Welcome to lecture 15! We are going to cover three important topics in food safety. These are biosecurity, bioterrorism, and agroterrorism. A lot of people really don’t think about keeping our food safe at the farm and other places where these factors come into play. So I hope you find today’s lecture interesting.

The following are the objectives for this lecture. Describe biosecurity and why it is critical to maintaining a safe food supply. We will explain the importance of food defense and the role of the government agencies. We will list the organisms most likely to be used for bioterrorism and the likely perpetrators. We will then do the same for agroterrorism. Hopefully you will understand that bioterrorism and agroterrorism are different though there may be some crossover in these two areas.

Biosecurity is something that many of us haven’t concerned in reference to our food supply. It refers to protecting the following from pests and diseases: economy, environment, community. For our purposes, we are referring only to biosecurity related to the food supply, but biosecurity is also applicable to general health. Annually about 10% of the food supply is lost to disease and pests. Biosecurity plans are put in place to prevent the introduction of disease and pests.

Many farms have signs such as this seen on the right. This could be on any kind of an agricultural facility. They may say something like “visitors please respect – Farm Biosecurity. Vehicles, machinery, people and animals can carry weed seeds, pests and diseases”. So the idea of putting these signs up is to prevent people from entering areas in which they can cause problems.
Biosecurity is managing the risks and potential harm from pests and diseases entering, emerging, establishing, or spreading in a region. For example, we currently have an outbreak of avian influenza in the Midwest. What would happen if a News crew did a story at an infected facility and then visited one that isn’t affected? Do you think they could carry disease on their trucks, clothing, etc? Biosecurity plans are in place to try to prevent these sorts of things from happening. Examples of managing risks can include restricted entry and practicing good hygiene. This can be very simple like buckets of bleach to clean boots off when entering and leaving farm areas. Control of pests is important and we talked about use of antibiotics to control diseases. There is a need to prevent cross contamination. Sick animals should be isolated. Diseases animals should be disposed. Recall the pictures of the battery cage and chickens walking on a dead chicken. This is a major problem and shouldn’t be allowed. Water sanitation and feed sanitation are important. The water coming into a farm needs to be clean. You cannot water crops with dirty water. We talked about how produce becomes contaminated if the water is dirty. There is a huge biosecurity risk if people trespass on farmland. In Indiana they introduced a bill to crack down on trespassers who enter farms. The law seeks to impose higher penalties for trespassing. Issues are sometimes related to activists attempted to take video of what they believe to be cruel behaviors at farms. They do pose a great security risk. Activists who are concerned can always contact the humane society who can investigate any charges.

Who are we concerned with about biosecurity risks? Mostly activists. Activists sometimes use extreme methods to protest activities at farms. Although they are often well intentioned, their methods can and do create significant biosecurity risks at farms and other establishments. For example, as shown at right, animal activists broke into a facility and put hen’s lives at risk. There have been issues were activists have set animals free in areas in which they don’t know how to survive. Activists have also freed diseased animals creating a potential for disease spread.
Slide 6

Biosecurity Risks - Imports
- Agricultural products cross many borders and the following could inadvertently be imported:
  - Exotic diseases
  - Exotic pests
  - Banned chemicals

There is also a biosecurity risk associated with imported foods. Agricultural products cross many borders and the following could inadvertently be imported. We could bring in exotic diseases. We could bring in exotic pests. And as I showed you before, we can also bring in banned chemicals. Here is another case of that on the right. The California Public Health Department warned that a dangerous pesticide was imported on edible cactus. Remember we talked about the circle of poison issue before and how this can occur.

Slide 7

Food Defense
- The food supply is vulnerable to deliberate acts of terrorism:
  - Large number of food products makes enforcement of safety regulations difficult.
  - Large number of imported foods, only a small number of which are inspected.
  - Millions of people involved in food production.
  - Large number of food establishments.

Why so much worry about food defense? You might remember this slide from the very first lecture in this class. The food supply is vulnerable to deliberate acts of terrorism. There are a large number of food products which makes enforcement of safety regulations difficult. Not to scare you but think about the number of foods in the grocery that someone could tamper with that no one would notice. There are lots of foods without packages such as fruits and vegetables. There are lots of packages that could be opened and shut again without the consumer noticing, such as bread. There are a large number of imported foods and only a small number of those are inspected. We will talk about how FSMA addresses this problem in the last section of this class. Millions of people are involved in food production. Unfortunately, some of those people have “issues” to put it mildly. Sometimes they are angry at their boss like we saw with the woman with the salsa. They may attempt to do something deliberately. There are a large number of food establishments which makes it very hard to police all of them. Usually when food is involved, the goal is economic harm, not killing people. It is usually an attack against a country or a food producer. Several agencies are involved in food defense, see next slides.

