CONVENIENCE FOODS AND HOME-PREPARED FOODS HEATED WITH AN ELECTRIC RANGE AND A MICROWAVE OVEN

by

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CHAPTER I

INTRODUCTION

Since World War II a great many convenience food products have been introduced into the American marketplace by food processors. In 1973 convenience products made up approximately half of the sales of food purchased for home consumption (Traub and Odland, 1979). Sales of processed foods in 1976 amounted to 53 percent of that year's supermarket sales of food items (Livingston and Chang, 1978). Clements (1980) indicated that the majority of women in the United States use convenience foods. Some of the factors which have been associated with increased use of convenience foods, such as a greater proportion of women in the work force, are expected to continue. Thus the demand for convenience in foods can also be expected to continue.

Despite the fact that convenience foods are widely consumed, questions are sometimes raised about their use. A majority of convenience foods have been reported to cost more than home-prepared foods (Traub and Odland, 1980, 1979) which may discourage consumers from buying these items. Some consumers have expressed concern about the healthfulness and value of convenience products as well as about the price (Handy and Hagar, 1977). Convenience foods

may vary in composition from home-prepared foods, and 58 percent of persons surveyed believed that convenience foods were not as nutritious as foods prepared at home (U.S. Dept. HEW, 1973-74).

Convenience foods also have advantages, and the development of convenience foods is one of the major factors that has shaped the modern food industry. Food purchasing decisions are very complex due in part to the large number of items on the market, and consumers need information about and guidance in selecting the most satisfactory forms of foods for their needs. Using this information will enable them to make informed choices concerning their diets.

The adoption of home microwave ovens is now recognized as a major trend in the use of convenience equipment (White, 1980). The food industry first made use of microwave ovens in 1944 (Aref, 1968). Although home microwave ovens were introduced into the marketplace in 1956, it was not until 1972 that the one percent saturation level was reached. (Schiffmann, 1977). Approximately 24 percent of American households owned a microwave oven in 1981 (Markov, 1982).

The United States has recently experienced an energy shortage which is expected to continue (Mandigo and Janssen, 1982). Household energy use makes up approximately 30 percent of the energy used in the food chain (Hirst, 1973), and consumers can thus be expected to be interested in

energy consumption by home appliances. Microwave ovens are frequently described as energy saving appliances (Bademmop, 1975). However, Laughon (1980) pointed out that contradictory evidence exists concerning whether the microwave oven is the most energy efficient appliance for heating all foods. Microwave ovens are also often said to decrease the total amount of time required to prepare foods. Little research has been reported, however, on the amount of active time needed to prepare foods using a microwave oven.

This research was designed to compare selected convenience foods and their home-prepared counterparts heated with a microwave oven and with a conventional electric range. The objectives of the study were to determine whether:

1. Convenience foods and home-prepared foods yield the same number of equal weight servings.

2. Foods prepared with an electric range and with a microwave oven yield the same number of equal weight servings.

3. Convenience foods and home-prepared foods require the same amount of total preparation time.

4. Foods prepared with an electric range and with a microwave oven require the same amount of total preparation time.

5. Convenience foods and home-prepared foods require the same amount of active preparation time.

6. Foods prepared with an electric range and with a microwave oven require the same amount of active preparation time.

7. Convenience foods and home-prepared foods require the same amount of energy to prepare.

8. Foods prepared with an electric range and with a microwave oven require the same amount of energy to prepare.

9. Convenience foods and home-prepared foods have the same preparation cost per serving.

10. Foods prepared with an electric range and with a microwave oven have the same preparation cost per serving.

11. The density, moisture content, or fat content of a food affects the energy consumption or heating time required to prepare foods with an electric range or with a microwave oven.

12. The degree-of-readiness of a food affects the energy consumption or the total or active preparation time required to prepare convenience foods or home-prepared foods.

13. Convenience foods and home-prepared foods have the same nutrient content.

14. Convenience foods and home-prepared foods have the same sensory quality.

15. Foods prepared with an electric range and with a microwave oven have the same sensory quality.

Overview of Remaining Chapters

Chapter II contains a review of literature relevant to this study, and the methods used in data collection and analysis are described in Chapter III. The results are presented and discussed in Chapter IV, and Chapter V contains a summary, conclusions, implications, and recommendations for further research.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The literature review is divided into three broad sections: 1) convenience foods, including definitions, use, yield, preparation time, energy consumption, cost, nutrient content, and sensory quality; 2) microwave ovens, covering operation, use, heating time, energy consumption, and sensory quality of foods; and 3) sensory evaluation, with an overview and sections on selection and training of panel members, the testing environment, preparation and presentation of samples, scoring, and sources of invalidity. The information was obtained from books, periodicals, government bulletins, unpublished reports, and masters' theses.

