Revising the U.S. Federal Ground Beef Purchase Program Based on Recommendations from the National Advisory Committee on Microbiological Criteria for Foods

Carl M. Schroeder and Craig A. Morris*

Livestock, Poultry, and Seed Program, Agricultural Marketing Service, U.S. Dept. of Agriculture, 1400 Independence Ave., Washington, D.C. 20250, USA

SUMMARY

The U.S. Department of Agriculture's Agricultural Marketing Service (AMS) procures ground beef for federal food and nutrition assistance programs, including the National School Lunch Program. In 2012, at the request of the Secretary of Agriculture, the National Advisory Committee on Microbiological Criteria for Foods (NACMCF) reviewed the AMS ground beef purchase specifications and in 2013 made its recommendations on how to strengthen the program. Over the ensuing three years, AMS used a stepwise approach to implement the changes recommended by NACMCF, including (i) discontinuing testing for *Escherichia coli* O157:H7 and *Salmonella* in beef destined for cooking, using a validated lethality step in a federally inspected establishment, (ii) discontinuing testing for *Staphylococcus aureus* in beef, and (iii) approving alternative laboratory methods, other than those outlined in the Food Safety and Inspection Service's Microbiological Laboratory Guidebook, for use by contract laboratories in testing for AMS. In addition, though not recommended explicitly by NACMF but instead based on stakeholder consultation, AMS initiated testing for *E. coli* O26, O45, O103, O111, O126, and O145 in beef to be delivered raw. Cumulatively, the changes have focused the AMS purchase specification requirements and saved approximately $780,000 per year, which AMS now uses to purchase additional food for federal food and nutrition assistance program recipients.

OVERVIEW

In 2012, the National Advisory Committee on the Microbiological Criteria for Foods (NACMCF) reviewed the purchase specifications used by the Agricultural Marketing Service (AMS) to procure ground beef for federal nutrition assistance programs. Over the past three years, AMS has implemented the NACMCF recommendations. This report summarizes the recommendations made by NACMCF, their implementation, and the resultant benefits.

BACKGROUND

The Agriculture Marketing Service (AMS), under authority of the Richard B. Russell National School Lunch Act, purchases food for distribution to recipients through federal food and nutrition assistance programs, including the National School Lunch Program (NSLP). Beef is an important component of these programs. During Fiscal Year 2015, for example, AMS purchased approximately 100 million pounds of fresh and frozen boneless and ground beef, approximately 94 million pounds of which were designated for the NSLP *(2)*. Based on inherent product risk and the potentially susceptible population of recipients, AMS requires microbiological testing, in addition to federal regulatory testing performed by the Food Safety and Inspection Service (FSIS), of beef it intends to purchase *(1)*. Testing results suggest that beef produced for AMS is safe and of high microbiological quality *(3, 5)*.

As part of an ongoing effort to ensure that the AMS beef purchase specifications reflect the best available science and to ensure that taxpayer dollars are used efficiently (costs for all microbiological testing done by AMS come from monies appropriated by Congress to purchase food; thus every dollar spent on testing is a dollar not spent on food), the Secretary of Agriculture in 2012 requested NACMCF—established in 1988 under provisions of the Federal Advisory Committee Act and with the objective of providing impartial scientific advice to federal food safety agencies *(6)*—independently review the AMS beef purchase specifications. NACMCF's recommendations were published in 2013 *(9)*.

Following publication of the NACMCF recommendations, AMS developed a three-year plan to implement systematically the recommendations, culminating with issuance of the AMS ground beef purchase specifications for the 2016–2017 purchase year (beginning June 2016) *(1)*.

