COST COMPARISON OF THREE FOODSERVICE SYSTEMS

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CHAPTER I

INTRODUCTION

Energy costs have increased 100 percent in the past four years. As a result, the management of energy consumption has become an area of immediate concern for all businesses, especially in the foodservice industry (1). The steadily increasing cost of energy makes it an integral component of the total meal cost (2). Therefore, energy consumption throughout the total food system is critical. A conscientious effort must be made to reduce energy consumption in all aspects of the foodservice operation (3).

Within the foodservice industry there are various types of foodservice systems. These systems include the conventional, convenience, cook-chill, cook-freeze and commissary foodservice systems. The alternate forms of foodservice systems were developed in response to increasing food and labor costs with little attention given to the various levels of energy consumption in each system (4). Today, the cost of energy must be considered when deciding which system to implement. All cost related aspects including food, labor and equipment must be considered in relation to the finite resource of energy when determining the food production system that will produce economical, high quality food products (3, 5).

Limited data are available on energy consumption during food production and service in various foodservice systems. Foodservice directors need more information about energy, food and labor costs, as well as sensory evaluations of food products, in order to determine which food system to implement. More research is needed concerning the energy consumption of foodservice equipment in relation to the various food preparation systems. Energy cost must be correlated with the various other costs incurred during food production to enable the foodservice director to evaluate the whole foodservice system.

Purpose

The purpose of this study is to evaluate the energy, labor and food costs involved in preparation of an entree for three foodservice systems: conventional, convenience and cook-chill.

Objectives

The objectives of the study are as follows:

To develop a formula that can be used for each foodservice system.

To meassure the energy required for the production and service of the standardized formula in three simulated foodservice systems.

To assess the cost of food items and labor in relation to the cost of energy for each food-service system.

To determine the effect of the method of preparation and storage on the sensory quality of the food item prepared.

CHAPTER II

REVIEW OF LITERATURE

The cost of energy in the United States (U.S.) has increased drastically in the past ten years and the future indicates further price increases. While only six percent of the world's population resides in the U.S., Americans consume 33 percent of the world's energy resources (6). American energy consumption far exceeds its energy production. As energy supplies continue to dwindle, energy costs will of necessity continue to increase.

The decreasing supply of energy has become a crisis that affects all sectors of our society (7). Energy conservation must become a dominant concern of all Americans if the rate of depletion is to be halted. Many new sources of energy may be developed in the future; however, energy researchers are of the opinion that the time between depletion of our available gas and oil supplies and the emergence of alternate energy technology will be long enough to allow conventional prices to rise higher and more rapidly than previously expected (8).

The U.S. government has stated that adequate nutrition for all people is a legitimate national goal (9). With the current estimates of world population growth and energy and food demands, the achievement of a balance between energy and food will require global cooperation among all food related professionals and political leaders (10). In 1975, the Select Committee on Nutrition and Human Needs (11) presented findings that energy use in the food systems has increased at an average annual rate of eleven percent each year since 1940. Increasing fuel costs could, over the next few years, increase food costs to consumers as much as 84 percent.

Of the total amount of energy utilized by the U.S. in 1976, the food system consumed 16.5 percent (12). Operations classified as out of home preparation facilities utilized 2.8 percent of the total. These facilities included fast food restaurants, coffee shops, table service restaurants, cafeterias and hotel/motel restaurants. Energy consumption data for hospitals, schools, governmental and military institutions were not available. These percentages, therefore, are understated due to limited coverage and accuracy of available data for the food system components.

Energy Consumption in Foodservice Facilities

Foodservice managers are becoming increasingly concerned with the energy situation when they realize that energy cost now accounts for six to seven percent of their gross expenses while a few years ago it accounted for only two to three percent (13). Koncel reported that "restaurants and hospitals consume more energy for heating, cooling, lighting and ventilation on the basis of their size than any other type of buildings" (7). As a result, many foodservice operators are reporting that energy cost is one of the largest budgetary expenditures exceeded only by personnel cost. Davis (14) projects that energy expenditure may one day be so critical that the productivity of a foodservice system will be evaluated on the basis of energy expenditure per meal rather than the present meals per man hour.

Observation of foodservice employees under actual working conditions revealed several areas where energy was being wasted. The door of a walk-in refrigerator was left open an average of 26.8 percent of the observation time. Excessive pre-heating time of a convection oven was also noted. The convection oven was operated a total of 3.5 hours even though all of the products could have been baked simultaneously reducing operating time to only one hour and 18 minutes (2).

Other cases have also been reported in which energy was wasted due to the unnecessary operation of cooking appliances (15). In some instances, appliances were turned on before 6:00 a.m. and left on almost all day until the last employees left at night. Many appliances were left on all day even when cooking was not in progress and some were left on all night. Energy as well as money could have been saved in all instances if foodservice personnel had been conscious of simple energy conservation techniques.

Various publications are now available which provide guidelines and information on energy conservation. The Federal Energy Administration has published the Guide To Energy Conservation For Food Service (16) which explains specific procedures for saving energy that the foodservice manager can perform himself. The Energy Conservation Guide For Industry And Commerce (17) outlines steps for the establishment of an ongoing energy conservation program.

Energy Conservation in Foodservice Facilities

New attitudes about energy use and a desire to conserve must precipitate any significant changes in the energy situation. The development and implementation of conservation techniques emphasizing more efficient energy utilization is the first step in relieving energy concerns (18). Since energy conservation can be time consuming and expensive, progress in this area has been slow (19). Foodservice managers, however, are beginning to realize that energy conservation entails more than simple cost savings in gas and electricity units. It permeates the whole cycle of purchasing, storing, preparing and serving food (20).

Many energy conserving measures require minimum investment and only a small amount of time and thought on the part of employees and managers. Campaigns to develop increased employee awareness, turning down thermostats and turning off lights are a few measures that can be implemented without added expense (19). Employees should be instructed to load each piece of equipment to its full capacity when in use, to stagger preheating times, to reduce peak demand and to turn off all equipment not in use (20). Maintenance charts should be available for all pieces of equipment to provide information on replacement of parts and cleaning schedules. The establishment of an energy management plan requires knowledge of how and where energy is being used in a foodservice operation (18).

In the past, operators in all segments of industry indicated primary concerns for equipment with labor saving potential, increased productivity and sanitation or safety features with little if any concern for energy consumption (21). This picture is changing; there is increasing interest in equipment that does not use excessive amounts of energy. As budgets decrease and money becomes tight, many foodservice managers may decide to keep old equipment rather than purchase new equipment. They may not be aware of the many pieces of equipment now available that save money when used over long periods of time (6). Pay back and investment are key terms that must be familiar to the cost-conscious foodservice manager (19). If the operator determines a pay back period for the purchase of two years or less, it is considered a good investment. Life cycle costing is a concept that requires a long term perspective on the pay back period rather than trying to make up the equipment investment immediately. The amount of investment, availability of resources and extremes of the environment are all factors that are included in life cycle costing.

Energy is often wasted by the inefficient operation of equipment by foodservice personnel (2, 15, 21). Through the use of energy control devices, energy use can now be decreased 20 to 30 percent by programming equipment to control use automatically. These devices are expensive and may not pay for themselves immediately but, as resources become increasingly scarce, the equipment will more than pay back the initial investment (19). A "raceway system" for utility distribution is one new improvement that can control the energy load to each piece of equipment in the foodservice operation. The foodservice manager can then monitor and program utility use.

