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AN ASSESSMENT OF
QUALITY ASSURANCE NEEDS IN
CONVENIENCE STORE FOODSERVICE SYSTEMS

by

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A THESIS

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ABSTRACT

**AN ASSESSMENT OF
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BY

NANCY L. BURCH

Foodservice is relatively new in convenience stores, a segment of the grocery store industry. This study of their processing methods included an on-site hazard analysis of roast beef sandwich processing at 6 locations in Lansing, Michigan and collection of food samples. Managers (n=13) and employees (n=27) at 15 locations were surveyed on their knowledge of safe food handling practices.

Critical control points were time-temperature and personnel sanitation. The log means for Total Plate Counts following processing were 6.04/g and 8.39/g after 3 days of refrigeration in the store. Presumptive S. aureus was isolated in 61% of the samples but never exceeded 4.00 logs/g. TPC increased as time and temperature of storage increased. Managers were more knowledgeable about handling food safely than employees but the temperature danger zone for bacterial growth in foods was identified by only 16% of all participants.

DEDICATION

in memory of

CHARLES H. SIMON

my silent partner in all educational pursuits

ACKNOWLEDGMENTS

In the years that it can take to develop and complete a project of this kind, many people play a significant role. I would like to express my appreciation for the parts many have played in helping me see this project through to print.

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INTRODUCTION

Consumer patterns for purchasing and consuming foods in the United States have changed dramatically in the last 20 years as more women entered the work force, family size diminished, more single households emerged, and fewer meals were eaten at home as a family unit due to family member's schedules. Hall (1984) referred to these new consumers as "grazers", a food industry term for impulse eaters rather than three meal a day eaters who wander from one establishment to another picking up nourishment. They choose food with a more healthful image that is ready for immediate consumption or offers the convenience of ready in minutes with microwave preparation. The National Food Review (1985) reported that 23% of food dollars are spent on food away from home based on 1977-1978 data. One would expect that more recent data would only increase the percentage. According to Gravani (1986) consumers want a food supply that is "wholesome and safe, appetizing, tasty and appealing, packaged properly, labeled fairly and accurately, attractively merchandized and sold at a price they can afford". It is interesting to note that wholesome and safe are listed first by the consumer and not assumed.

Retail food outlets, such as convenience stores, are cashing in on this market by entering the foodservice

field and retailing such items as prepared sandwiches, salads, soups, pizza and burritos. Those stores that are attempting to be the most creative with in-store preparation and customer service (ie. unwrapping and reheating for patrons) are the most likely to attract grazers. At the same time the potential for food poisoning incidents increases with more handling of these foods by employees.

Convenience stores are the largest segment of the grocery store industry with over 61,000 outlets across the United States represented by national chains, local chains, and independents. According to Downing (1980) 90% of all convenience stores were selling take-out food as early as 1979. This means the creation of a new foodservice system that is preparing potentially hazardous foods for a consumer with a large geographical scatter making epidemiological data rare should a food poisoning incident occur (Christian, 1980). This influx of foodservice sites is a tremendous burden on a governmental inspection program including both the Department of Public Health and the Department of Agriculture. These agencies have experienced budget cuts over the years resulting in too few inspectors in relationship to the work load. Grocery stores fall under the jurisdiction of the Department of Agriculture but foodservice is the domain of the Department of Public Health. Therefore many retail

stores are encumbered with dual inspections. Despite that overlap, regulatory agencies cannot assure safe food on a day to day basis in each establishment. Efforts to educate this group of food retailers in safe food handling practices is necessary since they carry the burden of responsibility for the safety of the food they sell (Davis, 1977). Effective self-inspection, on the part of the retailers could save the time and energy of governmental inspectors since visits could be less frequent (Chichy, 1983). This study assessed safe food handling knowledge of convenience store personnel and the relationship of that knowledge to any food safety training they had received in order to critique their ability to carry out a self-inspection program.

There are eighty-two convenience stores in the Lansing, Michigan area. Many of these outlets sell take-out foods prepared by corporate commissaries or food processing chains rather than preparing these foods on-site. My interest was in outlets that prepare their own take-out foods, those that contract with small local commissaries for their take-out foods, and local outlets that also function as commissaries. These outlets were selected because they work directly with potentially hazardous foods and could be observed. They were believed to typify outlets elsewhere using similar types of equipment. There are three commissary convenience stores

and eleven in-house convenience stores in the Lansing area.

One standard that has been used to judge the sanitary conditions under which foods have been prepared in foodservice systems is the microbiological evaluation of products. Research studies (Christiansen and King, 1971; Oblinger and Kennedy, 1980; Ockerman and Stec 1980) have looked at the microbiological content of take-out foods in fast food and retail outlets. Those studies and the work of Bobeng and David (1977) that developed a Hazard Analysis Critical Control Point (HACCP) model for quality control of food processing procedures in foodservice operation could be used as a standard to evaluate convenience store foodservice systems. Bobeng and David state that, "HACCP is a preventive approach to quality control emphasizing microbiological control and identifying process stages where loss of control could present a food safety risk". Time-temperature, equipment and personnel sanitation are the critical control points that they monitored. Bryan et al. (1978), Bryan and Lyon (1984), Bryan et al. (1981), and Bryan and Bartleson (1985) have applied the HACCP approach to evaluating foodservice systems in many different settings. HACCP has not been applied directly to the processing of foods in convenience stores. Therefore my objectives were:

1) to observe the foodservice system in place at convenience stores used to prepare take-out sandwiches in an effort to find any hazardous conditions during processing and identify the critical control points that should be internally monitored in order to assist convenience stores in producing the highest quality product under the safest conditions.

2) to compare the processing methods used to prepare take-out sandwiches in convenience stores involved with in-house production to local convenience store commissaries contracted to supply other convenience store outlets with sandwiches.

3) to monitor total bacterial and presumptive S. aureus counts associated with sandwiches currently prepared in selected convenience stores as a measure of sanitation during preparation.

4) to establish a profile of convenience store personnel and assess their knowledge of established safe food handling practices for the foodservice industry.

The following terms and definitions are of importance to this study;

FOODSERVICE SYSTEM: (Kiehl, 1977) A facility where large quantities of food intended for individual service and consumption are routinely provided, completely prepared. The term includes any such

place regardless of whether consumption is on or off the premises and regardless of whether or not there is a charge for the food.

TAKE-OUT FOODS: (National Restaurant Association, 1986) Ready-to-eat foods and beverages prepared at a full service restaurant, fast food place, convenience store, grocery store, supermarket or some other type of eating establishment and purchased to consume somewhere other than the place where it was bought.

CONVENIENCE STORE (C-store): A small (1,000 to 3,200 squarefeet), higher-margin grocery store that offers an edited selection of staple groceries, non-foods, and take-out foods along with various services and/or gasoline.

COMMISSARY FOODSERVICE SYSTEM: (Unklesbay et.al., 1977) This system has centralized food procurement and production functions with distribution of prepared menu items to several remote areas for final preparation and service.

IN-HOUSE CONVENIENCE STORE: Defined for this study as a convenience store processing sandwiches within their store for on-site service.

COMMISSARY CONVENIENCE STORE: Defined for this study as a convenience store processing sandwiches within their store for on-sight service and transporting

sandwiches to other contracted convenience store outlets.

HAZARD ANALYSIS (HA): (Bauman, 1974) The identification of sensitive ingredients, critical process points, and relevant human factors as they affect product safety.

CRITICAL CONTROL POINTS (CCP): (Bauman, 1974)

Key processing determinants whose loss of control would result in an unacceptable food safety risk.

LITERATURE REVIEW

The National Research Council Food Protection Committee (1985) emphasized that there is no greater need for control over microbiological hazards than in foodservice and the home. Ninety-seven percent of foodborne disease outbreaks can be attributed to these two sources (TABLE 1). With only about 1% of foodborne disease outbreaks reported to the Center for Disease Control in Atlanta, Georgia this information is not sensitive enough to show any significant involvement of retail food stores in these outbreaks. But, the most important factors contributing to the occurrence of outbreaks of foodborne disease are factors which apply to food production in any setting including retail food store production of take-out foods. TABLE 2 lists the eleven factors that contributed to foodborne disease outbreaks in order of frequency for the years 1961 to 1976 (Klien, 1984). Economic losses associated with foodborne disease outbreaks have been enumerated by Todd (1985). Costs for the 17 incidents of foodborne disease in Canada and the United States that he studied ranged from \$16,690 to over \$1 million with a median of the average costs per case of \$788. Costs included lost revenue due to bad publicity as well as

TABLE 1. Foodborne disease outbreaks classified by place of mishandling foods, United States, 1974 to 1978.

Place	Number of Outbreaks	Percent of Known Places
Foodservice establishment	1,285	77
Homes	327	20
Food processing plants	52	3
Other/unknown/unspecified	615	--
TOTAL	<u>2,279</u>	<u>100</u>

Source: Adapted from Bryan, 1981.

TABLE 2. The eleven most important factors contributing to the occurrence of outbreaks of foodborne disease during 1961 through 1976.

Contributing Factor	Rank ^a	Percent ^b
Inadequate cooling of foods	1	46
Lapse of a day or more between preparation and serving	2	21
Infected persons	3	20
Inadequate thermal processing, canning, or cooking	4	16
Inadequate hot storage	5	16
Inadequate reheating	6	12
Ingesting contaminated raw food or ingredient	7	11
Cross-contamination	8	7
Inadequate cleaning of equipment	9	7
Obtaining foods from unsafe sources	10	5
Using leftovers	11	4

Source: Klien et al. (1984) adapted from Bryan (1978).

Note: The survey reviewed 1,152 incidences reported in public health literature or surveillance data during the 16 year period.

^aRanked in order of frequency of occurrence; thus, 1 = the major contributory factor.

^bColumn adds to more than 100 percent because multiple factors are usually necessary for outbreaks of foodborne disease to occur.

legal settlements. Henry (1986) and Bryan (1981) chided the regulatory agencies for not significantly reducing the number of foodborne disease outbreaks in foodservice establishments via current routine inspection programs. Martin (1985) and others have warned the foodservice industry that with the current lawsuit trend in our society and the correlated rise in liability costs, a sound quality assurance program is necessary in every foodservice system regardless of size.

This review will focus on the c-store industry, their demographics and problems, and research that has been conducted to analyze needs in establishing a quality assurance program. Studies applying HACCP, microbiological evaluations as well as those covering training programs will be included.

