

Assessed Food Safety Risks Associated With Grocery Stores

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Abstract The growing grocery market industry is under increasing pressure to improve profit margins to maintain profitability. With the offerings at grocery stores continually evolving toward more profitable niches, food safety risks can be introduced or elevated as operations are added or modified. This study surveyed 132 private and corporate-owned grocery stores to assess food safety risk. A 2009 Food and Drug Administration *Food Code* risk category assessment score was assigned to each of the departments at these stores for comparison of risks associated with their processes and policies. Private stores had slightly more risk when compared with corporate-owned stores. High-risk processes, including reduced oxygen packaging and smoking and curing operations, existed in 13% of the grocery stores. Bakeries, delicatessens, and/or meat departments sharing the same operating space also increased the risk scoring.

Introduction

In 2015, there were over 38,000 grocery stores or supermarkets in the U.S. In 2012 in the U.S., grocery stores employed approximately 3.4 million workers. Grocery store revenue grew 14% from \$568 billion in 2007 to \$649 billion in 2015 (Food Marketing Institute, 2016). Nearly all of this growth has been attributed to adapting new marketing strategies and offerings to consumers in areas that were not widely offered over the last several decades (Rogers, 2012).

The grocery industry operates with a very low profit margin of approximately 1.5% (Food Marketing Institute, 2012). Emerging trends such as increasing demand from consumers for quick, convenient meals and organic foods have produced opportunities for grocers to increase their profit margins by meeting these needs (Binkley & Ghiselli, 2005). The vast majority of grocery stores now offer prepared foods for meals to eat in

the store or for take-out (U.S. Department of the Treasury, 2011).

Grocery stores have acquired equipment and implemented food preparation procedures to capitalize on these trends. Included in these changes have been the addition of large, fully operating kitchens to prepare foods in ways more traditionally found in restaurants.

Foods from around the world are more commonly available because of increased importing; however, the Food and Drug Administration (FDA) samples only 2.3% of the food lots imported into the U.S. (FDA, 2014). Large stores frequently include special areas to market diverse foods from around the globe. Food safety standards, however, vary greatly around the world and using imported foods to prepare new products has introduced additional risk that would not be present with foods produced in the U.S. (McLean, Dunn, & Palombo, 2010).

FDA estimates that there are more than 3,000 different federal, state, local, and tribal

agencies that regulate the safety for food distributed and sold in the U.S. (FDA, 2013). In Tennessee, food safety inspections of grocery stores are conducted using the state's Department of Agriculture regulations and inspectors. Agricultural inspections and regulations may have gaps, however, in completely addressing evolving food safety aspects in grocery stores.

During July 2010, the Centers for Disease Control and Prevention (CDC) and Environmental Health Specialists Network (EHS-Net) (www.cdc.gov/nceh/ehs/ehsnet), in conjunction with the U.S. Public Health Service (USPHS) (www.usphs.gov), completed a grocery store risk assessment survey in Davidson County, Tennessee. EHS-Net is a network of environmental health specialists and epidemiologists focused on investigating environmental factors that contribute to foodborne illness. EHS-Net is a collaborative project of CDC, FDA, U.S. Department of Agriculture (USDA), and state and local health departments. There were three goals for this study: identify high risk processes in grocery stores, provide data for development/improvement of risk-based inspection protocols, and collect baseline data for the Nashville-Davidson County Metropolitan Health Department.

Methods

The study population included 171 retail grocery stores with groceries being the primary business.

The survey used to collect data consisted of 37 questions. The survey can be found at www.nashville.gov/Portals/0/SiteContent/Health/PDFs/FoodProtection/GrocerySurvey.pdf. The survey was developed by senior environmental health specialists and

