California Department of Health Services
Food and Drug Branch

Fresh-cut Produce Re-Wash Panel
April 4, 2006

In early 2006, California Department of Health Services received a request to re-evaluate current recommendations regarding washing pre-bagged pre-washed lettuce to determine whether new scientific studies or findings would change previous recommendations stating that re-washing products produced in government-inspected facilities is not necessary. In response to this request, Food and Drug Branch convened a group of experts to review recent scientific literature and formulate guidance for consumers and retail foodservice operators. Results from this group of experts supported existing recommendations with only minor changes. These recommendations are provided in the files entitled Recommendations to Consumers Regarding Washing Ready-To-Eat Lettuce/Leafy Green Salads and Recommendations to Retail and Food Service Operators Regarding Ready-To-Eat Lettuce/Leafy Green Salads.

Panel members

Larry R. Beuchat, Professor, Center for Food Safety, University of Georgia
Christine M. Bruhn, Director, Center for Consumer Research, University of California, Davis
Barbara Cassens, District Director, US Food and Drug Administration, San Francisco District
Pascal Delaquis, Research Scientist, Agriculture and Agri-food Canada, British Columbia
Jeffrey M. Farber, Research Director, Health Canada
David E. Gombas, Vice President, Technical Services, International Fresh-cut Produce Association
James R. Gorny, VP Quality Assurance & Technology, United Fresh Fruit & Vegetable Association
Amy Green, US Food and Drug Administration, Center for Food Safety and Applied Nutrition
Linda J. Harris, Cooperative Extension Specialist (Food Safety and Microbiology), University of California, Davis
Keith Ito, Director, Laboratory for Research in Food Preservation, University of California-Davis
Michael T. Osterholm, Director, Center for Infectious Disease Research and Policy, University of Minnesota
Mary S. Palumbo, Research Scientist, California Dept. of Health Services, Food and Drug Branch
Michelle Smith, Interdisciplinary Scientist, US Food and Drug Administration, Center for Food Safety and Applied Nutrition
Katherine M.J. Swanson, Vice President Food Safety, Ecolab

Background

The following document was provided to the panel as background information in advance of the meeting. It includes a summary of current guidance, a review of scientific literature, and a list of scientific references.

Fresh-cut (minimally processed) fruit and vegetable sales have grown to approximately $15 billion per year in the North American foodservice and retail market and account for nearly 15% of all produce sales. The largest portion of U.S. fresh-cut produce sales at retail are fresh-cut salads, with sales of $2.7 billion per annum.

Many fresh-cut fruit and vegetable products are "ready-to-eat" food products and no further preparation is required (except for fresh-cut produce such as potatoes or butternut squash which obviously require cooking). These products are no different from any other ready-to-eat food product. The fresh-cut produce industry's very existence is based on providing convenient ready-to-eat foods which reduce the risk of food product contamination in food service establishments by placing preparation of fresh-cut produce in a controlled food manufacturing environment, not in a food service preparation environment.

Current Recommendations Regarding Re-Washing of Fresh-cut Produce

Authoritative information sources have put forward the following recommendations regarding re-washing of RTE fresh-cut produce:

California Department of Health Services Food and Drug Branch

"Bagged salad mixes may contain a variety of mixed greens including cabbage, lettuce, spinach, and chopped or sliced vegetables. Sometimes packets of salad dressing and condiments are included. "Ready To Eat" or "Wash Before Serving" may appear on the package. Consumers are advised to wash all produce which is not labeled as "ready-to-eat" or which contains an advisory to wash before consumption."
Source: CA DHS "Handling of "Value Added" Produce in Retail Markets", 1999 (www.dhs.ca.gov/ps/fdb/HTML/food/Fsn9903.htm)

"Wash all raw, unpackaged produce before cutting, chopping, or slicing. Discard any ice that may be packed with the produce. In a cleaned and sanitized sink, rinse produce under cold running water. Gentle rubbing with a soft brush made for use on food is ok. Don't forget to clean and sanitize the brush before using. After washing, antibacterial agents may be used on raw produce if they are approved for food contact and used according to directions. However, these products are not 100% effective in removing or eliminating bacterial pathogens, nor do they completely remove viruses such as the one that causes hepatitis A."

Source: CA DHS "Reducing Risk Of Foodborne Illness Associated With Green Onions And Other Produce – A Guide For The Retail Food Industry" www.dhs.ca.gov/ps/fdb/PDF/Produce%20Handling%2011%202503A.PDF

U.S. Food and Drug Administration and U.S. Department of Agriculture

"Ready-to-eat, prewashed bagged produce can be used without further washing if kept refrigerated and used by the "used-by" date. If desired, prewashed, ready-to-eat produce can be washed again (FDA, 2001).

