



The slide features an orange background with white and yellow decorative elements. On the left, a dashed yellow arc is partially visible. In the upper right, a white circle contains a photograph of an open cardboard pizza box with a slice of pizza and some stains. Below this, a white circle contains the 'Think FOOD Safe' logo, which includes a green square with the text 'Think FOOD Safe' and a white fork icon. The text 'Leftover Food Safety' is written in white in the center-left. Below the title, the name 'Daniel Engeljohn' is written in a white italicized font, followed by 'Food Safety Expert', 'dengeljohn@aol.com', and '11-29-23' in a smaller white font. A small white number '1' is located in the bottom right corner of the slide.

Leftover Food Safety

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11-29-23

Think
FOOD
Safe

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#1 – Introduction.

Outline of Presentation

Concepts --

- What's a leftover?
- Safely handled leftovers
- Chilling properly, and why
- Reheating to serve versus cooking
- Microwave oven considerations
- Foodborne illness awareness

Discussion, questions, and answers



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#2 — We will touch on these issues but please let me know throughout the presentation if you have questions. I will make a copy of the presentation, along with my Notes pages available to anyone who wants a copy. I didn't make hard copies to hand out but can email the presentation to anyone, including your children, grandchildren, and friends.

What's a Leftover?

Food Leftover –

- Intentionally kept edible food remaining from a larger portion after serving

Food Loss –

- Intentionally discarded edible food not consumed after serving

Food Waste –

- Intentionally discarded edible food prior to preparation and serving



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#3 – What's a Leftover?

- Upfront, I want to distinguish between food leftovers, food waste, and food loss.
- The amount of food loss in every household can be reduced simply by either creating subsequent servings or by using the “waste” to make tasty soup broths than can later be used to make a host of new meals.
- The Economic Research Service (ERS) at the United States Department of Agriculture (USDA) has extensively researched the impact of food loss and food waste. Their findings have helped identify that the “Use By Date” on retail foods is a driver for discarding food. Be aware that the “Use By” date is for best quality and is not related to food safety. One exception to the quality versus safety intent of the “Use By” date is for baby food. Baby food beyond the “Use By” date may have decreased nutritional quality necessary for developing bodies. Regardless, the foods beyond the “Use By” date have valuable nutrients albeit the product may not be as aesthetically pleasing as you might want. We will touch on food spoilage later in the discussion, which is impacted by the “Use By” date.

Household Food Discards

- 25 % of what consumers buy is discarded
- 1.2 pounds of food is wasted daily for a value of \$1,500 annually
- No good estimates for leftovers
 - What's your practice?



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#4 – Impact of Food Discards, from ERS/USDA published research on food waste readily available free online at the USDA website (www.ers.usda.gov).

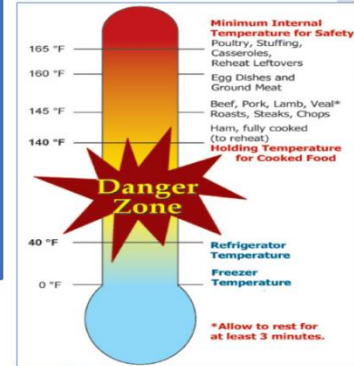
- I'd like to get a sense of how many of you collected at least one leftover meal in the past week or so. Show of hands.
- For those of you thinking you don't have leftovers in your refrigerator, let's see how many of you have an opened container of salami or cottage cheese; show of hands. Although the salami and cottage cheese may not be reheated before consuming, they technically are leftovers. Once the package of food is opened, the contents are "leftovers."

