Food Distribution Research Society

Journal of Food Distribution Research
Volume 43, Issue 1

The Bacteria Content of Bagged, Pre-Washed Greens as Related to the Best if Used by Date

Fur-Chi Chen[a⊕], and Sandria L. Godwin[b]

[a]*Research Associate Professor, Department of Family and Consumer Sciences, College of Agriculture, Human, and Natural Sciences, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, Tennessee, 37209-1561, 47907-2056 U.S.A. Phone: +1-615.963.5410, Email: fchen1@tnstate.edu*

[b]*Professor, Department of Family and Consumer Sciences, College of Agriculture, Human, and Natural Sciences, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, Tennessee, 37209-1561, 47907-2056 U.S.A.*

Abstract

The sale of ready-to-eat salads has increased over the past years, yet little is known about consumer usage and the related safety of these products. This study evaluated the changes of microbiological quality of pre-washed spinach and mixed leafy vegetables during refrigeration storage. Microbial loads were determined by aerobic plate count (APC) and Enterobacteriaceae count (EC). The microbiological quality of pre-washed greens varied widely and deteriorated rapidly in a refrigerator. At "best if used by" date, twenty percent of samples had APC of more than 7.0 Log CFU/g and all samples had EC of more than 5.0 Log CFU/g. It is recommended that consumers purchase and eat pre-washed greens in their entirety as far in advance of the "best if used by" date as possible.

Keywords: Best if used by, Food product dating, Pre-washed green, Refrigeration, Vegetables

Introduction

Bagged, pre-washed salad greens are gaining popularity in the market place as a healthy and convenient choice. Pre-washed greens are minimally processed with no heating procedure to inactivate the microorganisms; therefore, they are subject to rapid deterioration and can support the growth of large populations of bacteria. Consumers worry about the microbiological quality of pre-washed greens, as there have been numerous recalls associated with pre-washed greens; several have involved foodborne pathogens including *Salmonella, E. coli* O157:H7, and *Listeria monocytogenes* (FDA 2011). Some pathogenic bacteria, such as Listeria *monocytogenes,* can continue to grow during refrigeration storage. According to Food Marketing Institute, consumers often assume that the dates placed on the packages are an indication that the product is safe to consume at least until that date (FMI 2010). In a survey conducted in 2002, FMI reported that 54% of consumers believed that eating food past its sell-by/use-by date constituted a health risk (FMI 2002). However, consumers are often confused by the different food dating. A survey conducted by Research Triangle Institute and Tennessee State University revealed many consumers did not understand the meanings of the different types of open dates (Kosa et al. 2007). Only 18% of respondents correctly defined the ‘‘use-by’’ date, and more than half of respondents had the misconception that it indicates the last date recommended for safe consumption of a product. Most bagged, pre-washed greens carry an open date labeling, such as “use by” and “best if used by”, although it is not required by federal regulation. “Use-by” dates usually refer to best quality and are not safety dates. But even if the date expires during home storage, a product should be safe, wholesome and of good quality - if handled properly and kept at 40 °F or below (USDA-FSIS 2011). The purpose of this study was to evaluate the changes of microbiological quality of bagged pre-washed greens stored in the refrigerator after opening.