TABLE 1

2009 Food and Drug Administration Food Code Risk Categories

Risk Category	Description
1	<p>Examples include most convenience store operations, hot dog carts, and coffee shops. Examples also include establishments that</p> <ul style="list-style-type: none"> • serve or sell only prepackaged, nonpotentially hazardous foods (nontime/temperature control for safety [TCS] foods). • prepare only nonpotentially hazardous foods (non-TCS foods). • heat only commercially processed, potentially hazardous foods (TCS foods) for hot holding. • do not cool potentially hazardous foods (TCS foods). • would otherwise be grouped in Category 2 but have shown through historical documentation to have achieved active managerial control of foodborne illness risk factors.
2	<p>Examples include retail food store operations, schools not serving a highly susceptible population, and quick service operations. Examples also include establishments that</p> <ul style="list-style-type: none"> • have a limited menu. • have products that are mostly prepared or cooked and served immediately. • might involve hot/cold holding of potentially hazardous foods (TCS foods) after preparation or cooking. • perform complex preparation of potentially hazardous foods (TCS foods) requiring cooking, cooling, and reheating for hot holding that is limited to only a few potentially hazardous foods (TCS foods). • would otherwise be grouped in Category 3 but have shown through historical documentation to have achieved active managerial control of foodborne illness risk factors. • are newly permitted establishments that would otherwise be grouped in Category 1 until history of active managerial control of foodborne illness risk factors is achieved and documented.
3	<p>An example is a full service restaurant. Examples also include establishments that</p> <ul style="list-style-type: none"> • have an extensive menu and handle of raw ingredients. • perform complex preparation including cooking, cooling, and reheating for hot holding involving many potentially hazardous foods (TCS foods). • have a variety of processes that require hot and cold holding of potentially hazardous foods (TCS food). • would otherwise be grouped in Category 4 but have shown through historical documentation to have achieved active managerial control of foodborne illness risk factors. • are newly permitted establishments that would otherwise be grouped in Category 2 until history of active managerial control of foodborne illness risk factors is achieved and documented.
4	<p>Examples include preschools, hospitals, nursing homes, establishments conducting processing at retail, and establishments serving a highly susceptible population or that conduct specialized processes (e.g., smoking and curing, reduced oxygen packaging for extended shelf-life).</p>

included an FDA food inspector (www.fda.gov/Food/GuidanceRegulation/RetailFoodProtection/Standardization/default.htm) and an EHS-Net specialist. The survey questions focused on policies, equipment, processes, and training. Policy and training data were obtained through interviews, while equipment and process data were obtained through both observation and interviews. Qualifying formal manager food safety certification was through ServSafe, National

Registry of Food Safety Professionals, Prometric, or the local health department. The approximate size of each facility in terms of square footage was determined through manager interviews.

The survey instrument was administered by four teams with two USPHS officers each. Each USPHS team had at least one registered environmental health specialist (REHS). The Davidson County EHS-Net specialist conducted standardization training with all

survey teams. This training included pilot testing the instrument and developing a standardized administration and interpretation of the survey.

The criteria for assessing risk were based on the 2009 FDA *Food Code* guidelines. Departments included in the survey were bakeries, combination deli/bakeries, delis, meat and seafood, and produce. Combination deli/bakeries were defined as departments having both deli and bakery operations within the same physical space. Equipment such as dish washing, food preparation, and food storage may have been shared. Meat and seafood departments may have included meat department only, seafood department only, or a combination of meat and seafood. Risk categories listed in Table 1, as defined by Annex 5 of the 2009 FDA *Food Code*, are presented here from highest to lowest risk.

- Risk Category 4: Smoking, curing, and increased shelf-life with use of reduced oxygen packaging (ROP).
 - Risk Category 3: Extensive handling of raw ingredients, complex preparation, and hot or cold holding of foods needing temperature control.
 - Risk Category 2: Serving foods that are prepared but most are served immediately, with limited holding of foods needing temperature control.
 - Risk Category 1: Serving mostly prepackaged foods that are commercially processed.
- Based on the survey findings, the team assigned one of these risk categories to each department. Additional information was collected, including number of employees and the type of training they received. Grocery stores were classified as corporate or private based on ownership. Overall risk scores were determined by the highest individual department within each store.

Results

A total of 171 stores were visited. Of these, 7 were closed, 10 refused to be surveyed, and 22 were considered ineligible due to very limited food handling and preparation activities. Surveys were completed at 132 stores. Of the stores surveyed, 69 (52%) were corporate owned and 63 (48%) were privately owned.

Table 2 shows a comparison between corporate and private stores in terms of store size, number of employees, managers with formal food safety certification, no bare hand contact

policy, and 41 °F refrigeration policy. Corporate-owned stores generally were larger, with more employees and stricter policies.

There were a total of 339 different departments in the 132 stores surveyed. Of these 132 stores, 31 (24%) had a bakery, 34 (26%) had a combination deli/bakery, 47 (36%) had a deli, 115 (87%) had a meat and/or seafood department, and 111 (84%) had a produce department.

Table 3 contains the results by department for the practices assessed during the survey. A risk factor noted from the survey not listed in the table was that six meat and seafood departments (5%) did not have separate hand washing sinks present. In addition, fresh produce was observed in 43 (37%) of the meat and seafood departments and raw shellfish was observed in two (2%) of the produce departments.