Guidance for Safely Using Bagged Produce.

- Read the labels of bagged produce to determine if it is ready−to−eat
- Ready−to−eat, prewashed bagged produce can be used without further washing if kept refrigerated and used by the "use–by" date
- If desired, prewashed, ready−to−eat produce can be washed again

Use-by dates should be differentiated from purchase-by dates. Products with purchase-by dates can be used after that date; however, products with use-by dates should not be used after the use-by date. Although some studies have shown that antibacterial agents are proven effective in

reducing indigenous flora on produce such as lettuce during food service preparation (Smith et al., 2003), these solutions warrant additional testing and research in household settings.

Source: 2005 USDA and US DHHS Dietary Guidelines Advisory Committee Report
www.health.gov/dietaryguidelines/dga2005/report/PDF/D9_FoodSafety.pdf

"Fresh-cut produce does not require additional preparation, processing, or cooking before consumption, with the exception of washing or the addition of salad dressing, seasoning or other accompaniments."

Source FDA DRAFT Guidance to Industry - "Guide to Minimize Microbial Food Safety Hazards of Fresh-cut Fruits and Vegetables (www.cfsan.fda.gov/~dms/prodgui2.html)

Produce For Better Health Foundation

"If the bag contains the statement “Washed”, “Triple Washed” or “Ready-to-Eat” there is no need to wash the product again. In fact, Dr. Linda Harris, a specialist in microbial food safety at the University of California, Davis, has said “it’s safe to eat pre-washed vegetables straight out of the bag. These salads are usually prepared in facilities that are cleaner than anyone’s kitchen.”
In fact, one of the benefits to pre-cut, packaged produce is the reduced need for handling. Because it is ready-to-use, it does not need to be washed and little or no preparation is needed. Since improper handling in the home and/or in restaurants during preparation is a leading cause of food-borne illness outbreaks associated with produce, the use of pre-cut, packaged produce which requires less preparation actually reduces the risk of foodborne illness. If one chooses to wash pre-cut, packaged fruits and vegetables, it should be done carefully to avoid cross-contaminating the produce with meat, dairy, egg, poultry or seafood product residues that may be present on cutting boards, colanders, in sinks, or on kitchen counters."

Source: PBH "The Convenience, "Nutritional Value and Safety of Fresh-cut Produce", 2005 (www.5aday.com/pdfs/freshcut_pbhbriefing_aug05.pdf)

Partnership for Food Safety Education

"Packaged fruits and vegetables labeled “ready-to-eat”, “washed” or “triple washed” need not be washed."

Source: Fight BAC! Six Steps to Safer Fruits and Vegetables, Safe Handling of Fresh Fruits and Vegetables Partnership for Food Safety Education
http://portal.fightbac.org/pfse/toolsyoucanuse/phec

International Fresh-cut Produce Association

"Fresh-cut produce is convenient for today's fast-paced consumer because it is already washed, cut and packaged. It goes through a vigorous cleansing process before it is packaged and sold to the consumer. As long as it says "washed" , "triple washed" or "ready-to-eat" on the package, there is no need to wash it again once it's brought home. However, washing the product will not harm."

"Re-washing fresh-cut produce will not harm product quality. However, if you chose to re-wash ready-to-eat fresh-cut produce, appropriate sanitary washing and drying conditions in the food service, retail or in-home food preparation environment must be in place to reduce the potential for cross contamination of fresh-cut ready-to-eat produce with human pathogens.

Re-washing of ready-to-eat fresh-cut produce must occur in food preparation areas that have:

- clean and sanitary food contact surfaces (i.e. colanders, knives, drying cloths, etc),
- clean and sanitary preparer hands and
- in an environment clearly segregated from other food items (i.e. raw uncooked meat, poultry, etc.) which may harbor human pathogens."