*Author for correspondence:
Phone: +1 202.720.5705
Fax: +1 202.720.1112
E-mail: craig.morris@ams.usda.gov

REVISIONS BASED ON NACMCF RECOMMENDATIONS

Salmonella and _Escherichia coli_ O157:H7 testing

Approximately 60% of the beef purchased by AMS is delivered to an FSIS-inspected establishment and cooked using a validated lethality step prior to delivery to recipients; the other approximately 40% is shipped raw to recipients, including school foodservice facilities, where it is cooked by foodservice workers prior to being served. Beginning in 2010, AMS required testing for *Salmonella* and *E. coli* O157:H7 in approximately every 2,000 pounds of boneless beef and approximately every 10,000 pounds of ground beef destined for federal food and nutrition assistance programs, regardless of whether the product was to be cooked at an FSIS-inspected facility. Any lot found positive for either *Salmonella* or *E. coli* O157:H7 was rejected for purchase by AMS. Citing the effectiveness of validated cooking processes in eliminating pathogens completely and the unnecessary costs of testing and then diverting lots found positive, NACMCF recommended that testing for *Salmonella* and for *E. coli* O157:H7 in boneless beef trim and ground beef intended for further processing in an FSIS-inspected facility using a validated cooking process with AMS oversight be discontinued.

AMS implemented the NACMCF recommendation in a stepwise fashion to help ensure that controls necessary for traceability through the AMS production and purchasing system were in place and working effectively. It is paramount that beef destined for delivery to recipients raw continues to be tested for *Salmonella* and *E. coli* O157:H7.

First, in 2014, AMS discontinued testing for *Salmonella* and *E. coli* O157:H7 in boneless beef destined directly for cooking at an FSIS-inspected facility. This resulted in forgoing pathogen testing of approximately 7,700 lots of boneless beef during the year and a savings of approximately $284,900 in testing costs per year.

Second, in 2015, AMS discontinued testing for *Salmonella* and *E. coli* in O157:H7 in ground beef destined for cooking at an FSIS-inspected facility. This resulted in forgoing pathogen testing of approximately 2,100 lots of ground beef during the year and a savings of approximately $77,700 per year.

Third, in 2016, AMS discontinued testing for *Salmonella* and *E. coli* O157:H7 in boneless beef destined for grinding prior to cooking at an FSIS inspected facility. Based on purchase data from past years, we estimate that this resulted in forgoing pathogen testing of approximately 7,700 lots of ground beef per year, for a savings of approximately $284,900.

***Staphylococcus aureus* testing**

From 2003 through 2011, AMS required that every approximately 10,000 pounds of ground beef be tested for *S. aureus*, with any 10,000-pound lot found to contain *S. aureus* at a concentration of ≥ 500 colony-forming units (CFU) gram^{-1} rejected for purchase. Based on review of available evidence, NACMCF found no scientific basis for including *S. aureus* testing in the purchase specifications and thus recommended that such testing be discontinued. In 2012, AMS discontinued testing for *S. aureus* in ground beef, resulting in savings of approximately $99,000 per year.

Alternative laboratory methods

Microbiological testing analyses required by AMS ground beef purchase specifications are done by commercial laboratories under contract with AMS. The laboratories—referred to as AMS-designated laboratories (ADLs)—must meet specific criteria to be deemed an ADL and must undergo comprehensive annual audits by AMS. Traditionally, AMS has required that all ADLs use methods described in the FSIS Microbiological Laboratory Guidebook (MLG) *(8)*. To potentially reduce turnaround time and lower costs, NACMCF recommended that AMS allow alternative testing methods, based on ADL and/or AMS vendor requests, provided that such methods are validated against and compatible with MLG methods.

Based on the NACMCF recommendation, AMS has approved three alternative pathogen detection methods, each of which is proprietary to the ADLs that proposed its use. AMS has also approved a drill sampling device for use in lieu of the N60 scalpel excision method for boneless beef testing *(7)*.

Ongoing program reviews

NACMCF encouraged AMS to consult regularly with colleagues at FSIS and the Agricultural Research Service to continually review and refine the AMS ground beef purchase specifications. As a result, AMS initiated regular consultations with these two sister agencies (and others, including the Food and Nutrition Service and the National Institutes of Food and Agriculture) to solicit feedback on the program. In addition, AMS consults with other stakeholders, including industry, consumer advocacy, and public policy groups, to review its ground beef purchase program.

Non-O157 Shiga toxin-producing *Escherichia coli* (STEC) testing

Based on advice received through ongoing program reviews and stakeholder feedback, AMS in 2013 initiated testing of boneless beef for the six non-O157 *E. coli* serotypes (O26, O45, O103, O111, O126, and O145) declared adulterants by FSIS in 2012. Testing is done randomly on 1 out of every 10 lots of boneless beef, resulting in testing of approximately 7,700 lots per year. Testing for non-O157 STECs in boneless beef costs AMS approximately $15,400 per year.