Slide 8

Before you move on, take a minute and read the FDA's Mission Statement. Especially note the role of the FDA in security of the food supply. I would like you to do this not only to learn the security role of the FDA but in the last section of the course we will discuss the various agencies and what they do. They included all of these in their mission statement.
The USDA also plays an important role in regulating foods and in food safety. We will talk about what USDA does in the last section but it is important to note here that they control all (most) of the food animals. They are very concerned with biosecurity and activist activities involving farms. Please note that food defense is a key mission of FSIS. FSIS is the Food Safety and Inspection Service and we will talk more about what they do in that last section. One of their major goals is food defense and emergency response. One of the reasons we are covering these agencies is that their role in defense can provide jobs if you are interested in working in that area.

Recall that introduction of banned pesticides and the deliberate use of pesticides are threats to the food supply. This is a reminder that pesticides are largely regulated by the EPA. The EPA’s mission is in part to reduce risks associated with chemicals used on foods and reduce the risks of pesticides. They are the key agency when considering biosafety and pesticide use.

The one agency you might not have considered is the FBI. The FBI will get involved in the case of a food terrorism event. They can also get involved in other criminal charges related to foods. Just so you know, they do have a lot of meetings and discussion around agroterrorism and bioterrorism and will get involved if these occur.

The FBI was involved in this investigation shown. This happened at a Starbucks. A California woman went into a San Jose branch and took bottle of orange juice home with her. She put lethal amounts of rubbing alcohol (please note instructor misspoke and said pesticide) in the bottles. This woman was a chemist. Took them back to the Starbucks and put them back on the shelf. Fortunately, people noticed her trying to switch out the bottles and reported it before anyone got sick. To this day she hasn’t really said why she did this.
As mentioned, I worked in a bioterrorism lab for many years so I would like to talk to you a little bit about bioterrorism and food safety. We did a lot of work with food, it is an important topic, and many people are concerned about the safety of the food supply. Bioterrorism includes the use of pathogenic microorganisms and plant or microbial toxins against persons or property to intimidate or coerce a government, and/or the civilian population for political or social goals. That is a mouthful! They use deadly organisms or toxins for political goals is a good summary. For the most part, bioterrorism isn’t so much about killing people as it is to make a statement.

Please note that for the purpose of our lecture, we are only discussing organisms likely to be delivered via food. There are some organisms considered “select agents” that come from food animals, but would not likely be delivered via food especially: Bacillus anthracis, Brucella, and Francisella tularensis. The reason being is that this organisms can be spread by much more effective routes. Using a foodborne route would be difficult. You will recall that anthrax was used in the 2001 bioterrorism acts but this was intended to be by inhalation route. However, as seen in the picture, one of the cases was cutaneous anthrax.

Let’s talk about intentional food poisoning. The organisms that have been suggested as the most likely to be used in bioterror attacks include Salmonella because it causes a self-limiting illness. Salmonella is easy to grow. You would think self-limiting illness wouldn’t be the first choice but often the people responsible for these attacks make themselves sick doing it. Often the goal is to incapacitate people for a short amount of time. This is one reason why Salmonella has been a favorite pathogen. Shigella has a very low infectious dose so you don’t need much to attack many people. Staphylococcus toxin is very effective at very low doses. Studies using Staphylococcus enterotoxin B have shown it is very effective via the aerosol route as well. On the right is a picture of members of a cult. The cult was ultimately convicted of contaminating foods with Salmonella.
**Slide 16**

*Salmonella - Bioterrorism - Dalles, Oregon (1984)*

- Salmonella has been used in the past as a bioterror agent in food. This occurred in 1984 in Oregon. The Rajneeshees were a cult in Dalles whose members intentionally spread *Salmonella* in salad bars to influence local elections. Recall that bioterrorism is often used for political gain. They reasoned that if everyone in the area was sick, they would vote. If they didn’t vote, cult members could vote their own member into the city council. Fortunately, this actually failed. As you can see on the right side, 750 people became sick, luckily no one had serious illness. You can see the leader of the cult on the bottom right hand side.

**Slide 17**

*Salmonella - Bioterrorism - Dalles, Oregon (1984)*

- The leader of the cult was initially arrested on immigration charges. You can see his picture here again on the right. Other cult members were later arrested after one member defected and reported the *Salmonella* attack to the FBI. That is a scary thought! They were not discovered until one of their members turned on the cult. Once the FBI investigated the cult’s facilities, and there were many as this was a huge cult, they found not only *Salmonella* but *Yersinia pestis* the cause of the plague. It is much harder to get these organisms today, but in that past groups like this were able to acquire them. The FBI was not able to convict the cult leader. This was prior to 9/11 and we didn’t have the strict laws regarding terrorism that we have today (think Patriot Act). This guy got out of jail a long time ago and has established a new cult (if you will) in India.