Source: International Fresh-cut Produce Association (www.fresh-cuts.org)

Survival and Growth of Human Pathogens on Leafy Vegetables and the Location of Cells that Survive Initial Chlorine Treatment

Studies on survival and growth of pathogens on lettuce and parsley have shown that *Shigella sonnei*, *Salmonella baildon*, and *E. coli* O157:H7 will decrease in numbers when the produce is stored at 4-5 C, but increase at 12 C (*E. coli* O157:H7) and 21 C (all three pathogens). Seo and Frank (1999) inoculated lettuce by immersion in a suspension of *E. coli* O157:H7 overnight at 7 C, rinsed with sterile distilled water, then treated with 20 mg/liter chlorine solution. In a separate experiment, lettuce leaves were first immersed in a suspension of *Pseudomonas fluorescens* for 48 hours at 16 C to allow biofilm formation. The leaves were then rinsed with sterile water and transferred to a suspension of *E. coli* O157:H7 for 24 hours at 7 C. Examination of inoculated lettuce leaf surfaces by confocal scanning laser microscopy showed that *Pseudomonas* (predominant psychrotrophic spoilage organism) adhered to and grew mainly on the intact leaf surface, whereas *E. coli* O157:H7 was entrapped 20 to 100 um below the surface in stomata and cut edges. Many live *E coli* O157:H7 cells were found in stomata and on cut edges following the chlorine treatment. This indicates the probability that subsequent washing probably will not be effective in removing these cells. *Listeria monocytogenes* also has been shown to grow on lettuce.

Effect of Wash Procedures on Subsequent Growth or Survival During Storage

Delaquis et al. (2002) inoculated cut iceberg lettuce with *E. coli* O157:H7 and *Listeria monocytogenes* before and after washing for 3 minutes in cold (4 C) and warm (47 C) water containing 100 mg/liter total chlorine, then stored the product at 1 and 10 C under aerobic conditions. Populations of *E. coli* O157:H7 declined over 14 days storage at 1 C under both washing conditions as well as at 10 C when washed in cold chlorine solution (current industry practice). Populations increased when stored at 10 C after a warm chlorine solution wash. However, this is not the procedure currently used in commercial operations. Similar results were obtained with *Listeria monocytogenes*, which showed about a 1 log CFU/g increase in the inoculated control when stored at 10 C but a 2 log CFU/g increase when the lettuce was washed with warm chlorine solution. Li et al. (2001) also studied the survival and growth of *E coli* O157:H7 on lettuce treated with 20 ppm chlorine at either 20 or 50 C, then stored at 5 C for 18 days or at 15 C for 7 days. Populations declined throughout storage at 5 C, but increased by 2.3 to 3.2 log CFU/g within 2 days at 15 C, then continued to increase at a slower rate through the 7 days of storage at that temperature.

Home or Foodservice Washing Procedures

Vijayakumar and Wolf-Hall (2002) evaluated “household sanitizers” for their effectiveness in reducing levels of inoculated *E. coli* and naturally present aerobic mesophilic bacteria on iceberg lettuce. Sanitizers tested were diluted solutions of apple cider vinegar, 5% (0.3% acetic acid);

household bleach, 4% (180 ppm available chlorine); lemon juice, 13% (0.6% citric acid); and white vinegar, 35% (1.9% acetic acid). The white vinegar solution, used at 21 C for 10 minutes without agitation, or 5 minutes with agitation, produced a 5.4 log CFU/g reduction in E. coli compared to a 0.9 log CFU/g reduction achieved with distilled water at the same temperature. However, sensory evaluation of the lettuce treated with white vinegar showed that it was significantly less acceptable than samples treated with the other sanitizers. Lemon juice (at 4 C) and cider vinegar (at 21 C) gave reductions of 2.1 and 2.7 log CFU/g respectively, compared to 0.9 log CFU/g for distilled water. The bleach solution gave a reduction of 1.6 log CFU/g when used at 4 C with agitation for 10 minutes.

Several researchers have shown that washing lettuce with chlorine solutions (20 to 200 mg/L) reduces the microbial load (either naturally occurring microflora or inoculated pathogen) more than washing with water. However, the difference is relatively small and neither treatment eliminates pathogens or spoilage bacteria. For example, Lang, Harris and Beuchat (2004) obtained average reductions of *E. coli* O157:H7 on lettuce of 0.6 log CFU/ml with water and 1.4 log CFU/ml with chlorine (200 mg/liter) when the lettuce was submerged with agitation for 5 minutes. An inoculated sample that contained 5.10 log CFU before treatment contained 4.64 log CFU after washing with water and 3.70 log CFU after treatment with chlorine. Weissinger, Chantarapanont, and Beuchat (2000) obtained a reduction of less than 1 log when produce was immersed for 40 seconds in a 120 or 200 mg/liter free chlorine solution.

Smith et al. (2003) evaluated the effect of a commercial produce wash on the natural microflora in a food service setting, and found that when the initial contamination was greater than 100 CFU/g, use of the commercial wash resulted in about a 1 log CFU/g greater reduction than water alone.

