A Chainstore Approach to Food Safety and Emerging Pathogens

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ADDITIONAL INDEX WORDS. good agricultural practices, GAP, good manufacturing practices, GMP, product safety, quality standard, emerging pathogens, enteric bacterial infection, produce hygiene monitoring

SUMMARY. Pathogen control is of prime importance in the retail food industry. The Howard E. Butt Grocery Co. (HEB) instituted a testing program for *Escherichia coli* in 1997. Although not all strains of *E. coli* are harmful; it was chosen as a test organism because of the ease of assay and it is indicative of the potential presence of other pathogens. By the second quarter of 2000, HEB had reduced percentage of samples with *E. coli* from 15% to less than 5%. This was done with testing and producer educational programs to improve the safety of produce sold by HEB. Food suppliers to HEB must meet product safety and quality standards. HEB won the International Association for Food Protection's Black Pearl award in 1994, and was the first retailer to integrate hazard analysis and critical control points (HACCP) into their seafood markets. HEB's sampling program helped reduce *E. coli* levels in sprouts [alfalfa (*Medicago sativa*), bean (*Phaseolus aureus*), and radish (*Raphanus sativus*) sprouts], white mushrooms (*Agaricus bisporus*), and limes [persian lime (*Citrus aurantifolia*) and key lime (*C. latifolia*)], as well as in the prepared product, pico de gallo [a mixture of chopped tomato (*Lycopersicon esculentum*), pepper (*Capsicum annuum*), onion (*Allium sativa*), and cilantro (*Coriandrum sativum*)]. Incidence of *E. coli* in lettuce (*Lactuca sativa*) was related to the season of the year. *E. coli* levels varied with the crop, but generally better growers had lower *E. coli* regardless of crop. Country of origin has some effect on the incidence of *E. coli*, while organic vs. conventional production had little, if any, influence.

The Howard E. Butt Grocery Co. began in 1905 in Kerrville, Texas (Fig. 1). The company is privately held and has grown to 304 stores in Texas and northern Mexico with annual sales of over \$11 billion. HEB was founded on the twin principles of customer service and rigorous concern for the customer's safety. Pathogen control is of prime importance in the retail food industry for consumer safety. Successful pathogen control has helped to provide HEB's customers with safe, fresh, and economical food. Control of pathogens was important to the success of the new concept stores called Central Market stores, where people with a passion for food shop (Fig. 2). If they questioned HEB food safety they would not shop with the company. Food suppliers to HEB must meet product safety and quality standards. This company won the International Association for Food Protection's Black Pearl award in 1994, and was the first retailer to integrate HACCP into their seafood markets. The company has its own processing plants, has monitored

listeria (*Listeria monocytogenes*) since the early 1980s, and conducted salmonella (*Salmonella* spp.) reduction programs for ground beef, milk, and chicken. Recently HEB began efforts at campylobacter (*Campylobacter jejuni*) reduction in poultry. Since 1993 the company has had an *E. coli* O157:H7 testing program for ground beef.

In 1997, the produce hygiene monitoring and improvement program was initiated to help ensure the safety of the food supply. The industry had experienced outbreaks of Hepatitis A in strawberries (*Fragaria xananassa*) (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 1997), shigellosis (*Shigella sonnei*) in celery (*Apium graveolens*), and salmonella in cantaloupes (*Cucumis melo* group *Cantalupensis*) (Centers for Disease Control and Prevention, 2002). *E. coli* was chosen as an organism for which to test, due to its frequent association with other enterics and low

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Units To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
28.3495 (°F - 32) ÷ 1.8	oz °F	g °C	0.0353 (1.8 × °C) + 32

Fig.1. The first Howard E. Butt Grocery Co. store in Ker-ville, Texas, circa 1920.

Fig. 2. The new Central Market store in Plano, Texas.

cost in testing. Data were gathered, analyzed, and mined to examine trends and to perform risk assessments by crop and supplier. The basic method of examining produce hygiene was to collect a sample, weigh it in a sterile buffer, add Tween 80, agitate, and prepare a 3×3 most probable number (MPN) series in *E. coli* broth with 4-methylumbelliferyl-beta-D-glucuronic acid (MUG) from buffer wash of crop. Samples showing fluorescence after 24 h incubation at 42 °C are confirmed by streaking to eosin methylene blue (EMB) agar plates, which are incubated for 24 h at 37 °C and examined. Cultures producing fluorescence and green sheen/deep maroon colonies on EMB are considered positive. By using this wash method, even large samples, such as melons, could be examined.