**Slide 18**

*Shigella – Bioterrorism – Dallas, Texas (1996)*

- In 1996, a hospital laboratory worker in Dallas intentionally spread *Shigella* and *Salmonella* to workers, sickening a dozen co-workers. She was acquitted of all charges. She went in and changed her boyfriend’s hospital records because she was healthy and many people got sick including her boyfriend. She then went in and changed her boyfriend’s hospital records because he was hospitalized with Shigella to reflect something else. She is currently serving a 20 year sentence. So do the math, when is this lady’s sentence up?

**Slide 19**

*Ascaris – Bioterrorism - Quebec - 1970*

- In 1970, a college student reportedly contaminated his roommate’s food with eggs from the *Ascaris* worm. The student denied having intentionally contaminated his roommate’s food despite having threatened to do so. Believe it or not, the lawyer got this kid acquitted. The reason is that this infection randomly occurs so they were not able to prove that the infections resulted from this kid’s actions. In this day and age, we would easily have linked the kid to the infections by DNA.
Now we begin our discussion of agroterrorism. There is some crossover between bioterrorism and agroterrorism. You may see the same organisms used and the same motivation. Agroterrorism is defined as the deliberate introduction of an animal or plant disease for the following purposes. They may want to generate fear. They may want to cause economic losses. They may want to cause social unrest. And it is possible they may want to cause loss of confidence in the government. There has been a lot of talk about whether America’s food supply at its source (think farms) is safe from agroterrorism.

The following groups are considered to be high risk for agroterrorism. Of course terrorist groups and this includes both domestic and foreign. Disgruntled employees could be a potential problem. And again we have activist groups. In an FBI report, a gentleman who no longer works for the FBI in part for saying this on a public stage said the following. “The US food supply is among the most vulnerable and least protected potential targets of attack.” He then went on to say “I am surprised that no one has yet attacked foods”.

In case you didn’t think terrorist groups were thinking about this, here is a report from the FBI. “When American and allied forces overran al Qaeda sanctuaries in the caves of eastern Afghanistan in 2002, among the thousands of documents they discovered were U.S. agricultural documents and al Qaeda training manuals targeting agriculture”. You can see a piece of this one the right hand side. The Derunta training camp has a poisons course that lasts approximately two weeks and teaches students how to poison foods.

Disgruntled employees can be a problem as well. This is a case that happened in New Zealand. New Zealand has a problem with rabbits. Rabbits can destroy various crops. Some farmers got upset that the government wasn’t doing enough to control rabbits. They released a hemorrhagic disease to kill rabbits. This is problematic as the disease can spread and it is cruel to the animals.

As mentioned, activists groups can be a problem. One of the most common activists groups in the US in the Animal Liberation Front or ALF. They are suspected of burning 14 cattle hauling trucks at a large meat company. Fortunately, no animals were harmed as they were seeking to do economic damage to the company. In this case they didn’t use a disease, but instead they destroyed the property of the food company.
The following are the methods most likely used for agroterrorism. Threats to animals and plants include domestic pests. It is possible that someone could spread diseases or pests already present in the United States. There is also the possibility of introducing foreign pests. It is possible that someone could bring in and introduce prions, ergot, Trichinella, or various types of insects. Use of chemicals is much more likely because pesticides and herbicides are readily available. They could be inappropriately used to kill animals. Very unlikely but possible is the use of radioactive substances. You can see on the right that many states have agricultural emergency response teams. They can respond to any agroterrorism, bioterrorism, or things like the current avian influenza outbreak.

Agroterrorism could be carried out in the United States by intentionally dispersing pests. That includes both insects and microbes that are already present in the country. You could spread them to new areas, larger areas, or new crops. There have been new introductions that occurred and activists have claimed to be responsible. However, in most of these cases it is unlikely that activists had any role. [Note added: they like to take credit for things they didn’t do].

Another problem could be the use of foreign pests. Experts believe that terrorists would be most likely to use food and mouth disease. Please note that food and mouth disease is completely different than hand, food, and mouth disease that occurs in children. This is a very dangerous agricultural disease. It causes painful blisters on the tongue as shown in the picture, on the hooves, and teats of cattle, hogs, sheep, goats, and deer. Animals are unable to walk, give milk, or drink and usually it is fatal. The airborne transmission range of FMD virus is 50 miles. This is a huge concern as it could spread very rapidly. FMD was eradicated in the US in the 1920s but it still exists in many countries.