Studies on Washing Produce and General Food Handling by Consumers and Foodservice Establishments

Li-Cohen and Bruhn in 2002 published the most extensive consumer handling study of fresh produce from the time of purchase to the plate. Via a national mail survey of 624 respondents these researchers quantified consumer produce handling practices as they relate to food safety risk. Six percent of consumer respondents replied that they never or seldom wash fresh produce before consumption, and greater than 35% of respondents do not wash melons before consumption. Approximately 53% of all respondents did not wash their hands before handling fresh produce; 56% report that they always wash the sink before handling fresh produce, and of those that wash the sink 11% use water only. Ninety-seven percent of all respondents reported that they always washed food preparation surfaces after contact with raw meat products. However, 5% of respondents only dry wipe, and 24% of respondents wash these potentially contaminated food preparation surfaces only with water (without soap or a disinfectant). This survey also found that many respondents did not separate produce from raw meat, poultry or fish in their refrigerators. This data indicates that the possibility of re-contaminating a previously washed product in the consumer's kitchen is fairly high.

In 2003, the FDA collected data via site-visits to over 900 establishments representing nine distinct facility types including restaurants, institutional foodservice operations and retail food stores. Direct observations of produce handling practices were supplemented with information gained from discussions with management and food workers and were used to document the establishments' compliance status based on provisions in the 1997 Model FDA Food Code [65].

Failure to control product holding temperatures, poor personal hygiene, use of contaminated equipment/failure to protect food handling equipment from contamination and risk of potential chemical contamination were the risk factors found to be most often out of compliance with the 1997 FDA Model Food Code. The percentages of "out of compliance" observations for each of these risk factors were found to be: improper holding/time temperature (49.3%), poor personal hygiene (22.3%), contaminated equipment (20.5%) and chemical contamination (13.5%). Specifically, for the improper holding/time and temperature risk factor, it was found that maintaining cold holding temperatures at or below 5^{o}C (41^{o}F) for produce items that are classified as potentially hazardous foods (PHF) did not occur in 70.2% of the observed situations. Holding PHFs at or below 5^{o}C (41^{o}F) is critical to preventing the potential growth of human pathogens, which may rapidly proliferate on inadequately refrigerated PHFs. Date marking of refrigerated ready-to-eat, PHFs is also an important component of any food safety system, and it is designed to promote proper food rotation and limit the growth of *L. monocytogenes* during cold storage. However, appropriate date marking of ready-to eat, PHF produce items made on-site did not occur in 34.0% of the observations.

The personal hygiene risk factors associated with produce that are most in need of attention at retail and foodservice operations include adequate, available and accessible handwashing facilities. These personal hygiene risk factors were found by the survey to be not in compliance with the 1997 FDA Model Food Code 33.3%, 26.2%, and 20.6% of the time, respectively. Hands are a very common vehicle for the transfer of human pathogens to food products, and food handlers hands may become contaminated when they engage in activities such as handling raw meat products, using the restroom, coughing or handling soiled tableware.

Food safety procedures for cleaning and sanitizing food contact surfaces and utensils for handling produce were found to be not in compliance with the 1997 FDA Model Food Code in 44.4% of the observations in this study. Proper cleaning and sanitization of food contact surfaces is essential to preventing cross-contamination. Results for selected types of facilities and selected assessment criteria are shown below (Table 1).

Table 1. Percent of facilities observed that were out of compliance with assessment criteria based on 1997 Food Code. Contaminated equipment/protection from contamination is a multi-factor category that includes Surfaces/utensils cleaned and sanitized. Poor personal hygiene is a multi-factor category that includes Proper handwashing. From USHHS-FDA, 2004

Type of facility	Contaminated equipment/protection from contamination	Surfaces/utensils cleaned and sanitized	Poor personal hygiene	Proper hand-washing
Fast Food Restaurant	21.9	50.9	31.2	53.8
Full Serve Restaurant	37.3	56.6	41.7	72.7
Retail stores/produce	20.5	44.4	22.3	33.3

References

Beuchat, L.R. 1998. Surface decontamination of fruits and vegetables eaten raw: a review. WHO/FSF/F05/98.2. Food Safety Unit, World Health Organization, Geneva.

