Food Safety

Food safety sits at the intersection between “Nutrition” and “Surroundings” within the Circle of Health. Recently, the public has become aware of the importance of food safety, and this has affected purchasing behaviors. This movement was inspired by recently publicized food scares (e.g., mad cow disease, *E.coli* outbreaks, bagged salad recalls), uncertainty about genetically modified foods (GMOs), and concern over recent changes in food cultivation. The following tool focuses on some common questions—and potential solutions—regarding food safety concerns. It is meant to be a brief introduction to this topic. Referenced websites contain more detailed information.

Pesticides in Produce

Studies show that it is important to eat a well-balanced diet that includes 7 to 9 servings of fruits and vegetables daily. Unfortunately, most conventionally grown produce contains small amounts of synthetic pesticides, and research indicates that these can cause harm; for instance, insecticides, like many other toxic compounds, can affect brain development, [1] and may increase risk for disorders such as Parkinson’s disease.[2] In addition, pesticides frequently contain endocrine disrupting chemicals, which interfere with our body’s natural hormone production by increasing, decreasing, or completely changing the function of our hormones. Multiple environmental studies have shown that these changes can lead to reduced fertility, thyroid hormone disruption, increased cancer risk, and sleep disorders.[3]

The Environmental Working Group tests fruits and vegetables for pesticides and releases a yearly report on the “Dirty Dozen” and “Clean Fifteen” foods based on their findings. The foods for each list for 2020 are listed in Table 1[4] The Environmental Working Group also publishes dirty dozen guides to food additives. Focusing on eating based on these suggestions is especially important for pregnant and breastfeeding mothers and their children, because byproducts of chemicals in pesticides can cross the placenta and are found in breast milk.

Table 1. Foods with Higher and Lower Pesticide Concentrations5

Dirty Dozen (Buy these organic)	Clean 15 (Lowest in pesticides)
1. Strawberries	1. Avocados
2. Spinach	2. Sweet corn
3. Kale, collards, and mustard greens	3. Pineapples
4. Nectarines	4. Onions
5. Apples	5. Papaya
6. Grapes	6. Sweet Peas (frozen)
7. Cherries	7. Eggplants
8. Peaches	8. Asparagus
9. Pears	9. Broccoli
10. Bell and hot peppers	10. Cabbage
11. Celery	11. Kiwi
12. Tomatoes	12. Cauliflower
	13. Mushrooms
	14. Honeydew Melon
	15. Cantaloupe

The USDA certifies a food as "organic" when it is produced without synthetic chemicals or fertilizers, genetic engineering, radiation, or sewage sludge. More than ever, people are buying organic produce out of concern for their own health, environmental protection, and animal welfare. Reasonably, the question of whether organic foods are truly healthier has been studied. Early research showed that organic food was not necessarily safer than food grown through conventional agricultural practices (as conventionally grown food is already considered safe by USDA practices),[6] but more recent studies have demonstrated lower heavy metal content and higher amounts of favorable nutrients such as phytonutrients, flavonoids, and zinc.[7] Moreover, a 7-year prospective cohort study of 69,000 subjects in France recently showed that organic food consumption was associated with a reduction in the overall risk of cancer.[8]

A way to remember when to buy organic is by the thickness of the skin of produce. The thinner the skin (e.g., berries, apples), the more likely it is that pesticides have soaked through. Thicker-skinned produce (e.g., oranges, avocados) usually block harmful chemicals from entering the food or are easily peeled. There is little variation between the fruits and vegetables listed on the Dirty Dozen from year to year. Notably, if you wash fruits and vegetables for 30 seconds, you can greatly decrease the amount of pesticides on their surface. However, some amount may have already soaked into the food before washing.

For more information on pesticides, visit the following websites:

- Environmental Working Group
- What's on My Food?
- Pesticide Action Network Database to search pesticides
- U.S. Department of Agriculture's (USDA) National Organic Program

Fish and Shellfish Safety

Fish and shellfish contain high-quality protein, are low in saturated fat, and contain omega-3 fatty acids. These are all beneficial to our overall health and well-being.