CONVENIENCE STORES

DEMOGRAPHICS

The National Association of Convenience Stores (NACS) surveyed 140 companies representing 21,780 stores in 1986. From these data the association estimated that there are 61,000 c-stores doing 54.2 billion dollars in sales in the United States and that they employ 397,000 people. The top five c-store corporations listed in order of predominance are Southland Corp. headquartered in Dallas,

TX (7-Eleven); Circle K Corp. headquartered in Phoenix, AZ (Circle K and UtoteM); Cumberland Farms headquartered in Canton, MA (Cumberland Farms); Convenient Food Mart headquartered in Rosemont, IL (Convenient Food Mart); and National Convenience Stores, Inc. headquartered in Houston, TX (Stop 'N Go, Shop 'N Go, Hot Stop, Colonial, Stop 'N Serve, Super Stop, Schepp's Food Stores, Rebel, Rebel Plus). Schlossberg (1986) estimated that the volume of foodservice alone in c-stores is running from 8 to 10% of their inside sales. Kochak (1986) stated that the gross margins on most take-out foods is 40 to 60% which makes it a very attractive service since groceries usually gross only 25% or less. He projected that take-out food would soon account for 20% of annual merchandise sales. C-stores are filling a niche left by fast food operators that have upgraded their service and decor. They are competitive in the fast food market for several reasons; "One-stop shopping" allows consumers to combine a take-out food with gasoline and a pack of cigarettes, c-stores are using good price merchandising (Bernstein, 1985), the cost of a take-out order seldom runs more than \$3.00 (Amorese, 1984), c-stores are not labor intensive needing very few personnel to run them (Beckerman, 1982), 50% of all c-stores are open 24 hours (Brookman, 1985), and most transactions are completed in 2 to 3 minutes (Krueckeberg, 1986). Several articles in leading trade

magazines have reported attempts by c-store chains to team up with national fast food corporations such as Hardee's and Church's Fried Chicken (Zuckerman, 1986 and Jeffrey, 1986). According to Raffio (1986) that trend could bring a needed discipline to c-stores and "a national flag to run up their mast". Certainly these large corporations have spent a great deal of money training employees, developing processing methods, and instituting controls that c-store operators could profit from.

PRODUCT MIX

C-stores have the advantage of being able to tailor their menu to their customers (Larson, 1985). This accounts for some of the diversity of products seen within several stores in one community or within a chain. In 1984 40% of take-out foods were prepared in the stores with hot and cold sandwiches sold most often (Restaurants and Institutions, 1985). Amorese (1984) listed sandwiches, burritos, nachos, hot dogs, pastries, and beverages as common fare but it is not uncommon to find soups, chicken, pizza, ice cream, delis, fresh fruits and vegetables, salads, and in-house bake shops. Generally, these foods are prepared out front in the customer area. Brown (1985) feels that the appeal of in-house prepared take-out foods is their freshness. Plus, there is no waste since you eat what you buy. Estimates of the time

between purchase and consumption of take-out foods range from 40 minutes (Advertising Age, 1982) to 1 hour (Endicott, 1983).

CUSTOMERS

NACS surveyed 48 c-stores in 5 geographic locations in 1985. The responses of 3,967 customers helped to develop a profile of purchasing behavior and to create a data base. The power purchasers were identified as males earning \$15,000 or less and under 18 years of age. Customers over the age of 55 were said to be rare. Take-out foods that they most often purchased were first beverages and fourth hot sandwiches (Wrisley, 1985). A survey of 2,500 grocery operators by Progressive Grocer (1986) found that c-stores see 40% of all food shoppers weekly. Their customers visit them more than 2.1 times per week. This survey revealed that customers in grocery stores, in general, ranked cleanliness as the most important concern when selecting where to shop.

PROCESSING

Krueckeberg (1986) stated that 95% of c-stores use microwaves as a method of reheating foods to serving temperature. This includes customer self-service and employee handled equipment. Larson (1985) reported that a typical store prepared 8 to 10 sandwiches at a time and held them in a display case no more than one day. Product

turnover may extend to as much as seven days when products are prepared and shipped from commissaries.

EMPLOYEE TRAINING

It should be the manager's responsibility to both train employees and produce a manual on food preparation that is available at all times (Larson, 1985). Chipley and Cremer (1980) surveyed fast food operators and found that their organizations first concern was for education of their personnel in the practical aspects of food protection. Restaurants and Institutions Yearly Review (1985) cited employee training as the biggest problem facing that industry. In 1986 they re-emphasized the fact that foodservice requires a commitment on the part of c-store operators to spend money developing and conducting training programs for all employees.

INDUSTRY CONCERNS

Raffio (1986) was critical of c-store management for not having the discipline to throw away food. Part of the problem is a general lack of experience in foodservice on the part of management (Larson, 1985). A typical c-store managers' salary is approximately \$15,000 which is low for the foodservice industry (Telberg, 1983). Thus this salary would not attract well educated personnel or employees with extensive field experience. In fact, the average worker in institutional foodservice is less than

25 years old and remains on the job for less than one year (Marth, 1977).

HAZARD ANALYSIS AND CRITICAL CONTROL POINTS

BACKGROUND

HACCP began in the late 60's when Pillsbury established strict control measures in their processing system in order to meet NASA-Army space food standards for "zero" pathogens, especially salmonella (Bauman, 1974). Widespread application of this approach began in the 70's within the food processing industry particularly for improving microbiological control of low-acid canned foods. This system has since been extended to foodservice (Bobeng and David, 1978; Bryan et al., 1978; Bryan, 1981; Bryan et al., 1981; Bryan and Lyon, 1984; Bryan and Bartleson, 1985; and Snyder, 1979, 1981, 1986). Faulty practices can be identified during operations, often, in time to prevent the occurrence of foodborne outbreaks (Bryan, 1981).

HAZARD ANALYSIS

Conducting a hazard analysis begins with identifying those foods prepared in an establishment that are potentially hazardous including a look at each ingredient in a product. This is followed by observing each sequential step of the processing or preparation operation

including talking to employees about the process. The process is then diagramed for further study. Testing foods during certain processing steps can be done to see if there are potential microbiological hazards. Certain features of the operation found to be hazardous must be performed correctly to assure the safety of the final product (Bryan, 1981). Elimination of hazardous conditions or processes should be attempted. When elimination of the hazardous condition or process is not possible, it becomes an identified critical control point that must be monitored (Bauman, 1974).

CRITICAL CONTROL POINTS

Bobeng and David (1977) studied hospital foodservice systems and identified four critical control points (CCPs): 1) ingredient control and storage, 2) equipment sanitation, 3) personnel sanitation, and 4) time-temperature relationship. Time-temperature was a CCP in all systems studied. Equipment and personnel sanitation differed a great deal dependent on system and location. Loss of control at one point was found to have a cumulative effect on microbiological conditions of the product and a loss of control at subsequent control points. It was recommended that methods of monitoring control points and standards must be established for each foodservice system on an individual basis. The tools for effective monitoring include standardized procedures,

initial and end-heating temperature controls, microbial controls, and appropriate training procedures (Klein et al., 1984). When practical methods for monitoring CCPs do not exist in a foodservice system, more care must be taken to monitor other CCPs (Bryan and Lyon, 1984). Bobeng and David (1978) found that microbiological testing in hospitals prior to service was not a practical monitoring technique. The major problem in applying HACCP is one of the basic tools - trained staff who can both apply specific control measures for each critical control point and also understand appropriate monitoring procedures.

IMPLEMENTATION

Use of the HACCP model by governmental inspection programs and by foodservice systems as a method of self-regulation have been endorsed by many researchers in the field (WHO, 1980; Snyder, 1981; Bryan, 1981; Chichy, 1983; Henry, 1986). The National Restaurant Association has recently endorsed a HACCP program for their industry called "SAFE" (Harrington, 1986). The key to an effective quality assurance program of any kind is the management in the foodservice system. According to Bryan (1981), managers should have knowledge of and concern for 1) foodborne disease hazards associated with the foods they prepare, 2) the personal hygiene of their employees and, 3) proper food preparation and storage practices.

MICROBIOLOGICAL STUDIES

Many research studies have been conducted involving microbiological analysis of processed foods similar to those produced in c-stores. Ockerman and Stec (1980) examined 465 sliced roast beef type sandwiches obtained from fast food restaurants for total plate counts and coliform counts. Total bacterial counts per sandwich ranged from 190 to 15,250/g. Adding vegetables significantly increased ($P < 0.01$) the total plate counts. Intensive microbial growth began at 32 C and at 38 C when storage time was 4 hours or longer. Sandwiches purchased before a work shift and consumed at the lunch or dinner break could duplicate these conditions. Christiansen and King (1971) sampled commercially prepared salads and sandwiches for microbial content. Total counts varied considerably. Median counts for sandwiches ranged between 5 and 5.43 log/g. Seventy-six percent of the samples contained organisms which developed as typical staphylococcal colonies on TPEY agar. Despite the fact that S.aureus is a poor competitor, it was noted that these high counts would improve the bacteria's ability to compete. Oblinger and Kennedy (1980) analyzed sliced roast beef from eight Florida supermarkets for APC, yeast and molds, S. aureus, fecal strep, C. perfringens, total coliforms, coliforms, E. coli, and Salmonella. High APC

and coliform counts in many samples indicated a need for improved sanitation procedures at the processor and retail levels. Temperature abuse during slicing and packaging seemed more significant in effecting counts than storage temperatures in this study.

Christian (1980) stated that the microbiological counts found in food after processing is an indication of the hygienic conditions under which they were prepared. State Departments of Public Health use microbiological counts after a foodborne disease outbreak has occurred as a method of isolating causes. However, use of microbiological counts at the retail level is prohibitive as a control measure because of time and costs involved. Therefore counts are taken with an initial hazard analysis of the system in order to emphasize the importance of improved control methods. Wyatt and Guy (1980) used 10 retail food markets in Oregon to see if they could correlate scores on a sanitation profile evaluation form with microbiological counts of products gathered from those same locations. Fifty percent of the products sampled exceeded state bacterial load guidelines but no relationship could be found between the scores on the evaluation form and the microbiological counts. High counts did appear to be more directly related to poor temperature control. The evaluation form designed by

Wyatt and Guy used guidelines of that state's current inspection program and not HACCP.

In light of food processes that occur in c-stores, it is important to highlight possible sources of microbial contamination in the foodservice industry. Since microwaving is the primary method of reheat for take-out foods in c-stores, its effectiveness at reducing microbial load is of interest. Fung and Cunningham (1980) found that because of the unevenness of heating, microwaves may not be adequate for reducing high levels of foodborne microorganisms in all regions of the food. Effectiveness is dependent on the relationship between type and size of food coupled with time of exposure. Microwaves do not have the same killing effect on all bacteria. Equipment manufacturer's suggested reheat time and power levels listed on the appliances in c-stores may not always be adequate to control bacterial contamination. Fung and Cunningham suggested the use of a wrap to improve evenness of heating during microwaving. Sawyer et al. (1984) tested the effect of polyvinylidene chloride wrap on improvement of the unevenness of heating. Foods are reheated both wrapped and unwrapped in c-stores. In the study, S. aureus was inoculated on the surfaces of protein foods and then tested wrapped and unwrapped. Wrapping did not have a statistically significant effect on internal end temperature or on counts of bacteria.

C-store employees are often responsible for handling unwrapped food for customers as well as money. Handwashing is seldom done inbetween processes. Money handling by food handlers is a related issue that the Food and Drug Administration attempted to clarify in a 1984 interpretation of the Retail Food Store Sanitation Code (1982). They stated that paper currency and the inks used to print them contain a fungicidal agent having germicidal characteristics which retain their effectiveness throughout the circulating life of the currency. Although currency will not support growth, there was no mention of its ability to act as a carrier.

FOODSERVICE PERSONNEL

CERTIFICATION

Snyder (1986) stated "that there is no control over the causes of foodborne illness today in the foodservice industry because there has never been a required national educational program to teach owners and operators safe foodhandling practices to prevent foodborne illness". According to Bryan (1979), and Christian (1980) a certification program is needed that tests by observation that owners, managers, and supervisors are thoroughly knowledgeable and practicing good sanitary procedures. Certified owners, managers, and supervisors can then train

their employees. But, the quality assurance program in place must be consistent and followed at all levels of the operation (Holland, 1980).