The "black box" is another device that is capable of controlling the consumption rates for electric, steam or gas equipment (19, 20, 21). This system automatically energizes or deactivates equipment according to a schedule preset by operators. The operator can also combat rising utility rates by controlling peak demands which increase utility rates. Additional devices for energy control are being developed and introduced to promote the efficient use of equipment.

The British Thermal Unit (BTU) is the measurement used for energy consumption and can provide a useful comparison between two pieces of equipment that use different energy sources (22). Energy consumption, initial cost, capacity, maintenance and operating costs should all be evaluated before purchasing new equipment. Equipment layout should be evaluated to determine whether the equipment is located so that a minimum amount of energy is consumed. In addition, existing equipment should be checked to ensure that adequate insulation is installed and maximum utilization is accomplished. Energy conservation programs should not sacrifice microbial safety, maximal nutrient retention and food esthetics (2). At present, hospital and school foodservice departments can seldom obtain information about their energy consumption. The increased concern for energy conservation has stimulated change so that many of these departments may be individually metered in the future and will be accountable for the quantity of energy consumed (22).

Taylor (23) reported the results of a study performed by the Electricity Council in Britain which assessed foodservice equipment by evaluating its energy utilization. Various food items were produced under actual cooking conditions in measured amounts using four pieces of equipment: a bratt pan, boiling table, oven range and a steamer. A kilowatt-hour/kilogram of food usage factor was calculated for specific pieces of equipment. This factor could then be used in a formula devised to assess the installed equipment load necessary to handle a specific meal demand and also to assess the meal output that an existing facility is capable of producing. The oven and steamer were shown to consume more energy per kilogram of food produced than the other two pieces of equipment.

Romanelli (18) conducted a study at the University of Tennessee to provide data on the energy utilization characteristics for selected commercial foodservice equipment. Four types of equipment, a deep-fryer, a braiser, a deck oven and a convection oven, were compared to determine which of the four was the least energy intensive and produced the most acceptable product. The amount of energy required to cook twenty pounds of frozen precooked breaded chicken quarters was determined for each piece of equipment. A technique was developed to estimate energy consumption using energy ratings in combination with measuring the on time of the thermostat signal light. The results of this technique were compared to kilowatt-hour meter readings taken for each piece of equipment. The thermostat signal light timing technique did not vary significantly from the meter results.

In a comparison of total kilowatt-hour consumption, the braiser was found to be the most energy intensive and the convection oven the least energy intensive. Romanelli (18) concluded that once energy consumption values for the preparation of various food items has been determined, energy costs can be calculated; menu prices established; and, if necessary, the least energy intensive food products selected. The energy consumption value is also important to the foodservice manager when deciding which foodservice system to implement.

Types of Foodservice Systems

Since 1960, attempts have been made to alter the flow of food products within the foodservice facility (24). Throughout the foodservice industry these foodservice systems predominate: conventional, convenience and ready-prepared. These systems were developed with little consideration given to the cost of energy (3). Minimizing food and labor costs were the major reasons for their development. Today, however, energy is a vital concern when decisions are made regarding which foodservice system to implement.

The conventional foodservice system is one in which the menu is prepared daily from basic ingredients with preparation, assembly and finishing accomplished on premise (25, 26). Some prepared food items are purchased in a conventional system, such as, bread, ice cream, and canned or frozen fruits and vegetables. This system is labor intensive since most food items are prepared "from scratch" (24). As a result of steadily increasing labor costs, foodservice managers of conventional systems have gradually made changes to reduce labor requirements (28). The current trend is to procure more food products that have some degree of preprocessing. Today, therefore, a conventional foodservice system is described as those foodservices that prepare meals on premise prior to each meal and do not use, primarily, convenience foods (5). After menu items are produced in the conventional system, they are held in either a heated or chilled state (27). Under hot holding conditions, food quality can be affected by temperature, humidity and length of holding period.

The convenience system evolved in response to a chronic shortage of skilled labor available for food production on premise. Technologic advances in the food processing industry and the comprehensive marketing and distribution system available today for frozen food products have made this system feasible (27). The foodservice operation utilizing this system purchases commercially processed foods in a form that can be easily reconstituted and garnished on premise just prior to serving (5, 25, 26). Foodservice managers in charge of convenience systems attempt to provide food items of high quality while minimizing the amount of labor used within the operation (27).

Three types of food products are primarily used in the convenience system: completely prepared foods ready to serve; completely prepared foods ready to serve after a single production process such as heating; and partially prepared foods ready to combine with one or more ingredients before heating or chilling (5, 24, 27). After frozen storage, food items are tempered by defrosting in refrigerators to 36°-38°F. All three forms may be reheated for service by the convection or microwave ovens. In addition, the preplated form may be reheated by an integral heat system.

Food costs are higher in a convenience system than in a conventional system. These costs, however, may be offset by lower labor cost and a significant reduction in capital investment for equipment required in a conventional operation. Since quality of convenience products has fluctuated in the past, it must constantly be evaluated. In addition all food products required, especially those for modified diets, are not available. When available, these products are often of poor quality and unreasonable cost. Increasing transportation expenses may contribute to limited distribution of convenience foods in the future. Even with the problems associated with convenience systems, the system has been successfully implemented (26, 27).

The ready prepared foodservice system evolved as a result of a shortage of skilled food production personnel and increased labor costs (27). The partial success in implementing a total convenience system led many foodservice managers to adopt the ready foods system (5). The cook-chill and cook-freeze systems are the two types of ready food systems in operation today. Various market forms of food are utilized in the production of menu items that undergo a thermal break and storage before final assembly and/or heating. Menu items served hot are subjected to two stages of heat processing. The initial heat process takes place during quantity production and the second heating occurs immediately prior to serving the item to the consumer.

Two concepts provide the basis for the cook-chill foodservice system: (1) refrigerated food is less perishable and retains nutrients longer than hot food and (2) the holding time for refrigerated foods is less critical. Trays, therefore, can be assembled and distributed earlier eliminating peak work loads for production and delivery employees (5). In the cook-chill system, food items are prepared one to three days in advance, then quick chilled and held in a refrigerated state. The initial heat treatment should be minimal to avoid overcooking and deterioration in quality during the final heating period (27). The menu items are assembled chilled on the day of service, plated and loaded in refrigerated carts for delivery to unit galleys. The food is heated by galley attendants immediately before service.

Some hospitals have found that the cook-chill food concept, when compared to the conventional system, improves the quality of meals served, increases employee productivity and decreases food and labor costs (5). Production employees work from 8:00 a.m. to 5:00 p.m., five days a week and are under less stress resulting in a more relaxed atmosphere. This system also allows for the controlled production of therapeutic diets ready for use as needed (26). Since foods are stored and not served fresh, quality controls which include microbiological audits must be precise.

The cook-freeze system is one in which menu items are prepared in batches on a Monday through Friday production schedule (5, 24, 27). Immediately after production, food items are individually portioned and plated or portioned in bulk, blast frozen, stored, thawed and reheated immediately before service. The sensory quality of food items produced must be continually evaluated. When food is frozen and reheated, textural changes may occur and off flavors may develop especially in meats and vegetables. Thus, recipe formulation is a problem and therapeutic diets are difficult to prepare. Test kitchens are usually required when implementing the cook-freeze system. The addition of stabilizers as well as exercising greater control of storage time, temperature and packaging can aid in reducing or eliminating much of the damage to food items. This system has many of the same advantages inherent in the cook-chill system regarding employee scheduling and a relaxed work atmosphere (5).

A greater capital expenditure is needed with the ready prepared food system because greater storage capacity of refrigeration or freezing equipment is required (5, 26). A precise method of heating before service is also required. Microwave ovens, convection ovens and immersion techniques have proven to be effective in the reheating process (27).