EARLY PROGRAM DEVELOPMENT. In 1997 and 1998 HEB collected over 20,000 samples; 10% of these were positive for *E. coli*. There was significant variability not only between crops, but also between suppliers of the same crop. Citrus, with the exception of limes, had a very, very low incidence, and apples (*Malus × domestica*) and grapes (*Vitis* spp.) almost never had contamination. However, sprouts, limes, cilantro, and white mushrooms had levels much higher than the average. Regardless of crop, some suppliers seldom had high levels, while other suppliers always had high levels.

Further sampling focused on high-risk crops with increased frequency of *E. coli* with the same at-risk crops, those that would not be cooked and would be consumed with little or no preparation.

ADDRESSING SPECIFIC NEEDS. Sprouts had from 25% to 45% in-

cidence of *E. coli*, with levels often exceeding >2400 cfu/g. Audits of the facility found opportunities for improvement in good manufacturing practices (GMP). Testing of seeds showed they could also be the source of *E. coli*. Together, the supplier and HEB developed protocols that involved washing and disinfection of the seeds using concentrated hypochlorite, improved sanitation of the facility and equipment, and washing and disinfection of the sprouts using hypochlorite

solution and multiple washes. *E. coli* was virtually eliminated. Note the dramatic change in the second quarter of 2000 (Fig. 3).

Pico de gallo is an ethnic product that is processed and prepared from fresh tomatoes, onions, cilantro, and peppers. No pasteurization treatment is applied. There were high incidences of *E. coli* (Fig. 4) primarily from one supplier of the peppers and cilantro. A change of supplier delivered significant improvement, and a washing and dis-

Fig. 3. Incidence of *Escherichia coli* in alfalfa, bean, and radish sprouts in 1997–2004; 1Q = first quarter, 2Q = second quarter, 3Q = third quarter, 4Q = fourth quarter.

Fig. 4. Incidence of *Escherichia coli* in pico de gallo (a combination of onions, peppers, tomatoes, and cilantro) in 1997–2002; 2Q = second quarter, 4Q = fourth quarter.

infection process utilizing hypochlorite and multiple washes for peppers and cilantro was developed. Any new ingredients were treated with an antimicrobial agent. Even with these changes *E. coli* is a dynamic organism and constant adjustments are necessary to monitor treatment to keep it at bay.

Both sprouts and pico de gallo came from the same supplier. The supplier did not have a laboratory and lacked technical expertise to determine and solve the problem. HEB provided the laboratory and the expertise, and in combination with the supplier's flexibility and willingness to change methods, made significant improvement possible.

Limes from Mexico initially showed no *E. coli*, but *E. coli* was present on the fruit HEB received (Fig. 5). Most limes were from Mexico, and crop production was suspected to be the source of contamination. Further investigation showed that sampling and testing limes direct from growers in Mexico showed no *E. coli*. *E. coli* was being introduced in U.S. when the product was sized and graded. Audits of the processing facilities showed general lack of cleaning and sanitizing of equipment. Once the sizing and grading facilities began cleaning and sanitizing equipment, the incidence of *E. coli* was reduced. Changes in suppliers and difficulties in getting all suppliers to adopt rigorous cleaning and sanitizing procedures has limited success. Some progress has been made with limes, but not as much as with sprouts or pico de gallo.

Mushrooms are obtained from two suppliers. While mushrooms are not typically considered a fresh fruit or vegetable, they are sold in the produce section. Incidence of *E. coli* in mushrooms from one supplier was initially very low—close to zero, while incidence from another was much higher—initially close to 60%. Mushrooms are grown on sterilized chicken litter. Audits revealed the potential for cross-contamination of sterilized and unsterilized growth media. Laboratory tests confirmed the problem and it was resolved. Once the contamination issue was resolved, the incidence dropped precipitously (Fig. 6). Since the initial testing of mushrooms began, there have been some occasional fluctuations in *E. coli* levels, mostly due to the addition of new types of mushrooms and suppliers. The increases in the later

Fig. 5. Incidence of *Escherichia coli* in limes in 1997–2003; 2Q = second quarter, 4Q = fourth quarter.

Fig. 6. Incidence of *Escherichia coli* in white mushroom in 1997–2003; 1Q = first quarter, 2Q = second quarter, 3Q = third quarter, 4Q = fourth quarter.

Fig. 7. Seasonal variation in the incidence of *Escherichia coli* in head lettuce in 1997–2003; 1Q = first quarter, 2Q = second quarter, 3Q = third quarter, 4Q = fourth quarter.

stages of the program correlated with new suppliers of novelty mushrooms, such as shitake (*Lentinus edodes*), oyster (*Pleurotus ostreatus*), etc., and are caused by the same problem with new suppliers.