There is a certification program that is provided by the National Institute for the Foodservice Industry (Clingman, 1977). Unfortunately this program was not mandated for state adoption. Penninger (1984) surveyed 20 agencies composed of 9 voluntary and 11 mandatory certification training programs. He found that 83.6% of the participants in the mandatory program did become certified whereas only 28.6% were certified in the voluntary programs. Asked if scores following routine governmental inspections had improved with certification of employees, 91% of the mandatory programs reported yes, whereas only 33.3% of the voluntary programs reported yes. Marth (1977) reported on an earlier and related study of the short term and long term effects on the food handling practices of employees working under a trained manager. A positive correlation was noted between the length of time since the manager was trained and the incidence of poor food handling practices by his/her employees.

EMPLOYEE KNOWLEDGE

Wyatt (1979) surveyed managers and owners of 219 randomly selected food markets in Oregon. Under study were their attitudes and knowledge of safe food handling practices. From a return rate of 49.8% the study showed a

clear lack of specific knowledge of basic principles of sanitation on the part of the participants. Of the respondents, 29.6% were from convenience stores. Forty percent had not received training in safe food handling practices but 74.1% had worked in the industry for over 10 years. Fifty two percent did not recognize the unsafe temperature range of 45 to 140 F for potentially hazardous foods. This study lends support to the need for mandatory sanitation training at the retail level.

METHODS AND MATERIALS

In light of the objectives of this study, several instruments had to be developed. The instruments were needed for screening the sample, surveying managers and employees, eliciting store owners interest and support, analyzing hazards, and reporting results to the participants. This section will discuss the methods used to develop these materials, whereas Chapter I and II will present methods used for the physical, microbiological, and statistical analysis of the data gathered.

SAMPLING

A computerized list of all licensed grocery stores and catering establishments in Ingham County, Michigan was obtained from the Michigan Department of Agriculture and the Ingham County Health Department. The two lists were then cross checked to assure a complete sampling frame was being used. A telephone survey (Appendix 1) was conducted to determine which of the licensees were in fact convenience stores and if they processed take-out foods. All convenience stores that produced take-out foods or those that functioned as commissaries were included in the study. All participating stores were assigned a randomly selected three digit number to serve as a code to protect their anonymity when gathering and reporting the data.

SURVEY INSTRUMENT

Appendix 2 and 3 are the survey instruments used to gather demographic data on the stores, employee profiles, and information about the safe food handling knowledge of persons working in the store. Surveys were screened and approved by the University Committee on Research Involving Human Subjects (UCRIHS) Michigan State University (Appendix 4). Surveys were also pre-tested for readability and validity with managers and employees of three local convenience stores not used in the study.

ON-SITE INSTRUMENTS

A project statement (Appendix 5) and consent form (Appendix 6) were developed to share with the store owners or managers when visited for the first time. The initial visit was made to elicit their support of the research allowing production to be observed and sandwich samples to be collected. The on-site visit permitted the researcher to evaluate the store conditions from a consumer's point of view using a prepared form presented as Appendix 7. Scores for the rating of store cleanliness as well as the yes/no answers were used from this form for correlation studies. Those stores that agreed to participate in the Hazard Analysis portion of the study, were visited by appointment during production of roast beef sandwiches. Length of observation was from one to two hours. An evaluation form, adapted from Bryan (1981), was used to

conduct the analysis (Appendix 8). Sandwich samples were obtained for microbiological analysis. Participating stores were contacted by mail following the analysis of the data and informed of the counts found in their products (Appendix 9). Interpretation of results by means of the information given in the letter was left up to the store owners or managers. No further contact was made.

CHAPTER 1

Hazard Analysis of Foodservice Systems in Convenience Stores

ABSTRACT

Processing of roast beef sandwiches was studied in nine convenience stores in the Lansing, Michigan area. Four stores produced food on-site and two functioned as commissaries supplying product to three other stores studied. Analysis consisted of observing the processing methods, recording time-temperature relationships, and obtaining sandwich samples for microbiological counts. Hazards identified were receiving, tempering, assembling, transporting, chilled storage and microwaving. Time-temperature and personnel sanitation were the identified critical control points. The geometric mean for TPC in roast beef immediately following processing was 6.04 logs/g and after 3 days of refrigeration in the store was 8.39 logs/g. Presumptive counts for S. aureus were isolated in 61% of the samples but never exceeded 4 logs/g. Counts increased as time and temperature of storage increased. Commissary convenience stores exhibited more hazards in food handling than on-site convenience stores.

INTRODUCTION

CONVENIENCE STORE (c-stores) - A small (1,000 to 3,200 square feet), higher-margin grocery store that offers an edited selection of staple groceries, non-foods, and take-out foods along with various services and/or gasoline.

According to a 1986 report of the National Association of Convenience Stores (NACS) there are over 61,000 c-stores in the United States. As early as 1979, 90% were marketing take-out foods (Downing, 1980). Gross margins on take-out food are 40 to 60% making it a very attractive service compared to groceries that gross only 25% or less (Kochak, 1986). C-store operators tailor their menu to their customers. They typically offer sandwiches, salads, nachos, burritos, pizza, and perhaps fried chicken or baked goods. Some c-store operators sell product provided by wholesalers while many others produce their own products on-site. This is a relatively new foodservice system that seems to be growing to fill a niche left by fast food restaurants that are upgrading their service. One-stop shopping appeals to customers, mostly male and under 18 years of age (NACS, 1985). Twenty-four hours a day, they can pick up a beverage and food for under \$3.00 (Amorese, 1984), in 2 to 3 minutes (Krueckeberg, 1986), while also gassing up the car and grabbing a pack of cigarettes.

Foodservice establishments accounted for 77% of known sources of foodborne disease outbreaks between 1974 and 1978 (Bryan, 1981). In more than 50% of the reported outbreaks from 1968 to 1977 the vehicle of transport was meat or poultry with ham, turkey, and roast beef most common (Bryan, 1980).

Hazard Analysis and Critical Control Points (HACCP) is a method of identifying system hazards that are either eliminated or monitored to gain better processing control. The objective is to prevent possible foodborne disease outbreaks. Many studies have been conducted of foodservice systems in hospitals, airlines, mexican and fast food restaurants, and catering establishments using HACCP to assess their risk of producing a foodborne disease outbreak (Bryan et al., 1978; Bobeng and David, 1979; Bryan et al., 1981; Bryan and Lyon, 1984; Bryan and Bartleson, 1985). C-stores have not been studied using this approach. Producers of take-out foods have no control over the abuse that customers may give their products once they have left the store. Abuse can include hours of storage at ambient temperatures before consumption at a lunch or dinner break. Therefore, the control during production of these foods is critical since sanitary abuses of foods, particularly time-temperature are cumulative (Bobeng and David, 1978).

The purpose of this study was to conduct a hazard analysis of c-stores in the Lansing, Michigan area that process roast beef sandwiches and to identify critical control points and effective ways of monitoring them. Both stores that produce their products on-site and stores that produce for themselves and for other stores (commissaries) in the area were to be studied and compared. Sandwich samples were gathered for microbiological evaluation as an indicator of the sanitary conditions under which they were produced.

MATERIALS AND METHODS

SAMPLE SELECTION

A sampling frame was established from lists of licensed grocery stores and catering establishments obtained from the Michigan Department of Agriculture and the Ingham Department of Public Health. Phone interviews established which licensees were c-stores and of them, which stores produced take-out foods on-site. Out of 82 c-stores in the Lansing area, eleven were preparing take-out foods on-site, six of which agreed to participate in the study. One out of the six stores was part of a national chain and two were commissaries. Three additional stores that contracted with commissaries for prepared sandwiches were used as pick-up sites for sandwich samples in the microbiological analysis.

Participating stores were assigned a randomly selected three digit number as a code to protect their anonymity during the gathering and reporting of data.

TIME-TEMPERATURE STUDY

Ambient, food, and cooler temperatures were taken using the Wahl digital heat-prober thermometer (model 350XC, Probe P/N 202, Wahl Instruments, Inc., Culver City,, Calif.). Ambient temperatures were taken every 15 minutes during production and cooler temperatures were taken at the beginning of production and when sandwich samples were obtained. Temperatures for sandwiches to be analyzed for bacterial counts were tested aseptically at the geometric center.

During a pre-study of the hazard analysis technique, the Wahl thermometer was used to obtain temperatures of chilled roast beef sandwiches which were then microwaved by the store employee. Internal temperatures were taken at three locations to determine end point temperature and its variability in the sandwich.

HACCP STUDY

Consent was obtained from participants before the analysis began. The form used in the store during observations was adapted from Bryan (1981). The hazard analysis consisted of taking temperatures, observing production, questioning employees on procedures used, and gathering food samples.

MICROBIOLOGICAL ANALYSIS

Duplicate samples of roast beef sandwiches from observed productions were obtained at each store immediately following processing and after 3 days of storage in the store. Sandwiches meant for analysis and stored for 3 days on-site were identified by code in the cooler to prevent employees from selling them to customers. Samples were transported on ice to the laboratory for analysis. Samples were refrigerated within 20 minutes of pick-up and plating was conducted within 6 hours.

Under sterile conditions, 25g of meat from each sandwich was homogenized in 225 ml of 0.1% peptone via the stomacher. Six-fold dilutions were prepared and 0.1 ml of each was used for duplicate plating on Plate Count Agar (Difco) and incubated for 48 hours at 32 C. Dilutions of 0.1 ml were also plated using Baird Parker Agar (Difco) with egg yolk tellurite enrichment and incubated for 48 hours at 37 C. Plates with 30 to 300 colony forming units were counted using a Standard Colony Counter I (Spencer Manufacturing, Buffalo, NY). The results were recorded as number of organisms per gram of sample.

RESULTS

HAZARD ANALYSIS

FIGURE 1 is a process flow diagram for the production of roast beef sandwiches observed at on-site stores and commissaries. Hazards were observed in receiving, tempering, assembling, transporting, chilled storage, and microwaving.