Microwave ovens provide the most rapid reheating method; however, their capacity is limited to one to two meals per cycle (27). Variations of the microwave are being developed and tested. The tunnel microwave and microwave-convection oven combination may have future applications in the ready foods system. Moist foods may be reheated effectively by immersing pouches in boiling water or steamers. Convection ovens provide an efficient way to reheat large quantities of food. In addition, moist and crisp foods may be heated at the same time and will retain their desired quality characteristics.

A ready prepared food system is comparable to a large scale conventional system, although the staffing requirements of the two systems differ (26). With the elimination of shifts and weekend work in the ready prepared food system, the total number of workers is reduced along with labor costs. Peak demands for labor are eliminated because production is designed to meet future rather than daily needs. A more relaxed atmosphere results and employee productivity is increased. Food cost can be reduced by purchasing food items in large quantities. However, if the additional expenditures for a test kitchen, storage facilities, equipment and food inventory cannot be absorbed by the foodservice organization, a ready prepared foodservice system may be contraindicated (27).

Energy Utilization in Various Foodservice Systems

Limited data are available concerning energy use in the various foodservice systems. In an effort to identify the accumulated energy expenditures from food procurement to foodservice, Unklesbay and Unklesbay (29) initiated an exploratory research project to assess the energy requirements for preparing chicken entrees in four types of foodservice systems. A computerized energy accounting model based on thermodynamic theory was developed and validated by Dwyer et al. (9) which allowed energy consumption for the direct processes associated with food production in foodservice operations to be documented. The energy accounting model was applied in the various foodservice systems to calculate the accumulated energy expenditures per unit of nutrient per pound of menu item processed for service.

Before applying the energy accounting model, Unklesbay and Unklesbay (9, 29) detailed the process steps which identified the chicken product flow from initial food storage to foodservice. This step was critical to the application and accuracy of the model. To verify the usefulness of the model, it was applied to chicken menu items in four foodservice systems: conventional, cook-chill and convenience--preplated and bulk. Data were collected by onsite visitation to each foodservice system; therefore, the weight of each menu item processed could not be controlled by the researchers. The energy accounting model was applied to the initial and leftover production of barbecued chicken in a conventional system, the production of baked chicken in a cook-chill system and preplated baked chicken in the convenience system (29). Data revealed that more energy was expended per calorie and per gram of protein in the production of leftover barbecued chicken than for the other chicken items. In the cook-chill system, cooking, refrigeration and reheating accounted for 97 percent of all the process energy with refrigeration alone representing 70 percent of the energy. The three steps involved in refrigerating, distributing and reheating the frozen, preplated baked chicken entrees revealed the lowest energy expenditures within the foodservice operation.

Energy for producing fried chicken was anlayzed in a conventional system and two convenience systems, with one using bulk and one using preplated products. In the conventional system, chilled chicken portions were procured daily, deep-fat fried for 13 minutes and held in a warmer for 90 minutes. Less energy was spent in the conventional system than the assembly/serve (convenience) system in which bulk, frozen precooked fried chicken was purchased. Frozen portions were cooked in vegetable oil at 300°F for 13 minutes, requiring 14,913 BTUs per pound of fried chicken for initial production and 21,395 BTUs per pound for left-over production. The assembly/serve (convenience) system using preplated fried chicken required the least energy for processing (29).

The production of chicken cacciatore was analyzed in the conventional and assembly/serve (convenience) systems (29). In the conventional system frozen, diced chicken was purchased, thawed and cooked with other ingredients.

The process steps which involved refrigeration, cooking and warming during initial and leftover production used 94 percent of the 2,795 BTUs consumed per pound of chicken cacciatore. Energy expenditure increased 893 percent when leftovers were produced and chilled for 48 hours. The preplated chicken cacciatore used in the assembly/serve (convenience) operation consumed 1,081 fewer BTUs per pound than the initial production in the conventional system.

Unklesbay and Unklesbay (29) concluded that although this data indicated some trends, implications could not be made about the energy effectiveness of different foodservice systems. In the assembly/serve (convenience) preplated system the frozen, preplated entrees were only in frozen storage for 24 hours. If the storage period had been longer, the energy required would have been greater. When a change in one process step is proposed, the effect on the entire processing operation should be determined. The energy consumed per pound of menu item produced in the initial production in the conventional system was greater than in the assembly/serve (convenience) but less than that used for leftover production in that same system. The researchers further concluded that without more extensive data, comparisons could not be made among the alternate systems and should not be made until each system has implemented all of the energy conserving techniques available.

As a result of further analysis of the data gathered in the previously mentioned studies, Unklesbay and Unklesbay (9, 29) discovered that foodservice administrative decisions about food procurement, production and service can have as great an effect upon the amount of energy consumed for some menu items as the type of foodservice system in use (4). A dependable forecasting system which reduces the incidence of over- and under-production facilitates the effective use of energy for food production. The production of leftovers, as noted previously (29), increases energy consumption per serving. Refrigeration is the process step consuming the most energy (4, 9, 29). Therefore, if leftovers are produced, storage time should be as short as possible.

Foodservice administrators should prepare specifications which specify the appropriate quality of food desired and which minimize the accumulative energy consumption throughout the food processing/foodservice industry (4). Energy costs influence the purchase price; therefore, foodservice administrators should strive to purchase quality foods at the lowest possible cost.

The length of time that food is stored is influenced by administrative decisions concerning food procurement (4, 9). Many factors influence the amount of energy expended during storage, such as the length of time, the initial temperature of a product when entering a refrigerated unit, the physical location of the refrigerated unit, the amount of food stored in relation to the capacity of the unit and the frequency of opening the refrigerated unit. Administrators should attempt to establish policies which require the location of food products so that the most effective expenditure of energy occurs.

When frozen, diced chicken was thawed in a steamer rather than in a refrigerator, an excessive amount of energy was expended (4, 9). Considerable energy was lost to the foodservice environment because the steamer was poorly insulated. Chicken tetrazzini lost 20 BTUs/pound during a 270 minute warming period. The loss was due to the long holding period, an uninsulated warming cabinet and frequent door openings. Management policies should attempt to minimize energy expenditures by establishing effective operating procedures and when possible, acquiring energy efficient foodservice equipment.

McProud (30) investigated energy use and management in the preparation of entrees in three foodservice systems: conventional, cook-chill, and cook-freeze. A comparison of theoretical and actual energy consumption was made for the three systems. Meters were used to determine actual energy consumption. Readings were converted to BTUs. Apportioned Energy was calculated on the percentage of usable equipment space occupied by the food product. Theoretical Energy was based on temperature change, mass and heat capacity. A significant difference in Actual Energy consumption was found for the three systems. The means for Actual Energy were: conventional, 51,503 BTU; cook-chill, 80,042 BTU; and cook-freeze, 1,503,165 BTU. There was only a small difference among the means of Apportioned Energy used in the three systems. The mean energy consumption for each system was: conventional, 48,805 BTU; cook-chill, 51,084 BTU; and cook-freeze, 52,721 BTU. The conventional system required significantly less Theoretical Energy than that required by the other two systems. The system means of Theoretical Energy were: conventional, 1,633 BTU; cook-chill, 3,333 BTU; and cook-freeze, 3,261 BTU. The convection oven and freezer used the highest amount of energy. McProud (30) concluded that the best measure of energy used to produce beef loaves in a simulated hospital foodservice system was Apportioned Energy.