The biggest concern about fish and shellfish is the level of pollutants and chemicals they contain, especially mercury. High levels are toxic to the brain and nervous system. Therefore, it is especially important for pregnant and breastfeeding women and small children to avoid seafood with high levels of mercury. Follow these rules from the EPA when eating fish:

1. Do not eat shark, swordfish, king mackerel, marlin, orange roughy, tilefish, ahi (yellowfin) tuna, or bigeye tuna. These eight types of fish contain the highest levels of mercury. Another commonly eaten fish, albacore ("white") tuna, is also high in mercury. Don't eat more than 6 oz. per week.
2. Eat up to 12 oz. (two average meals) a week of a variety of fish and shellfish that are lower in mercury. Some of the most commonly eaten fish that are low in mercury are shrimp, salmon, herring, tilapia, pollock, sardines, and catfish.
3. If eating sushi, choose fish and shellfish such as eel, salmon, crab, or clam instead of predator fish such as tuna, mackerel, sea bass, or yellow tail.
4. Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas. If no advice is available, eat less than 6 ounces per week of fish caught locally. Don't eat any other fish during that week.
5. Choose to eat fish that were caught sustainably. Today, 80% of the world's sources of seafood are fully fished, overexploited, depleted, or recovering from depletion.

For more information on fish and shellfish safety, visit the following websites:

- National Resources Defense Council's Mercury in Fish Wallet Card
- Food and Drug Administration (FDA) Table of Mercury Concentration in Fish and Shellfish
- Monterey Bay Aquarium's Seafood Watch has up-to-date information on sustainable fishing and consumer guides for each state

Meat and Poultry Safety

Although you can get adequate protein from other sources (e.g., soy, legumes, dairy), meat has become a staple of the American diet. If you choose to eat red meat, buy beef that is antibiotic-free and hormone-free; the excessive use of antibiotics during animal growth may increase antibiotic resistance in humans.[9] Circulating hormones and chemicals such as nitrites in beef can also increase the risk of all-cause mortality and some long-term health conditions.[10] Additionally, higher quality meat is more nutritious. Studies have shown grass-fed beef has a more favorable fatty acid profile when compared to grain-fed beef. The grass-fed beef is higher in omega-3 fats and conjugated linoleic acid (CLA) and lower in omega-6 fats. While the overall concentration of total saturated fat is not different between feeding regimens, grass-fed beef tends toward a higher proportion of cholesterol neutral stearic fatty acid, and less cholesterol-elevating saturated fats, such as myristic and palmitic fatty acids. Furthermore, grass-fed meats have higher quantities of the precursors for vitamin A, vitamin E, and antioxidants.[11,12] Hormones are not allowed in poultry, but make sure it is antibiotic-free as well. You may also consider buying local animal products to reduce your carbon footprint.

For more information on meat and poultry safety, visit the following website

- U.S. Department of Agriculture

Food Packaging, Preparation, and Storage

Plastic bottles and food containers may contain chemicals that leach into your food, especially when heated. Store water and other fluids in a glass, aluminum, or bisphenol-A-free (BPA-free) plastic bottle. Additionally, avoid using or heating plastic containers with the recycle code numbers 3 (polyvinyl chloride), 6 (polystyrene), and 7 (polycarbonate, i.e., BPA). These numbers are usually outlined in a triangle on the base of a plastic product.

When you prepare food, it is a good policy to use two cutting boards. Use one for cutting uncooked meats, poultry, and fish; use the other for ready-to-eat foods (e.g., fruits, vegetables, breads, or cheeses). This prevents potentially harmful bacteria on uncooked meats from cross-contaminating ready-to-eat foods. Always wash cutting boards in hot, soapy water after use.

Leftover foods should be refrigerated within two hours to prevent bacterial growth. The safest temperature to prevent bacterial growth in the refrigerator is less than 40 degrees Fahrenheit.

Safe Cooking Temperatures

When cooking, it is important to bring food to the right temperature to ensure harmful microbes are killed. Below is a guide to cooking temperatures for different types of food:[13]

Category	Food	Temperature
Ground Meat and Meat Mixtures	Beef, Pork, Veal and Lamb	160°F
	Hamburgers (prepared as patties, meatballs, etc.)	160°F
	Turkey and Chicken	165°F
Fresh Beef, Veal, Pork and Lamb	Steaks, Roasts and Chops*	145°F*
Poultry	Whole Chicken and Turkey	165°F
	Poultry Breasts and Roasts	165°F
	Poultry Thighs, Legs and Wings	165°F
	Duck and Goose	165°F
	Stuffing (cooked in bird or alone)	165°F
Pork	Fresh Pork*	145°F*
	Fresh Ham (raw)*	145°F*
	Precooked Ham (to reheat)**	140°F
Egg Dishes	Egg Dishes	160°F
	Eggs	Cook until yolk and white are firm

Category	Food	Temperature
Leftovers and Casseroles	Leftovers	165°F
	Casseroles	165°F
Seafood	Fin Fish	145°F or until flesh is opaque and separates easily with a fork
	Shrimp, Lobster and Crabs	Cook until flesh is pearly and opaque
	Clams, Oysters and Mussels	Cook until shells open during cooking
	Scallops	Cook until flesh is milky white or opaque and firm
Game Animals	Venison, Elk and Bison	160°F
Game Birds	Grouse, Guinea fowl, Partridge, Squab (young pigeon), Quail, Pheasant, Ratites (emu, ostrich, and rhea), Wild Ducks, Wild Geese, Wild turkey, and other species	165°F

*Must reach an internal temperature of 145°F and allow to rest for at least 3 minutes before carving or consuming.