CONCLUSIONS

NACMCF recommendations are the cornerstone for strengthening the AMS ground beef purchase specifications. The NACMCF review was not initiated to identify cost savings. Rather, it was initiated to identify the best available science and use such information to guide revision of the specifications. Regardless, eliminating superfluous, scientifically unjustified specifications identified by NACMCF saves approximately $780,000 per year. These savings remain within the federal food and nutrition assistance program and are now used to better effect, through targeting testing for emerging pathogens and purchasing more food for program recipients. AMS monitors ground beef microbiological testing data closely, and any indication of an increase in microbiological contamination would lead to an immediate reexamination of testing requirements *(3)*.

Throughout the three-year implementation of the NACMCF recommendations, AMS engaged its full range of stakeholders. As a result, and in addition to incorporating the NACMCF recommendations, AMS updated its purchase specifications to include testing for the non-O157 *E. coli* serotypes declared adulterants by FSIS (i.e., O26, O45, O103, O111, O126, and O145), a change principally informed by consultation with the Safe Food Coalition *(4)*. AMS continues aggressively to solicit expertise from across the stakeholder spectrum to inform purchase specification development.

AMS views food purchase specifications as value judgments informed by science. Stakeholders—in particular program recipients and those who advocate on their behalf—provide AMS feedback about acceptable risks, desirable quality attributes, and price concerns. AMS combines the information and develops purchase specifications accordingly. Implementation of the NACMCF recommendations, together with ongoing stakeholder consultation, helps ensure that the science on which the AMS beef purchase specifications rests is sound.

ACKOWLEDGMENTS

We thank Steve Whisenant, Darin Doerscher, Terry Lutz, Kerry Smith and Rod Bowling for their work in revising the AMS ground beef purchase specifications based on the NACMCF recommendations. We also thank Kadeem Hinton for reviewing the manuscript draft.

AUTHOR INFORMATION

Phone: +1 202.720.5705
Fax: +1 202.720.1112
E-mail: craig.morris@ams.usda.gov

REFERENCES

1. Agricultural Marketing Service. 2016. Federal Purchase Program Specification (FPPS) for Ground Beef Items, Frozen. Available at: https://www.ams.usda.gov/sites/ default/ files/media/ FPPS%20Ground%20Beef%20 Items%20April%202016.pdf. Accessed July 14, 2016.
2. Agricultural Marketing Service. 2016. Food Commodity Purchasing. Available at: https://www.ams.usda.gov/ reports/ food-commodity-purchasing. Accessed July 14, 2016.
3. Agricultural Marketing Service. 2016. Microbiological Testing of AMS Purchased Meat, Poultry and Egg Commodities. Available at: https://www.ams.usda.gov/resources/ microbiological-testing. Accessed July 14, 2016.
4. Consumer Federation of America. 2016. Safe Food Coalition. Available at: http://consumerfed.org/issues/food-and-agriculture/. Accessed July 14, 2016.
5. Doerscher, D. R., T. L. Lutz, S. J. Whisenant, K. R. Smith, C. A. Morris, and C. M. Schroeder. 2015. Microbiological testing results of boneless and ground beef purchased for the National School Lunch Program, 2011 to 2014. *J. Food Prot.* 78:1656–1663.
6. Food Safety and Inspection Service. 2016. National Advisory Committee on Microbiological Criteria for Foods. Available at: http://www.fsis.usda.gov/wps/portal/ footer/!ut/p/a0/04_Sj9CPykssy0x-PLMnMz0vMAfGjzOJNAyxdDU28Db-wsvLxdDDzDnA3NLIONjdzCjPQLsh-0VAZaJ_MY!/?1dmy&current=true&uri=wcm%3Apath%3A%2Ffsis-content%2Finternet%2Fmain%2Ftopics%2Fdata-collection-and-reports%2Fnacmcf%2Fnacmcf. Accessed July 14, 2016.
7. Food Safety and Inspection Service. 2010. Verification activities for *Escherichia coli* O157:H7 in raw beef products. Available at: http://www.fsis.usda.gov/wps/wcm/ connect/c100dd64-e2e7-408a-8b27-ebb378959071/10010.1Rev3.pdf?MOD=AJPERES. Accessed July 14, 2016.
8. Food Safety and Inspection Service. 2014. Microbiology Laboratory Guidebook. Available at: http://www.fsis.usda.gov/ wps/portal/fsis/topics/science/laboratories-and-procedures/guidebooks-and-methods/microbiology-laboratory-guidebook/microbiology-laboratory-guidebook. Accessed July 14, 2016.
9. National Advisory Committee on Microbiological Criteria for Foods. 2013. Expedited response to the questions posed by the United States Department of Agriculture agricultural marketing service to support ground beef purchase for the federal food and nutrition assistance programs. *J. Food Prot.* 76:523–537.

