Chapter 5 - FOOD SAFETY

Contents:

A. Introduction

Consumers want safe and nutritious food choices. Chicken is an excellent source of dietary protein but many consumers, rightly or wrongly, associate poultry products with foodborne diseases, primarily *Salmonella*. Food safety involves those steps that are taken to reduce or eliminate the potential for foodborne illness that can occur from contamination that may be introduced from the farm to the table.

Bacterial pathogens cause the majority of the food-borne illness. The following are some bacteria associated with chicken:

- *Salmonella*
- *Staphylococcus*
- *Clostridium perfringens*
- *Clostridium botulinum*
- *Campylobacter jejuni*
- *Listeria monocytogenes*

Although *E. coli* is a commonly monitored organism in poultry processing plants, the principle reason for concern with *E. coli* is as an indirect indicator of fecal contamination. The majority of *E. coli* isolates from poultry are relatively host adapted for birds and are not considered potential human pathogens. However, poultry are highly susceptible to infection with *E. coli* O167:H7, a highly pathogenic organism causing hemorrhagic enteritis in humans.

Research has clearly demonstrated that the reduction of microbial contamination of processed poultry requires identification of both pre- and post-harvest critical control points where contamination may occur, and the implementation of integrated control programs.

To reduce bacterial contamination of processed chicken, it is important that the flock be negative for food-borne pathogens such as *Salmonella* and *Campylobacter*. Research has clearly shown that flocks with low level *Salmonella* infections or where *Salmonella*

was undetectable prior to slaughter, could enter processing plants and remain essentially *Salmonella* free through the sequential stages of processing, prior to processing the first contaminated/infected flock of the day. However, after the first *Salmonella* contaminate/infected flock was processed, carcasses from a subsequent non-contaminated/ uninfected flock, were cross-contaminated during processing. This research clearly demonstrates the importance of controlling live bird contamination/ infection.

B. On farm food safety programs

To date there is no single identified critical control point that will assure reductions of food-borne pathogens, but integration of multiple approaches, focused on known critical control points, has been partially effective.

Any program developed to reduce carcass contamination with food-borne pathogens must start with live production. Grow out conditions should be kept as clean as possible, and feed ingredients containing animal or fish by-products should be laboratory-certified free of Salmonella.

- ***Clean breed flocks:*** There is evidence indicating that a major factor for ultimate success of ante-mortem intervention is the production and maintenance of food-borne pathogen free breeders flocks. This is difficult because of the necessity of feed restriction during growth and the stress associated with egg production but some of the interventions recommended for broiler growers will also hold for broiler breeder flocks.

- ***Biosecurity:*** Wild birds, pets, rodents and people have all be implicated as fomites for transmission of Salmonella into broiler flocks. Because of the high animal density in modern broiler production, Salmonella is likely to amplify in an infected flock and persist through slaughter and processing.

- ***Reduced light intensity:*** Reducing light intensity during the in-house feed withdrawal period reduces the incidence of litter pecking and has been shown to reduce crop contamination with both *Salmonella* and *Campylobacte*r. With the potential for rupture and leakage during processing the crop is a potential critical control point.

- ***Addition of organic acids to the drinking water:*** Feed withdrawal has been shown to change the environment of the crop, primarily by increasing pH. Changes in the crop environment have the potential for growth of food-borne pathogens. One way to reverse the increasing crop pH due to feed withdrawal is to re-acidify the crop. For example, 0.44% lactic acid in the drinking water has been shown to reduce Salmonella and Campylobacter contamination of chicken carcasses.

- ***Use of chemical litter treatments:*** If litter acidity is reduced to about pH 5, conditions are unfavorable for Salmonella and other potential pathogens. To achieve this, chemical treatments can be added to the litter to lower the pH and

reduce ammonia production. Such treatments must be cost effective and safe for farm workers. Several chemical additives have been used to decrease the pH of poultry litter. Examples include aluminum sulfate, ferrous sulfate, phosphoric acid, sodium bisulfate and acetic acid. For more information on litter treatments, refer to chapter 14.

- ***Use of competitive exclusion products:*** The gastrointestinal tract of newly hatched chicks is essentially sterile and highly susceptible to colonization/ infection with pathogenic bacteria. One approach to prevent the colonization of pathogenic bacteria is to accelerate establishment of normal intestinal flora in chicks as early as possible, thus providing a source of competition for subsequent pathogens to which the host chick may be exposed. Competitive exclusion is the delivery of a suspension of healthy adult cecal microflora. The benefits of competitive exclusion treatment on reducing *Salmonella* and *Campylobacter* shedding and environmental contamination are now well documented.

5.4

POULTRY PREPARATION - Focus on: Chicken

What's for dinner tonight? There's a good chance it's chicken -- now the number one species consumed by Americans. Interest in the safe handling and cooking of chicken is reflected in thousands of calls to the USDA Meat and Poultry Hotline, second only to turkey in number of specific inquiries. The following information answers many of the questions these callers have asked about chicken.