Materials and Methods

Fifteen bags of prewashed, precut lettuce, spinach or mixed greens (5 bags of precut lettuce, 5 bags of spinach and 5 bags of mixed greens) with different “best if used by” dates (BIUBD) were purchased from a local grocery store at three different times during two-month period. The prewashed greens were stored in the original bags at 40 °F in a home-style refrigerator. Samples were taken from the bags and analyzed on the first day of purchasing and were tested continuously every two days until the tenth day past the BIUBD labeled on the bags. Microbiological quality of the bagged vegetables was determined by aerobic plate count (APC) and Enterobacteriaceae count (EC). In brief, a portion of the vegetable (about 25g) was placed in a sterile stomacher bag and 5 volumes (v/w) of Butterfield’s phosphate buffer (pH 7.2) were added to each bag. The contents of the sample bags were blended using a Stomacher R 400 Circulator (Seward Limited, UK) at 230 rpm for 2 minutes. The liquid contents were serially diluted in Butterfield’s phosphate buffer from 10-1 to 10-8 folds for subsequent plating. Petrifilm plates (3M Microbiology, St. Paul, MN) for Aerobic Count, and Enterobacteriaceae Count were inoculated with 1 mL of the serially diluted samples. The Petrifilm plates were incubated at 35° C for 24-48 hours per the manufacturer’s instructions. The colonies were enumerated manually and recorded after incubation. APC and EC were converted to Log CFU/g of sample. Microbiological data were analyzed using Statistical Package for Social Sciences (SPSS) software, Version 15.0 for Windows. Means and standard deviations were calculated and significant differences were tested using

General Linear Model. Significance thresholds for all tests were set at P = 0.05. Pearson correlation was used to correlate APC and EC with storage time.

Results and Discussion

There was no significant difference between microbiological quality and types/brands of the products. The microbiological quality of pre-washed greens varied widely among samples when the packages were first tested on the day of purchasing. The APC levels, commonly known as total bacterial count, ranged from 3.8 to 5.9 Log CFU/g, with an average of 5.4 Log CFU/g. The EC levels, commonly known as an indicator for poor sanitation and fecal contamination, ranged from 2.8 to 5.8 Log CFU/g, with an average of 5.2 Log CFU/g. Samples with one to four days from their BIUBD had significant higher bacteria levels, APC more than 5.7 Log CFU/g and EC more than 5.6 Log CFU/g, than samples with eight to ten days from their BIUBD, APC less than 4.0 Log CFU/g and EC less than 3.8 Log CFU/g (Figure 1). When tested at their BIUBD, 3 of the 15 samples had APC of more than 7.0 Log CFU/g; the average APC of all samples was 6.2 Log CFU/g. All 15 samples had EC of more than 5.0 Log CFU/g; the average EC of all samples was 5.9 Log CFU/g. There were positive correlations between storage time and APC, as well as EC. The results indicated a constant deterioration of microbial quality of bagged salad vegetables during refrigerated storage. The estimated initial microbiological quality at the tenth day before BIUBD was 4.1 Log CFU/g for APC (Figure 2) and 3.7 Log CFU/g for EC (Figure 3), respectively. The average increase of APC in every two days was 2.5 times (0.40-log); and the average increase of EC in every two days was 2.7 times (0.43-log). Average APC and EC reached more than 8 Log CFU/g at the tenth day after BIUBD. Our results indicated the pre-washed greens can support the rapid growth of microorganisms during refrigeration storage. Pre-washed greens, unlike other processed food, have no heating procedure during processing; therefore, good sanitation and temperature controls during processing and distribution are the key to ensuring the quality of pre-washed greens. The National Advisory Committee on Microbiological Criteria for Foods (NACMCF) recommends that retail and consumer packages carry a uniform standardized label (NACMCF 2005). The National Institute of Standards and Technology has published a model ‘‘Uniform Open Dating Regulation’’ for consideration as a means of assisting state regulatory agencies in addressing date labeling issues (NIST 2001). Consumers should benefit from an “Uniform Open Dating’ that is easy to understand when judging food qualities.