Fruit and Vegetable Washing in Food Retail Environments

Anna Starobin[1*] and Sally Foong-Cunningham[2]

[1]Ecolab Inc., 8300 Capital Drive, Greensboro, NC 27409, USA

[2]Ecolab Inc., 370 Wabasha St. North, St. Paul, MN 55102, USA

SUMMARY

Consumption of fruits and vegetables is encouraged as part of a healthy diet by The Dietary Guidelines for Americans for 2010. If the benefits of fruits and vegetables are to be enjoyed, they need to be handled properly at all steps along the supply chain, from farm to fork. Approximately 131 produce-related outbreaks occurred between 1996 and 2010. These outbreaks resulted in 14,132 illnesses, 1,360 hospitalizations and 27 deaths, and were associated with approximately 20 fresh produce commodities. Food retail plays a big role in providing safe produce to consumers. This paper gives an overview of the procedures used by retail establishments and explains the reasons for some of the practices recommended in industry guidelines.

OVERVIEW

Fruits and vegetable are known to be a good source of many important nutrients, including potassium, vitamin C, folate, fiber, and numerous phytochemicals *(3)*. Vegetables and fruits with high levels of fiber may reduce the risk of obesity and type 2 diabetes; those rich in potassium may lower blood pressure and lower the risk for kidney stone development *(13)*. Aside from being recommended for weight management, fruit and vegetable consumption is recommended for bone development and chronic disease risk management *(2, 14)*.

Worldwide concern and knowledge about foodborne illness have been steadily increasing over the past several decades. Historically, the problem of microbiological contamination of fruits and vegetables was not considered significant, since it was originally believed that the low pH of fruits and vegetables would control the contamination *(15)*. In addition, few outbreaks were associated with fruits and vegetables because of the lack of adequate pathogen identification technology. Today, it is increasingly recognized that raw fruits and vegetables are vulnerable to contamination, since final consumption occurs without a cooking step. In view of the complexity of the vegetable washing procedure, this paper summarizes recommendations provided by various guidelines and research papers for proper handling of fruit and vegetables in food service establishments.

Based on the Centers for Disease Control and Prevention's (CDC) evaluation of estimated foodborne illnesses, hospitalizations, and deaths due to food commodities in the United States between 1998 and 2008, it is estimated that 46% of illnesses and 23% of deaths were produce related *(4)*. Twenty-two percent of illnesses were associated with leafy vegetables, which were the main items associated with illnesses within the produce category, which resulted in 14% of hospitalizations and caused 6% of deaths *(4)*.

A variety of microorganisms have been linked to foodborne outbreaks connected to the consumption of raw fruits and vegetables. These organisms, which can contaminate fruits and vegetables, come from multiple sources outside of the food service establishment, including water, wild animals, soil, harvest containers, harvest crews and handlers, inadequate hygiene of buildings and equipment, transportation and storage. The complexity of contamination sources, both upstream and downstream, from the receiving door of the restaurant, retail deli or other food service facility is shown in *Fig. 1* *(5)*.

Microbial contamination can be caused by bacteria, viruses, parasites, molds and yeasts. According to the Food and Drug Administration (FDA) database between 1996 and 2010, bacterial agents (86.5%), parasites (11.6%) and viruses (1.9%) were associated with the majority of fresh produce-related outbreaks and illnesses *(12)* *(Fig. 2)*.