History & Definitions

The chicken is a descendant of the Southeast Asian red jungle fowl first domesticated in India around 2000 B.C. Most of the birds raised for meat in America today are from the Cornish (a British breed) and the White Rock (a breed developed in New England). Broiler-fryers, roasters, stewing/baking hens, capons and Rock Cornish hens are all chickens. The following are definitions for these:

- *Broiler-fryer* a young, tender chicken about 7 weeks old which weighs 2½ to 4½ pounds when eviscerated. Cook by any method.
- *Rock Cornish Game Hen* - a small broiler-fryer weighing between 1 and 2 pounds. Usually stuffed and roasted whole.
- *Roaster* - an older chicken about 3 to 5 months old which weighs 5 to 7 pounds. It yields more meat per pound than a broiler-fryer. Usually roasted whole.
- *Capon* - Male chickens about 16 weeks to 8 months old which are surgically unsexed. They weigh about 4 to 7 pounds and have generous quantities of tender, light meat. Usually roasted.
- *Stewing/Baking Hen* - a mature laying hen 10 months to 1½ years old. Since the meat is less tender than young chickens, it's best used in moist cooking such as stewing.
- *Cock or rooster* - a mature male chicken with coarse skin and tough, dark meat. Requires long, moist cooking.

Chicken Inspection

All chickens found in retail stores are either inspected by USDA or by state systems which have standards equivalent to the Federal government. Each chicken and its internal organs are inspected for signs of disease. The "Inspected for wholesomeness by the U.S. Department of Agriculture" seal insures the chicken is free from visible signs of disease.

Chicken Grading

Inspection is mandatory but grading is voluntary. Chickens are graded according to USDA Agricultural Marketing Service regulations and standards for meatiness, appearance and freedom from defects. Grade A chickens have plump, meaty bodies and clean skin, free of bruises, broken bones, feathers, cuts and discoloration.

Fresh or Frozen
The term *fresh* on a poultry label refers to any raw poultry product that has never been below 26°F. Raw poultry held at 0°F or below must be labeled *frozen* or *previously frozen*. No specific labeling is required on raw poultry stored at temperatures between 0-25°F.

Dating of Chicken Products
Product dating is not required by Federal regulations, but many stores and processors voluntarily date packages of chicken or chicken products. If a calendar date is shown, immediately adjacent to the date there must be a phrase explaining the meaning of that date such as *sell by* or *use before*.

The use-by date is for quality assurance; after the date, peak quality begins to lessen but the product may still be used. It's always best to buy a product before the date expires. If a use-by date expires while the chicken is frozen, the food can still be used.

Hormones & Antibiotics
No hormones are used in the raising of chickens.

Antibiotics may be given to prevent disease and increase feed efficiency. A "withdrawal" period is required from the time antibiotics are administered before the bird can be slaughtered. This ensures that no residues are present in the bird's system. FSIS randomly samples poultry at slaughter and tests for residues. Data from this monitoring program have shown a very low percentage of residue violations.

Additives
Additives are not allowed on fresh chicken. If chicken is processed, however, additives such as MSG, salt, or sodium erythorbate may be added but must be listed on the label.

Foodborne Organisms Associated with Chicken
As on any perishable meat, fish or poultry, bacteria can be found on raw or undercooked chicken. They multiply rapidly at temperatures between 40°F and 140°F (out of refrigeration and before thorough cooking occurs). Freezing doesn't kill bacteria but they are destroyed by thorough cooking.

USDA's Food Safety and Inspection Service has a zero tolerance for bacteria in cooked and ready-to-eat products such as chicken franks or lunch meat that can be eaten without further cooking.

Most foodborne illness outbreaks are a result of contamination from food handlers. Sanitary food handling and proper cooking and refrigeration should prevent foodborne illnesses.

Bacteria must be consumed on food to cause illness. They cannot enter the body through a skin cut. However, raw poultry must be handled carefully to prevent cross-contamination. This can occur if raw poultry or its juices contact cooked food or foods that will be eaten raw such as salad. An example of this is chopping tomatoes on an unwashed cutting board just after cutting raw chicken on it.

Following are some bacteria associated with chicken:

- *Salmonella* Enteritidis may be found in the intestinal tracts of livestock, poultry, dogs, cats and other warm-blooded animals. This strain is only one of about 2,000 kinds of *Salmonella* bacteria; it is often associated with poultry and shell eggs.
- *Staphylococcus aureus* can be carried on human hands, in nasal passages, or in throats. The bacteria are found in foods made by hand and improperly refrigerated, such as chicken salad.
- *Campylobacter jejuni* is one of the most common causes of diarrheal illness in humans. Preventing cross- contamination and using proper cooking methods reduces infection by this bacterium.
- *Listeria monocytogenes* was recognized as causing human foodborne illness in 1981. It is destroyed by cooking, but a cooked product can be contaminated by poor personal hygiene. Observe "keep refrigerated" and "use-by" dates on labels.

Rinsing or Soaking Chicken

It is not necessary to wash raw chicken. Any bacteria which might be present are destroyed by cooking.

Liquid in Package

Many people think the pink liquid in packaged fresh chicken is blood, but it is mostly water which was absorbed by the chicken during the chilling process. Blood is removed from poultry during slaughter and only a small amount remains in the muscle tissue. An improperly bled chicken would have cherry red skin and is condemned at the plant.