Beuchat, L.R., B.V. Nail, B.B. Adler, and M.R.S. Clavero. 1998. Efficacy of spray application of chlorinated water in killing pathogenic bacteria on raw apples, tomatoes, and lettuce. J. Food Protection 61 (10): 1305-1311

Delaquis, P.J., L.R. Fukumoto, P.M.A. Toivonen, and M.A. Cliff. 2004. Implications of wash water chlorination and temperature for the microbiological and sensory properties of fresh-cut iceberg lettuce. Postharvest Biology and Technol. 31(1): 81-91

Delaquis, P., S. Stewart, S. Cazaux, and P. Toivonen. 2002. Survival and growth of *Listeria monocytogenes* and *Escherichia coli* O157:H7 in ready-to-eat iceberg lettuce washed in warm chlorinated water. J. Food Protection 65: 459-464

Escudero, M.E., L. Velazquez, M.S. DiGenaro, and A.M.S. de Guzman. 1999. Effectiveness of various disinfectants in the elimination of *Yersinia enterocolitica* on fresh lettuce. J. Food Protection 62: 665-669

Harris, L.J. 2005. Pathogens associated with produce. Presentations May 25, 2005 to 13th Annual Food Safety Farm to Table Conference in Moscow, Idaho (Sponsored by Washington State University and Idaho State University), and to Southern California, Central California, and Northern California Food Technical Advisory Committees in 2003 and 2004.

Kilonzo-Nthenge A. F. Chen and S.L. Godwin. 2006. Efficacy of Home Washing Methods in Controlling Surface Microbial Contamination on Fresh Produce. J. Food Protection 69: 323-329.

Kondo, N., M. Murata and K Isshike. 2006. Efficiency of Sodium Hypochlorite, Fumaric Acid, and Mild Heat in Killing Native Microflora and *Escherichia coli* O157:H7, *Salmonella Typhimurium* DT104, and *Staphylococcus aureus* Attached to Fresh-Cut Lettuce. J. Food Protection 69:323-329.

Lang, M.M., L.J. Harris, and L.R. Beuchat. 2004. Survival and recovery of *Escherichia coli* O157:H7, *Salmonella*, and *Listeria monocytogenes* on lettuce and parsley as affected by method of inoculation, time between inoculation and analysis, and treatment with chlorinated water. J. Food Protection 67: 1092-1103

Li, Y., R.E. Brackett, J. Chen, and L.R. Beuchat. 2001. Survival and growth of *Escherichia coli* O157:H7 inoculated onto cut lettuce before or after heating in chlorinated water, followed by storage at 5 or 15 C. J. Food Protection 64: 305-309

Li, Y., R.E. Brackett, R.L. Shewfelt and L.R. Beuchat. 2001. Changes in appearance and natural microflora on iceberg lettuce treated in warm, chlorinated water and then stored at refrigeration temperature. Food Microbiology 18: 299-308

Li-Cohen, A.E., and C.M. Bruhn. 2002. Safety of consumer handling of fresh produce from the time of purchase to the plate: A comprehensive consumer survey. J. Food Protection 65: 1287-1296.

Sapers, G.M. 2006. Washing and sanitizing treatments for fruits and vegetables. In Microbiology of Fruits and Vegetables, G.M. Sapers, J.R. Gorny, and A.E. Yousef, Eds. CRC Press, Boca Raton. FL

Seo, K.H., and J.F. Frank. 1999. Attachment of *Escherichia coli* O157:H7 to lettuce leaf surface and bacterial viability in response to chlorine treatment as demonstrated by using confocal scanning laser microscopy. J. Food Protection 62:3-9

Singh, N., R.K. Singh, A.K. Bhunia, and R.L. Stroshine. 2002. Effect of inoculation and washing methods on the efficacy of different sanitizers against *Escherichia coli* O157:H7 on lettuce. Food Microbiology 19: 183-193

Smith, S., M. Dunbar, D. Tucker, and D.W. Schaffner. 2003. Efficacy of a commercial produce wash on bacterial contamination of lettuce in a food service setting. J. Food Protection 66: 2359-2361

U.S. Health and Human Services, Food and Drug Administration. 2004. FDA Report on the Occurrence of Foodborne Illness Risk Factors in Selected Institutional Foodservice, Restaurant, and retail Food Store Facility Types (2004). Accessed at http://www.cfsan.fda.gov/~dms/retrsk2.html#execsum

Vijayakumar, C., and C.E. Wolf-Hall. 2002. Evaluation of household sanitizers for reducing levels of *Escherichia coli* on iceberg lettuce. J. Food Protection 65: 1646-1650.

Weissinger, W.R., W. Chantarapanont, and L.R. Beuchat. 2000. Survival and growth of *Salmonella* Baildon in shredded lettuce and diced tomatoes, and effectiveness of chlorinated water as a sanitizer. Int. J. Food Microbiol. 62 (1-2): 123-131

Wu, F.M., M.P. Doyle, L.R. Beuchat, J.G. Wells, E.D. Mintz, and B. Swaminathan. 2000. Fate of *Shigella sonnei* on parsley and methods of disinfection. J. Food Protection 63: 568-572