Labor is another resource which must be considered by the foodservice manager when deciding to implement a particular foodservice system. Carroll (31) compared the labor time per serving required to prepare 59 entree items for a cook-freeze and conventional system. The work measurement techniques of work sampling and stop-watch time study were used to calculate labor time. All items of production, including the 59 entree items, were studied so that unallocated productive time and non-productive time could be distributed equitably among all of the items produced in each system. No significant differences in production time were found. The mean labor time per serving in the cook-freeze system was 0.83 and the mean labor time per serving in the conventional system was 0.93 minutes. The hospital in which the cook-freeze system was studied was a 386 bed medical center. Carroll (31) stated that a greater savings in labor time might have resulted if the food items were produced in higher volumes. In addition to labor time, a thorough examination of all the advantages and disadvantages of a foodservice system should provide meaningful information for the foodservice director when deciding on a particular foodservice system to implement.

Little information is available on the quality of food products produced in alternate foodservice systems. Zallen et al. (32) compared the effects of storage over a nine day period on the quality of cooked beef loaves prepared by methods used for the ready-prepared foodservice systems. The beef loaves were either cooked and refrigerated; cooked, pasteurized and refrigerated or cooked, frozen and thawed before refrigerated storage treatment. The findings indicated that the stored products did not maintain quality characteristics over time at an acceptable level when compared to the freshly prepared loaves. Among the stored products, taste panel scores and thiobarbituric acid (TBA) numbers did not indicate a significant difference between the refrigerated loaves and those pasteurized before refrigerated storage. The process of pasteurization did not retard flavor deterioration and the researchers concluded that the process was, therefore, unnecessary. The loaves that were cooked, frozen, thawed and refrigerated resulted in the least acceptable product as indicated by taste panel and TBA scores. The authors then concluded that if refrigerated storage is used for cooked beef loaves, the process of freezing, thawing and refrigerating produces the least acceptable product.

Bobeng (33, 34) developed and applied a Hazard Analysis Critical Control Point (HACCP) model to measure and compare the quality of beef loaves produced in three simulated hospital foodservice systems: conventional, cook-chill and cook-freeze. Quality encompassed microbiological, nutritional and sensory attributes of food. Time-temperature standards were established for critical control points throughout the three systems. These time-temperature standards were designed to minimize the time that the temperature of the entrees was in the region of growth for microorganisms, 45-140°F.

Weight or yield of beef loaves produced in the three systems was not significantly different at the point of service. Beef loaves produced in the conventional system received significantly greater scores for overall acceptability than those produced in the cook-chill and cook-freeze systems. The mean scores for overall acceptability were: conventional, 5.30; cook-chill, 3.73; and cook-freeze, 2.78. Possible scores ranged from 1.00, very unacceptable, to 7.00, very acceptable. Off flavors were reported by the judges for cook-chill and cook-freeze loaves. Bobeng (33, 34) recommended further implementation of the HACCP model for quality control in entree production in conventional, cook-chill, and cook-freeze hospital foodservice systems.

CHAPTER III

PROCEDURE

Energy, food, and labor costs and product acceptability are aspects which must be evaluated when deciding on which type of foodservice system to implement. These four characteristics were investigated in the production of turkey tetrazzini in three simulated foodservice systems: conventional, convenience, and cook-chill.

The investigation was conducted at Lewisville Memorial Hospital, a 110 bed hospital in Lewisville, Texas. The layout of the foodservice department is presented in Appendix A. Specifications for the quick-chiller and freezer utilized for calculation of energy requirements are also included in Appendix A.

Preparation of Product

Turkey tetrazzini, an entree suitable for service in an institutional or commercial operation, was chosen for investigation of energy and labor requirements of the three simulated foodservice systems. The turkey tetrazzini was prepared according to a standardized formula for the conventional and cook-chill systems (Appendix B). The product for the conventional system was placed on a steam table and served immediately. The cook-chill product was refrigerated for 24 hours prior to portioning and rethermalizing in a microwave. The convenience form of turkey tetrazzini was purchased from an institutional distributor in the Dallas/Fort Worth metroplex. The product was received by the food-service operation approximately 24 hours prior to preparation. After rethermalizing in the convection oven from a frozen state, as specified by the manufacturer, the convenience product was served immediately.

Energy Consumption of Equipment

The technique developed by Romanelli (18, 35) was used to estimate KWH consumption of each piece of equipment used in the study. The procedure consisted of the following six steps:

1. "Begin measuring the on-time of the thermostat signal light immediately after placing food products in the equipment.
2. Record the total on-time of the thermostat signal light during the cooking process.
3. Conduct five replications using the same equipment, cooking temperature and food product.
4. Calculate the arithmetic mean of the on-time of the thermostat signal light from the five replications.
5. Divide the mean on-time of the thermostat signal light by 60 to determine the representative percentage of one hour.
6. Multiply the percentage by the electrical rating of the quipment. The result is a figure for estimated cooking KWH consumption for the food product inthe equipment under study" (18, 35).

A form was developed to record the thermostat on and off time for the five replications (Appendix C).

No attempt was made to estimate or evaluate energy consumption required for the processing and storage of food products prior to receipt of the product by the foodservice facility. Energy consumption for the conventional and cook-chill systems began with the initial preparation step; whereas, energy consumption for the convenience systems began with receipt of the frozen product.

Labor Costs

The tasks necessary to produce and serve turkey tetrazzini were identified. Forms were developed for data collection and identified the steps and level of employee required for production and service of the product for the three systems (Appendix C). A stop watch was used to assess the amount of time required for the researcher to perform each task.

To determine average salaries and benefits for employees in the Dallas/Fort Worth area, a cover letter and survey form (Appendix D) were sent to randomly selected foodservice establishments. Additional wage information was obtained by personal contacts made by the researcher. Wage data was averaged and multiplied by labor time to determine labor costs for production and service of turkey tetrazzini for each system.

Food Costs

Food costs were based on prices of ingredients obtained from institutional distributors in the Dallas/Fort Worth metroplex at the time of the investigation. The prices were converted to costs required to produce 25 servings of turkey tetrazzini according to the formula (Appendix B) for the conventional and cook-chill system. The price of the convenience product was obtained by contacting the distributor.

$$UP = \frac{CP}{Y}$$ where UP = unit price
CP = case price
Y = number units per case

and $$SC = \frac{UP}{X}$$ where SC = serving cost
UP = unit price
X = number servings per pan

Product Acceptability

The acceptability of a food product prepared in a commercial or institutional foodservice operation is of utmost importance. Each of the three foodservice systems investigated required different treatments, thus the end product varied slightly. A sensory evaluation of the turkey tetrazzini produced in this study was conducted to determine the acceptability of each product produced in the three systems.

Turkey tetrazzini was prepared according to the formula in Appendix B for the conventional and cook-chill foodservice systems. The convenience product was purchased in a bulk prepared, frozen state. The cook-chill product was prepared three days prior to the sensory evaluation. The product was baked at 350°F for 15 minutes and then was refrigerated for three days. Individual six ounce servings were rethermalized in a microwave oven for two minutes and 30 seconds. The conventional product was prepared on the day of the sensory evaluation; baked at 350°F for 15 minutes and held in a warm state. Individual six ounce servings were portioned from the bulk product for immediate service.

The convenience product was purchased in a frozen state and held in this condition until one day prior to service. The product was then placed in the refrigerator for a 24 hour period to begin the tempering process. The product was baked on the day of service for one hour and 30 minutes at 400°F and held in a warm state. Individual six ounce servings were portioned from the bulk container.