Convenience Foods

Definition. Although the term "convenience food" is frequently not defined in publications, several authors have tried to establish a definition. Weiss (1954) classified foods into three forms: those having as little advance preparation as the market affords, those which are partially prepared, and those which are ready to serve. Kinder (1962) stated that convenience foods are those which were generally

unavailable before World War II and that have built into them some of the preparation done in the home kitchen prior to that time. Similarly, Harp and Dunham (1963, page 3) called convenience foods "those foods which have services added to the basic ingredients to reduce the amount of preparation required in the home," while Bivens (1969) defined convenience foods as those foods "which have services added to the basic ingredients to reduce the amount of preparation required in the home." Hamilton and Whitney (1979, page 334) identified convenience foods as those prepared at home from foods already cooked or processed before reaching the market. Convenience foods have also been described as "foods that have had a comparatively large amount of processing or market services done on them and may be served with a minimum of effort and skill" (Bennion, 1980, page 12).

Attempts also have been made to classify convenience foods. Axler (1974) recognized the broad spectrum of foods available on the market, and said they could be classified by product type, process of manufacture, degree of processing, and cost. Paulus (1977) classified foods as ready to process, ready to kitchen process, ready to cook, ready to heat, and ready to eat. Traub (1974a) placed an emphasis on "newer" convenience foods by calling a convenience food "any fully or partially prepared food

introduced into the retail market in the last ten years in which significant preparation time, culinary skills, or energy input have been transferred from the end user's kitchen to the food processor and distributor." This definition was modified when Traub and Odland (1979, page 3) said that convenience foods were "fully or partially prepared foods in which a significant amount of preparation time, culinary skills, or energy inputs have been transferred from the home kitchen to the food processor and distributor." They further classified convenience foods as "established" if they were introduced before 1960, or "new generation" if they were introduced in 1960 or later.

Probably the first convenience food to appear on the market was baking powder, a combination of baking soda and cream of tartar which was developed in the United States in 1850 (Bailey, 1940). It allowed a cook to make one measurement instead of two. Most people today would not consider baking powder a convenience food, however. Foods generally thought of as convenience foods came into being in large quantity in the late 1940's and have increased in number and variety since that time (Miller, 1962). It is now hard to find any foods in the supermarket that do not have some measure of convenience added, such as washing, trimming, or packaging, if not cooking or freezing. For this reason, Traub and Odland (1979) excluded fresh foods

such as meat and produce and ingredient foods such as flour and fluid milk from the convenience food category in their study.

Use. Because convenience foods are so common in the supermarket it is likely that most Americans use convenience foods at least occasionally. Several demographic and lifestyle changes occurring in recent years may have affected the demand for convenience foods. Per capita incomes have risen, the educational level of the population has increased, more women have entered the work force, and family size has decreased (Stafford and Wills, 1979). One- and two-person households now make up more than 50% of the U.S. population (U.S. Dept. Commerce, 1981). These trends may have contributed to an increased use of convenience foods in the United States.

Between 1955 and 1965 low income households increased their use of convenience foods more than higher income households, the South had a greater increase in use of convenience foods than the rest of the nation, and rural families increased their use of convenience foods more than urban families although they still used less in absolute amounts (Bivens, 1969; Anon., 1968).

More recent studies have shown that a variety of variables affect convenience food use. Russell (1971) reported that as the age of the homemaker increased there

was a trend toward using fewer convenience foods, and Tinklin, Fogg, and Wakefield (1972) similarly reported that households where the male head was less than 50 years of age used more convenience foods. However Redman (1980) found that the age of the woman was positively correlated to increased use of convenience foods.

Several reports have indicated that families with higher incomes use more convenience foods (Redman, 1980; Tinklin et al., 1972; Russell, 1971). Redman (1980) further reported that urban households spent more on convenience foods than did rural households, but that blacks spent less than other races.

Tinklin et al. (1972) reported that households which were headed by a college graduate were more likely to use convenience foods. However Reilly (1982), Redman (1980), and Russell (1971) all found that educational level was negatively related to the number of convenience foods served. Redman (1980) postulated that persons with more education are more nutrition conscious and selective of ingredients.

Redman (1980) reported that employment of the wife was positively correlated to increased use of convenience foods, although Russell (1971) found that unemployed women used more convenience foods than employed women. Schaninger and Allen (1981) classified households on the basis of the

wife's occupational status and found that families with a "low-occupational-status working wife" consumed more quick and instant convenience foods, while families with a "high-occupational-status working wife" used convenience foods which required more time to prepare.

Redman (1980) and Russell (1971) both reported increased use of convenience foods as family size increased. Additionally, Tinklin et al. (1972) found that families with children used more convenience foods than families without children.

Two other groups that have been mentioned as possible frequent users of convenience foods are the elderly and persons who live alone. For elderly persons convenience foods offer ease of storage, preparation, and consumption (Farthing and Cassilly, 1976). Persons living alone could enjoy greater menu variety with convenience foods since many homemade recipes require too many ingredients or yield too many servings to be practical (Peterkin and Cromwell, 1971). Retailers, aware of the shifts in population characteristics, are now promoting the advantages that convenience foods have for small families, working women, older people, and families with many different meal times (Adduci, 1977).