Complex processes involving the cooking of raw animal product and its subsequent cooling were noted in 43 (62%) of the corporate-owned stores as compared with 18 (29%) of the privately owned stores surveyed. Figure 1 shows the risk scores assigned and averaged for the five types of grocery departments surveyed.

Discussion

By conducting risk-based surveys, our team was able to inventory and assign risk categories to store departments. This information has provided insight into the current state of risk distribution among Davidson County grocery stores. Based on the findings in this survey, when comparing the relationship of risk between private and corporate-owned stores, the overall risk scoring was slightly higher for private stores (Figure 2). There may be a variety of factors that contribute to differences in risk scores between private and corporate-owned stores.

Our study found that both store size and number of employees were considerably larger for corporate-owned stores as compared with privately owned stores, which could increase risk. Employees are significant sources for contamination of food, which can result in foodborne outbreaks (Hedican et al., 2010); therefore, a lower number of employees might reduce food safety risk. Employees well trained in food safety practices, however, may offset this concern. Further, having fewer employees

TABLE 2

Comparison of Selected Results for Private Versus Corporate-Owned Grocery Stores

	Corporate (n = 69)	Private (n = 63)
Average size of grocery store	56,000 ft ²	2,000 ft ²
Average number of employees per grocery store	110	8
Managers with formal food safety certification	30 (43%)	11 (17%)
No bare hand contact policy for ready-to-eat foods	61 (88%)	41 (65%)
41 °F refrigeration policy	60 (87%)	36 (57%)

TABLE 3

Selected Results for Various Practices by Grocery Store Department

Practice	Department Type				
	Bakery (n = 31)	Combination Deli/Bakery (n = 34)	Deli (n = 47)	Meat and Seafood (n = 115)	Produce (n = 111)
Reheating/cooking	22 (71%)	34 (100%)	41 (87%)	N/A	N/A
Cooling	20 (65%)	33 (97%)	28 (60%)	N/A	N/A
Hot/cold holding	N/A	34 (100%)	43 (91%)	N/A	N/A
Raw meat processing	N/A	N/A	N/A	115 (100%)	8 (7%)
Raw shellfish processing	N/A	N/A	N/A	43 (37%)	2 (2%)
Smoking or curing	N/A	N/A	N/A	10 (9%)	N/A
Grinding	N/A	N/A	N/A	94 (82%)	N/A
Tenderizing	N/A	N/A	N/A	61 (53%)	N/A
Slicing/chopping/ washing	N/A	N/A	N/A	N/A	70 (63%)
Salad bar	N/A	N/A	N/A	N/A	6 (5%)
Reduced oxygen packaging	N/A	4 (11%)	N/A	4 (3%)	N/A

N/A = not applicable.

might discourage ill-worker exclusion due to unavailable employee replacements, which could increase risk.

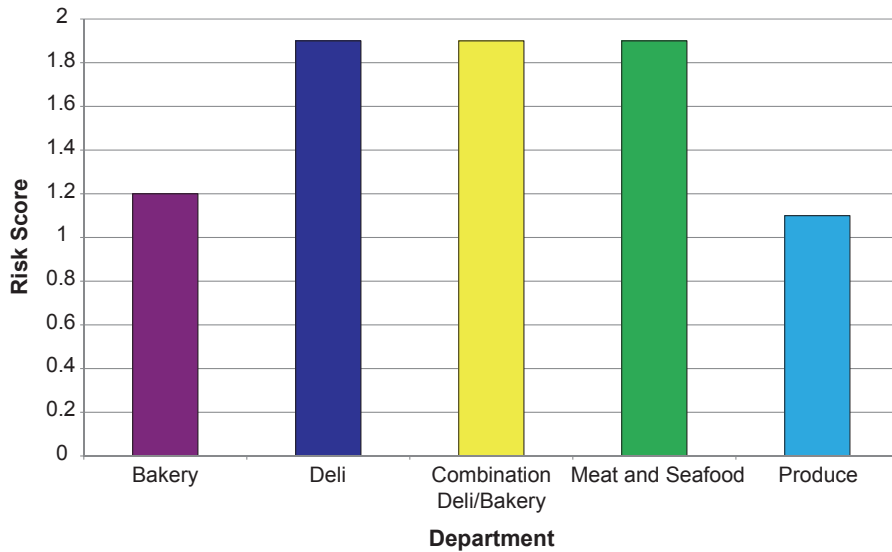
The presence of a certified food manager has been found to reduce risk for foodborne outbreaks (Hedberg et al., 2006). Formal food safety certification as recognized by the FDA was reported to be higher at corporate-owned stores (43%) versus privately owned stores (17%). Additional requirements and resources through the corporate-owned store structures

were likely to influence the higher level of certification for corporate store employees.