Safely Handled Pre-Leftovers

- Cooking goals --
 - As measured by a food thermometer, to an internal temperature
 - 145° Fahrenheit (F) – fish and pasta
 - 160° – red meat
 - 165° – poultry
 - Avoid the



...40° to 140°



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#5 — Safe cooking

- 165 degrees – poultry, stuffing, casseroles, reheating leftovers that potentially were cross contaminated or that are nearing 4 days old; 145 degrees – Beef, pork, lamb veal roasts, steaks, chops – Note that any thick items (greater than 0.5 inch) should rest for 3 minutes at the highest internal temperature before consuming).
- The food safety information for today’s presentation starts with an expectation that the leftover food was safety prepared and served. Note the “Danger Zone” and the standing/dwell time of at least 3 minutes of rest before consuming.
- Instant read thermometers can be purchased online, ranging in cost from \$8.00 up to \$56.00. The \$8.00 thermometers are just as reliable and accurate as the higher priced, in my opinion.
- Note the correct placement of a food thermometer in the thigh of a roasted turkey. The internal thigh contents are more shielded from heat than other parts of the turkey roast. Thus, for safety, check the thigh not the breast.
- For accurate internal temperature readings, when temperature-checking cuts of meat/poultry and ground meats less than 1.5 inches in thickness, be sure to place the thermometer tip through the side and not down through the top.

Safely Handled Pre-Leftovers

- Handwashing goals --
 - Think of "***Mary Had A Little Lamb***"
 - One verse is roughly 20 seconds
 - Rubbing soapy hands together under running water



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#6 — Applicable to handling food as well as everyday hygiene issues, including after a cough into the hand.

Safely Handled Pre-Leftovers

- Cross contamination goals
 - Don't touch ready-to-eat (RTE) with not-ready-to-eat (NRTE)
 - Do you know the difference?
 - Don't touch RTE foods bare handed
 - Use tongs or serving spoons instead
 - Keep items intended for RTE separate from NRTE



Although this is raw meat, some or all the vegetables may be used as RTE and/or NRTE

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#7 — Cross-contamination can occur at any time.

- Although I don't intend to offer advice on family gathering issues, we all need to be aware that poor hygiene is a documented leading cause of foodborne illness (as discussed later). At a family gathering for a holiday meal, be aware of these potential issues: Aunt Shirley's uncovered cough at the dinner table; Uncle Bernie's repeated dipping of his partially eaten dinner roll into the common gravy bowl; or Rascal, the cat, walking across the dinner table and the counter tops.
- Cross contamination may be the reason why you must thoroughly recook your leftovers versus simply warm them for best aesthetic appeal.

Chilling or Incubating?

- **Hint** – There are at least three food safety concerns in this pic...can you identify one or more?



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#8 — Most likely, this scenario will result in the incubation of pathogens in more than just the contents of the hot pot.

- Food safety issues:
 - Hot pot as evidenced by stove mittens
 - Sitting the hot pot directly on the refrigerator glass/plastic surface
 - Lack of tray or other catchment for moisture building onto the side of the container over time
 - Extra-large container of hot content that won't chill quickly at the center
 - Sitting the hot contents next to milk and other highly perishable items
 - Crowded refrigerator that doesn't allow for good cool air circulation

Safely Handled Leftovers

- Chilling goals --
 - Under refrigeration within 2 hours
 - Use small (short/wide) containers
 - Cover all items in the refrigerator, if feasible
 - Store at less than 41°



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#9 — Let's focus on the correct after-meal chilling aspects of food safety.

- Place a refrigerator thermometer into the cavity of the refrigerator. Cost online ranges from \$4.00 to \$26.00. The less expensive thermometers are just as accurate as the more expensive, in my opinion.
- One reason for covering all items relates to a discussion later but centers on one pathogenic microorganism – *Listeria monocytogenes* – that grows at temperatures above 41 degrees. The organism is ubiquitous in the environment and easily transfer on air currents inside and outside the refrigerator. Also, drippage and cross-contamination can be reduced when items are covered.
- Be sure not to overcrowd the refrigerator. Air circulation is critical for good chilling.
- Spoilage organisms are present on foods and grow well under refrigeration.

Safely Handled Leftovers

- Hot chilling (70° – 140°) goals --
 - Get into refrigeration within 2 hours ... but ...
 - MUST attain 41° within 4 hours!



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#10 —Importantly, for hot foods, an additional step prevents toxin formation!

Safely Handled Leftovers

- Why is chilling so important?
 - Microbial growth and toxin formation...illness/death
 - Even RTE foods can have surviving undetected pathogens
 - Rapid doubling every 20 minutes in the



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#11 — Microorganisms, both good and bad, are the reason for the concern about time and temperature. Microorganisms are ubiquitous in the environment and often at very high numbers.