No temperature checks were used at receiving in any of the stores and product sat until employees could find the time to check product in and chill or freeze it. Tempering of frozen pre-sliced beef and meatballs at room temperature was observed at several locations. Time-temperature abuse in commissary locations occurred more often than in on-site stores due to the larger quantity of product being assembled at room temperature (time ranged from 45 minutes to 2 hours and 20 minutes for roast beef sandwiches). Numerous examples of cross-contamination were noted in all stores including transporting containers from the floor to the counter, adding fresh product to containers of old product, multi-purpose use of sinks for hands and equipment, using an all-purpose cloth for counter clean-up and hands or face, touching the face or hair during production without washing the hands, and eating or drinking by employees during assembly of sandwiches. Number and severity of abuses varied by store. Commissaries transported sandwiches within the

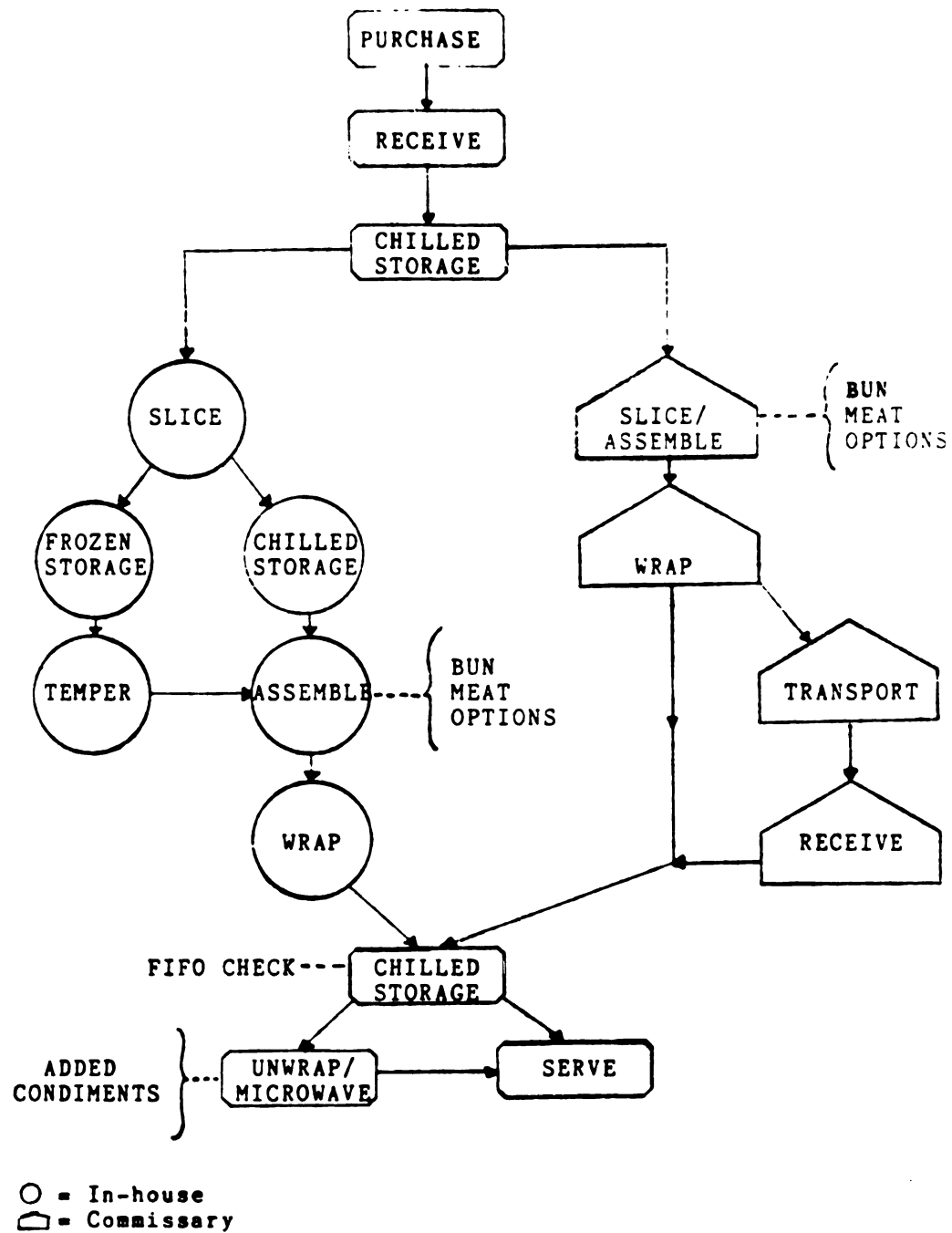


FIGURE 1 - Process flow diagram for pre-cooked beef sandwich production at convenience stores.

Lansing area without benefit of chilled storage (max. distribution time of 1 hour 30 minutes). Chilled storage temperatures were above 5 C at two locations (TABLE 1). Temperatures of coolers during the course of the day varied due to processing and customer service that required opening and closing the doors. Four stores expressed problems either with chilling equipment, broken thermometers, or freezing equipment as temperatures were being taken by the researcher.

A pre-study conducted in 3 stores prior to the hazard analysis research is summarized in TABLE 2. The table compares internal temperatures of roast beef sandwiches before and after microwaving. The variability of the results from one part of the sandwich to another points out the hazard of relying on microwave heating in the stores as an effective way to reach a reheat temperature for food of 60 C or above which would destroy bacteria.

CRITICAL CONTROL POINTS

Hazards that could be eliminated are tempering and transport by using refrigeration in both cases at 7 C or below. Time-temperature was a critical control point in most of the other processes (receiving, storage, and assembly). Equipment and personnel sanitation were critical control points during assembly. Evenness of microwave heating as a means of destroying bacteria cannot be controlled in the store and therefore all other

TABLE 1. Temperatures, Total Plate Counts and *S. aureus* Counts for Beef Sandwiches at Selected Convenience Stores

STORE CODE	^a PC °C		^b TIME	FOLLOWING PROCESSING		PC °C	^d U °C	AFTER 3 DAYS ^e	
	°C	°C		TPC log/g	<i>S. aureus</i> log/g			TPC log/g	<i>S. aureus</i> log/g
689	8	23	-	6.66	0	10	5	8.81	3.60
689	7	23	-	6.11	0	12	5	9.60	4.60
868						5	2	9.96	0
868						5	2	9.49	3.30
175						5	1	7.45	3.48
163	14	24	35	6.00	0	5	1	7.91	3.30
163	15	24	35	7.53	4.00	4	1	7.63	4.08
405	10	24	20	5.00	4.00	4	1	6.76	4.11
405	9	24	20	4.00	0	6	2	7.53	3.70
769	8	24	23	6.83	3.48	6	2	7.76	0
769	10	24	23	7.15	3.48	0	4	7.57	3.60
797	5	22	25	6.83	3.70	0	4	7.64	3.79
797	5	22	25	6.60	3.49	11	5	9.49	0
364	17	21	32	5.64	0	10	5	10.04	3.70
364	17	21	32	4.15	0	3	3	8.26	0
238						1	3	8.49	0
238									

Note: all temperatures expressed in degrees celcius

a all counts expressed in colonies per gram

ap product temperature at geometric center

b Time of exposure in minutes at ambient temperature during processing

c Ambient temperature in store during processing

d Cooler temperature on day of pick up

e In-store chilled storage

TABLE 2. Temperatures before and after heating of roast beef sandwiches by store employee using the microwave oven in 3 different c-stores.

Store	Condition	Heating Time/ seconds	Temp. at Specific Locations			$\bar{x}$	s
			L ^a C ^a	PC ^b C ^b	R ^c C ^c		
A	Before heating	-	-	41	-	66.3	$\pm .86$
	After heating	78	68	57	74		
B	Before heating	-	-	35	-	47.7	$\pm .60$
	After heating	32	47	42	54		
C	Before heating	-	-	36	-	39.0	± 1.59
	After heating	50	57	27	33		

^aLeft of center
^bGeometric center
^cRight of center

controls must be carefully monitored prior to microwaving (Bryan and Lyon, 1984).

MICROBIOLOGICAL ANALYSIS

The results of the analysis are given in TABLE 2. Store code 689 supplied products for 868 and 175, and 364 supplied product for 238. Product was transported to the second site/s by the commissary and picked up three days later by the researcher. Initial bacterial load was high (a log mean of 6.04/g) which might relate to receiving techniques currently used by c-stores. The log mean count after 3 days of storage was 8.39/g. Products delivered by commissaries to other c-stores had the highest Total Plate Counts after 3 days which might relate to unrefrigerated transport. Total Plate Counts were also higher as temperature of cooler and temperature at geometric center increased. Mean counts for S. aureus changed very little over storage time and never exceeded 4 logs/g.

DISCUSSION

The processes diagramed in FIGURE 1 varied only in that commissaries ship their products to additional stores, and one on-site c-store operator sliced and froze beef to lengthen shelf life followed by tempering and assembly. Commissaries generally process more product at one time than on-site stores and therefore freezing or refrigerated storage following slicing of meats or cheese

was not necessary prior to assembly. One hazard observed was the length of time the products were held at room temperature prior to shipment. The time-temperature relationship is based on a known danger zone of 7 to 60 C (45-140 F) in which bacteria multiply rapidly. Exposure to this zone should be controlled at 4 hours or less (Longree and Blaker, 1982). This hazard could be eliminated by using a refrigerated walk-in for assembly or simply the division of labor to move sandwiches into coolers more quickly. C-store employees were observed assembling and wrapping hot meatball fillings into sandwich buns for the cooler. The insulating effect of the bun (Hodge, 1960) and high cooler temperatures is a hazard that could be eliminated by cooling the filling below 7 C before wrapping. The abuses of time-temperature during receiving - tempering - assembling - and transport within the temperature danger zone will be further abused by the consumer and all abuses have a cumulative effect.

Receiving should be accomplished with speed and by monitoring incoming food temperature looking for below 7 C for fresh foods or 0 C for frozen. All stores should have a stem type metal thermometer accurate to ± 2 F (MEHA, 1983).

Hazards observed during assembly involving equipment and personnel sanitation are largely a matter of training

on the part of management and employees to gain control. Certification programs, such as that offered by the National Institute for the Foodservice Industry, lay the groundwork for providing knowledgeable employees who understand the risk of foodborne disease and how its transmitted. A trained employee can implement controls by applying correct monitoring techniques. Management can develop a schedule of when to clean and post directions on how to clean equipment (Bryan 1971). Knowledgeable owners and operators can become effective self-inspectors saving the time of public health and other governmental officials.

A study by Fung and Cunningham (1980) found that because of the unevenness of heating, microwaves may not be adequate for reducing high levels of foodborne microorganisms in all regions of the food. Effectiveness is dependent on the relationship between type and size of food coupled with time of exposure. Observed technique in the stores varied considerably in terms of length of time the products were heated. Employees in c-stores are not capable of making judgements on adequacy of heating in reducing bacterial load and therefore this control point is not feasible.

Total Plate Counts exceeded those found by Oblinger and Kennedy (1980) for chilled beef with a mean of 4.84 logs/g and Ockerman and Stec (1980) for whole roast beef

sandwiches at 190 - 15,250/g. Counts were similar to those found by Christiansen and King (1971) for whole beef sandwiches at 3.11 - 8.85 logs/g marketed at ambient temperatures. Such high counts initially and after only 3 days of storage in this study seem excessive since most commissaries labeled their products with a 7 day pull date. Observation of the assembly methods and recordings of time-temperature relationships during assembly did not offer any insight as to the reason for these counts (max. time at 24 C was 45 minutes during assembly).

Stores for which records showed the highest number of total abuses or hazards during observation did not have correspondingly high microbiological counts. High counts may be related to the cumulative abuses of time-temperature beyond assembly. But presumptive counts of S. aureus in 17 out of 29 samples indicated a need for improved handling practices. Wyatt and Guy (1980) explored the feasibility of bacterial quality as a predictor of sanitary conditions on-site in 10 retail stores. Data in their study also showed no correlation existed between the microbiological quality of products processed in the store and total store profile sanitary condition. High counts recorded appeared directly related to poor temperature control.

CONCLUSIONS

C-stores do not represent a unique foodservice system in that the hazards and critical control points identified were similar to Bobeng and David's (1977) findings; time-temperature, personnel sanitation, and equipment sanitation. Total plate counts were unusually high and increased as time and temperature increased. Commissary c-stores producing products for other c-stores exhibited more time-temperature hazards than c-stores producing their own products.

ACKNOWLEDGMENT

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CHAPTER 2

Safe Food Handling Knowledge of Convenience Store Personnel

ABSTRACT

Managers and employees of 13 Lansing, Michigan convenience stores were surveyed to establish their knowledge of safe food handling practices. Information from the surveys was compared to that recorded by the researcher on store practices and conditions. Statistical tests of frequency distribution, correlation and analysis of variance were performed. None of the participants were certified by the National Institute for the Foodservice Industry or the Michigan Department of Public Health. Only 51% of the employees (n=27) indicated they had been trained in safe food handling by their employer although 88% handled unwrapped food. Managers (n=13) scored higher on a food safety test than employees but both groups scored poorly on knowledge of safe holding temperatures. Establishing a training program in safe food handling procedures in this foodservice cannot be overlooked as a means of establishing quality control.