How to Handle Chicken Safely

- **Fresh Chicken:** Chicken is kept cold during distribution to retail stores to prevent the growth of bacteria and to increase its shelf life. Chicken should feel cold to the touch when purchased. Select fresh chicken just before checking out at the register. Put packages of chicken in disposable plastic bags (if available) to contain any leakage which could cross-contaminate cooked foods or produce. Make the grocery your last stop before going home.

  At home, immediately place chicken in a refrigerator that maintains 40 F, and use within 1 or 2 days, or freeze at 0°F. If kept frozen continuously, it will be safe indefinitely.

  Chicken may be frozen in its original packaging or repackaged. If freezing longer than two months, over wrap the porous store plastic packages with airtight heavy-duty foil, plastic wrap or freezer paper, or place the package inside a freezer bag. Use these materials or airtight freezer containers to repackage family packs into smaller amounts or freeze the chicken from opened packages.

  Proper wrapping prevents "freezer burn," which appears as grayish-brown leathery spots and is caused by air reaching the surface of food. Cut freezer-burned portions away either before or after cooking the chicken. Heavily freezer-burned products may have to be discarded because they might be too dry or tasteless.

- **Ready-Prepared Chicken:** When purchasing fully cooked rotisserie or fast food chicken, be sure it is hot at time of purchase. Use it within two hours or cut it into several pieces and refrigerate in shallow, covered containers. Eat within 3 to 4 days, either cold or reheated to 165°F (hot and steaming). It is safe to freeze ready-prepared chicken. For best quality, flavor and texture, use within 4 months.

Safe Defrosting
FSIS recommends three ways to defrost chicken: in the refrigerator, in cold water and in the microwave. Never defrost chicken on the counter or in other locations. It's best to plan ahead for slow, safe thawing in the refrigerator. Boneless chicken breasts will usually defrost overnight. Bone-in parts and whole chickens may take 1 to 2 days or longer. Once the raw chicken defrosts, it can be kept in the refrigerator an additional day or two before cooking. During this time, if chicken defrosted in the refrigerator is not used, it can safely be refrozen without cooking first.

Chicken may be defrosted in cold water in its airtight packaging or in a leak proof bag. Submerge the bird or cut-up parts in cold water, changing the water every 30 minutes to be sure it stays cold. A whole (3 to 4-pound) broiler fryer or package of parts should defrost in 2 to 3 hours. A 1-pound package of boneless breasts will defrost in an hour or less.

Chicken defrosted in the microwave should be cooked immediately after thawing because some areas of the food may become warm and begin to cook during microwaving. Holding partially cooked food is not recommended because any bacteria present wouldn't have been destroyed. Foods defrosted in the microwave or by the cold water method should be cooked before refreezing.

Do not cook frozen chicken in the microwave or in a slow cooker. However, chicken can be cooked from the frozen state in the oven or on the stove. The cooking time may be about 50% longer.

Stuffed Chicken
The Hotline does not recommend buying retail-stuffed fresh whole chicken because of the highly perishable nature of a previously stuffed item. Consumers should not pre-stuff whole chicken to cook at a later time. Chicken can be stuffed immediately before cooking. Some USDA-inspected frozen stuffed whole poultry MUST be cooked from the frozen state to ensure a safely cooked product. Follow preparation directions on the label.

Marinating
Chicken may be marinated in the refrigerator up to 2 days. Boil used marinade before brushing on cooked chicken. Discard any uncooked leftover marinade.

Safe Cooking
FSIS recommends cooking whole chicken to a safe minimum internal temperature of 165°F as measured using a food thermometer. Check the internal temperature in the innermost part of the thigh and wing and the thickest part of the breast. For reasons of personal preference, consumers may choose to cook poultry to higher temperatures.

For approximate cooking times to use in meal planning, see the following chart compiled from various resources.

Approximate Chicken Cooking Times				
Type of Chicken	**Weight**	**Roasting 350 °F**	**Simmering**	**Grilling**
Whole broiler fryer[1]	3 to 4 lbs.	1¼ - 1½ hrs.	60 to 75 min.	60 to 75 min[2]
Whole roasting hen[1]	5 to 7 lbs.	2 to 2¼ hrs.	1¾ to 2 hrs.	18-25 min/lb[2]
Whole capon[1]	4 to 8 lbs.	2 to 3 hrs	Not suitable	15-20 min/lb[2]
Whole Cornish hens[1]	18-24 oz.	50 to 60 min.	35 to 40 min.	45 to 55 min[2]
Breast halves, bone-in	6 to 8 oz.	30 to 40 min.	35 to 45 min.	10 - 15 min/side
Breast half, boneless	4 ounces	20 to 30 min.	25 to 30 min.	6 to 8 min/side
Legs or thighs	8 or 4 oz.	40 to 50 min.	40 to 50 min.	10 - 15 min/side
Drumsticks	4 ounces	35 to 45 min.	40 to 50 min.	8 to 12 min/side
Wings or wingettes	2 to 3 oz.	30 to 40 min.	35 to 45 min.	8 to 12 min/side

[1]Unstuffed. If stuffed, add 15 to 30 minutes additional time.
[2]Indirect method using drip pan.