A total of 21 untrained panelists volunteered to participate in the sensory evaluation of the turkey tetrazzini, with 15 participating in all three sessions. All panelists were residents of Denton, Texas at the time of the tests. A cross section of the community was represented due to different age groups and occupations of the panelists. All participants were of the middle class socioeconomic level.

A special testing area was established at the Texas Woman's University Home Management House allowing for the control of many environmental factors. Suggestions from the Guide Book For Sensory Testing (36), Amerine and Panghborn (37), and Paul and Palmer (38) were followed when the testing environment was arranged. A room separate from the food preparation facility was provided. Off-white portable tasting booths were placed on tables covered with white paper. Individual booths were provided for each tester. Noise in the room and outside distractions were reduced as much as possible and talking between the panelists was prohibited. Overhead fluorescent lights provided uniform and adequate lighting for each booth. Panelists tested the products the same day of the week and at the same time of the day for each test session.

Participants were asked to test three products at each testing session; one from each of the three foodservice systems being evaluated. The participants were then asked to complete a score sheet (Appendix C) developed for the product (36, 37). The samples were served in individual pyrex cups on a coded white plate. The order of the samples and the codes for each sample were randomized. All participants were instructed on how to complete the score sheet.

Statistical Analysis

One way analysis of variance was utilized to determine if there was a significant difference among the three systems in relation to total energy, labor time and cost. A randomized block design was used to evaluate consumer acceptability. Panelists were the block and ratings the repeated measures in the analysis. A significance level of $p \leq 0.05$ was used to infer significant difference in acceptability of products for the three systems.

CHAPTER IV

RESULTS AND DISCUSSION

The production of turkey tetrazzini was evaluated for conventional, cook-chill and convenience foodservice systems. Energy consumption utilizing the technique developed by Romanelli (18, 35), food costs, labor costs and product acceptability was determined and analyzed in facilities simulating the three foodservice systems.

Energy Consumption

Data on energy consumption for the production of 25 servings of turkey tetrazzini simulating the three foodservice systems were collected by the use of the thermostat signal-light timing technique. The study was conducted in an ongoing foodservice facility; therefore, the equipment had been in use for several years and was in various stages of wear (Appendix A).

Totals for the estimated KWH consumption in each system are presented in Tables 1, 2, and 3. Mean KWH consumption in the production and service of turkey tetrazzini was significantly different ($p \leq 0.05$) for the three systems. As illustrated in Table 4, the cook-chill system consumed the most energy while the convenience system required the least.

TABLE 1

AVERAGE KWH CONSUMPTION USING THE THERMOSTAT SIGNAL-LIGHT TIMING TECHNIQUE FOR TURKEY TETRAZZINI PRODUCED IN THE CONVENTIONAL FOODSERVICE SYSTEM

Equipment	Thermostat Signal-Light				KW Rating of Equipment	Estimated KWH Consumption
	Minutes of Time On:					
	Pre-Heat	Processing	Total	% Per Hour		
Steamer	28.20	11.40	39.60	66.00	24.00	15.80
Slicer	--	0.70	0.70	1.10	0.61	0.03
Grill	7.00	7.40	14.40	24.00	16.50	4.00
Convection Oven	9.00	4.40	13.40	22.30	22.00	4.90
Steam Table	--	5.80	5.80	9.70	3.00	0.30
					Total	25.00

TABLE 2

AVERAGE KWH CONSUMPTION USING THE THERMOSTAT SIGNAL-LIGHT TIMING TECHNIQUE FOR TURKEY TETRAZZINI PRODUCED IN THE COOK-CHILL FOODSERVICE SYSTEM

Equipment	Thermostat Signal-Light Minutes of Time On:				KW Rating of Equipment	Estimated KWH Consumption
	Pre-Heat	Processing	Total	% Per Hour		
Steamer	28.20	11.40	39.60	66.00	24.00	15.80
Slicer	--	0.70	0.70	1.10	0.61	0.03
Grill	7.00	7.40	14.40	24.00	16.50	4.00
Convection Oven	9.00	4.40	13.40	22.30	22.00	4.90
Quick-Chiller	--	4320.00	4320.00	7200.00	5.10	12.00*
Microwave	--	70.7	70.70	117.80	1.50	1.80
					Total	38.50

*This figure indicates an estimate of the energy used based on the percentage of usable equipment space occupied by the turkey tetrazzini for three days (30).

TABLE 3

AVERAGE KWH CONSUMPTION USING THE THERMOSTAT SIGNAL-LIGHT TIMING TECHNIQUE FOR TURKEY TETRAZZINI PRODUCED IN THE CONVENIENCE FOODSERVICE SYSTEM

Equipment	Thermostat Signal-Light Minutes of Time on:				KW Rating of Equipment	Estimated KWH Consumption
	Pre-Heat	Processing	Total	% Per Hour		
Freezer	--	1440.00	1440.00	2400.00	2.20	0.27*
Convection Oven	9.2	10.00	19.20	32.00	22.00	7.00
Steam Table	--	4.90	4.90	8.20	3.00	0.25
					Total	7.50

*This figure indicates an estimate of the energy used based on the percentage of usable equipment space occupied by the turkey tetrazzini stored in the freezer for 24 hours (30).

TABLE 4

MEAN KWH CONSUMED FOR THREE FOODSERVICE SYSTEMS

Type of Foodservice System	Mean KWH Consumed
Conventional	25.0*
Cook-chill	38.5*
Convenience	7.5*

$*p \leq 0.05$

The convection steamer was the largest consumer of energy in all three systems. The large KWH consumption was due to the amount of time and energy required to reach the proper pressure, which in an ongoing operation would only occur once a day. The quick-chiller and freezer had high kilowatt ratings; however, their KWH consumption was based on the percentage of usable equipment space occupied by the weight of the turkey tetrazzini. In an actual operation where the majority of usable space would be occupied by prepared or purchased products, the KWH consumption would be significantly greater.

The energy requirement for the production of turkey tetrazzini was identical for the conventional and cook-chill systems. Immediately after removing the product from the oven the product for the cook-chill system was placed in a quick-chiller which requires an intense amount of energy. Since products for a cook-chill system are often portioned in a chilled state prior to rethermalizing in a microwave, a steam table is not required. The amount of energy required to hold the product on a steam table while portioning 25 servings is less than the amount of KWH required to rethermalize 25 servings in the microwave. Only 0.3 KWH was required to hold the product for the conventional system on the steam table; whereas, 1.8 KWH was consumed in rethermalizing the cook-chill product.

The amount of energy required to hold the turkey tetrazzini on the steam table for 30 minutes would be 1.5 KWH. This value is similar to the amount required by the mircowave to reheat 25 servings. The additional KWH consumption for a longer holding period would not increase the system mean by an amount large enough to cause a difference in the comparison of the systems.

The values for KWH consumption in the conventional and cook-chill systems are consistent with those of McProud (30). McProud (30) compared energy requirements for production of beef loaves in the conventional, cook-chill and cook-freeze foodservice systems. The cook-freeze system was the most energy intense system followed by the cook-chill system. Results of both studies indicate that the cook-chill system requires more energy than the conventional system.

Labor Time and Cost

Labor time required for production and service of turkey tetrazzini was determined by use of a stop watch time study. Labor cost was determined by multiplying the average amount of hourly salary including benefits for each level of employee by mean time required for production and service activities. Time required by each level of employee for the three systems is presented in Table 5. Mean labor time and costs are presented in Table 6. The cook-chill system required significantly ($p \leq 0.05$) more time thus the higher labor cost than either conventional or convenience system. Since the convenience system involved primarily portioning of the product prior to service, it required significantly less labor of a lower skill level than the conventional system. The convenience system, therefore, had the lowest labor cost of the three systems investigated.