Increased inspections of groceries alone are not likely to reduce food safety risk in this evolving industry (Jones, Pavlin, LaFleur, Ingram, & Schaffner, 2004). Instead, the implementation of applicable food safety systems and policies, along with training for specific food handling practices, are key to controlling food safety risk.

FIGURE 1

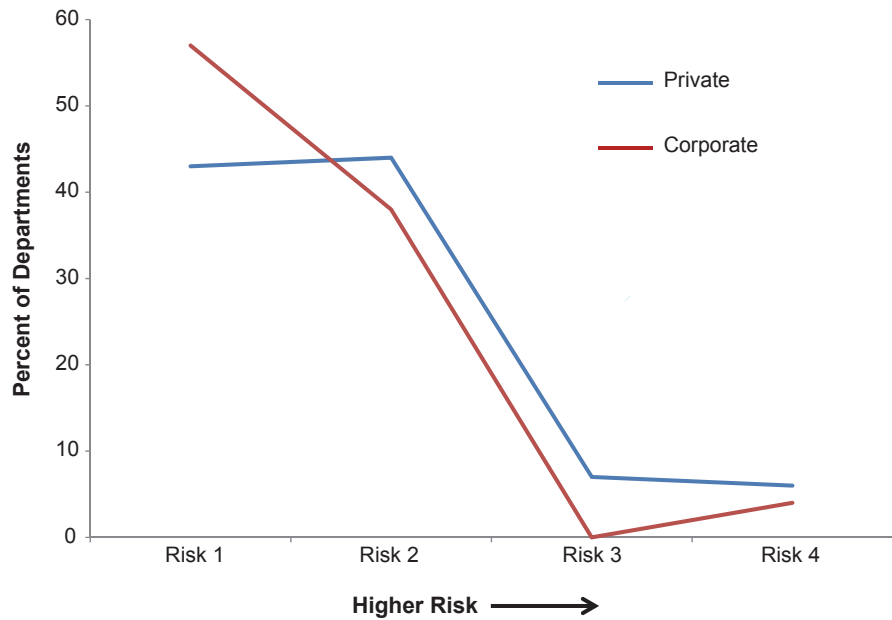
Average Risk Score by Grocery Store Department Type (N = 339)



Based on 2009 Food and Drug Administration risk assessment criteria.

FIGURE 2

Distribution of Risk Scores for Private Versus Corporate-Owned Grocery Stores (N = 132)



The number and type of food processes within a store department may relate to food safety risk. Grocery stores that serve only

ready-to-eat foods with limited preparation prior to service are likely to pose less risk than departments that conduct complex

food handling processes such as preparing and cooking raw animal products, cooling, and hot/cold holding temperature control for safety (TCS) foods. In addition, special food preparation processes such as smoking, curing, and ROP increase food safety risk if critical limits are not maintained during the production process (FDA, 2009). Several of the stores surveyed were repackaging food with the use of ROP, which confers many benefits including extended shelf life, enhanced quality, increased profit margins, and reduced waste (Herald, 2014). Strict controls that may be unfamiliar to both customers and food service workers, however, are necessary to ensure ROP products remain safe during preparation, storage, display, and service. As a result, federal guidelines suggest implementation of a hazard analysis critical control points (HACCP) program for special food preparation processes.

Raw animal products can contain pathogenic bacteria. Data from 2002 to 2011 from the Retail Meat Annual Report published by the FDA reported retail chicken sampled from participating states had high levels of bacterium (FDA, 2012). As seen in Figure 1, departments where raw animal products and ready-to-eat products are prepared in the same environment may increase the risk of cross-contamination, especially if common equipment is used for both product types. This survey found that all combination deli/bakery departments were processing raw animal products and ready-to-eat products in the same environment.

For the meat departments surveyed, grinding was found at 82% and tenderizing at 53%. Mechanical tenderizing of meats by grocery stores is a value-added procedure that can also increase profit margins. Mechanical tenderizing is, however, likely to spread surface contamination into deep tissue of meats such as steaks. Safe cooking practices for intact meat cuts can be achieved with lower temperatures than for commuted meat such as hamburger. The degree of elevated risk for mechanically tenderized meat is not well defined, but it is generally accepted (Gill & McGinnis, 2004).