Microwave Directions:

- Microwave on medium-high (70% power): whole chicken, 9 to 10 minutes per pound; bone-in parts and Cornish hens, 8 to 9 minutes per pound; boneless breasts halves, 6 to 8 minutes per pound.
- When microwaving parts, arrange in dish or on rack so thick parts are toward the outside of dish and thin or bony parts are in the center.
- Place whole chicken in an oven cooking bag or in a covered pot.
- For boneless breast halves, place in a dish with ¼ cup water; cover with plastic wrap.
- Allow 10 minutes standing time for bone-in chicken; 5 minutes for boneless breast.
- The USDA recommends cooking whole poultry to a safe minimum internal temperature of 165°F as measured using a food thermometer. Check the internal temperature in the innermost part of the thigh and wing and the thickest part of the breast. When cooking pieces, the breast, drumsticks, thighs, and wings should be cooked until they reach a safe minimum internal temperature of 165°F. For reasons of personal preference, consumers may choose to cook poultry to higher temperatures.

Partial Cooking

Never brown or partially cook chicken to refrigerate and finish cooking later because any bacteria present wouldn't have been destroyed. It is safe to partially pre-cook or microwave chicken immediately before transferring it to the hot grill to finish cooking.

Color of Skin
Chicken skin color varies from cream-colored to yellow. Skin color is a result of the type of feed eaten by the chicken, not a measure of nutritional value, flavor, tenderness or fat content. Color preferences vary in different sections of the country, so growers use the type of feed which produces the desired color.

Dark Bones
Darkening around bones occurs primarily in young broiler-fryers. Since their bones have not calcified completely, pigment from the bone marrow can seep through the porous bones. Freezing can also contribute to this seepage. When the chicken is cooked, the pigment turns dark. It's perfectly safe to eat chicken meat that turns dark during cooking.

Pink Meat
The color of cooked chicken is not a sign of its safety. Only by using a food thermometer can one accurately determine that chicken has reached a safe minimum internal temperature of 165°F throughout. The pink color in safely cooked chicken may be due to the hemoglobin in tissues which can form a heat-stable color. Smoking or grilling may also cause this reaction, which occurs more in young birds.

Color of Giblets
Giblet color can vary, especially in the liver, from mahogany to yellow. The type of feed, the chicken's metabolism and its breed can account for the variation in color. If the liver is green, do not eat it. This is due to bile retention. However, the chicken meat should be safe to eat.

Fatty Deposits
Chickens may seem to have more fatty deposits or contain a larger "fat pad" than in the past. This is because broiler fryer chickens have been bred to grow very rapidly to supply the demand for more chicken. Feed that is not converted into muscle tissue (meat) is metabolized into fat. However, the fat is not "marbled" into the meat as is beef or other red meat, and can be easily removed. Geneticists are researching ways to eliminate the excess fat.

Trisodium Phosphate
Food-grade trisodium phosphate (TSP) has been approved by FSIS for use in poultry slaughter as an antimicrobial agent. When immersed in and/or sprayed in a dilute solution on chickens, it can significantly reduce bacteria levels. TSP is "generally recognized as safe" (GRAS) by the FDA, and has been safely used for years, particularly in processed cheese.

Irradiation of Poultry
In 1992, the USDA approved a rule to permit irradiation of raw, fresh or frozen packaged poultry to control certain common bacteria on raw poultry that can cause illness when poultry is undercooked or otherwise mishandled. Irradiation at 1.5 to 3.0 kilo Gray, the smallest, most practical "dose," would eliminate more than 99% of Salmonellae organisms on the treated poultry.

Packages of irradiated chicken are easily recognizable at the store because they must carry the international radura symbol along with the statement, "treated with irradiation" or "treated by irradiation."

Storage Times

Since product dates aren't a guide for safe use of a product, how long can the consumer store the food and still use it at top quality? Follow these tips:

- Purchase the product before the date expires.
- Follow handling recommendations on product.
- Keep chicken in its package until using.
- Freeze chicken in its original packaging, overwrap or re-wrap it according to directions in the above section, "How to Handle Chicken Safely".

Refrigerator Home Storage (at 40° F or below) of Chicken Products	
Product	**Refrigerator Storage Times**
Fresh Chicken, Giblets or Ground Chicken	1 to 2 days
Cooked Chicken, Leftover	3 to 4 days
Chicken Broth or Gravy	1 to 2 days
Cooked Chicken Casseroles, Dishes or Soup	3 to 4 days
Cooked Chicken Pieces, covered with broth or gravy	1 to 2 days
Cooked Chicken Nuggets, Patties	1 to 2 days
Fried Chicken	3 to 4 days
Take-Out Convenience Chicken (Rotisserie, Fried, etc.)	3 to 4 days
Restaurant Chicken Leftovers, brought immediately home in a "Doggy Bag"	3 to 4 days
Store-cooked Chicken Dinner including gravy	1 to 2 days
Chicken Salad	3 to 5 days
Deli-sliced Chicken Luncheon Meat	3 to 5 days
Chicken Luncheon Meat, sealed in package	2 weeks (but no longer than 1 week after a "sell-by" date)
Chicken Luncheon Meat, after opening	3 to 5 days
Vacuum-packed Dinners, Commercial brand with USDA seal	Unopened 2 weeks Opened 3 to 4 days
Chicken Hotdogs, unopened	2 weeks (but no longer than 1 week after a "sell-by" date)
Chicken Hotdogs, after opening	7 days
Canned Chicken Products	2 to 5 years in pantry

United States Department of Agriculture
Food Safety and Inspection Service

Food Safety Information

The Poultry Label Says "Fresh"

"I am shopping for a fresh turkey because I do not want the hassle of defrosting a frozen one. When should I buy it and how do I know if it is fresh? What does 'fresh' on the label really mean?"

