.

Some colors such as beta-carotene are added to deepen existing colors:

- FD&C Blue Nos 1 and 2
- FD&C Red Nos 3 and 40
- FD&C Green No. 3
- FD&C Yellow Nos 5 and 6
- Annatto extract
- Beta-carotene
- Vegetable and Fruit Juices, etc.

Colors – Yellow 5 and 6 – Mac and Cheese

- Due to consumer concerns, yellow dyes No. 5 and 6 were removed from some Kraft Macaroni and Cheese.
- In Europe foods with these dyes are labeled that they may cause hyperactivity in children.
- The FDA has cited several problems with this conclusion and insists that data does not support a role for these dyes in attention deficit disorders.
- Both dyes continue to be approved for use in the US.

Artificial flavors are often matched to artificial colors.

Food Additives - Flavors

- Many foods taste good because of the added natural and artificial flavors.
  - See next slide
- Many foods contain both artificial and natural flavors.
- Flavor enhancers act to improve the taste of flavors already present.
- Note: colors and flavors are matched to alert the consumer:
  - In other words, if you don’t like banana flavor, don’t eat the yellow candy.

- Flavor enhancers may include:
  - MSG – monosodium glutamate
  - Hydrolyzed soy protein
  - Autolyzed yeast extract
Food Additives – Flavors (continued)

- Natural flavors include:
  - Spices
  - Herbs
  - Bark, Leaf, Bud, or other plant material
  - Essential oils
  - Fruit and fruit juices
  - Vegetables and Vegetable juices
  - Meat, Poultry, Eggs
  - Seafood
  - Dairy

- Synthetic flavors:
  - Made in a laboratory using chemicals.

Note: both are derived from chemicals, only the source is different. 1000s of flavorings have been tested with no health effects noted.

Food Additives – Flavor Enhancer - MSG

- Monosodium glutamate is added to foods to enhance their flavor.
- MSG enhances food’s flavor by triggering a savory response.
- Many persons have reported a link between MSG and physiological responses, especially headaches.
- Despite these reports, no clinical study has been able to show a link and MSG remains FDA approved.

Food Additives – Nutrients

- Nutrients may be added to foods to replace vitamins and minerals that are lost during processing.
- Nutrients may also be added to add vitamins or minerals lacking in the diet (fortification).

Commonly added nutrients include:
- Thiamin
- Niacin
- Riboflavin
- Folate
- Iron
- Iodine
- Vitamin A
- Vitamin D
- Vitamin C
- Calcium
- Vitamin B12
- Amino acids

Food Additives – Nutrients – Vitamin D

- Many diseases can be prevented by fortifying foods.
- In the United States, we fortify a number of foods, especially milk, flour, and cereals with vitamins such as vitamin D.
- Check your foods, are they fortified?
- The UK does not fortify milk and flour and this may be contributing to a resurgence of rickets in that country.

Food Additives – Sweeteners

- Refers to a number of compounds added to foods to increase sweetness, with or without added calories.
- Please note, the controversy surrounding high fructose corn syrup is not a safety issue and will not be discussed in this course.
- All added sugars have health consequences and are beyond the scope of this lecture.

Common sweeteners include:
- Sucrose
- Fructose
- Glucose
- Sorbitol
- Mannitol
- Corn syrup
- High Fructose Corn Syrup
- Saccharin – Sweet n’ Low®
- Aspartame – NutraSweet® /Equal®
- Sucralose – Splenda®

Despite repeated testing and assurances from Public Health agencies, the public is still bombarded with unsubstantiated claims on the health risks from artificial sweeteners.
Food Additives - Others

- Fat replacers
- Emulsifiers
- Stabilizers
- pH control
- Leavening agents
- Anti-caking agents
- Dough strengtheners and Conditioners
- Firming agents
- Enzymes
- Gases
- Etc.

Lecture Summary

- Food allergies affect a significant portion of the population and labeling is required to prevent illnesses.
- Physical and chemical hazards to the food supply exist along the entire production line and care must be taken to avoid accidents.
- Antibiotics have an important role in animal health, but like growth hormones, their role in growth promotion is controversial.
- Food additives including colors, flavors, and preservatives are commonly added to foods and are considered safe with no known health effects noted.