The incidence of *E. coli* in lettuce proved to be cyclical and very difficult to alter. Frequency of *E. coli* started out low in first quarter of a year, increased in second, peaked in the third, only to drop in the fourth quarter. Audits,

coaching, and improved sanitation of irrigation and process waters all failed to reduce contamination (Fig. 7).

WHAT CHANGES DID WE AFFECT FOR GROWERS AND PACKERS? After 400 audits, HEB and our growers and packers became closer than ever before—especially the higher-risk ones. Farmers and packers were introduced to the concepts of good agricultural practices (GAP), GMP, and HACCP. Growers are implementing these principles.

GAP IMPACTED. Irrigation waters are now getting the attention they deserve. Growers are aware of the need for sanitary irrigation water, including large organic growers and small local growers. HEB and suppliers also have a heightened awareness that runoff from adjoining property can impact crop safety. Several growers have adjoining dairy and beef cattle operations, which could potentially contaminate their crops. For example, runoff from a dairy farm was contaminating a spinach (*Spinacia oleracea*) crop so the grower formed berms to prevent ingress of runoff, and the problem was greatly reduced.

For many growers this was their first time to receive training in the basics of food safety. Most growers were receptive, but some resisted. In the end, as other retailers began to require third-party audits, the resistant growers came around.

GMP IMPACTED. Few growers, if any, were testing processing water or ice. Now they understand the importance of the sanitary quality of water and ice. Many have regular testing programs that include cleaning and sanitizing procedures for ice machines.

Employees are now required to have documented minimal personal hygiene training. Sometimes educating the employees has a greater impact than what the company does with the managers or owners.

Sanitation and pest control have been improved. Cats for rodent control programs are no longer considered acceptable. Appropriate commercial cleaners and sanitizers have replaced plain water in many operations for washing and cleaning equipment. In many operations there is a designated responsible person in charge of cleaning. Managers have an increased awareness of cross-contamination from unclean surfaces, workers' unwashed hands, and dripping condensation.

IMPACT OF COUNTRY OF ORIGIN ON FOOD SAFETY. There are many ways to examine the set of data comparing imported crops with domestic crops. In order to make fair comparisons, the company only compared countries with at least 500 samples. Also, crops with extraordinarily low incidence of contamination (apples, grapes) and extraordinarily high incidence of contamination (sprouts, mushrooms) were removed (Fig. 8). Mexican crops

Fig. 8. Incidence of *Escherichia coli* as influenced by the country of origin.

Fig. 9. The type of production system influenced the occurrence of *Escherichia coli*, but not in the manner that might have been predicted. "Select conventional" compares results for a mix of fruit and vegetables, which more closely paralleled the organic.

had an incidence rate 42% higher than U.S. crops. Increased vigilance may be needed with some imported crops. However, the incidence of contamination from crops grown in Canada and Chile are low, perhaps as a result of the much higher proportion of samples of tree fruit.

ORGANIC VS. CONVENTIONAL? Some published studies (e.g., Mukherjee et al., 2004) have shown, and the popular opinion is, that organics which utilize manure fertilization and reduced chemical usage have higher rates of contamination. This is not the case for our organic suppliers and crops (Fig. 9).

SUMMARY. Over 7 years, more than 55,000 samples have been analyzed and over 440 audits have been completed. Subsequent coaching of growers and packers has reduced incidence *E. coli* from 10% to less than 5%, in turn reducing the risk to consumers.

Growers are aware of the need for sanitary irrigation water and how runoff from adjoining property can

impact crop safety. Some growers have formed berms to prevent ingress of runoff water. Many producers have regular water-testing programs and follow a regular cleaning and sanitizing program for ice machines.

For many growers, this was their initial contact and education in the basics of food safety. Many were receptive; but some battled the company and other retailers who required third-party audits.

Managers now have an increased awareness of cross-contamination from unclean surfaces, workers with unwashed hands, and from dripping condensation. Sanitation and pest control have been improved. Commercial cleaners and sanitizers have replaced water in many instances, with responsible employees in charge of cleaning and sanitizing, instead of untrained employees.

A comparison of domestic crops vs. imported crops showed that some crops (apples and grapes) are extraordinarily low in contamination, while others (sprouts and mushrooms) are

extraordinarily high. Mexican crops had an incidence rate 42% higher than U.S. crops, but the U.S. incidence is higher than Canada and Chile.

Organic crops are sometimes viewed as “dirtier” crops due to the utilization of compost and reduced chemical fertilizers. This was not the case for our HEB organic suppliers and crops.

Our screening program and educational programs have helped to improve food safety for our suppliers and our customers, thus allowing HEB to better serve consumer needs.

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