Prior to 1997, poultry could be sold as "fresh" even if it was frozen "as solid as a block of ice". However, consumer concerns about "rock" frozen poultry being sold as "fresh" led USDA to reconsider the term "fresh" as it applies to raw whole poultry and cuts of poultry. Furthermore, national press coverage and testimonies at public hearings indicated strong interest in the term "fresh" being re-defined.

After lengthy hearings, surveys and reviews of science-based information, USDA published a "fresh" labeling rule that went into effect in December 1997. Today the definition of "fresh" is intended to meet the expectations of consumers buying poultry. Below are questions and answers about the "fresh" labeling rule and the terms "fresh" and "frozen."

Why is 26°F the lowest temperature at which poultry remains fresh?

Below 26°F, raw poultry products become firm to the touch because much of the free water is changing to ice. At 26°F, the product surface is still pliable and yields to the thumb when pressed. Most consumers consider a product to be fresh, as opposed to frozen, when it is pliable or when it is not hard to the touch.

What are the labeling requirements for frozen, raw poultry?

Raw poultry held at a temperature of 0°F or below must be labeled with a "keep frozen" handling statement.

What does the "fresh" rule mean to consumers?

For consumers, "fresh" means whole poultry and cuts have never been below 26°F. This is consistent with consumer expectations of "fresh" poultry, i.e., not hard to the touch or frozen solid. Fresh poultry should always bear a "keep refrigerated" statement.

Is there an increased microbiological safety risk associated with raw poultry that is maintained at 26°F?

No. The National Advisory Committee on the Microbiological Criteria for Foods, as well as several scientific organizations, agreed that there is no increased microbiological risk associated with raw product maintained at 40°F or below.

How should consumers handle fresh or frozen raw poultry products?

Fresh or frozen raw poultry will remain safe with proper handling and storage.

Fresh, raw poultry is kept cold during distribution to retail stores to prevent the growth of harmful bacteria and to increase its shelf life. It should be selected from a refrigerated cooler which maintains a temperature of below 40°F and above 26°F. Select fresh poultry just before checking out at the store register. Put packages in disposable plastic bags (if available) to contain any leakage that could cross-contaminate cooked foods or fresh produce.

At home, immediately place fresh raw poultry in a refrigerator that maintains 40°F or below and use it within 1 to 2 days, or freeze the poultry at 0°F or below. Frozen poultry will be safe indefinitely. For best quality, use frozen, raw whole poultry within 1 year, poultry parts within 9 months, and giblets within 4 months.

The Poultry Label Says "Fresh"

Poultry may be frozen in its original packaging or repackaged. If you are freezing poultry longer than 2 months, you should wrap the porous store plastic packages with airtight heavy-duty foil, freezer plastic wrap or freezer bags, or freezer paper. Use freezer packaging materials or airtight freezer containers to repackage family-sized packages into smaller units.

Proper wrapping prevents "freezer burn" (drying of the surface that appears as grayish brown leathery spots on the surface of the poultry). It is caused by air reaching the surface of the food. You may cut freezer-burned portions away either before or after cooking the poultry. Heavily freezer-burned products may have to be discarded because they might be too dry or tasteless.

What is the difference in quality between fresh and frozen poultry?

Both fresh and frozen poultry are inspected by USDA's Food Safety and Inspection Service. The quality is the same. It is personal preference that determines whether you purchase fresh or frozen poultry.

What does the date on the package mean?

"Open Dating" (use of a calendar date as opposed to a code) on a food product is a date stamped on the package of a product to help the store management determine how long to display the product for sale. It is a quality date, not a safety date.

"Open Dating" is found primarily on perishable foods such as meat, poultry, eggs, and dairy products. If a calendar date is used, it must express both the month and day of the month (and the year, in the case of shelf-stable and frozen products). If a calendar date is shown, immediately adjacent to the date must be a phrase explaining the meaning of that date such as "sell by" or "use before." A "sell-by" date tells the store how long to display the product for sale. You should buy the product before the date expires. A "use-by" date is the last date recommended for the use of the product while at peak quality. In both cases, the date has been determined by the food processor.

There is no uniform or universally accepted system used for "Open Dating" of food in the United States. Although dating of some foods is required by more than 20 states, there are areas of the country where much of the food supply has almost no dating.

What should you do if you find poultry that is frozen, but labeled "fresh"?

You can call the USDA Meat and Poultry Hotline and file a complaint.

Food Safety Questions?

Call the USDA Meat & Poultry Hotline

If you have a question about meat, poultry, or egg products, call the USDA Meat and Poultry Hotline toll free at **1-888-MPHotline (1-888-674-6854)**; TTY: 1-800-256-7072.