**Reheat cooked hams packaged in USDA-inspected plants to 140°F and all others to 165°F.

For help remembering the proper cooking temperatures and other food safety tips while cooking, download this helpful food safety app: "Is My Food Safe?"

Food Additives and Intolerance

Food additives are ingredients that preserve flavor or improve the taste or texture of a product. They include dyes, antioxidants, emulsifiers or stabilizers, flavor enhancers, and preservatives. These substances are derived from a variety of places, including coal tar and cochineal bugs. Today, there are over 14,000 man-made preservatives and additives added to the food we eat. The FDA must identify them as "Generally Recognized as Safe" (GRAS) before they can be added to food products. Yet, it is thought that some FDA approved additives can still cause symptoms of physical illness, such as abdominal pain, vomiting, diarrhea, headaches, fatigue, and breathing problems. For instance, there is a great deal of controversy regarding the use of aspartame (NutraSweet) due to concerns about increased risk for developing neurological symptoms.[14] and food dyes, which may be associated with hyperactive behavior and other health concerns.[15] Refer to Table 2, below.

Table 2. Food Additives and Potential Symptoms Attributed to Them[16]

Chemical	Foods that contain it	Symptoms/diseases
MSG (monosodium glutamate)	• Chinese food	• Headache • Nausea • Asthma • Weakness
Yellow dye #5 (tartrazine)	• Mountain Dew • Yellow dyed foods	• Allergy • Overactive behavior • Asthma
Xylitol/sorbitol	• Sugarless gum	• Abdominal spasm and cramping
Nitrates/nitrites	• Processed meats	• Headache • Hives
Aspartame/saccharin	• Artificial sweetener	• Headache • Cancer in animal studies
Benzoates	• Juice • Carbonated drinks	• Asthma • Allergic rhinitis • Hyperactivity
Sulfites	• Dried fruits • Bottled lemon juice	• Asthma • Allergy • Severe, rapid reactions
Carrageenan	• Nut milks • Pudding • Snack bars	• Irritable and inflamed bowels
High-fructose corn syrup	• Sweetened, processed foods	• Diabetes • Obesity • Fibrosis of liver
Trans fat (partially hydrogenated oils)	• Stick margarine • Shortening • Nondairy coffee creamers • Fried fast foods	• Heart disease • Diabetes

A person may have an allergy or intolerance to a food additive if they have symptoms after eating foods that are prepackaged or from a restaurant. Allergies include rapid symptoms mediated by immunoglobulin E and associated with a histamine response. Most reactions to foods, however, may actually be intolerances. Food allergies can be identified through allergy testing. In contrast, food intolerances are primarily discovered by trial and error. If symptoms stop when a person quits eating a food or foods containing suspected additives, then he or she

is likely intolerant to those additives, especially if symptoms recur if the food is eaten again. Detecting food intolerances requires careful reading of food labels. Unfortunately, not all additives are listed on labels. A food diary can be helpful during this process. Carefully track the food you eat, the symptoms you have, and when they occur. See the "Elimination Diets" information, and consider the safety summary for food additives listed in the "For More Information on Food Additives" box, below.

For more information on food additives, visit the following websites:

- Center for Science in the Public Interest: safety summary for food additives
- FDA: information on food ingredients and colors
- Better Health Channel (State Government of Victoria, Australia):
- recipes for people with food intolerances
- Non GMO Project: information on genetically modified (GM) foods

A genetically modified organism's (GMO) genes have been altered in a way that does not occur naturally. Genetic engineering can be used to alter plants used as food. This is done so crops are more resistant to insects and common agricultural diseases; it can also create plants that require fewer chemicals during the growing season. Research on the safety of GMOs is controversial,[17] but there is some evidence of associated environmental and health risks.[18] There are few human studies on GMO foods, but animal studies show that some GMOs may have toxic effects on the liver, pancreas, reproductive organs, and kidneys.[19] Few GMO fruits or vegetables are available at stores. However, most processed foods contain GMO ingredients from soybeans or corn. While 64 other countries require GMO labeling of foods, the United States does not. However, many Americans are in favor of creating regulations on GMOs.[20]