INTRODUCTION

Convenience stores (c-stores) are small, higher-margin grocery stores that offer an edited selection of staple groceries, non-foods, and take-out foods along with various services and/or gasoline. Some of the national chains familiar to the general public are 7-Eleven, Circle K, Convenient Food Mart, Cumberland Farms, or Stop 'N Go. The National Association of Convenience Stores annual report (1986) estimates that there are 61,000 stores in the United States employing 397,000 people. As early as 1979, 90% of these stores were marketing take-out foods (Downing, 1980) and many established a foodservice area to produce foods within the store. Some potentially hazardous foods produced include meat sandwiches, moist protein salads, burritos, fried chicken, and pizza.

Consumers have certain expectations of the foodservice establishments that they frequent and one of these is that the food is prepared under sanitary conditions to protect them from food poisoning. Yet, foodservice establishments accounted for 77% of known sources of foodborne disease outbreaks between 1974 and 1978 (Bryan, 1981). The median of the average cost per incident is \$788 according to Todd (1985) adding up to a

total of \$4 billion dollars in the U.S. for the estimated 5 million outbreaks per year. Control is thought to be the function of governmental inspection programs at the state and local level but considering the vast number of outlets and budget restrictions, foodservice locations must assume the primary burden of preventing the occurrence of foodborne disease (Chichy, 1983; Bryan, 1979). As Snyder (1986) points out, "It is well understood today that inspection can find a problem, but only management can prevent a problem."

The focus of this study was the people involved with foodservice in c-stores at the management and employee levels. A profile of these persons and an assessment of their knowledge of safe food handling practices was obtained by use of a survey and observations of store practices and conditions.

MATERIALS AND METHODS

SAMPLE SELECTION

A computerized list of all licensed grocery stores and catering establishments in Ingham County, Michigan was obtained from the Michigan Department of Agriculture and the Ingham County Health Department. A telephone survey was conducted to determine which of the licensees were in fact c-stores and if they processed potentially hazardous foods. Thirteen stores fit the criteria out of the 82 in

the Lansing area. Six of these stores agreed to observations of their processing techniques beyond the initial surveys. Each participating store was assigned a randomly selected three digit number to serve as a code to protect their anonymity while gathering and reporting data and to allow for statistical analysis.

SURVEY FORMS

Two survey instruments were designed. The manager survey consisted of 21 questions concerning the store and 18 to establish a manager profile. The employee survey consisted of 20 questions. The surveys were screened and approved by the University Committee on Research Involving Human Subjects at Michigan State University and pretested for readability and validity. A consent form was used for participating stores and survey forms were filled out in the presence of the researcher.

STATISTICAL ANALYSIS

Data gathered during observations and from the two surveys were analyzed using frequency distribution, correlation, and analysis of variance. A probability of $<.05$ was used as a test of significance in all analyses. Surveys were voluntarily filled out and in some cases only partially filled out, but all responses were used.

RESULTS

STORE DEMOGRAPHICS

The stores in this study varied very little from the stores described in the National Association of Convenience Stores' 1986 - State of the Industry Report. Most stores (92.3%) were not open 24 hours a day but 84.6% were open 7 days a week. Cost of a take-out order was under \$3.00 and take-out ranked third in order of total sales whereas nationally it ranks much farther down the list. Their average customer was listed as 18-30 years of age (75%) and predominately male (81.8%). Of the 82 c-stores contacted by phone, only 17% had heard of the National Association of Convenience Stores and none of the stores were members. The Michigan Food Dealers Association was recognized 32% of the time but only 5% of the stores were members. Only 46.2% reported using written policies for food production and sanitation.

OBSERVATIONS

Observations of store conditions and processing techniques resulted in a long list of time-temperature abuses and incidences of cross-contamination by personnel working directly with foods. This list included tempering foods at room temperature, using cloth towels to clean up work areas and hands, eating while assembling foods, adding new sliced foods to containers that were not yet

empty, and assembling hot fillings into sandwich buns just before wrapping and storing at refrigeration temperatures.

PROFILES

Ages for store managers (n=13) ranged from 24 to 64 with a mean of 46. Males represented 62% of the sample with 46% having a high school certificate or less. The additional 54% attended college and one was a graduate. Sixty-nine percent had worked in c-stores less than six years but 83% had chosen retail food management as a career. Almost 70% had had no formal training in food sanitation and of those who had, it was from their current employer. None of the managers were certified by the National Institute for the Foodservice Industry (NIFI) or the Michigan Department of Public Health (MDPH).

Ages for the employees (n=27) ranged from 16 to 52 with a mean of 29. Females represented 58% of the sample with 68% having a high school certificate or less. An additional 19% had attended college and 11% had a two year college certificate. Ninety-three percent had worked in retail foods for less than 5 years. No clear job titles emerged from the study as most employees were working several positions (ex. cashier/cook/stock person). Of the 52% who said they had received training in food sanitation, 53% received it from their current employer. None of the employees were certified by NIFI or MDPH.

STATISTICAL ANALYSIS

Ten questions on both the manager and employee surveys were identical. They were asked to place an X on a 15 cm line marked from poor to excellent to represent their perceived knowledge of safe food handling practices. The same scale and technique was used for their rating of the overall cleanliness of the store they worked in currently as compared to other stores they had worked in or visited. The other eight questions comprised a quiz on principles of safe food handling which included fill-in the blank for hot and cold holding temperatures and six true or false questions.

FIGURE 1 compares the percent of managers (n=10) and employees (n=25) who actually marked the line at a specific interval for perceived knowledge of safe food handling practices. Employees were more likely to rate themselves as average to above average whereas managers chose above average to excellent on 70% of the surveys.

FIGURE 2 compares the percent of managers (n=13) and employees (n=27) who marked the line at a specific interval for store cleanliness with the ranking given for each store by the researcher. The ranking by the researcher was done on the initial visit to the store using the same 15 cm rating scale. The researcher was only able to rate cleanliness from the consumer's viewpoint at that time. In 30% of the stores, the

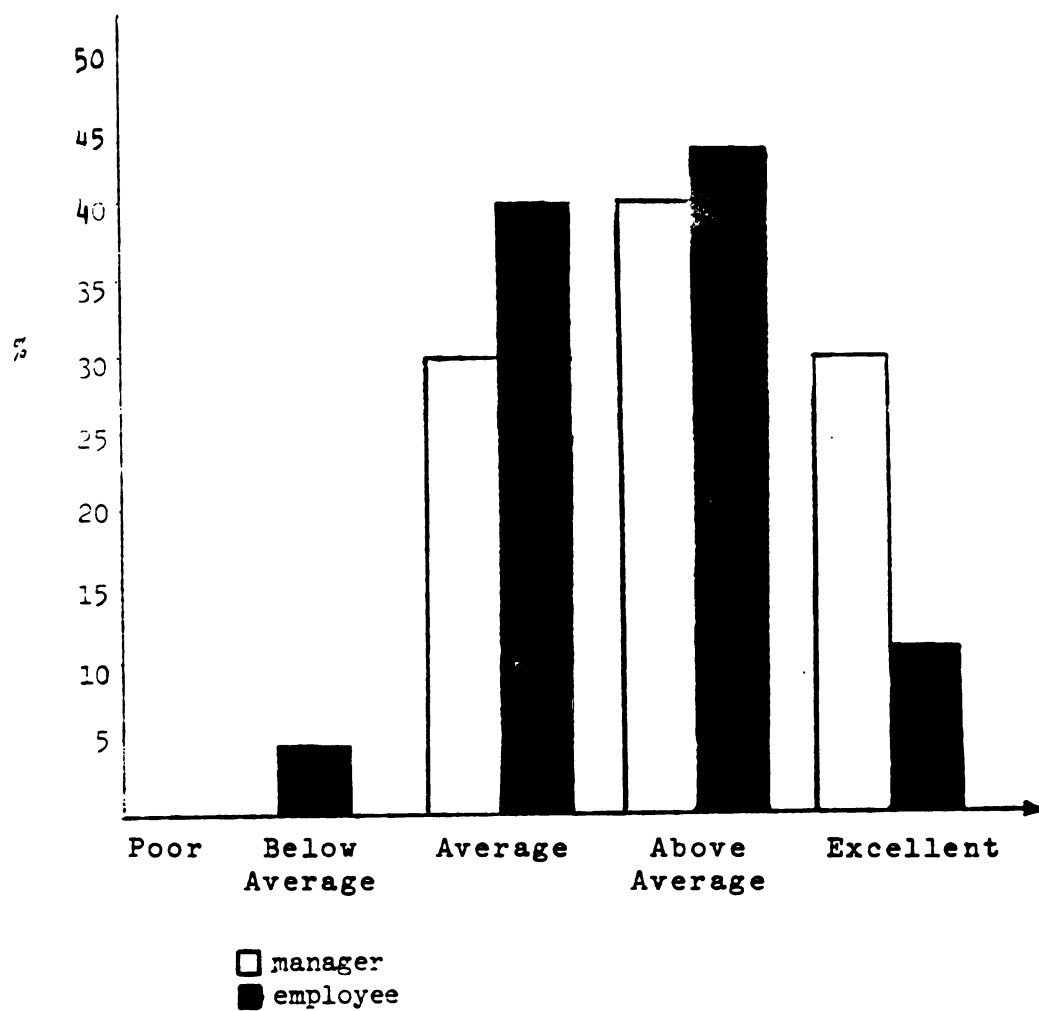


FIGURE 1. A comparison of the ratings given for perceived knowledge of safe food handling practices by managers and employees.