The hotline is open year-round Monday through Friday from 10 a.m. to 4 p.m. ET (English or Spanish). Recorded food safety messages are available 24 hours a day. Check out the FSIS Web site at **www.fsis.usda.gov**.

Send E-mail questions to **MPHotline.fsis@usda.gov**.

Ask Karen!

FSIS' automated response system can provide food safety information 24/7.

www.fsis.usda.gov

United States Department of Agriculture
Food Safety and Inspection Service

Food Safety Information

The Color of Meat and Poultry

I've just opened a package of fresh chicken and the skin looks blue. Is it safe to use?

My package of ground beef is dark in the center. Is this old meat?

The turkey was cooked according to the directions, but the breast meat is pink. Will it make us sick?

These are just a few of the many questions received at the U.S. Department of Agriculture's Meat and Poultry Hotline concerning the color of meat and poultry. Color is important when meat and poultry are purchased, stored, and cooked. Often an attractive, bright color is a consideration for the purchase. So, why are there differences in the color and what do they mean? Listed below are some questions and answers to help you understand the color differences.

1. What factors affect the color of meat and poultry?

Myoglobin, a protein, is responsible for the majority of the red color. Myoglobin doesn't circulate in the blood but is fixed in the tissue cells and is purplish in color. When it is mixed with oxygen, it becomes oxymyoglobin and produces a bright red color. The remaining color comes from the hemoglobin which occurs mainly in the circulating blood, but a small amount can be found in the tissues after slaughter.

Color is also influenced by the age of the animal, the species, sex, diet, and even the exercise it gets. The meat from older animals will be darker in color because the myoglobin level increases with age. Exercised muscles are always darker in color, which means the same animal can have variations of color in its muscles.
In addition, the color of meat and poultry can change as it is being stored at retail and in the home (see explanation in question 5). When safely stored in the refrigerator or freezer, color changes are normal for fresh meat and poultry.

2. Does a change in color indicate spoilage?

Change in color alone does not mean the product is spoiled. Color changes are normal for fresh product. With spoilage there can be a change in color—often a fading or darkening. In addition to the color change, the meat or poultry will have an off odor, be sticky or tacky to the touch, or it may be slimy. If meat has developed these characteristics, it should not be used.

3. If the color of meat and poultry changes while frozen, is it safe?

Color changes, while meat and poultry are frozen, occur just as they do in the refrigerator. Fading and darkening, for example, do not affect their safety. These changes are minimized by using freezer-type wrapping and by expelling as much air as possible from the package.

4. What are the white dried patches on frozen meat and poultry?

The white dried patches indicate freezer burn. When meat and poultry have been frozen for an extended period of time or have not been wrapped and sealed properly, this will occur. The product remains safe to eat, but the areas with freezer burn will be dried out and tasteless and can be trimmed away if desired.

THE COLOR OF MEAT

5. When displayed at the grocery store, why is some meat bright red and other meat very dark in color?

Optimum surface color of fresh meat (i.e., cherry-red for beef; dark cherry-red for lamb; grayish-pink for pork; and pale pink for veal) is highly unstable and short-lived. When meat is fresh and protected from contact with air (such as in vacuum packages), it has the purple-red color that comes from myoglobin, one of the two key pigments responsible for the color of meat. When exposed to air, myoglobin forms the pigment, oxymyoglobin, which gives meat a pleasingly cherry-red color. The use of a plastic wrap that allows oxygen to pass through it helps ensure that the cut meats will retain this bright red color. However, exposure to store lighting as well as the continued contact of myoglobin and oxymyoglobin with oxygen leads to the formation of metmyoglobin, a pigment that turns meat brownish-red. This color change alone does not mean the product is spoiled (see explanation in question 2).

6. Why is pre-packaged ground beef red on the outside and sometimes grayish-brown on the inside?

These color differences do not indicate that the meat is spoiled or old. As discussed earlier, fresh cut meat is purplish in color. Oxygen from the air reacts with meat pigments to form a bright red color which is usually seen on the surface of ground beef purchased in the supermarket. The interior of the meat may be grayish-brown due to the lack of oxygen penetrating below the surface.

7. A beef roast has darkened in the refrigerator, is it safe?

Yes, it is safe. The darkening is due to oxidation, the chemical changes in myoglobin due to the oxygen content. This is a normal change during refrigerator storage.

8. Can cooked ground beef still be pink inside?

Yes, ground beef can be pink inside after it is safely cooked. The pink color can be due to a reaction between the oven heat and myoglobin, which causes a red or pink color. It can also occur when vegetables containing nitrites are cooked along with the meat. Because doneness and safety cannot be judged by color, it is very important to use a food thermometer when cooking ground beef. To be sure all harmful bacteria are destroyed, cook all ground beef products to an internal temperature of 160 °F throughout.

9. What causes iridescent colors on meats?
Meat contains iron, fat, and other compounds. When light hits a slice of meat, it splits into colors like a rainbow. There are various pigments in meat compounds that can give it an iridescent or greenish cast when exposed to heat and processing. Wrapping the meat in airtight packages and storing it away from light will help prevent this situation. Iridescence does not represent decreased quality or safety of the meat.