Pathogens involved in these outbreaks include *Escherichia coli* O157:H7, *Salmonella* species, *Listeria monocytogenes, Cyclospora, Shigella sonnei,* Hepatitis A and norovirus *(4, 12)*. Sprouts, leafy greens, tomatoes, melons (e.g., cantaloupes and honeydew melons), berries, herbs and green onions accounted for 88.5% of the total produce-associated outbreaks *(12)*.

In addition to food safety risks that are introduced upstream in the supply chain, improper handling of fruits and vegetables in the food service establishment can lead to microbiological cross-contamination and/or growth of pathogens that are already on the produce. Effective hand washing coupled with thorough cleaning and sanitation, as well as suitable storage and proper handling procedures of fruits and vegetables, can reduce this risk. Most microbial

* Author for correspondence:
Phone: +1 336.931.2185
Fax: +1 336.668.9763
E-mail: anna.starobin@ecolab.com

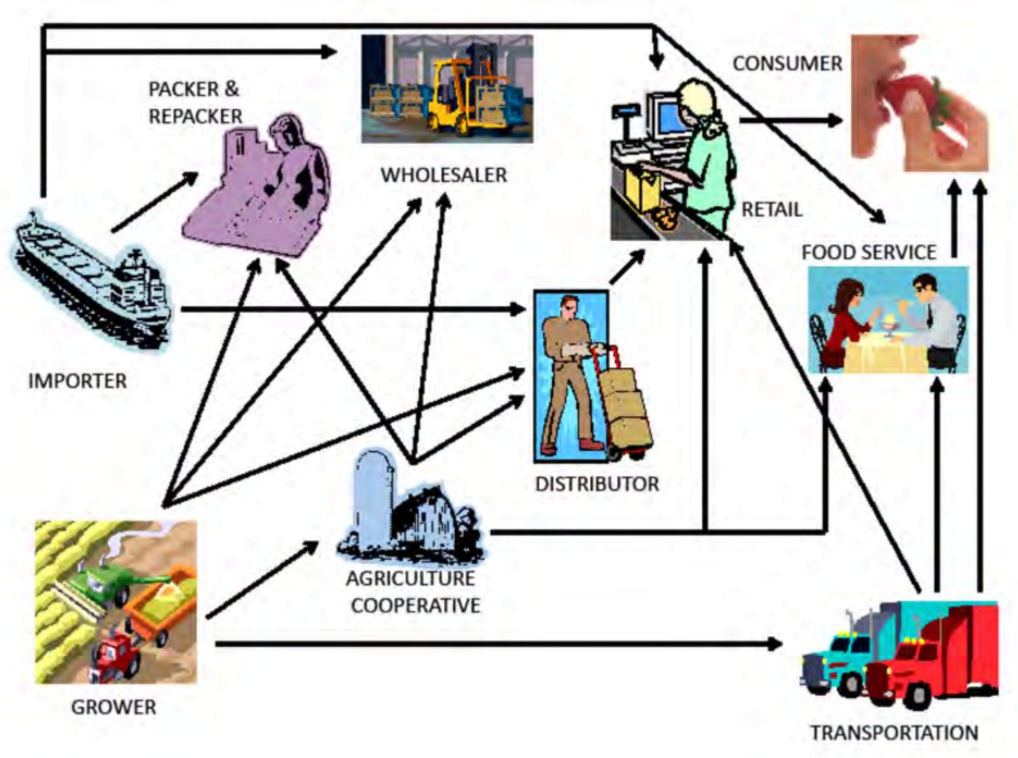

Figure 1. Fresh fruit and vegetable supply chain illustrating the complexity of contamination sources (5)