- Consequently, when we think of killing off the microbes in food, think in terms of 10-fold reductions occurring over time. For the typical cooking of raw meat, the recommended safe internal temperature of 160 degrees achieves a 5-log reduction of *Salmonella*, resulting in 1 surviving cell for every 100,000 present (e.g., a 99.999 % reduction). For poultry, because the numbers of *Salmonella* generally are greater, a 7-log reduction at 165 degrees internal temperature is necessary to result in 1 surviving cell for every 10,000,000 present (i.e., a 99.99999 % reduction). It is estimated that as few as 15 cells of *Salmonella* in a serving of food will cause a foodborne infection. From these examples, there always is the consideration that at least 1 microbial cell survives the cooking process and is available for growth later on the leftovers if not properly refrigerated to slow or inhibit further growth.
- Generally, microorganisms can grow (i.e., double in number) every 20 minutes under favorable conditions.
- Favorable conditions exist at warm temperatures (between 70 degrees and 140 degrees), when there is moisture, and a protein-rich environment that is slightly acidic. This is why cakes, and most pastries can be unrefrigerated. They lack the necessary ingredients for microbial growth.
- Importantly, one organism, *Listeria monocytogenes*, grows well at 45 degrees (i.e., inside the refrigerator). This is why foods should be stored at 41 degrees or below. This situation reflects why the temperature range of 40 and 140 degrees is referred to as “the danger zone.”
- Know the temperature maintained in your refrigerator. Keep it as cold as possible. Ensure there is room in the refrigerator for air circulation, which facilitates cooling.
- Although microorganisms begin to die off at temperatures near 140 degrees, sitting at temperatures between 70 and 140 degrees incubates them. Some microorganisms, when at high numbers, create toxins that are not killed by subsequent cooking. It is these toxins that create one of the reasons for why you need to discard food left out of refrigeration for more than 4 hours, or that is not quickly chilled between 70 and 140 degrees.

- Starchy foods are commonly associated with *Bacillus cereus*, which forms a toxin that causes gastrointestinal illness involving vomiting and diarrhea.
- Meats, poultry, and gravies are commonly associated with *Clostridium perfringens*, which forms a toxin that causes gastrointestinal illness involving cramps, diarrhea, and bloating.
- Many of you may have heard of *Clostridium botulinum* (e.g., botulism). This is another organism that creates a toxin mostly due to improper canning. However, it is becoming more of a problem these days due to consumer preference for alternative cured products that do not include sodium nitrite. Sodium nitrite is the traditional curing agent that helps create the cured meat color (e.g., ham) and prohibits the growth of *Clostridium botulinum*. This organism also grows well in an oxygen-free environment (e.g., zip lock storage bag). Thus, individuals that select these alternative cured products and then temperature abuse the food (e.g., while hiking without refrigerating their bagged snacks), the toxin can grow. You can't cook out the toxin. Unfortunately, a quick death results.

Safely Handled Leftovers

- Why are covered containers so important?
 - Limits cross contamination from both drippage and “air deposits”
 - Protective due to favorable growth conditions on the surface of most foods (i.e., being moist, protein-rich, aerated, and slightly acidic)



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#12 — Although covered containers is important for preventing cross contamination such as drippage and tipping of stored items, over-stuffing the refrigerator (or freezer) also is important. Overstuffing prevents good air circulation and even cooling.

Safely Handled Leftovers

- What about spoilage?
 - Nature's way of telling you to discard
 - The food is beyond good eating quality
 - Some molds are encouraged (e.g., cheese)
 - Rancidity can occur under frozen storage due to oxidation
 - Can cause vomiting/upset stomach