The following foods are most likely to be genetically modified: soybeans, corn (especially in high-fructose corn syrup), grapeseed/canola oil, sugar beets, rice, cottonseed oil (present in vegetable oil and margarine), dairy products from hormone-injected cattle, aspartame, papayas, apples, squash, potatoes, and farm-raised salmon. The following guidelines can help you reduce intake of GMO foods:

1. Buy foods that are 100% organic, as GMO foods cannot be labeled with this designation. Regular "organic" foods can contain up to 30% GMOs. Alternatively, seek products that are labeled as non-GM or GMO-free. Foods are not often labeled, since it is not required by the FDA.
13. Avoid processed foods containing corn starch, corn syrup, corn oil, canola oil, soybean oil, "vegetable oil," and sugar (mostly from GMO sugar beets, unless otherwise noted on the label; cane sugar is not GMO).
14. If you choose to purchase red meat, buy beef that is 100% grass-fed.
15. If you choose to buy dairy products, buy products that use milk from cows not injected with hormones.
16. Shop locally at farmers' markets or get your produce from a Community Supported Agriculture (CSA) farm. Or, grow your own food!

For more information on GMOs, visit the following websites:

- World Health Organization Q&As on GMOs
- FDA

Additional Resources

Websites for General Food Safety Information

- Centers for Disease Control and Prevention (CDC) websites on food safety and food outbreaks in the United States
- FDA website on food topics
- University of Wisconsin-Extension website on food safety and health
- U.S. government website on food recalls and alerts, keeping food safe, and food poisoning
- World Health Organization (WHO) website on food safety

Books

- Fast Food Nation: The Dark Side of the All-American Meal, Eric Schlosser (2001)
- Food Rules: An Eater's Manual, Michael Pollan (2009)
- The Omnivore's Dilemma, Michael Pollan (2006)
- What to Eat, Marion Nestle (2006)

Resource Links

- Better Health Channel: https://www.betterhealth.vic.gov.au/?opendocument
- Centers for Disease Control and Prevention (CDC) on food outbreaks: https://www.cdc.gov/foodsafety/outbreaks/multistate-outbreaks/outbreaks-list.html
- Centers for Disease Control and Prevention (CDC) on food safety: https://www.cdc.gov/foodsafety/
- Center for Science in the Public Interest: https://cspinet.org/eating-healthy/chemical-cuisine
- Elimination Diets: https://www.fammed.wisc.edu/files/webfm-uploads/documents/outreach/im/handout_elimination_diet_patient.pdf
- FDA on food: https://www.fda.gov/food
- FDA on food ingredients and colors:
- FDA website on food topics: https://www.fda.gov/food/food-ingredients-packaging/overview-food-ingredients-additives-colors
- Is My Food Safe?: https://www.eatright.org/-/media/homefoodsafety/multimedia/downloads/is-my-food-safe-app.pdf?la=en&hash=C3DC25661331E1EB1C284D1C37FD32051DD62F53
- Mercury in Fish: https://www.nrdc.org/sites/default/files/walletcard.pdf
- Monterey Bay Aquarium's Seafood Watch: https://www.seafoodwatch.org/
- Non GMO Project: information: https://www.nongmoproject.org/gmo-facts/
- Passport to Whole Health: https://wholehealth.wisc.edu/wp-content/uploads/sites/414/2018/09/Passport-to-Whole-Health-3rd-Edition-2018.pdf
- Pesticide Action Network Database: http://www.pesticideinfo.org/
- The Environmental Working Group: https://www.ewg.org/
- University of Wisconsin-Extension on food safety and health: https://foodsafety.wisc.edu/
- U.S. Department of Agriculture: https://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/food-labeling/meat-and-poultry-labeling-terms/meat-and-poultry-labeling-terms
- U.S. Department of Agriculture's (USDA) National Organic Program: https://www.ams.usda.gov/about-ams/programs-offices/national-organic-program

- U.S. government website: https://www.foodsafety.gov/
- What's on My Food? : http://www.whatsonmyfood.org/
- Whole Health Library website: https://wholehealth.wisc.edu/
- World Health Organization Q&As on GMOs: https://www.who.int/foodsafety/areas_work/food-technology/faq-geneically-modified-food/en/
- World Health Organization (WHO): https://www.who.int/health-topics/food-safety/

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