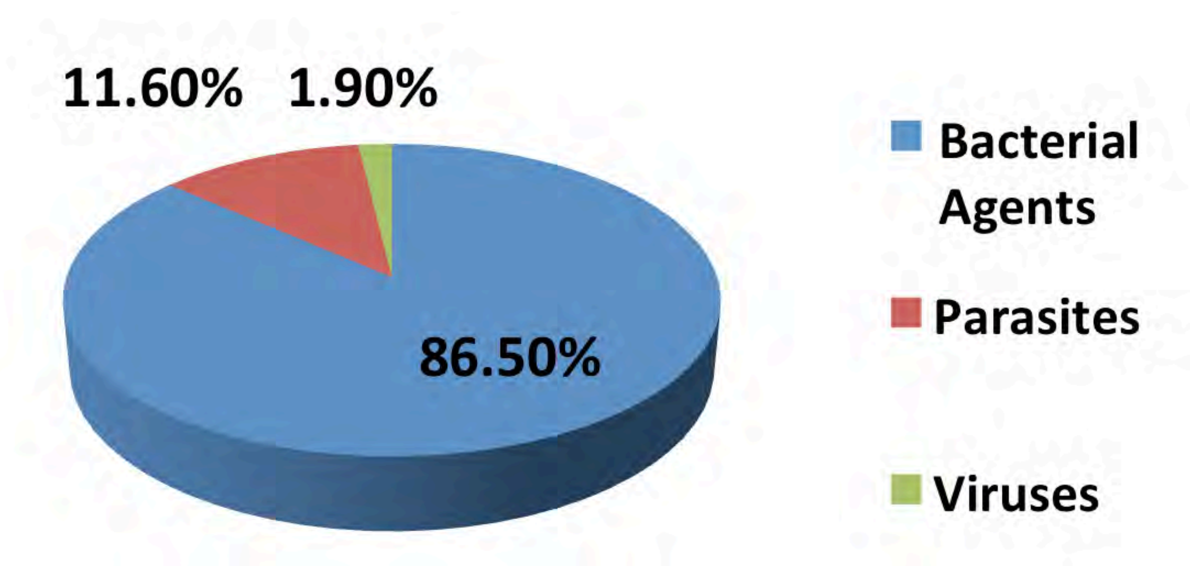

Figure 2. Fresh produce-related outbreaks and illnesses microbial contamination (12)

contamination is on the surface of the produce; therefore, washing produce can reduce the overall potential for microbial food safety hazards. If pathogens are not removed or inactivated, contamination can spread to additional produce while the food is being processed *(9)*.

Fresh produce, especially of the leafy green type, is often soaked in ice water to preserve quality. When the microbiological water quality is not maintained, this practice has the potential to lead to food safety problems. The water in which produce is soaked, along with pathogens that may be present in the water, could be drawn into the interior of the produce through stem scars, cracks, cuts or bruises of fruits and vegetables, as a result of a temperature-generated pressure differential *(7, 10)*. *Figure 3* shows an example of this phenomenon.

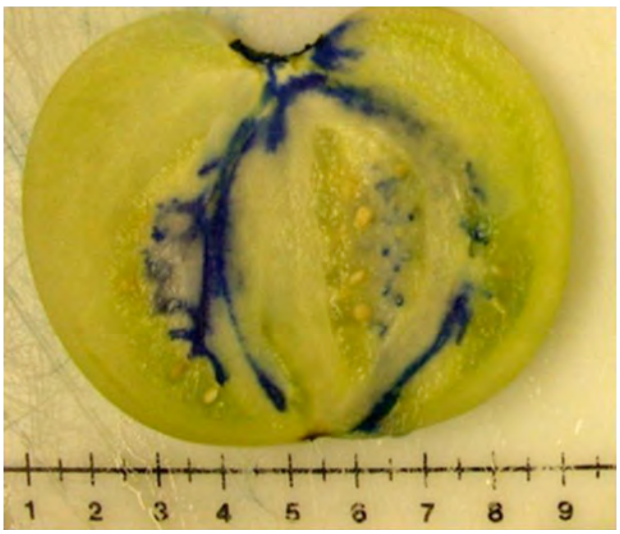

Figure 3. Potential internalization of microorganisms inside a tomato, as illustrated with a dye solution that entered through the stem and blossom-end scar (1)

Courtesy: Institute for Food and Agricultural Sciences–University of Florida.

Maintaining a sanitary condition of the water and a temperature difference between produce and water can reduce the risk of microorganism infiltration *(8)*. Antimicrobials can minimize the potential for cross-contamination from processing water to the product, especially in situations when having a temperature differential between the wash water and the produce is not practical. Using spray-type wash treatments instead of submerging produce could be considered as well *(9)*.