The conventional and cook-chill systems required the same amount of time for the production activities. This finding is consistent with Carroll (31) who compared labor time requirements for conventional and cook-freeze systems. The cook-freeze system differs from cook-chill primarily in temperature of the thermal break. Carroll (31) found that the cook-freeze foodservice system required more labor time than the conventional system. Both studies found that the additional labor requirement resulted from time necessary to rethermalize the product prior to service.

TABLE 5

MEAN LABOR TIME REQUIREMENTS FOR EACH EMPLOYEE LEVEL IN THREE FOODSERVICE SYSTEMS

Type of System	Skill Level of Employee		
	Cook Task Time (Minutes)	Assistant Cook Task Time (Minutes)	Foodservice Worker Task Time (Minutes)
Conventional	35.59	12.22	6.05
Cook-chill	35.59	12.22	77.93
Convenience	--	--	5.53

TABLE 6

MEAN AND STANDARD DEVIATION OF TOTAL LABOR TIME AND COST IN THREE FOODSERVICE SYSTEMS

Type of System	Labor Time (Minutes)	Labor Cost*
Conventional	53.90± 1.10	$ 4.90± 0.10
Cook-Chill	125.74± 2.21	$10.45± 0.20
Convenience	5.50± 0.50	$ 0.43± 0.00

*Labor cost is based on average hourly wages in foodservice establishments in the Dallas/Fort Worth metroplex. Benefits were calculated based on figures presented by Solnick (39).

Food Cost

Increasing food cost is of significant concern to most foodservice directors. Food cost for 25 servings of turkey tetrazzini is presented in Table 7. The cost of the product purchased for the convenience system was two times greater than for the other two systems. Products purchased for convenience systems have the majority of labor cost incorporated into the price the operation pays for the products.

TABLE 7

RAW FOOD COST OF TURKEY TETRAZZINI
IN THREE FOODSERVICE SYSTEMS

Type of System	Cost/25 Servings	Cost/6 oz. Serving
Conventional	$12.42	$0.50
Cook-Chill	$12.42	$0.50
Convenience	$22.55	$0.90

Total Cost

All aspects including food, labor and energy costs must be considered when deciding to implement a particular foodservice system. The total cost required to produce 25 servings in the three foodservice systems under investigation is presented in Table 8. The KWH cost was calculated from values charged to commercial and institutional foodservice establishments in the Lewisville, Texas area at the time of the study.

TABLE 8

TOTAL COST OF TURKEY TETRAZZINI*
IN THREE FOODSERVICE SYSTEMS

Type of Foodservice System	Cost			Total
	Energy**	Labor	Food	
Conventional	$1.00	$ 4.90	$12.42	$18.32
Cook-Chill	1.54	10.45	12.42	24.41
Convenience	0.30	0.43	22.55	23.38

*Cost is based on 25 servings.

**KWH costs for institutional and commercial foodservice establishments were calculated from values obtained from the Community Public Service of Lewisville, Texas at the time of the study.

The cook-chill system was found to be slightly more costly than the convenience system. The conventional system was shown to be the least expensive. The cook-chill system was most expensive due to a higher energy and labor cost. The use of the quick-chiller accounted for a large increase in the KWH consumption of the cook-chill system over that of the conventional system. The cost of labor in the cook-chill system was higher than that of the conventional system due to the amount of time required to reheat individual portions in the microwave oven.

The total cost of 25 servings of turkey tetrazzini in the convenience system was slightly less than that of the cook-chill system but more than the conventional system. Although the food cost of the convenience system was almost twice as much as the other two systems this increase in food cost was offset by the decreased labor and energy requirements.

The findings of this study are in disagreement with those of Herz and Souder (25) who conducted a cost comparison of the conventional, convenience, cook-chill and cook-freeze foodservice systems in hospitals using projected theoretical costs. The authors compared labor, food and energy costs for the four systems. Herz and Souder (25) concluded that the cost per meal for each system was: convenience $3.04, conventional $2.94, cook-chill $2.77, and cook-freeze $2.68. Since estimates were made in 1977, prices have increased significantly in all areas.

Product Acceptability

A taste panel evaluated the turkey tetrazzini produced in each foodservice system to determine whether quality differences existed. Panelists scores (Table 9) indicated that for all quality characteristics the scores for the

TABLE 9

MEAN SCORES AND STANDARD DEVIATIONS FOR SENSORY ATTRIBUTES OF TURKEY TETRAZZINI

Session	Type of Foodservice System	Number of Panelists	Attribute						
			Aroma	Appearance	Texture	Flavor	Mouth Feel	After Taste	Overall Acceptability
Trial I	Conventional	21	5.7± 1.0	5.6± 1.0	5.8± 0.9	5.8± 1.0	5.8± 0.8	5.9± 0.8	5.8± 0.9
Trial I	Cook-chill	21	5.6± 1.0	5.3± 1.2	5.3± 1.0	5.4± 1.2	5.5± 1.0	5.6± 1.2	5.6± 0.9
Trial I	Convenience	21	4.7± 1.2*	3.9± 1.4*	3.8± 1.2*	3.8± 1.6*	3.7± 1.6*	3.7± 1.6*	3.3± 1.8*
Trial II	Conventional	20	5.4± 1.0	5.5± 1.0	5.4± 1.3	5.4± 1.2	5.2± 1.2	5.2± 1.3	5.5± 1.0
Trial II	Cook-chill	20	5.3± 1.1	5.2± 1.4	5.6± 1.0	5.8± 1.0	5.4± 1.3	5.8± 1.1	5.6± 1.0
Trial II	Convenience	20	4.7± 1.4*	4.2± 1.8*	3.9± 1.6*	3.4± 1.6*	3.8± 1.6*	3.5± 1.7*	3.6± 1.7*
Trial III	Conventional	18	5.2± 1.2	5.4± 1.1	5.5± 1.0	5.7± 1.2	5.7± 0.9	5.7± 1.1	5.8± 0.9
Trial III	Cook-chill	18	5.4± 1.1	5.4± 1.1	5.7± 1.0	5.8± 0.8	5.6± 0.9	5.6± 1.0	5.7± 1.0
Trial III	Convenience	18	4.4± 1.6*	4.0± 1.7*	4.0± 1.5*	3.2± 1.3*	3.7± 1.6*	3.2± 1.7*	3.6± 1.6*

*Attributes significantly ($p \leq 0.05$) lewer than those in conventional and cook-chill systems.

turkey tetrazzini produced in the conventional and cook-chill foodservice systems were significantly greater ($p \leq 0.05$) than those for the convenience system. The mean scores for overall acceptability in the conventional and cook-chill systems ranged from 5.5 to 5.8 while scores for the convenience system ranged from 3.3 to 3.6. Panelists reported off flavors and poor texture for the convenience product.

The results of this study were similar to those found by Zallen, et al. (32) who compared freshly prepared beef loaves with those subjected to treatments used in chilled foodservice systems. The scores for freshly prepared loaves were significantly higher than the refrigerated loaves; which was not true in this study.