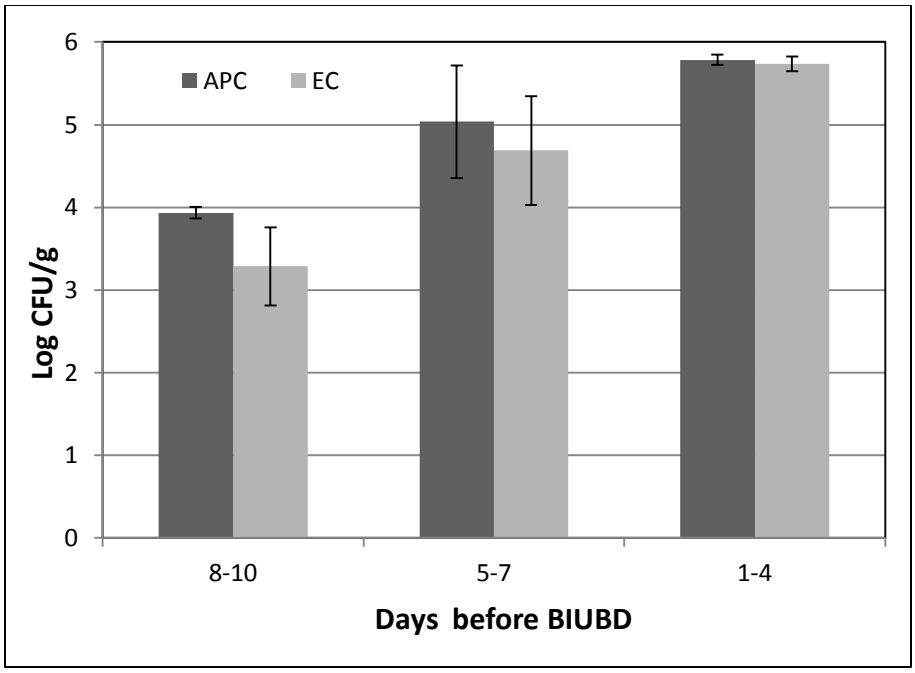

Figure 1. APC and EC of bagged pre-washed greens on the day of purchasing

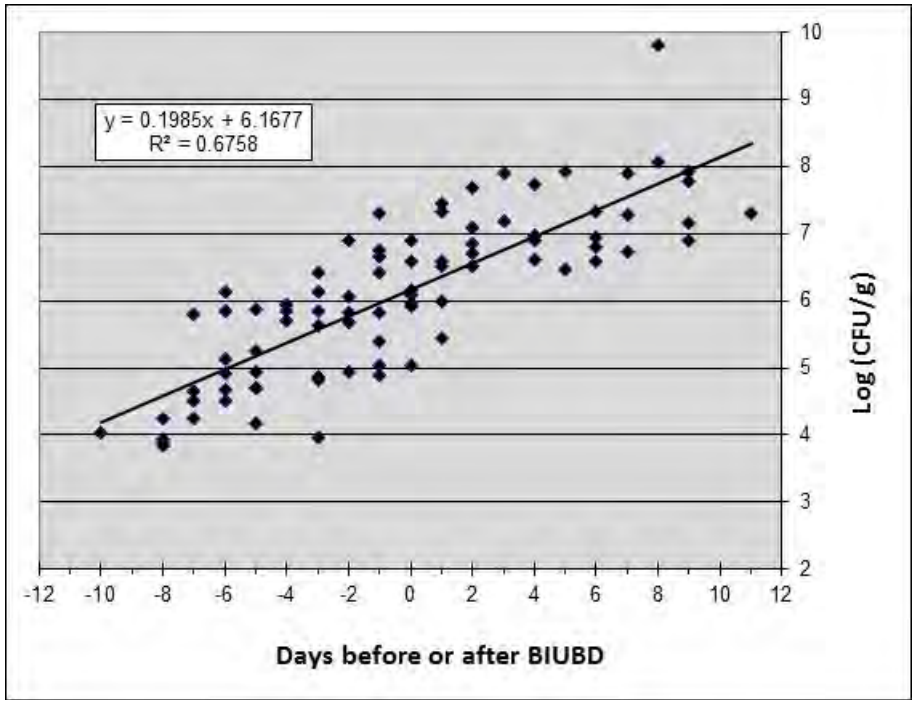

Figure 2. Correlation of APC to BIUBD

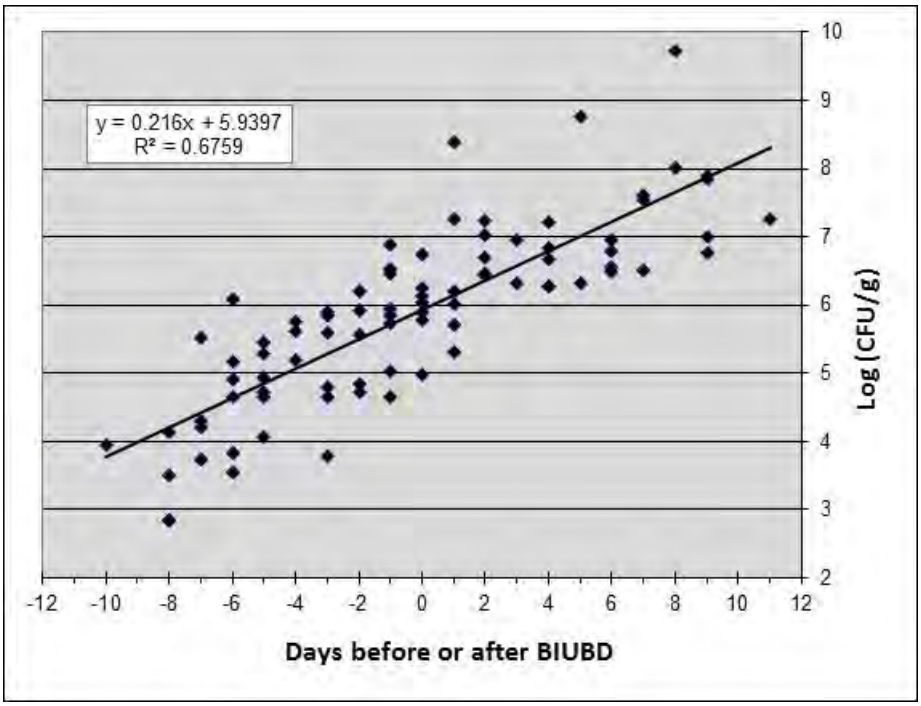

Figure 3. Correlation of EC to BIUBD

Conclusions

Our results showed that the microbiological quality of bagged pre-washed greens is highly variable and complex and showed relevant storage problems. For consumers who choose to purchase pre-washed, bagged greens it is recommended that they purchase and eat them in their entirety as far in advance of the "best if used by" date as possible.

Acknowledgements

This research was financially supported by grants from USDA-NIFA. The authors would like to thank Ms. Bhargavi Sheshachala for the assistance in laboratory work.

References

Food Marketing Institute. 2002. *Trends in the United States Consumer Attitudes and the Supermarket.* Food Marketing Institute, Washington, D.C.

Food Marketing Institute. 2010. *U.S. Grocery Shopper Trends 2010*. Food Marketing Institute, Washington, D.C.

Kosa, K.M., S.C. Cates, S. Karns, S.L. Godwin, and D. Chambers. 2007. Consumer Knowledge and Use of Open Dates: Results of a Web-based Survey. *Journal of Food Protection* 70(5):1213-1219.

National Advisory Committee on Microbiological Criteria for Foods. 2005. Considerations for Establishing Safety-based Consume-by Date Labels for Refrigerated Ready-to-eat Foods. *Journal of Food Protection* 68 (8 Suppl.):1761-1775.

National Institute of Standards and Technology. 2001. "Uniform Open Dating Regulation." p. 117–122. In "Uniform Laws and Regulations in the Areas of Legal Metrology and Engine Fuel Quality". NIST handbook no. 130, 2001 ed. National Institute of Standards and Technology, Gaithersburg, Md.

U.S. Department of Agriculture, Food Safety and Inspection Service. 2011. *Food Safety Information-Food Product Dating*. http://www.fsis.usda.gov/PDF/Food_Product_Dating.pdf. (Accessed October 24, 2011).

U.S. Food and Drug Administration. 2011. *Recalls, Market Withdrawals, & Safety Alerts.* http://www.fda.gov/Safety/Recalls/default.htm. (Accessed October 24, 2011).