RECOMMENDATIONS FOR PROPER HANDLING OF FRESH PRODUCE BY FOOD SERVICE OPERATORS

1. Purchase produce from a safe and reliable source of supply. Evaluate the growing and processing conditions, including the produce washing procedure, and employee hygiene practices.
2. Store raw cut melons, fresh sprouts, cut leafy greens and cut tomatoes at temperatures at or below 41°F (5°C) *(11)*.
3. Wash hands thoroughly with soap and running potable water before and after handling produce.
    - Employees can be carriers of pathogenic microorganisms located on the skin, hair and hands or in the respiratory tract or digestive system. When employees come into contact with food, the potential exists for transmitting foodborne illness by contaminating the food, contact surfaces, water sources or other employees *(8)*.
4. Wash, rinse and sanitize all sinks, utensils, cutting boards, slicers and other food contact surfaces before and after use with fresh produce.
    - Microorganisms may be transmitted from an unclean sink or utensil to produce.
    - Protect sources of water from contamination. Use potable water for washing. Comply with applicable local requirements for water that comes into contact with fresh-cut produce or food-contact surfaces.
    - Wash produce under running potable water or immerse whole produce along with using an antimicrobial in the wash water prior to preparing it in ready-to-eat form *(9, 11)*.
    - Antimicrobial chemicals used with quality water can minimize the possibility of processing water becoming contaminated with microorganisms that could ultimately cross contaminate the product *(9, 16)*. All chemical substances that disinfect or sanitize wash water and contact food must be used in accordance with FDA and EPA regulations and according to the manufacturer's labels *(9)*. Rinsing produce with potable water may be required, unless otherwise indicated on the product label.
5. Maintain the wash water temperature at 10°F (6°C) warmer than the temperature of the pulp of the produce being washed.
    - Colder water can cause pathogens from the produce surface to be pulled into the plant material because of the osmotic pressure difference. If this occurs, washing is unlikely to reduce pathogen numbers. The recommended temperature differential may be achieved either by heating the water or by air cooling the produce before immersion *(10)*.
    - As an alternative to using water alone for submerging produce, the use of antimicrobial chemicals in the wash water or in a spray could be considered *(9)*.
6. Validation of the product's antimicrobial properties should be done using scientifically valid and standard test methods. When an actual use process is evaluated, validation goals should be clearly articulated. For example, consider whether the method is intended to improve produce shelf life or reduce/prevent

cross-contamination of pathogens via wash water. Other factors to consider include the types and levels of microorganisms, the procedure used for inoculation, number of test replicates, and test conditions, such as produce and sanitizer temperatures. If an antimicrobial is used for washing produce, follow EPA-registered label instructions or the manufacturer's directions for use. Rinse the washed produce with potable water if this step is recommended by manufacturer or required by FDA.

7. Scrubbing produce is recommended only when a clean brush is used on produce with a peel or a tough rind, such as on citrus fruits or cantaloupe, that will not be bruised or penetrated by the brush bristles *(10)*.
8. Leafy green salads in sealed bags labeled "washed" or "ready-to-eat" that are packaged in a facility inspected by a regulatory authority and operated under cGMPs do not need additional washing at the time of use unless this is specifically directed on the label. Safety is not enhanced by additional washing of ready-to-eat green salads. The risk of cross-contamination from food handlers and food contact surfaces during washing may outweigh any food safety benefit that further washing may provide *(6)*.