This brings us to the idea of chemicals that could be used for agroterrorism. Refers to the use of toxic chemicals to poison foods or beverages. Pesticides provide a readily available poison for use at the farm. You wouldn’t have to go very far to find a pesticide to poison food animals. Many consider botulinum toxin as a likely candidate for agroterrorism. Recall that I said there is some crossover here as this is a toxin from a microorganism and could also be considered bioterrorism. Many countries including the US used botulinum toxin in their biological warfare programs. We know a lot about this toxin as it has been used in the past.
Radioactive substances would be unlikely but a great deal of fear could be generated by introducing a radioactive substance to the food supply. Largely because most people don't really understand what radioactive substances can do, they are not physically visible, and they are hard to detect if you are not looking for them. It is considered unlikely as these substances are highly regulated. The most likely source would be radioactive waste. You may remember the story on right for a few years ago. A truck was stolen that was carrying medical waste. Whomever stole this truck, opened the container. No one knows who stole it, but by opening the container they exposed themselves to fatal amounts of radioactivity.

Also recall that the heated controversy around GM crops has made them a popular target for activists. I told you about the activists who destroyed the Golden Rice field trial. This is a great economic loss but also a huge loss to the science.

Looking at cases of terrorism involving food in the 1900s (please note instructor misspoke and said in the 90s here). Note the cases and the perpetrators involved. Note all the physicians! Then dentists and chemists. In other words, people who have access to biologicals are most likely to use them.

How do we prevent this? Really the best we can do is vigilance. Farmers and other workers in the food industry should report any suspicious activity. Farmers do work hard to keep people out of their fields. Education on biosecurity is important and requires safe food handling practices. Regulation is really important. We need to ensure that biological agents cannot get into the hands of people who would use them for wrongful deeds. Chemicals are another issue and many places are locking up pesticides. Radiologicals are highly regulated and must be secured wherever possible. And of course surveillance, we are always testing for the introduction of agents. When outbreak occurs we also think about bioterrorism and agroterrorism.
This brings us to a few slides on food irradiation. This may seem like an odd place to put these slides but some of the terrorism and agroterrorism risks could be negated by irradiating foods at the end point. In other words, contaminated foods wouldn’t matter if they were irradiated before entering the market. Right now all irradiated foods must have the Radura symbol (shown at right). But only if the entire food has been irradiated, not required if ingredients such as spices have been irradiated. Please note that legislation in progress may change this requirement. This is an unexpected consequence of the demand for GMO labels. The FDA has said that GMOs do not require labels because they are safe. People against GMOs said the FDA said the same about irradiated foods but requires them to be labeled. The FDA has countered that they are going to remove the irradiation label requirements. The FDA and USDA approval has been obtained to irradiate wheat flour, potatoes, pork, poultry, meat, fruit and vegetables, and herbs and spices.

You may be wondering why is everyone so interested in irradiating foods? It is one process that is very quickly done that can do all the things shown in the figure at right. It can inhibit sprouts. You probably know that if you have an onion or a potato in your refrigerator for a long period of time it will begin to sprout. Irradiation can delay this process. Irradiations can disinfect insects. Many cereals contain insect parts despite the best efforts to screen them out. Irradiation can disinfect remaining insect parts. It can extend the shelf-life of chicken, meat, and fish. If can allow certain foods to bypass quarantine. Some fruits have to undergo quarantine during which they can go bad. And of course the biggest thing is pathogen reduction. Disease causing germs are reduced or eliminated. The food does not become radioactive. This has always been a big concern. Years ago people thought microwaving foods made them radioactive. Dangerous substances do not appear in foods. The nutritional value of the food may change but not significantly more than tradition methods. For example, pasteurization may slightly change the nutritional value of milk but the change is negligible. Currently we irradiate all kinds of non-food items including band-aids, tampons, cotton balls, Q-tips, and on and on.
Slide 35

**Food Irradiation - the Negative**
- Some countries have banned the use of irradiation on food.
- Long-term effects of irradiation are unknown.
- Eggs and some vegetables become mushy with radiation.
- Irradiation is not widely available.
- Irradiation does not destroy viruses.

What is the negative side of this? Some countries have banned the use of irradiation on food. Largely those are the same countries and places that don’t allow nuclear power. In other words, they are against any of these types of technologies. The long-term effects of irradiation are unknown because we really don’t do much of it. Eggs and some vegetables become mushy with radiation and no one really knows why this is. Irradiation is not widely available. Even if you wanted to do this, you wouldn’t be able to do so. And finally, irradiation does not destroy viruses because of their small size. It would be useless against pathogens like norovirus.

Slide 36

**Lecture Summary**
- The food supply is vulnerable to attack from both domestic and foreign terrorists.
- The motivations for attack include monetary, activism, personal, and anti-governmental.
- A large scale attack would have devastating effects on the US economy and exports.
- Steps are in place to preserve biosecurity and prevent bio- and agroterrorism.

To sum up this lecture, the food supply is vulnerable to attack from both domestic and foreign terrorists. The motivations for attack include monetary, activism, personal, and anti-governmental.

A large scale attack would have devastating effects on the US economy and exports. Steps are in place to preserve biosecurity and prevent bio- and agroterrorism.