At the time of this study, the minimum temperature requirement for refrigerated TCS foods was 45 °F in the state of Tennessee. However, federal guidelines suggest 41 °F or below for refrigeration storage or holding of

TCS foods. Stores under corporate ownership were significantly higher in compliance with the 41 °F refrigeration federal guideline (60, 87%) compared with privately owned grocery stores (36, 57%), even though the lower temperature was not locally mandated.

In addition, a no bare hand policy such as glove use while handling ready-to-eat foods was not required at the time of the survey. Bare hand contact of ready-to-eat foods increases risk. It has been demonstrated that many pathogens can survive on the hands for extended periods of time. *Salmonella* was found to survive for at least 3 hours in normal working conditions after an inocula of <100 organisms per fingertip (Hedberg et al., 1991). Although not mandated by Tennessee food regulations, management reported 102 (77%) of the grocery stores had a no bare hand contact policy for ready-to-eat foods. This high rate of voluntary compliance may be attributed to multistate corporate policies and customer expectations where food processing and preparation are highly visible.

Produce was washed considerably more in corporate-owned stores (49, 71%) than in privately owned stores (14, 22%). This finding likely indicates more ready-to-eat foods were being created from produce in corporate stores. Significant food safety risk may occur when ready-to-eat foods are contaminated without a temperature “kill step” to inactivate pathogens before the food is consumed (Podolak, Enache, Stone, Black, & Elliot, 2010).

Cross-contamination prevention during produce handling is imperative to food safety. Cross-contamination was reportedly involved in 57% of known causes for foodborne outbreaks in the United Kingdom (Podolak et al., 2010). Norovirus is the leading cause of foodborne outbreaks in the U.S. and has been found to easily spread through cross-contamination (Hall, 2012). Washing produce may create opportunities for cross-contamination if all food contact surfaces involved are not

properly cleaned and sanitized. Cross-contamination prevention should be promoted through employee training, as well as active managerial control.

Some pathogenic organisms can survive in harsh and unlikely environments. For example, *Salmonella* grows in a wide range of temperature and pH, and it has been found to have greater heat resistance in low-moisture foods (Podolak et al., 2010). Procedures and products must be continually evaluated as marketing approaches change so that employees can be adequately trained and systems can be modified to prevent growth or survival of pathogens to reduce risk.

Additional food safety risks may be introduced as stores add new marketing, display, and self-service venues. For example, self-service food bins and salad bars without adequate dispensing utensils, practices, and sneeze guards may increase risk from both employee and customer contamination. Further, inadequate barriers between raw and ready-to-eat foods may occur with temporary promotional food displays.

Health trends in customer preferences have encouraged shifts toward more preservative-free, low-fat, gluten-free products with reduced calories (Smith, Daifas, El-Khoury, Koukoutsis, & El-Khoury, 2004). Modifications of traditional products and packaging may also greatly influence risk factors that would promote growth of emerging pathogens. Home meal replacement (HMR) prepared at stores is a current trend that is likely to continue. HMR food out of appropriate temperature range while in transit or awaiting to be consumed provides time for pathogens to multiply. Results from this survey, however, indicate that the grocery industry is implementing many measures to reduce the food safety risks for these trends. Another study looking more specifically at HMR operations found that only 10% of workers reported that they did not receive food safety

training (Binkley & Ghiselli, 2005). Current trends and widening landscapes for store formats often require additional food safety risk considerations that go far beyond those of previous generations.

There were several limitations identified with this study. The survey area was limited to Davidson County, Tennessee, with a total of 132 stores included. Although every effort was made to collect factual data, much of the information in this study was collected through interviews with managers. In addition, self-reported behaviors and policies inevitably include bias. Inquiries to ascertain employee health programs could have yielded additional useful data with ill-employee exclusions and restrictions being an important part of any retail food safety program.

Conclusion

Findings from this study could be used to prioritize and justify resources necessary to achieve recommended inspection frequency within high-risk stores. Locations with increased risk often place additional burden on regulatory agencies related to inspection frequency and administrative activities. Recommendations from the FDA *Food Code* suggest increased inspection frequency for establishments with higher risks. Other jurisdictions may find these data useful for comparisons or to facilitate additional resource justification. 🐼

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