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#13 — Spoilage organisms

- Keep in mind that there are good and bad microorganisms. Bad microbes cause an infectious foodborne illness. However, the good microbes also are important to understand and that they don't cause an infectious foodborne illness. The good microorganisms can, however, cause you to vomit or have an upset stomach if present at high numbers.
- Although both good and bad microorganisms are present in foods, the good microorganisms (e.g., those causing food spoilage), spoilage organisms generally outnumber the bad microorganisms.
- Both good and bad microorganisms compete for the same nutrients, and both grow and are killed under similar conditions, albeit the spoilage organisms do grow well under refrigeration (i.e., just like *Listeria monocytogenes*, the infectious microorganism growing in the refrigerator).
- Over time, especially under refrigerated temperatures, the spoilage organisms can grow to a number that creates noticeable odor, flavor, textural, and appearance changes. We call this spoiled food.
- Food spoilage also can be caused by non-microbial mechanisms, especially during frozen storage. Chemical changes, mostly from oxygen present in the sealed food container, create oxidative rancidity. As with microbial spoilage, consumption of rancid food doesn't cause an infectious foodborne illness, but it could at least cause vomiting and an upset stomach.

Safely Consuming Leftovers

- Reheating
 - 90 % of US households have at least 1 microwave
 - If without a turntable, be sure to manually rotate and stir the food
 - There is only 1.5-inch penetration by the microwaves



Note that if you need to warm your leftovers, a toaster oven works just as well as a microwave oven or traditional oven.

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#14 – Microwave ovens

- Microwave ovens are excellent for warming foods, especially if yours has a turntable. The turntable helps to avoid cold spots.
- If you don't have a turntable in the microwave, manually turn the food half-way through and, if feasible, stir the food.
- Be aware that microwaves, at high power, can only penetrate at most 1.5 inches of a food.
- Microwave oven that are set on the defrosting cycle deliver only 30 % of full power with less penetration of the microwaves.
- Toaster ovens and traditional ovens work well for warming leftovers.

Safely Consuming Leftovers

- Use a proper container
 - Only use containers/materials approved for use in a microwave oven
 - Others may leach chemicals onto food
 - Cover the container, allowing steam to exit
 - Wet a paper towel; fully cover to generate steam inside that is sufficient to kill off any new microbial growth



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#15 – Proper containers (e.g., pictured are a glass microwavable container with rubber lid, and a dinner plate covered with a wet paper towel).

- Be aware of the food container that you use inside the microwave oven.
- Not all leftover containers are approved for microwaving. Unless the container says that it is microwavable, don't reheat leftovers in a questionable container.
- The microwave process can cause chemicals in an unapproved container to leach onto the food. The U.S. Food and Drug Administration is responsible for approving components used in food packaging containers.

Safely Consuming Leftovers

- Defrosting
 - Four safe methods
 - Refrigerator, but be sure to place in a container to capture drippage
 - Microwave oven, 30 % power
 - Submerging in cold water in a tightly sealed bag, changing water every 30 minutes to keep cold water exposure
 - Cooking, recognizing that a desired internal temperature may take 50 % longer than if unfrozen



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#16 – Defrosting -- Don't temperature abuse the outer surface of the frozen product during thawing. Remember the danger zone.

- You can heat/cook and cool/freeze foods as many times as you want.
 - Understand that each heating and cooling event causes cell damage within the food, allowing retained moisture to purge and result in a mushier and dryer food item. The food isn't unsafe, but it might not provide the eating experience you desire.
- If you put your leftovers into the freezer and are now ready to consume them, you likely will want to defrost them before eating.
- If thawing in the refrigerator, note that you will need to allow at least a full day in the 40-degree environment of the refrigerator for foods weighing less than 1 pound.
 - More days in the refrigerator are needed for products weighing more than 1 pound.
- If placing in a container and thawing in the sink under cold water, the water should be chilled, not hot.
- If using a microwave oven, continually rotate the product (e.g., turn around, place upside down) because the lowered power will not allow as good microwave penetration to warm the product.