AUTHOR INFORMATION

Phone: +1 336.931.2185
Fax: +1 336.668.9763
E-mail: anna.starobin@ecolab.com

REFERENCES

1. Bartz, J. A., S. A. Sargent, and M. Mahovic. 2012. Guide to identifying and controlling postharvest tomato diseases in Florida. Available at: http://edis.ifas.ufl.edu/pdffiles/HS/HS13100.pdf. Accessed 18 August 2016.
2. Bica, L. A., and E. M. Jamelske. 2012. USDA fresh fruit and vegetable program creates positive change in children's consumption and other behaviors related to eating fruit and vegetables. *J. Child Nutr. Mgmt.* http://eric.ed.gov/?id=EJ1000222. Accessed 18 August 2016.
3. Centers for Disease Control and Prevention. 2011. Strategies to prevent obesity and other chronic diseases: The CDC Guide to strategies to increase the consumption of fruits and vegetables. Atlanta: U.S. Department of Health and Human Services. Available at: http://www.cdc.gov/obesity/downloads/FandV_2011_WEB_TAG508.pdf. Accessed 25 August 2016.
4. Centers for Disease Control and Prevention. 2013. Attribution of foodborne illnesses, hospitalizations, and deaths to food commodities by using outbreak data, United States, 1998–2008 *Emerg. Infect. Dis.* Available at: http://www.cdc.gov/foodborneburden/ attribution-1998-2008.html. Accessed 25 August 2016.
5. International Fruit and Vegetable Alliance (IFAVA). 2013. 4.3 Identifying structure and stakeholders. Available at: http://ifava.org/ifava-toolkit-online/step-by-step-guide-to-starting-your-national-program/identifying-structure-and-stakeholders. Accessed 25 August 2016.
6. Palumbo, M. S., J. R. Gorny, D. E. Gombas, L. R. Beuchat, C. M. Bruhn, B. Cassens, P. Delaquis, J. M. Farber, L. J. Harris, K. Ito, M. T. Osterholm, M. Smith, and K. M. J. Swanson. 2007. Recommendations for handling fresh-cut leafy green salads by consumers and retail foodservice operators. *Food Prot. Trends* 27:892–898.
7. Parish, M. E., L. R. Beuchat, T. V. Suslow, L. J. Harris, E. H. Garrett, J. N. Farber, and F. F. Busta. 2003. Methods to reduce/eliminate pathogens from fresh and fresh-cut produce. *Compr. Rev. Food Sci F.* 2:161–173.
8. U.S. Food and Drug Administration. 2008. Guidance for industry: Guide to minimize microbial food safety hazards of fresh-cut fruits and vegetables. V. Personnel. Available at: http://www.fda.gov/Food/GuidanceRegulation/ GuidanceDocumentsRegulatory-Information/ProducePlantProducts/ucm064458.htm#ch5. Accessed 25 August 2016.
9. U.S. Food and Drug Administration. 2008. Guidance for industry: Guide to minimize microbial food safety hazards of fresh-cut fruits and vegetables. VIII. Production and process controls. Available at: http://www.fda.gov/Food/GuidanceRegulation/Guidance-DocumentsRegulatoryInformation/ProducePlantProducts/ucm064458.htm#ch8. Accessed 25 August 2016.
10. U.S. Food and Drug Administration. 2013. FDA Food Code 2013: Annex 3 – Public health reasons/administrative guidelines – Chapter 3, Food. 3-302.15. Available at: http://www.fda.gov/downloads/Food/GuidanceRegulation/RetailFoodProtection/Food-Code/UCM374510.pdf. Accessed 17 September 2016.
11. U.S. Food and Drug Administration. 2013. FDA Food Code 2013: Chapter 3 – Food. 3-302.15 Washing fruits and vegetables. Available at: http://www.fda.gov/downloads/ Food/GuidanceRegulation/RetailFoodProtection/FoodCode/UCM374510.pdf. Accessed 17 September 2016.
12. U.S. Food and Drug Administration. 2013. Standards for the growing, harvesting, packing, and holding of produce for human consumption. Available at: http://www. regulations.gov/#!documentDetail;D=FDA-2011-N-0921-0001. Accessed 25 August 2016.
13. United States Department of Agriculture (USDA). Why is it important to eat vegetables? Available at: https://www.choosemyplate.gov/vegetables-nutrients-health. Accessed 25 August 2016.
14. Vatanparast, H., A. Baxter-Jones, R. A. Faulkner, D. A. Bailey, and S. J. Whiting. 2005. Positive effects of vegetable and fruit consumption and calcium intake on bone mineral accrual in boys during growth from childhood to adolescence: the University of Saskatchewan Pediatric Bone Mineral Accrual Study. *Am. J. Clin. Nutr.* 82:700–706.
15. World Health Organization, Food Safety Unit. 1998. WHO/FSF/FOS/98.2 Surface decontamination of fruits and vegetables eaten raw: a review. Available at: http://apps.who.int/iris/bitstream/10665/64435/1/WHO_FSF_FOS_98.2.pdf?ua=1. Accessed 25 August 2016.
16. Zhang, G., L. Ma, V. H. Phalen, and M. P. Doyle. 2009. Efficacy of antimicrobial agents in lettuce leaf processing water for control of *Escherichia coli* O157:H7. *J. Food Prot.* 72:1392–1397.