

**WORLD FOOD PRIZE SYMPOSIUM
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Thank you, Dr. Horn, for that very kind introduction. It's a real pleasure to be with all of you and be a part of this very distinguished program.

As a food microbiologist, we have traditionally been interested in doing what we can to reduce or eliminate pathogens that are associated with foods. But with the recent events of the day, a new perspective has been brought to us which has, you might say, made it an even more difficult challenge. And that is the issue of intentionally adding microbial contaminants.

There are two major driving forces that we have that I think are working against us, and that is the food processing industry has become more and more centralized in that it is producing more food, a large quantity of food, and packaging it and distributing it in a central location that is then sent out to a wide distribution, both nationally and in some cases internationally. And secondly, we have us as consumers wanting food that is more freshlike, less processed, convenient and ready to eat. And together, this makes the challenge of producing microbiologically safe foods that may be intentionally contaminated even a greater challenge.

So I want to share with you this afternoon what I perceive as some of the major challenges that are associated with producing safe foods that could conceivably be intentionally contaminated by foodborne pathogens. This is a list of what I consider to be some of the important factors that influence this challenge:

First of all, the degree of virulence of the bacteria that could be present. And I'm going to get into depth about each of these points.

Secondly, highly susceptible populations, of which we now have many in our population, are more sensitive to foodborne pathogens and the issues of intentional microbiological contamination.

Thirdly, there are pathogens that can survive and grow very well in foods, and this is another important point that needs to be considered. The scope of distribution of the foods, whether the foods are distributed regionally versus nationally or internationally, is also a very important component. Detection of pathogens in foods is what I consider to be a weakness, and many people think that the government and others can resolve our food safety problem by simply testing foods and determining which ones are contaminated. And then finally, as I mentioned, the microbial inactivation treatments that are applied to foods before consumption are a very important factor.

Now, relative to the virulence of pathogens, those that in my view are of greatest concern are those that are highly infectious, which means less than a hundred cells. Ingesting a very low

population of these organisms can produce illness, and if they do produce illness, it can be a very severe disease, such as kidney failure or something that will lead to death.

And here are a few examples of some of those types of pathogens that I think are truly of concern: The e-coli 0157, 87 that we heard earlier – this organism, it's thought that ingesting as few as ten cells can produce illness. And in children, 10% of those children that develop bloody diarrhea will lead to a syndrome called hemolytic ___ syndrome, which is kidney failure that can ultimately lead to death. Shigella dysenteriae, another very severe pathogen with low infectious dose. Salmonella typhi, cyclospora, hepatitis A virus – all very infectious organisms that have very severe symptoms of illness.

You notice I did not include anthrax on there, and based on what we're learning, this organism does not appear to be highly contagious. It appears that we have to ingest rather large numbers in order to develop illness, and so I haven't included that on my list.

Highly susceptible populations. This is a very important consideration because children, the amino-compromised, the elderly, are all much more susceptible to these types of bacteria than are the normal population. In fact, the infectious dose for these particular organisms is generally lower for these susceptible populations, and the severity of illness that's expressed ultimately is much greater than what we would see for those individuals that are not amino-compromised.

I mentioned survival of these pathogens in foods as being important. Well, micro-organisms differ widely in their ability to tolerate the adverse conditions that might be present in foods. But we have some organisms today that have unique tolerances to conditions like acid. Apple juice is an example. Acid in apple juice has long been considered to make apple safe from foodborne pathogens. We have had outbreaks recently associated with e-coli 0157 because this organism has unique acid tolerance. Cyclospora, a parasite, has been shown to be uniquely resistant to chlorine. So in water treatment, chlorine is not going to kill cyclospora. Nonfat dry milk powder has been a problem with Salmonella because this organism can survive drying processes for long periods of time.

The scope of distribution of the food is another very important factor. And this would influence how widely distributed the pathogen might be in the food supply. As I mentioned, widespread distribution, that is national distribution versus a regional distribution, could expose a food that's contaminated to millions of consumers.

Also, consumption profiles is another important consideration. Foods that are consumed by most segments of the population, and I could think of many, such as fresh salads that are packaged and ready to eat, milk, are just examples of those types of foods that would be widely consumed by a large segment of the population. And then we'd have specialty foods, such as kosher foods, that could be used to target very specific ethnic groups or very specific parts of our population.

I talked about detection as something... The average person thinks detection procedures can be relied on as a means of identifying those foods readily that are contaminated. And it

sounds good when you say it fast, but the reality is that, when there are low-level contamination of pathogens, we do not have tests that will rapidly detect these harmful bacteria. It normally will take a day or more to detect pathogens in a food.

And secondly, when pathogens are present in foods, they're generously not homogeneously distributed. They're not all the way through foods; there's usually spot contamination. And as a result, you would have to test an awful lot of the food to determine whether the pathogen is present or not, and that's just not practical with the size and scope of today's food market.

Microbiological inactivation treatments of foods – this is probably the most important slide I have here. And that is that the consumption of contaminated raw or minimally processed foods presents the greatest risk. But if we properly handle and heat treat foods, if we properly cook foods, we ourselves can control the situation, that is, we would kill the harmful bacteria that are present. However, the greater that a country's reliance is on those types of foods that are ready to consume, that means we have a greater risk of foodborne illness resulting from intentional contamination.

Now let me talk a bit about some of the food categories that are the most vulnerable to intentional pathogen contamination. I talked about treatment of the food by the food processor. Well, those types of foods that are going to be of highest risk are those that are minimally processed; they don't receive a heat treatment or something that would kill the pathogens that could already be on the food.