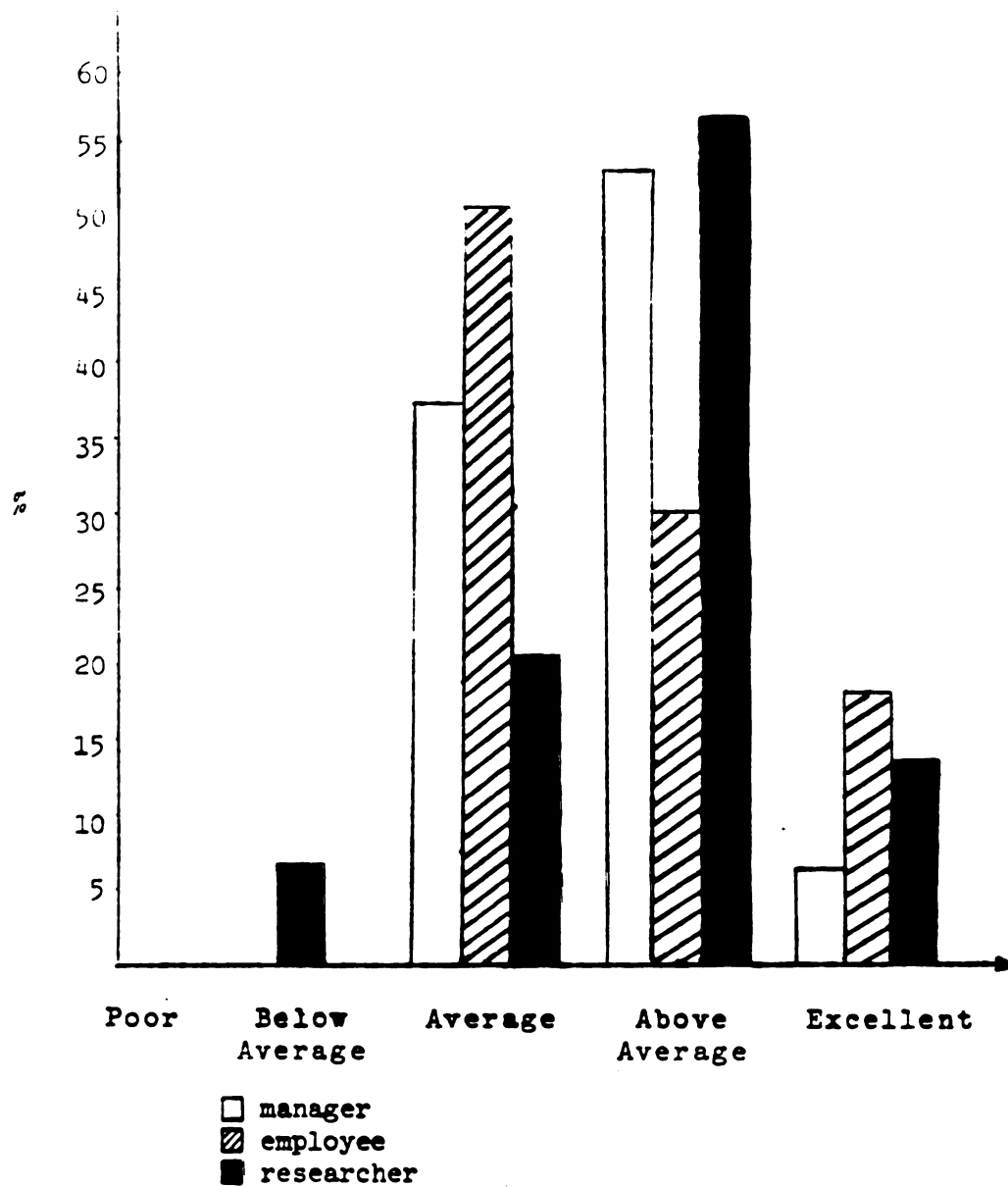


FIGURE 2. A comparison of the ratings given for store cleanliness by the store managers, employees, and the researcher acting as consumer.

researcher, managers, and employees rated the store at the same level for cleanliness.

TABLE 1 summarizes the answers to the cold holding question and TABLE 2 summarizes the hot holding question from the food safety quiz for the manager and employee responses. Many participants left these questions blank although other questions were answered. None of the managers and only one employee gave the correct response to the question, "Cold food must be kept at _____ or below?". Only one response was too high but unfortunately it was a manager. "Hot food must be kept at _____ or above?" resulted in 8 correct answers but 12 answers were within the temperature danger zone. The most frequently missed true or false question dealt with defrosting. Forty-four percent of the employees and 46% of the managers felt that it was alright to defrost foods at room temperature. There was no significant correlation between the scores on the quiz for managers and employees, but average scores on the quiz were higher for managers than for employees. In addition, the researcher's rating of store cleanliness was positively correlated ($r=.6134$, $P<.000$) with the manager's quiz score.

The statistical analysis of the employee survey generated the largest number of significant findings. Less educated employees scored themselves as more knowledgeable of safe food handling practices ($r= -.3517$,

TABLE 1. Frequencies and percentages for manager and employee answers to questions regarding cold holding temperatures.

PERSON	ANSWEROF	FREQ	%	CUM %
MANAGER				
	30	1	7.7	7.7
	34	1	7.7	15.4
	35	1	7.7	23.1
	36	1	7.7	30.8
	38	3	23.1	53.8
	39	1	7.7	61.5
	40	3	23.1	84.6
	42	1	7.7	92.3
	50	1	7.7	100.0
	TOTAL	13	100.0	
EMPLOYEES				
	32	4	21.1	21.1
	34	2	10.5	31.6
	35	2	10.5	42.1
	38	2	10.5	52.6
	40	8	42.1	94.7
	45	1	5.3	100.0
	TOTAL	19	100.0	

TABLE 2. Frequencies and percentages for manager and employee answers to questions regarding hot holding temperatures.

PERSON	ANSWER ^{OF}	FREQ	%	CUM %
MANAGER	0	1	14.3	14.3
	90	1	14.3	28.6
	120	1	14.3	42.9
	140	4	57.1	100.0
	TOTAL	7	100.0	
EMPLOYEES	40	1	5.3	5.3
	65	1	5.3	10.5
	70	1	5.3	15.8
	72	1	5.3	21.1
	86	1	5.3	26.3
	100	2	10.5	36.8
	110	1	5.3	42.1
	120	1	5.3	47.4
	140	4	21.1	68.4
	160	1	5.3	73.7
	185	1	5.3	78.9
	200	3	15.8	94.7
	250	1	5.3	100.0
	TOTAL	19	100.0	

$P < .042$) and higher knowledge ratings positively correlated with higher ratings for overall store cleanliness ($r = .4942$, $P < .006$). Those employees who indicated that they had received no training in safe food handling performed better on the food safety quiz ($r = -.4729$, $P < .006$), rated themselves as more knowledgeable ($r = -.6310$, $P < .000$), and gave a higher rating for overall store cleanliness ($r = -.3248$, $P < .049$). The data on the significance of training on knowledge score, cleanliness score and food safety score is supported by one way analysis of variance in TABLE 3, TABLE 4, and TABLE 5.

DISCUSSION

The abuses of time-temperature and cross-contamination observed in 6 of the c-stores, point out a need for sanitation training. When preparing take-out food for consumption off the premises, the foodservice worker has no control over the abuses the consumer will subject the food too and therefore the importance of good sanitary practices during processing becomes even more critical (Bryan, 1981).

Employee turnover in the foodservice industry is considered to be rapid as attested to by Marth (1977) who stated that the average worker in institutional foodservice is less than 25 years old and remains on the

TABLE 3. Analysis of variance and test of significance for knowledge score and level of food safety training of employees.

Source of Variation	df	SS	MS	F	Signif of F
Explained	1	77.042	77.042	15.215	.001
Residual	23	116.458	5.063		
TOTAL	24	193.500	8.063		

TABLE 4. Analysis of variance and test of significance for store cleanliness score and level of food safety training of employees.

Source of Variation	df	SS	MS	F	Signif of F
Explained	1	44.282	44.282	6.086	.022
Residual	23	167.358	7.276		
TOTAL	24	211.640	8.818		

TABLE 5. Analysis of variance and test of significance for score on the food safety quiz and level of food safety training of employees.

Source of Variation	df	SS	MS	F	Signif of F
Explained	1	14.017	14.017	7.203	.013
Residual	25	48.650	1.946		
TOTAL	26	62.667	2.410		

job for less than one year. Turnover could account for the lack of training noted in this study. No one wants to repeat a task over and over again if it can be avoided. Written policies and procedures covering food processing and sanitation in the store would simplify the task of acclimating new employees to the job, ultimately saving management time. Fifty-four percent of the stores in this study did not use any form of written material in this area. The mean age for managers and employees in this study was higher than that reported by Marth. Furthermore, 83% of the managers had chosen food marketing as a career and 69% had worked at least 6 years. The benefits of investing in a training program for these foodservice workers would be worthwhile.

In this study of 13 c-store managers, there was no correlation between the ratings of their knowledge in safe food handling and their test scores covering basic food handling knowledge. In a study by Wyatt (1978) of 109 managers and owners of food markets in Oregon, seven percent of the participants in that study were also c-store operators. That survey elicited the concerns, experiences, attitudes and practices of the owners regarding sanitation and safe food handling procedures. The survey was worded differently but one general finding was that operators tended to overestimate their level of knowledge in safe food handling practices in relationship

to their actual knowledge shown in answers on a food safety test.

Knowledge in the area of safe holding temperatures for participants in both Wyatt's study and the current study was weak. Only 37% of the respondents on Wyatt's survey of 109 operators recognized the temperature danger zone of 45 - 140 F. Respondents in the current study were asked to give the range rather than identify it which may be even more difficult.

Training identified by employees was not evaluated for content. In addition, it was informal and dependent on the manager's knowledge level. Coupled with the observations of processing procedures in the store and the responses on the safe food holding temperatures questions, it seems that the significant negative correlations of training to the food safety quiz scores may be erroneous. Restaurants and Institutions Yearly Review (1985) sighted employee training as the biggest problem that the industry had to tackle.

Holland (1980) stated that there are three main problems effecting sanitary conditions in the foodservice industry and the first one is management followed closely by governmental inspectors and then employees. In all three cases what is needed is a good training program and consistency in what is done and expected. Management must be committed to a sound sanitation program with a good

understanding of the problems. Wrisley (1985) developed a foodservice operations guide for the convenience store industry in connection with NACS. National associations can provide help in establishing policies and instituting training programs but as the survey revealed too few c-stores are aware of the association or are members.

Many authorities in the field of sanitation are promoting the mandatory certification of foodservice management personnel in safe food handling practices (Clingman, 1977; Bryan, 1979; and Snyder, 1986). Penninger (1984) surveyed 20 agencies composed of 9 voluntary and 11 mandatory certification training programs. He found that 83.6% of the participants in the mandatory program did become certified whereas only 28.6% were certified in the voluntary programs. Asked if scores following routine governmental inspections had improved with certification of employees, 91% of the mandatory programs reported yes, whereas only 33.3% of the voluntary programs reported yes. Marth (1977) reported on an earlier and related study on the short term and long term effects on the food handling practices of employees working under a trained manager. A positive correlation was noted between the length of time since the manager was trained and the incidence of poor food handling practices by his/her employees.

CONCLUSIONS

Managers in foodservice operations need a sound training program in safe food handling practices. A mandatory, certified program should be established. Training programs within the store should then be developed and implemented to meet individual needs based on menu. A written manual on policies and procedures covering food processing techniques and sanitation should be available for employee use no matter how small the operation.

ACKNOWLEDGMENT

I wish to thank the Michigan Food Dealer's Association for the funding provided to defray the costs of printing evaluation devices used in this study.

SUMMARY AND CONCLUSIONS

Convenience stores in the Lansing, Michigan area were used as a sampling frame for two studies - a hazard analysis of their foodservice system and an assessment of the safe food handling knowledge of their managers and employees. The objectives of the study were to discover what hazards might be present in the foodservice system of c-stores and identify the critical control points, to compare the processing methods used to produce take-out foods in commissary c-stores with those of in-house producing c-stores, to gather microbiological data on the bacterial load of the sandwiches they produce, and to assess the safe food handling knowledge of managers and employees. As a result of these studies, the following conclusions were drawn;

1. There are five hazards in the c-store foodservice system - receiving, tempering, assembling, transporting, chilled storage, and microwaving.

2. The critical control points were time-temperature and personnel sanitation. Tempering and transporting hazards can be eliminated but microwaving as a means of controlling bacterial load is not possible in the c-store setting.

3. Commissary c-stores studied exhibited more hazards than non-commissary stores due to transport and number of products prepared at one time.

4. Managers and employees of c-stores in this study generally lacked knowledge of safe food handling temperatures and practices.

5. The safe food handling training that employees received did significantly effect their attitude about their level of knowledge in this area and their test scores on the food safety quiz and their rating of store cleanliness. The negative correlation for quiz score was not explained by the data available and further study is needed.

6. The introduction of foodservice in c-stores calls for a training program to better prepare managers and employees to work with food in a manner that protects the consumer from foodborne disease outbreaks.