Bobeng (33) also conducted a sensory evaluation of beef loaves while applying the HACCP models. Loaves were produced in the conventional, cook-chill and cook-freeze systems. Scores for overall acceptability were significantly greater ($p \leq 0.05$) for loaves produced in the conventional system than loaves produced in the cook-chill or cook-freeze system. In this study the cook-chill product was rated similar to the conventional product. The cook-freeze products studied by Zallen (32) and Bobeng (33) were produced in a conventional method and then frozen while the frozen product used in this study was purchased as a convenience product. Scores for all three frozen products evaluated were significantly lower than products produced in a conventional or cook-chill system.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

A comparison of energy, labor and food costs and product acceptability was conducted for three simulated foodservice systems. Results indicated that turkey tetrazzini produced and served in the cook-chill system was the most expensive while the conventional system was the least expensive. Energy and labor requirements were the two factors which contributed to the greater cost of the cook-chill system (Table 8). Although food cost for the convenience system was higher than for the other two systems, lower energy and labor costs offset the higher food cost. Turkey tetrazzini prepared in the cook-chill and conventional systems was rated more acceptable than the convenience product.

When deciding to implement a particular foodservice system, all aspects of the system and the facility in which it will be implemented must be considered. At one time, labor was the most important factor to consider when deciding on a foodservice system. The alternate systems such as the cook-chill and convenience were designed to reduce the need for the higher skill level of employee (3, 27). Today, as energy and food prices skyrocket, these factors increase in importance and may become the deciding factors in the foodservice system implementation decision.

Energy consumption for each system as determined through the thermostat light timing technique (18, 35) indicated that the cook-chill system was the most energy intensive (Tables 1, 2, and 3). System means for energy consumption were all significantly different ($p \leq 0.05$) from each other.

With the cost of energy becoming an increasingly important factor, more foodservice departments may begin monitoring their electrical consumption to determine if alternate systems such as the cook-chill do in fact result in energy savings. Alternate foodservice systems will require the purchase of expensive pieces of equipment such as the quick-chiller for the cook-chill system. The convenience system will require an increase in freezer space. The cost and energy consumption of this equipment must be examined to determine system feasibility.

Proponents of the cook-chill system state that a saving in energy consumed results due to increased employee productivity and a five day production week. Research needs to be conducted to determine the amount of energy consumed during a five day period for production of a seven day supply of food in comparison to the amount consumer during seven day production, to determine if an actual savings results. The total energy and labor required for portioning, reheating and serving of individual meals should also be analyzed and compared to time and energy required for bulk service from the steam table as occurs in the conventional system.

Additional studies similar to the one in operational facilities by Carroll (31) should be conducted to ascertain the amount of labor required for the various systems. A comparison of actual labor requirements should then be conducted to provide foodservice directors with additional information on which to base implementation decisions.

The energy and labor requirements for the convenience system were less than those for the other two systems. The total cost of the convenience system was less than that of the cook-chill system (Table 8). The convenience system may be implemented in areas where labor shortages occur (5, 26, 27). The system can be cost efficient if only the necessary pieces of equipment are purchased. Many establishments, however, purchase the kinds and amounts of equipment as necessary for a conventional or cook-chill system (5, 28). As a result, much of the equipment stands idle and a considerable amount of money is wasted.

The quality of convenience products must be constantly evaluated if a foodservice establishment decides to implement this system. The results of the sensory evaluation of this study indicated a significant difference ($p \leq 0.05$) in product acceptability between the convenience system and the other two systems (Table 9). The convenience product was consistently rated lower than the other products.

Few studies have been done in the area of energy consumption. As energy costs rise information regarding energy requirements for menu items and foodservice systems will become of major importance to the directors of all foodservice operations. Studies of all menu items may be necessary so that only the least energy intensive may be produced. Energy comparisons between foodservice systems will be necessary when deciding on the implementation of a particular system. As indicated in this study, the cleanliness and condition of the equipment affect energy consumption and must be considered when conducting energy studies. In the comparison of foodservice systems, institutions studied should be of the same size. Food products analyzed should yield the same number of servings. All aspects of production and service should be compared to determine the overall energy, labor, food and other cost aspects. Comparisons between different foodservice systems will be inconclusive until each system has "implemented all of the energy conserving technologies available" (29). Valid comparisons can only be made when each system is as effective as technically feasible.

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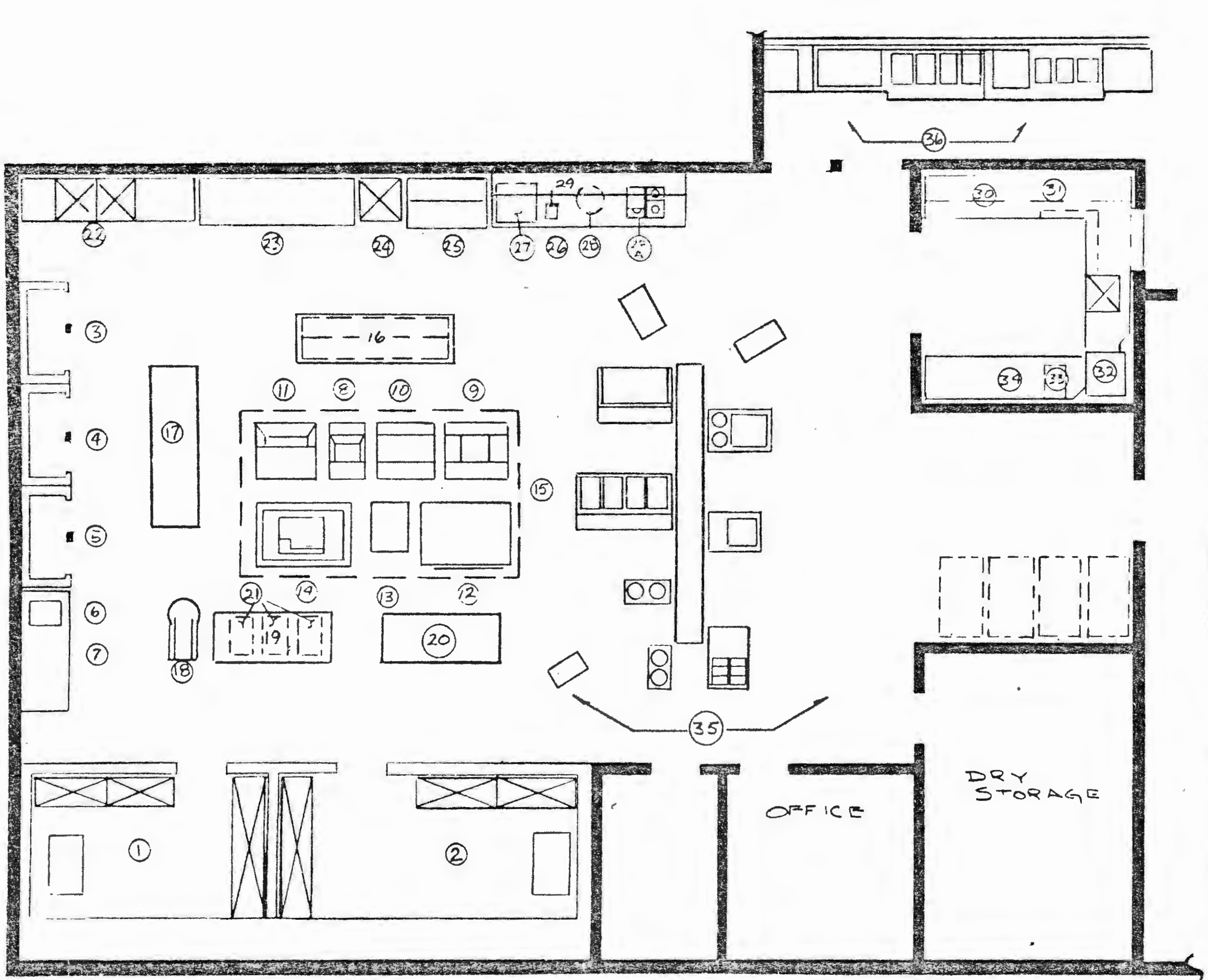
APPENDIX A