Foodborne Illness

Annual US estimates:

- 48 million sickened
- 128 thousand hospitalizations
- 3 thousand deaths

Top 5 Germs Causing Illness, Hospitalizations, and Deaths From Food Eaten in the United States

Illnesses	Hospitalizations	Deaths
1. Norovirus	1. <i>Salmonella</i> (non-typhoidal)	1. <i>Salmonella</i> (non-typhoidal)
2. <i>Salmonella</i> (non-typhoidal)	2. Norovirus	2. <i>Toxoplasma gondii</i>
3. Clostridium perfringens	3. <i>Campylobacter</i>	3. Listeria monocytogenes
4. Campylobacter	4. Toxoplasma gondii	4. Norovirus
5. Staphylococcus aureus	5. E. coli O157	5. <i>Campylobacter</i>

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#17 – Germs causing illness

- The number one cause in the U.S. for illnesses is due to norovirus resulting from contaminated food and water. Norovirus can spread easily from person to person. You may be familiar with norovirus being referred to as “cruise ship sickness” due to large groups of people being in proximity.
- California is where the most illnesses occur in the U.S.
- The month of May is the time of the year in which the most illnesses occur in the U.S.
- Incubation for foodborne illness is from several hours to one week. Stomach flu symptoms may be evidence of a foodborne illness.
- General symptoms for foodborne illness appear within
 - 30 minutes and up to 8 hours — nausea, vomiting, stomach cramps, diarrhea
 - Within 24 hours — watery diarrhea, nausea, stomach cramps, vomiting, fever, chills
 - 6-24 hours — diarrhea, stomach cramps that last for less than 24 hours — vomiting and fever are not common
 - Quickest onset for foodborne illness — *Staphylococcus* and *Bacillus cereus* (1-7 hours) from produce.
 - Explosive diarrhea — foodborne illness, food intolerance, irritable bowel syndrome (IBS), Crohn’s, ulcerative colitis
 - Stomach bug — 12-48 hours to develop but foodborne illness symptoms are much faster. Within 6 hours of consuming an infected dish.
- Resolving — let run its course with rest and a BRAT diet (bananas, rice, applesauce, toast, broths)

Who's At Risk for Foodborne Illness

- Groups at highest risk –
 - Adults 65 years of age and older
 - Children younger than 5 years
 - People whose immune systems are weakened (illness or treatment)
 - Pregnant women

Top 5 risk factors:

- Poor personal hygiene
- Improper holding temperatures
- Improper cooking temperatures
- Food from unsafe sources
- Contaminated equipment/cross contamination

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#18 – General Foodborne Illness Information

- Contaminated equipment/cross-contamination – remember Aunt Shirley, Uncle Bernie, and Rascal the cat from the earlier discussion?
- Least likely foods for foodborne illness are ambient stable items (e.g., bread, biscuits, cereal, crisps, and cakes — but not cream cakes). Such foods are preserved by smoking and salting, are dry, acidic (pickled, vinegar), fermented, high sugar/fat content (jam and chocolate), unopened tinned food.
- Most likely foods for foodborne illness are perishable moist items (e.g., cooked meat and poultry, dairy products, egg products, shellfish, farinaceous dishes — cooked rice, pasta, couscous).
- Transplant patients are especially susceptible to *Listeria monocytogenes*.
- Weakened immune function can be due to diabetes, liver disease, kidney disease, alcoholism, HIV, autoimmune disorders (lupus), receiving chemotherapy or radiation therapy.
- 66 % of people do not use food thermometers correctly when cooking ground turkey patties (as observed; July 1, 2020, Journal Food Protection, Volume 83, Issue 7; FSIS) -- placement inside of patty to reach the center and coldest spot; correct temp of 165 degrees Fahrenheit; not rubbing hands together using soap for at least 20 seconds; contaminated the spice containers and raw lettuce for salad).
- Symptoms from bad seafood appear 30-60 minutes after consuming bad seafood
- Hepatitis A and norovirus are spread by poor hygiene

Discussion

- What resonated with you?
- Are you going to change your behavior?
- Are you going to talk to a friend about their risky behavior?
- What questions do you have?

If you are interested in learning about food labeling issues, check out my Spring AZ Humanities Seminar course – *“Truth in Food Labeling: It’s Anyone’s Guess”* – begins March 14, 2-4 PM

Thank you.



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#19 — NOTE:

- If you are interested in learning more about food labeling, Dr. Engeljohn will be teaching a course this Spring in the University of Arizona Humanities Seminars program.
- The course is --
 - “Truth in Food Labeling: It’s Anyone’s Guess”
 - In-person at the campus and online
 - 2:00 – 4:00 PM
 - Thursday
 - March 14, 21, 28; April 4, 11, 18