PROPOSALS FOR FURTHER RESEARCH

In the course of conducting this research in the field and reviewing the literature, ideas for further study surfaced. Receiving by temperature was recommended in this study to c-store operators as a means of exerting some control over the bacterial loads in the foods they purchased and received. A standard method for performing that control which would increase the probability for receiving high quality foods has not been established. Research could take the form of a controlled experiment in a laboratory setting using packaged and unpackaged, frozen and refrigerated foods commonly received by c-stores and others in the foodservice industry.

The issue of money handling by food preparation employees without interim handwashing is an unresolved issue. The Food and Drug Administration's interpretation of code endorses this practice stating that the fungicidal agents used in production of currency prevent growth of bacteria on surfaces. This does not negate currencies ability to act as a carrier of bacteria. A study of the potential cross-contamination of bacteria carried on money handlers hands to foods processed for sale in c-stores should be conducted.

Owners and managers in c-stores represent many ethnic groups. Because of the socio-cultural implications of this diversity, a study of the educational programs developed by national organizations to train people in safe food handling practices should be conducted. For these programs to be effective, they need to be tailored to meet the socio-cultural differences represented.

Few operators contacted by phone (n=82) were members of state (5%) or national (0%) organizations representing convenience stores or grocers in general. These state and national organizations do disseminate information about effective safe food handling practices, training programs, methods of compliance with governmental regulations etc. An investigation of ways that national associations could contact and be of service to independent food retailers may open up a line of communication through increased memberships.

APPENDICES

APPENDIX 1. TELEPHONE SURVEY

APPENDIX 1

TELEPHONE SURVEY

Objective (Telephone Interview)- to eliminate sites from the MFL list that are not convenience stores; to divide the convenience stores into strata; and to establish their knowledge of and membership in the Michigan Food Dealers Association and National Association of Convenience Stores.

Hi! Could I speak to the Manager?

Hi! I'm Nancy Burch with Michigan State University working through the Food Science and Human Nutrition Department. May I ask to whom I'm speaking and your position with the store?

Mr./Ms. _____ I'm undertaking a study of convenience stores and was given a list by the Michigan Department of Agriculture of licensed food store operators in the Lansing Area. Would you answer 7 short questions for me to determine if your store fits into my sampling frame for later study?

A convenience store is defined as a small, higher margin grocery store that offers an edited selection of staple groceries, non-foods, and other convenience items such as "take out" foods and gasoline.

* I'd like to thank you Mr./Ms. _____ for your time and help in beginning this research!

Goodbye!!!!!!

STORE _____ ADDRESS _____
 TELEPHONE # _____ DATE _____

MANAGER OR CONTACT _____

Mr./Ms. _____

1. Do you feel that your store fits that definition? yes _____ no _____
 (If no) Why? _____

Since your store does not fit my sample -----(skip to *)

2. Do your employees assemble "take out" food in the store? yes _____ no _____
 (If no) Are your "take out" foods assembled at a local commissary? yes _____ no _____
 Where is the commissary located? _____

3. Approximately when did the practice of preparing "take out" food begin?

4. Do your employees reheat food for customers? yes _____ no _____

5. Is this store run as a local independent _____ local chain _____ or national chain _____?
 (If local chain or national chain) Independent _____ Corporate _____

- (LI) Could I have the name of the store owner as well as an address and phone number?

 # _____

- (LC)(MC) Could I have the name of a Marketing Manager or Public Relations Contact for this store as well as an address and phone number?

 # _____

(Why?: To ask permission to visit your store to do an onsite survey.)

6. Have you heard of the Michigan Food Dealers Association? yes _____ no _____
 Is this store a member? yes _____ no _____

7. Have you heard of the National Association of Convenience Stores? yes _____ no _____
 Is this store a member? yes _____ no _____

APPENDIX 2. MANAGER'S SURVEY

MANAGER SURVEY

DEMOGRAPHICS

- [illegible]

5. Sandwiches are prepared in the store on which days of the week?
_____ (days)

If sandwiches are not prepared in this store, skip to question number 8.

6. Which shift(s) prepare these sandwiches?
_____ (time/s)

7. Are written recipes available and always used for preparing sandwiches, salads, pizza, etc. in this store?
_____ Yes _____ No

Comments: _____

8. The store's average cash register sale per customer of "take out" food is;

_____ 0 - \$1.00 _____ \$2.01 - 3.00
_____ \$1.01 - 2.00 _____ \$3.01 - up

9. Please rank the following items in the order they represent of your total sales.

1 = would indicate greatest sales
8 = would indicate lowest sales

BEVERAGES _____	"TAKE OUT" FOODS _____
NON-FOOD ITEMS _____	DAIRY PRODUCTS _____
GROCERY ITEMS _____	CIGARETTES _____
GASOLINE _____	PUBLICATIONS _____

10. Please check below the age group and sex which most closely represents your average customer?

_____ 13 to 17 years old	_____ 31 to 50 years old
_____ 18 to 30 years old	_____ 51 to 90 years old or older
_____ Male	_____ Female

11. What percent of your customers are age 65 or older?

_____ % over 65

12. The customer counts in this store are highest between;

_____ 6 and 9 AM	_____ 2 and 5 PM	_____ 12 and 6 AM
_____ 9 and 11 AM	_____ 5 and 8 PM	
_____ 11 AM and 2 PM	_____ 8 PM and 12 AM	

13. On a typical day, how many customers would purchase "take out" foods?

_____ (#/day)

14. How many times per year is this store inspected by the Michigan Department of Agriculture? _____

15. The last inspection of this store by the Michigan Department of Agriculture occurred during _____ (month and year).

16. Is this store inspected by the local health department?
 _____Yes _____No

If yes, how often is the store inspected? _____/year

When was the last inspection? _____ (month and year).

Has the store encountered problems due to dual inspection meaning inspection by both the MDA and the Local Health Department?

 _____Yes _____No

If yes, briefly describe these problems. _____

Has the inspection covered more than sanitation?

 _____Yes _____No

If yes, briefly describe what was inspected. _____

17. Has a customer ever complained of having become ill after eating a product from your store? _____Yes _____No

If Yes, please indicate what the suspect product was and restate the customers complaint; _____

18. Refrigerated and frozen foods are delivered to this store on what days and what times?

DAY

TIME

_____	_____
_____	_____
_____	_____
_____	_____

19. Are written specifications used for purchasing and/or receiving food?
 _____Yes _____No

20. In the last two years the electrical power to the store has been interrupted how many times? _____

21. If a power outage has occurred in the last two years, what was the longest time it was interrupted?
 _____(minutes or hours or days)

MANAGEMENT PROFILE

22. Please state your age. _____
23. Please check one of the following categories as it describes you.
 _____male _____female
24. Please place an X in front of the most advanced educational degree you have obtained as listed below.
- _____Less than high school
 - _____High school diploma
 - _____Completed vocational program after receiving high school diploma
 - _____Attended a college but did not receive a diploma
 - _____Received 2 year college diploma (AA)
 - _____Received 4 year college diploma (BA or BS)
 - _____Received post graduate degree (Masters, PhD, etc.)
25. How long have you worked as a manager in the grocery industry?
- _____0 to 6 months
 - _____6 months to 1 year
 - _____1 year to 2 years
 - _____2 years to 5 years
 - _____5 years to 10 years
 - _____more than 10 years
26. Is retail grocery store management your career choice?
 _____Yes _____No
27. Is there a job description for your position with this store?
 _____Yes _____No
28. Have you received training in food sanitation or safe food handling practices?
 _____Yes _____No
- If yes:
 Who provided it? _____

 When did you receive this training ? (month and year) _____
 How long was the training? (days or weeks or months) _____

Do you have a certificate in safe food handling? ____Yes ____No

If yes, check the following institution that granted it:

National Institute for the Foodservice Industry ____
Michigan Department of Public Health ____
Other (specify) _____

29. Please mark an X at the location on the line below that indicates how you would rate yourself on your knowledge of safe food handling practices.

POOR BELOW AVERAGE AVERAGE ABOVE AVERAGE EXCELLENT

Please answer the following questions by filling in the blanks.

30. Hot food must be kept at _____ F or above.

31. Cold food must be kept at _____ F or below.

Mark the following questions as True or False in the space provided.

32. _____ Food containers must be stored off the floor.

33. _____ Generally, frozen foods can be safely defrosted at room temperature.

34. _____ Food handlers must wash their hands after taking breaks.

35. _____ Food handlers may eat while preparing foods.

36. _____ Knives must be cleaned and sanitized when switching from cutting one kind of food to another.

37. _____ Cooking utensils can not be cleaned in hand wash sinks.

38. Are written policies and procedures on sanitation and safety available to all employees in the store? ____Yes ____No

39. Please mark an X at the location on the line below that indicates how you would rate this store in terms of overall sanitary conditions.

POOR BELOW AVERAGE AVERAGE ABOVE AVERAGE EXCELLENT

Thank you for your cooperation in filling out this survey and contributing to my study.

Nancy L. Burch
Nancy L. Burch.

APPENDIX 3. EMPLOYEE'S SURVEY

APPENDIX 3

EMPLOYEE'S SURVEY

EMPLOYEE SURVEY

STORE CODE # _____
IN-HOUSE _____ COMMISSARY _____
DATE _____
TIME _____ am/pm

Please fill out this survey as completely as possible placing your answers in the spaces provided. You are free to participate or not participate in this study.

Your privacy is assured in filling out this survey as your name will not be taken and the location of the facility will be identified by code number only. The results of this survey will be shared with your employer only as a part of the information from all stores in my study and not as an individual response for your store.

Filling out this survey constitutes consent for use of this information as a part of this study.

1. Your job title is _____.
2. Have you seen a written job description for your position?
_____ Yes _____ No
3. Have you received training in food sanitation or safe food handling practices?
_____ Yes _____ No

If Yes:

Who provided it? _____

When did you receive this training (month and year) _____
How long was the training? (days or weeks or months) _____
Do you have a certificate in safe food handling? _____ Yes _____ No

If Yes, check the following that Institution that granted it;

National Institute for the Foodservice Industry _____
Michigan Department of Public Health _____
Other (name) _____

4. Do you handle unwrapped foods in the store?

____ Yes ____ No

If Yes, check the foods you handle below and describe how.

<u>FOOD</u>	<u>PREPARATION</u>
(example) Sandwiches <u>X</u>	(example) assemble and wrap
Sandwiches ____	_____
Salads ____	_____
Soups ____	_____
Baked Goods ____	_____
Pizza ____	_____
Ice Cream ____	_____
Hot Dogs ____	_____
Snacks ____	_____
Other ? ____	(Specify) _____

5. Please mark an X at the location on the line below that indicates how you would rate yourself on your knowledge of safe food handling practices.

Poor Below Average Average Above Average Excellent

Please answer the following questions by filling in the blanks.

6. Hot food must be kept at _____ F or above.

7. Cold food must be kept at _____ F or below.

Mark the following questions as True or False in the space provided.

8. _____ Food containers must be stored off the floor.

9. _____ Generally, frozen foods can be safely defrosted at room temperature.

10. _____ Food handlers must wash their hands after taking breaks.

11. _____ Food handlers may eat while preparing foods.

12. _____ Knives must be cleaned and sanitized when switching from cutting one kind of food to another.

13. _____ Kitchen utensils can not be cleaned in hand wash sinks.

14. Please mark an X at the location on the line below that indicates how you would rate this store in terms of overall cleanliness as compared to other stores you have worked in or visited.