LAYOUT OF LEWISVILLE MEMORIAL HOSPITAL

SPECIFICATIONS OF QUICK-CHILLER AND FREEZER



EQUIPMENT LIST

1	WALK-IN COOLER
2	WALK-IN FREEZER
3	SALAD REFRIGERATOR
4	COOKS REFRIGERATOR
5	BAKERS REFRIGERATOR
6	SLICER
7	WORK TABLE
8	FRYER
9	HOT TOP RANGE
10	GRIDDLE TOP RANGE
11	BROILER
12	CONVECTION OVEN
13	PAN RACK
14	STEAMER
15	CANOPY (NO BLOWER)
16	WORK TABLE
17	WORK TABLE
18	MIXER BOOT
19	BAKER TABLE
20	WORK TABLE
21	BINS
22	POT SINK
23	WORK TABLE
24	SINK
25	ICE MACHINE
26	WORK TABLE
27	ICE BIN + WATER STATION
28	ICE TEA DESPENSER
28A	COFFE
29	WALL SHELF
30	SOILED TABLE
31	WALL SHELF
32	DISH WASHER
33	BOOSTER HEATER
34	CLEAN TABLE
35	TRAY MAKE-UP
36	SERVING COUNTER

LAYOUT OF LEWISVILLE MEMORIAL HOSPITAL

EQUIPMENT USED IN STUDY

Equipment	Manufacturer	Model No.
Convection Oven	Toastmaster	3025A
Convection Steamer	Cleveland	IDE-24
Freezer	Hobart	WF-200
Grill	Toastmaster	20A2MA
Quick-Chiller	Hobart	QHE2R
Slicer	Hobart	410 Slicer
Steamtable	Turnmaduke	E-304-25

SPECIFICATIONS

Quick-Chill Refrigerator

Calculations for the quick-chill refrigerator are based on a Hobart two section unit. A 400 pound load of food at 160°F can be chilled to 45°F in approximately four to seven hours. The two section unit used 17,500 BTU's/Hour. It is a 200 volt, three phase unit.

Walk-In Freezer

Calculations for freezer KWH consumption are based on a Hobart freezer with an actual size of 5'10" x 10'7 1/2". It is capable of holding 2400 pounds. The unit used 7610 BTU's/Hour. It is a 208 volt, three phase unit.

APPENDIX B

FORMULA FOR TURKEY TETRAZZINI

TURKEY TETRAZZINI

Yield: 25 Portions — Each Portion: 6 oz.

Ingredients

3 lb.	turkey, boned
1 lb.	spaghetti
4 1/4 oz.	margarine
1/2 C + 2 T	flour
2 t	salt
1 C + 1/3 C	nonfat dry milk
4 C	water
2 C	mushrooms
1/4 t	white pepper
1/8 t	garlic powder
1/8 t	onion powder
1/8 t	paprika
1/8 t	cayenne pepper
1 lb	Old English Cheese, cubed
1 lb	Velveeta Cheese, cubed

Procedure

Cook spaghetti until tender. Drain spaghetti. Melt margarine and blend in flour. Add salt, nonfat dry milk and water to make a white sauce. Add remaining ingredients and continue cooking until cheese melts. Put spaghetti in bottom of steam table pan. Pour turkey and cheese sauce mixture over the top. Bake in convection oven at 350°F for 15 minutes.

APPENDIC C

THERMOSTAT SIGNAL-LIGHT RECORDING FORM

THERMOSTAT SIGNAL-LIGHT RECORDING FORM

	On Time in Minutes of Thermostat Signal-Light					
Equipment	Warm-Up	Processing	Total	Warm-Up	Processing	Total

LABOR TIME REQUIRED FOR THE CONVENTIONAL SYSTEM

Steps of Preparation	Labor Level	Trials				
		I	II	III	IV	V
1. Gather ingredients from refrigerated and dry areas.						
2. Measure ingredients for spaghetti.						
3. Place spaghetti in the steamer.						
4. Prepare turkey: weigh and dice.						
5. Measure ingredients for white sauce.						
6. Prepare sauce.						
7. Add turkey and mushrooms.						
8. Place spaghetti in bottom of pan. Pour sauce over spaghetti.						
9. Place in oven and bake.						
10. Clean work area.						
SERVICE						
11. Place on steam table.						
12. Portion and put on plates--25 servings.						

LABOR TIME REQUIRED FOR THE COOK-CHILL SYSTEM

Steps of Preparation	Labor Level	Trials				
		I	II	III	IV	V
1. Gather ingredients from refrigerated and dry areas.						
2. Measure ingredients for spaghetti.						
3. Place spaghetti in the steamer.						
4. Prepare turkey: weigh and dice.						
5. Measure ingredients for white sauce.						
6. Prepare sauce.						
7. Add turkey and mushrooms.						
8. Place spaghetti in bottom of pan. Pour sauce over spaghetti.						
9. Place in oven and bake.						
10. Clean work area.						
11. When done, place product in quick-chiller.						
SERVICE						
12. Place on service table						
13. Portion and put on plate--25 servings.						
14. Reheat in microwave 25 servings.						

LABOR TIME REQUIRED FOR THE CONVENIENCE SYSTEM

Steps of Preparation	Labor Level	Trials				
		I	II	III	IV	V
1. Remove product from freezer and place in oven.						
<u>SERVICE</u>						
2. Place on steam table.						
3. Portion and put on plates--25 servings.						

APPENDIX D

COVER LETTER AND SURVEY FORM USED TO DETERMINE AVERAGE SALARIES

October 24, 1979

Dear Foodservice Director,

I am a graduate student at the Texas Woman's University and need your assistance in gathering data for my thesis. The study involves determining the cost of producing an entree in various foodservice systems by comparing the actual energy costs, food costs and labor expenses for each system. In order to get an idea of the average wages paid foodservice workers in the Dallas-Fort Worth Metroplex, I am surveying various foodservice facilities. Your facility was selected at random and all information that you provide will be kept confidential.

Please fill out the enclosed form and return it to me by November 5 at the latest. Your assistance in gathering this information will be greatly appreciated. The information you provide will be most beneficial in the development of this study.

Thank you,

Theresa Glazener

Theresa Glazener

Enclosure

LABOR EXPENSE FORM

Please complete the following chart and return it to the researcher in the enclosed self-addressed, stamped envelope by November 5. Ranges may be used in completing the chart.

Employee Information	Cook	Assistant Cook	*Foodservice Worker I	**Foodservice Worker II
Hourly Salary Paid				
Monthly Deducations FICA				
Retirement				
Insurance				
Withholding Tax				
Other				
Monthly Accruals Annual leave (vacation)				
Sick leave				
Other				

*Foodservice Worker I--utility worker.

**Foodservice Worker II--trayline worker.

APPENDIX E

SENSORY EVALUATION FORM

Name ________________________________ Date ____________

Product ________________________________

This scale is used to reflect consumer acceptance of a food product. Please rate acceptance of each coded food product using the seven-point scale.

Quality Description					
Aroma					
Appearance					
Texture					
Flavor					
Mouth Feel					
After Taste					
Overall Acceptability					

Quality Description	Rating
Like extremely	7
Very satisfactory	6
Pleasing	5
Neither like nor dislike	4
Slightly unpleasing	3
Not satisfactory	2
Rejected	1

Please answer the following questions about the coded food products.

Which product(s) was most acceptable? _____ _____ _____

What characteristic(s) did you like about the product you rated most acceptable?

What characteristic(s) made the other product(s) less acceptable?

Comments ________________________________

____