10. What causes grayish or green color on cured meats?

Exposure to light and oxygen causes oxidation to take place, which causes the breaking down of color pigments formed during the curing process. Chemicals in the cure and oxygen, as well as energy from ultraviolet and visible light, contribute to both the chemical breakdown and microbial spoilage of the product. Cure, such as nitrite, chemically changes the color of muscle. Curing solutions are colored in order to distinguish them from other ingredients (such as sugar or salt) used in fresh and cured meat products. For example, cured raw pork is gray, but cured cooked pork (e.g., ham) is light pink.

THE COLOR OF POULTRY

11. What is the usual color of raw poultry?
Raw poultry can vary from a bluish-white to yellow. All of these colors are normal and are a direct result of breed, exercise, age, and/or diet. Younger poultry has less fat under the skin, which can cause the bluish cast, and the yellow skin could be a result of marigolds in the feed.

12. What causes the differences in color of raw ground poultry?

Ground poultry varies in color according to the part being ground. Darker pink means more dark meat was used and a lighter pink means more white meat was included (or skin was included). Ground poultry can contain only muscle meat and skin with attached fat in proportion to the whole bird.

13. What causes dark bones in cooked poultry?

Darkening of bones and meat around the bones occurs primarily in young (6-8 weeks) broiler-fryer chickens. Since the bones have not calcified or hardened completely, pigment from the bone marrow seeps through the bones and into the surrounding area. Freezing can also contribute to this darkening. This is an aesthetic issue and not a safety one. The meat is safe to eat when all parts have reached at least 165°F.

14. What color is safely cooked poultry?

Safely cooked poultry can vary in color from white to pink to tan. For safety when cooking poultry, use a food thermometer to check the internal temperature. Poultry should reach a safe minimum internal temperature of 165°F throughout the product. For a whole chicken or turkey, check the internal temperature in the innermost part of the thigh and wing and the thickest part of the breast. All the meat-including any that remains pink—is safe to eat as soon as all parts reach at least 165°F.

15. Why is some cooked poultry pink?

Chemical changes occur during cooking. Oven gases in a heated gas or electric oven react chemically with hemoglobin in the meat tissues to give it a pink tinge. Often meat of younger birds shows the most pink because their thinner skins permit oven gases to reach the flesh. Older animals have a fat layer under their skin, giving the flesh added protection from the gases. Older poultry may be pink in spots where fat is absent from the skin. Also, nitrates and nitrites, which are often used as preservatives or may occur naturally in the feed or water supply used, can cause a pink color.

16. If fully cooked smoked poultry is pink, is it safe?

Poultry grilled or smoked outdoors can be pink, even when all parts have attained temperatures well above 165°F. There may be a pink-colored rim about one-half inch wide around the outside of the cooked product. Commercially prepared, smoked poultry is usually pink because it is prepared with natural smoke and liquid smoke flavor.

Food Safety Questions?

Call the USDA Meat & Poultry Hotline

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Ask Karen!

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Water in Meat and Poultry

"Why is all this water in the meat and poultry packages?" "There is so much water in my roast that I can't brown it — it's simmering instead!" "Are they injecting water into chickens?" These are some of the questions that consumers have asked about water in packages of fresh meat and poultry. Here is some background information about water in meat and poultry.

Naturally Occurring Moisture Content of Meat and Poultry

Meat and poultry are composed of naturally occurring water, muscle, connective tissue, fat, and bone. People eat meat for the muscle. The muscle is approximately 75% water (although different cuts may have more or less water) and 20% protein, with the remaining 5% representing a combination of fat, carbohydrate, and minerals. The percentage of naturally occurring water in meat varies with the type of muscle, the kind of meat, the season of the year, and the pH of the meat. Fat in meat is found both *between* muscles and *within* muscles. In both locations, fat contributes to overall flavor and juiciness in meats.

Water Content of Meat and Poultry

The amount of naturally occurring water, or moisture, present in meat and poultry may surprise consumers (see chart). An eye of round roast is 73% water before cooking. The same roast after roasting contains 65% water. A whole broiler-fryer contains 66% water before cooking and 60% afterwards. Leaner meat and poultry contain more protein and less fat. Since water is a component of protein (but not fat), a leaner cut will contain slightly more water on a per weight basis.

WATER CONTENT OF MEAT AND POULTRY

PRODUCT NAME	PERCENTAGE WATER	
	RAW	**COOKED**
Chicken fryer, whole	66%	60%
White meat chicken, with skin	69%	61%
Dark meat chicken, with skin	66%	59%
Ground beef, 85% lean	64%	60%
Ground beef, 73% lean	56%	55%
Beef, eye of round	73%	65%
Beef, whole brisket	71%	56%

Leaner Beef Contains More Water
Hotline callers sometimes comment that today's beef contains more water and also doesn't taste the same as in the past. One reason for this is that today's animals are bred to be leaner. Meat from these animals is naturally leaner and contains more water. The fat in meat contributes to flavor, so a leaner cut will taste different than a fattier cut. Some of these leaner cuts are enhanced with a flavor solution.

Enhanced Meat and Poultry Products
Many grocery stores are now offering meat and poultry products that have flavoring solutions added to them. For example, pork chops may be packaged with a solution of water, salt, and sodium phosphate (a solution that can add flavor and moisture to leaner meats). These new products also provide convenience by saving steps in preparation, such as "Teriyaki Beef in Teriyaki Sauce." To prevent confusion, the presence of flavor solutions must be stated on the front of the package.