Poor Below Average Average Above Average Excellent

15. Has a customer ever complained to you of having become ill after eating a product from this store? Yes No

PROFILE:

16. Please state your age. _____
17. Please check one of the following categories as it describes you.
 male female
18. Please place an X in front of the most advanced educational degree you have obtained as listed below.

☐ Less than high school
☐ High school diploma
☐ Completed vocational program after receiving high school diploma
☐ Attended a college but did not receive a diploma
☐ Received 2 year college diploma (AA)
☐ Received 4 year college diploma (BA or BS)
☐ Received post graduate degree (Masters, PhD, etc.)

19. How long have you worked in convenience stores such as this one?

☐ 0 to 6 months
☐ 6 months to 1 year
☐ 1 year to 2 years
☐ 2 years to 5 years
☐ 5 years to 10 years
☐ more than 10 years

20. How many hours per week do you work at this store?
 _____ (hours/week)

Thank you for your cooperation in filling out this survey and contributing to my study.


 Nancy L. Burch

**APPENDIX 4. UNIVERSITY COMMITTEE ON RESEARCH INVOLVING HUMAN
SUBJECTS - LETTER OF APPROVAL**

APPENDIX 4

UNIVERSITY COMMITTEE ON RESEARCH INVOLVING HUMAN
SUBJECTS - LETTER OF APPROVAL

MICHIGAN STATE UNIVERSITY

UNIVERSITY COMMITTEE ON RESEARCH INVOLVING
HUMAN SUBJECTS (UCRHS)
236 ADMINISTRATION BUILDING
(517) 399-2186

EAST LANSING • MICHIGAN • 48824-1046

July 10, 1986

Dr. Carol A. Sawyer
Food Science & Human Nutrition
Campus

Dear Dr. Sawyer:

Subject: Proposal Entitled "Microbial Quality Control Factors of
Foodservice Operations in Convenience Stores."

UCRHS' review of the above referenced project has now been completed. I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and the Committee, therefore, approved this project at its meeting on July 7, 1986.

You are reminded that UCRHS approval is valid for one calendar year. If you plan to continue this project beyond one year, please make provisions for obtaining appropriate UCRHS approval prior to July 7, 1987.

Any changes in procedures involving human subjects must be reviewed by the UCRHS prior to initiation of the change. UCRHS must also be notified promptly of any problems (unexpected side effects, complaints, etc.) involving human subjects during the course of the work.

Thank you for bringing this project to our attention. If we can be of any future help, please do not hesitate to let us know.

Sincerely,



Henry E. Bredeck
Chairman, UCRHS

HEB/mjt

cc: Nancy L. Burch ✓

APPENDIX 5. PROJECT STATEMENT

APPENDIX 5

PROJECT STATEMENT

August 1986

PROJECT STATEMENT

As a graduate student, I am seeking permission from you to conduct a study using information gathered at your convenience store. This research is a project of the Department of Food Science and Human Nutrition at Michigan State University and is endorsed by the Michigan Food Dealers Association.

My interest is in the innovative trend of many convenience stores to enter the take-out food business as a true convenience to their shoppers. In my many travels to and from Lansing for classes, I have grown dependent on convenience stores for meals as I tired of fast food outlets and their offerings. The objectives of my study are to identify procedures in the handling and preparation of "take out" foods sold in your store that influence their bacterial safety; to describe for the grocery industry who the convenience store employees and customers are; and to gather information on dual inspection by the Michigan Department of Agriculture and the local health departments for the use of the Michigan Food Dealers Association in support of a call for a unified inspection code.

To gather data of this kind, I will need to have employees and managers at your store fill out a brief questionnaire. Pre-studies, using these forms, have shown that it takes approximately 5 minutes for the employees and about 15 minutes maximum for the managers to fill out these forms. Also, I would observe food preparation and handling practices at your facility as well as purchase food items for further study. Swabs of counter surfaces, employee hands, and equipment would be taken. All data collected in this study will be treated confidentially when summarized and shared with the grocery industry through scientific and trade journals. Information would be coded to protect your identity and the identity of your employees.

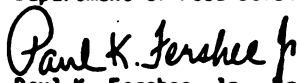
It is hoped that the findings of this study will assist you or the convenience store industry in doing the best job possible. After all, as good food handling procedures for take-out foods are practiced, shelf life is increased meaning happier customers, and increased profits.



Nancy L. Burch, Graduate Student
Michigan State University



Carol A. Sawyer, Ph.D.
Department of Food Science and Humans Nutrition



Paul K. Fershee, Jr., President
Michigan Food Dealers Association

APPENDIX 6. CONSENT FORM

APPENDIX 6

CONSENT FORM

I have been informed about the research study to be conducted in my store concerning Quality Control Factors for Foodservice Operations in Convenience Stores. The researcher has explained that there will be in-store visits consisting of a brief questionnaire to be filled out by employees and managers plus an overview of the facilities by the researcher. The researcher will then return to the store to observe production and/or receiving of "take out" foods and obtain samples of these "take out" foods for further study. Temperatures of holding areas and swabs of work areas and employee hands will be taken.

The researcher assures me that the results of this research are strictly confidential, and that my name, the store's name, and employee names will not be associated with the data gathered. When this investigation is concluded, I will be able to obtain a copy of the results from the researcher.

My signature below indicates that I agree to participate in this study but I am free to withdraw my consent and discontinue my participation in this study at any time.

Name _____ Date _____

Store/s Name _____

Address/s _____

Researcher Name _____ Date _____

Code # _____

**APPENDIX 7. ON-SITE EVALUATION FORM TO EVALUATE STORE
CONDITIONS ON INITIAL VISIT**

APPENDIX 7

ON-SITE EVALUATION FORM TO EVALUATE STORE
CONDITIONS ON INITIAL VISIT

STORE CODE # _____ IN-HOUSE _____ COMMISSARY _____
DATE _____ TIME _____ am/pm

- 1) Are recipes, job descriptions, or printed policies on safe food handling available to me? ☐ Y ☐ N May I have copies? ☐ Y ☐ N
- 2) May I gather data in the store today? ☐ Y ☐ N
- 3) What training has been done of employees in safe food handling?
- 4) Have you heard of the Michigan Food Dealers Association? ☐ Y ☐ N
Are you a member? ☐ Y ☐ N
- 5) What is the manager schedule in your store? _____
- 6) Would you be willing to donate samples of your products for my use in this study? ☐ Y ☐ N

SANDWICHES:	Sold	Prep'd		Sold	Prep'd
Beef	___	___	Egg Salad	___	___
Beef/Cheese	___	___	Tuna Salad	___	___
Turkey	___	___	Ham Salad	___	___
Turkey/Cheese	___	___	Chicken Salad	___	___
Submarine	___	___	Sausage	___	___
Hotdogs	___	___	Reuben	___	___
Other _____	___	___	Other _____	___	___

SNACKS:					
Pizza	___	___	Ice Cream	___	___
Burritos	___	___	Nachos	___	___
Cheese	___	___	Other _____	___	___

SALADS:					
Potato	___	___	Cole Slaw	___	___
Macaroni	___	___	Chef	___	___
Tossed	___	___	Other _____	___	___

SOUPS:					
Meat/Cream	___	___	Seafood/Cream	___	___
Meat/Vegt.	___	___	Poultry/Vegt.	___	___
Other _____	___	___	Other _____	___	___

Soap and single use towels available for employees	___	Y	___	N
Employees wash hands before beginning work	___	Y	___	N
Employees wash hands after smoking/breaks/sneezing/bathroom use	___	Y	___	N
Employees have no visible infected burns, cuts, or boils	___	Y	___	N
Cutting boards are washed and sanitized between operations	___	Y	___	N
All utensils and equipment are washed and sanitized after use	___	Y	___	N
Food prep equipment not in use is clean	___	Y	___	N
Temperature of refrigerators are at 45 F or below	___	Y	___	N
Temperature of freezers are 0 F or below	___	Y	___	N
Foods are defrosted under refrigeration or cold running water	___	Y	___	N
Metal stem type thermometers are used for measurement	___	Y	___	N
Pull dates are used on in-house prepared foods	___	Y	___	N
Pull dates are used on commissary provided foods	___	Y	___	N
Pull dates are not expired	___	Y	___	N
FIFO is used for "take out" foods	___	Y	___	N

TOTAL POINTS: _____

RATING OF OVERALL SANITARY CONDITIONS OF STORE:

POOR BELOW AVERAGE AVERAGE ABOVE AVERAGE EXCELLENT

APPENDIX 8. HAZARD ANALYSIS EVALUATION FORM

 Other (specify)

**APPENDIX 9. LETTER TO PARTICIPATING STORES ON
MICROBIOLOGICAL ANALYSIS**

APPENDIX 9

LETTER TO PARTICIPATING STORES ON
MICROBIOLOGICAL ANALYSIS

MICHIGAN STATE UNIVERSITY

DEPARTMENT OF FOOD SCIENCE AND HUMAN NUTRITION

EAST LANSING • MICHIGAN • 48824-1224

January 8, 1987

Dear

This letter is in regards to the visits I made to your store in September of 1986. At that time I observed your production methods for "take out" food and collected beef sandwich samples for microbiological evaluation. Two tests were completed - Total Plate Counts (TPC) and Staphylococci Counts (STAPH).

The following results are for the sandwiches prepared at your store the day of my visit and for those picked up three days later.

	<u>TPC</u>		<u>STAPH</u>	
	<u>Sample 1</u>	<u>Sample 2</u>	<u>Sample 1</u>	<u>Sample 2</u>
Day 1	440,000	14,000	0	0
Day 4	3,100,000,000	10,800,000,000	0	5,000
Store #2	182,000,000	310,000,000	0	0

An explanation of the tests, standards with which to compare your results, the range of scores for all stores sampled, and a summary of the data are given on an attached page.

Thank you for your cooperation. Results from this study will be available after March of 1987. If I can be of further help to you in interpreting these data please feel free to contact me at 334 Food Science Building in the Department of Food Science and Human Nutrition or at 355-8469.

Sincerely,

Nancy L. Burch
Graduate Student, MSU

DEFINITIONS

TPC - A count of all spoilage organisms and bacteria in a food sample expressed in colonies per gram of food.

STAPH - A count of a particular disease bacteria in a food sample expressed in colonies per gram of food.

STANDARDS

TPC - All foods contain spoilage organisms. A TPC count of 25,000 is considered an acceptable level for meat sandwiches. As counts increase, such as 50,000 which is twice as high as the acceptable level, quality of the product is effected until eventually the product would be discarded because of smell, discoloration, or off flavor.

STAPH - Counts of staphylococcus give good indication of food handling problems that result in food contamination by humans during preparation. Extremely high counts (7,500,000) have been associated with severe food poisoning.

RANGE OF COUNTS FOR ALL STORES IN THIS STUDY

	<u>TPC</u>		<u>STAPH</u>	
	Low	High	Low	High
DAY 1	10,000	34,000,000	0	5,000
DAY 3	5,700,000	10,800,000,000	0	6,000

SUMMATION

The key factor that affected the TPC counts was the internal temperature of the sandwiches while held in the refrigerated case in the stores. As temperatures increased, the bacterial counts increased. The lower the temperature in the refrigerator holding the sandwiches, the longer the shelf life will be. The STAPH counts were all within acceptable levels. Bacteria were isolated so holding temperatures need to remain out of the danger zone of 45°F to 140°F to prevent additional growth.

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LIST OF REFERENCES

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