Secondly, the treatment by the food preparer – that's you and me or someone in food service. Whoever prepares that food for us is very important. And if it's a ready-to-eat food that is not further cooked, those types of foods would be of the highest risk. Of course, consumption patterns and rates, the highest-risk foods would be those foods that are consumed in large quantities and by large segments of the population – and I know you can think of many of those – and the survivability of the organism in the food. There are certain types of foods that we don't have antimicrobial properties to kill bacteria present, such as acid would be in certain types of beverages. Some foods, like chicken, for example – cooked chicken meat has very low preservatives, and as a result, harmful bacteria, if added, could survive for long periods of time.

Large-volume contamination of food would be another that would influence the risk of foods vulnerable to intentional contamination. If, for example, a food was processed in very large quantities, especially liquid, a small amount of inoculum of the bacterium could be added to this liquid and be spread throughout the product.

The scope of distribution – I mentioned that national distribution would be a higher risk than regional distribution. And a point that really needs to be emphasized is: we're poor security. In many processing facilities there are areas that are extremely sensitive where pathogens could be introduced. I don't want to give anyone any ideas, but if there were unscrupulous employees in these processing plants, these types of processes could be at high risk.

A few types of specific foods that I would consider to be highly vulnerable to intentional contamination would, first of all, be fresh produce. Many people say, “Well, just wash the fruit or wash the vegetables, and whatever dirt you remove takes away all the bacteria.” But that’s not true. I have a colleague that has done a lot of work in this area, and, frankly, just washing and rinsing fruit or vegetables will usually remove about tenfold or 90% of the bacteria. So if you have high-level contamination, that is not going to make produce safe. In fact, if it’s a leafy-type lettuce or leafy-type vegetable, the reality of it is, it’s going to be very hard to eliminate all the harmful bacteria that may be present.

Another type of product is the minimally processed, ready-to-eat produce – something I enjoy, where you can get, for example, lettuce that’s already been processed and put in a bag; you open the bag and eat it. These types of salads do not receive a heat treatment before consumption, at least, I don’t heat it before consumption – maybe some of you do. But they also can contain imported ingredients, especially certain times of the year when you can’t grow certain ingredients within this country. And if you look on the back, sometimes you’ll see, “Imported from Mexico” or certain other areas.

If you go out to California, for example, and see how this produce is harvested, you’ll see that the primary people employed are transient, immigrant labor; and they’re not only just employed in the processing field, but they’re also employed in the processing plants where the product is further processed. And these types of products are widely distributed. For example, we, in Georgia, receive fresh produce that has been cut and packaged from California, so that’s across the nation.

Another type of food that I would consider to be highly vulnerable are the minimally processed, ready-to-eat deli foods. Many grocery store chains are going to centralized locations where they will process and prepare these types of salads, tuna salad or noodles, that would then be distributed to all their different grocery stores throughout a region. And these products generally do not receive heat treatment prior to cooking. You bring them home in a package and keep them refrigerated and then eat them. They’re, as I say, prepared in a central facility, distributed widely, and, depending on the location, there may be an immigrant labor force that prepares these foods.

Beverages are another type of product that could be highly vulnerable, especially those that would receive minimal processing, such as fresh juices and those that have very weak antimicrobial activity.

So in summary, I’d like to bring out a few points. First of all, contaminated foods that have the greatest potential for adverse effects on human health, if they are intentionally contaminated, would be those foods in which micro-organisms are highly virulent and produce very severe illness, those foods that are supportive of pathogen survival and growth, those foods that are consumed raw or receive very minimal heat treatment before they’re consumed, those types of foods that are nationally or internationally distributed, and those types of foods that are consumed by a large segment of our population.

Now we have in our favor at our Centers for Disease Control, in cooperation with state health departments, a network that has been set up, that if harmful bacteria are isolated, they are fingerprinted, DNA tested; and the fingerprint is then fed to a databank at CDC and distributed across the country. And when common fingerprints show up in rather short periods of time, our Centers for Disease Control puts out an alert that there may be an outbreak in progress. And this is a way in which we are able to detect outbreaks that are occurring. So we have an excellent surveillance program in existence. The downside is, not all harmful bacteria are in the system. And so we need to expand that surveillance program.

Another thing that we need to consider is to develop strategies to categorize and securely produce foods that are of the greatest risk of intentional microbial contamination. And once we've developed this strategy and identified these high-risk foods, then processors of foods need to employ well-qualified and trustworthy personnel that would work in positions within that plant that are highly sensitive to the potential of intentional contamination.

We also need to work on developing innovative processes and treatments that will ensure the safety of these high-risk foods. If we don't want to rely on heat treatment as our ultimate treatment at home to treat foods, and if, for example, we like fresh lettuce and don't want to eat it cooked, then we're going to have to come up with some innovative processes or treatments that can be applied to keep those foods intact as a freshlike product.

Finally – I don't want to leave on a negative note – fortunately, most foodborne, infectious bacteria are very sensitive to heat. And if we pasteurize products or properly cook a food, we will kill it. And so we ourselves as consumers have control. Cooking foods before consumption will usually make them safe to eat.

And we've heard a lot about anthrax; we read a lot about it in the news. Well, about a year ago there was a small outbreak of anthrax, meatborne anthrax, in the state of Minnesota where a farmer had animals that actually were dying and annually bleeding, definite symptoms of anthrax. And he actually processed one of the animals, made hamburger out of it and steaks and put it in the freezer, and the family ate this meat. And of the several people who ate the meat, two became ill. But they were very mild symptoms – mild diarrhea and in one case some abdominal pain, nausea and diarrhea. None of them were treated, symptoms went away within two days. And so more and more evidence is indicated... By the way, this meat, they said, was fully cooked.

So there's more and more evidence to indicate that if we fully cook the foods that we eat, then the likelihood of being exposed to pathogens that might intentionally be added to foods and causing severe illness would be greatly minimized if not eliminate.

So with that, I think you for your attention.