Enhanced or value-added meat and poultry products are raw products that contain flavor solutions added through marinating, needle injecting, soaking, etc. The presence and amount of the solution will be featured as part of the product name, for example, "Chicken Thighs Flavored with up to 10% of a Solution" or "Beef Steak Marinated with 6% of a Flavor Solution." The ingredients of the flavor solution must be prominently identified on the label. Typically, this information will be on the principal display panel or the information panel.

The labeling term "marinated" can only be used with specific amounts of solution. "Marinated" meats can contain no more than 10% solution; boneless poultry, no more than 8% solution; and bone-in poultry, no more than 3% solution.

In the case of enhanced products, the solutions that are added to the meat or poultry, or into which the meat or poultry are placed for flavoring, seasoning, and tenderizing, are intended to be part of the product. The solutions are required by regulations and policies to be identified as part of the product names of the enhanced products, and whether the solution is incorporated into the product or is free-flowing, it is considered part of the product.

Freezing Meat and Poultry
When meat and poultry are frozen, the water that is a natural component of all meats turns to solid ice crystals. The water expands when it freezes. The sharp-edged crystals push into the surrounding tissue, rupturing the cells. The water that is outside the cell wall freezes first. As it does, it leeches water from inside the cell walls. When it thaws, the original balance does not return to normal. The thawed product will have lost some of its natural springiness. The water released during freezing seeps out of the thawing meat and poultry into the package.

The faster meat and poultry freezes, the smaller the ice crystals will be. Smaller ice crystals will do less damage. Products that are flash-frozen by the manufacturer will have superior quality to fresh products frozen by the consumer.

Moisture Loss from Meat and Poultry
Meat and poultry are transported from slaughter and processing plants in refrigerated trucks that can be kept as cold as 1°F. Although they may not be frozen solid, they are in a semi-frozen or "hard-chilled" state. Any moisture that is in the product is thus held in the tissue of the product.

Beef is often ground while partially frozen. Because ice crystals are in the frozen beef, there may appear to be more liquid in it.

At the grocery store, the products are displayed in refrigerator cases as cold as 26°F. At this temperature, the cells of the product will "loosen up" somewhat and some of the moisture will melt and gradually seep out. The production of this visible meat or poultry juice is known in the industry as *weep* or *purge*. It occurs during display of retail cuts, during shipment of wholesale cuts, and during storage of cuts prior to shipment.

In a home refrigerator set at 40°F or below, even more liquid will seep out of the product. The longer a product sits in the refrigerator, the more liquid will be released from the muscle cells.

Packaging of Meat and Poultry
Some meat and poultry products are vacuum-packed to prolong the storage times. Products are packaged in air- and leak-proof packages under vacuum, and, in some cases, a specific gas will be pumped into the package to preserve flavor and quality. While the package sits in the refrigerator case, the vacuum is still in effect, extracting the juices out of the meat. Because these packages are airtight and leak proof, the juices accumulate in the package. In contrast, the plastic wrapped packaging, typically used by most supermarkets, allows a certain amount of evaporation.

Water in Meat and Poultry

FSIS Regulations and Policies Relative to Retained Water

Meat and poultry naturally contain moisture and may also contain moisture retained from post-evisceration processing. During processing, recently slaughtered animal carcasses and their organ meats (hearts, livers, kidneys, etc.) are chilled to cool them down to a safe temperature. The absorption of water used for post-evisceration processing is called “retained water” or “absorbed water.” If the carcasses or parts have absorbed such water, the amount of water by percentage along with the terms “retained water’ or “absorbed water,’ (e.g., “up to X% retained water,” or “may contain up to X% retained water” or “with X% absorbed water”) must be stated on the label.
Consumers can compare product labels for the presence of retained (or absorbed) water to assure that products compare equally. Establishments may include a “no-retained-water” statement on the label when the product has not been exposed to a post-evisceration process that adds water, or the establishment has data or information that establishes that the post-evisceration processing used does not add water to the product.

Retained Water in Raw Poultry Products

Poultry is not injected with water, but some water is absorbed during cooling in a chill-tank, a large vat of cold, moving water. The chill-tank lowers the temperature of the slaughtered birds and their giblets (hearts, livers, gizzards, etc.). During this water chilling process, turkeys and chickens will absorb some of the water, and this amount must be prominently declared on the label. It is not unusual for poultry to declare 8 to 12% retained water on the label.

Retained Water in Raw Meat Products

Beef is rinsed during slaughter, but the small amount of water used is usually absorbed on the surface of the meat, not bound to the protein or inside the tissue, and quickly evaporates or drips out. Meat processors will periodically shower red meat carcasses to minimize moisture loss or “shrink” that occurs in the cooler prior to processing. Beef carcasses and their parts cooled with water during post-evisceration processing must be appropriately labeled with the retained water statement.

Cooking Meat and Poultry

In general, the higher the cooking temperature, the more moisture will be lost in cooking. It is not unusual for a beef roast to lose 1/3 of its original size and weight when cooked at a high temperature or cooked too long.

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