If consumers are to use convenience foods they must perceive that these foods offer advantages, solve problems,

or meet a need (Traub, 1974b). White (1980) reported that consumers wanted foods and recipes requiring few ingredients and little preparation and cleanup time. Some of the reasons consumers have given for using convenience foods are savings in time, work, and money; and the fact that they are handy in an emergency. Lower income users have also stated a preference for the quality of convenience foods (Tinklin et al., 1972). Use of convenience foods may eliminate buying and storing infrequently used ingredients, and convenience foods may expand the variety of items served. Cleanup chores are also frequently reduced when convenience foods are used (Isom, 1979). Convenience foods may require less energy to prepare, less storage space, less knowledge of cooking, and in some cases may cost less than home-prepared foods (Stafford and Wills, 1979). Even if convenience foods are priced higher, Peterkin and Cromwell (1971) stated that they may be a better buy if time and/or cooking skills are limited.

Several different surveys have shown a variety of convenience foods to be commonly used by consumers. Between 1955 and 1965 the convenience foods for which use was increased the most were fresh commercial fruit juice, powdered fruit ades and punches, dehydrated soups, and instant coffee (Anonymous, 1968). Large increases were also seen in use of frozen, canned, and processed potatoes; and

in mixtures without meat (Bivens, 1969). Between 1962 and 1972 the biggest gains in use of convenience foods were for frozen vegetables, frozen processed potatoes, dry mix potato casseroles, frozen plate "TV" dinners, and various snack food items (Traub, 1974a). Tinklin et al. (1972) reported that bread, bakery products, cereals, potato products, canned and frozen vegetables, fruit juices, canned tuna, fish sticks, canned soups, frozen pot pies, and dry macaroni and cheese mixes were the convenience foods most frequently used by a sample of Kansas households. Frozen main courses were used mainly by single persons; complete TV dinners were used by lower income households; and other frozen foods were used most often by middle and upper income households (Anonymous, 1975).

Yield. Yield of convenience products compared to home recipes is an important factor for consumers to consider. King, Gilpin, and Dawson (1962) found that yield in servings per pound of convenience potato products was comparable to the yield from fresh potatoes. Woolsey and Tinklin (1966) reported that brownies which were homemade, from a dry mix, or from refrigerated dough yielded approximately the same number of 20-gram servings, while a package of frozen brownies contained about half as many servings. Traub and Odland (1979) found that some home-prepared recipes yielded more equal-weight servings than did corresponding

convenience items, and many of the home-prepared items contained more meat, cheese, or vegetable while convenience items often had a higher proportion of noodles, sauce, or other starchy components.

Preparation Time. Researchers have compared the amount of time needed to prepare convenience and home-prepared foods. Weiss (1954) found that preparing a day's meals for a family of four, including preparation, cleaning up and serving, took the most time when home-prepared items were used and the least time with ready-to-serve foods. Paul, Batcher, and Fulda (1954), in comparing various forms of yellow and white cakes, found that commerical mixes took the least time to prepare, while cakes baked and then frozen and thawed took the most time.

Asp, Noble, and Clark (1957) found that the time needed to prepare cake, cookies, biscuits, and pie crust from individual ingredients or from a homemade mix differed only slightly when the time for making the mix was included. When the time needed to make the homemade mixes was not included, preparation time for baked products made from homemade and commercial mixes was very similar.

In 1961, one day's ready-to-serve meals for a family of four took one and one-half hours to prepare, while the same meals from a recipe took five and one-half hours (U.S. Dept. Agric., 1961). Preparation time for all products made from

fresh potatoes was longer than for the equivalent convenience products. The amount of time saved by using the convenience foods varied with the kind of potato product (King et al., 1962). In comparing various forms of brownies, Woolsey and Tinklin (1966) found that both total and active time were longest for the homemade product and shortest for the bakery product, which required no preparation time. Intermediate times were needed for preparation of brownies from a dry mix, refrigerated dough, and for frozen brownies.

Quam, Fitzsimmons, and Godfrey (1967) found that using convenience foods to prepare several menu items saved 36% - 73% in labor time. Although the cost of the food alone was greater for the convenience foods, when food and labor costs were combined 80% of the items cost less in the convenience form. Other researchers found that seven menu items took only one-fourth as much time to prepare in the convenience form. Although the convenience foods themselves cost more, when the cost of employee time was added to the cost of the ingredients, the convenience items cost an average of 40% less than the homemade items (Anonymous, 1967). Traub and Odland (1979) reported that the cost of active time needed to prepare most convenience products was considerably lower than the cost of preparing the same foods from a recipe. In general, products having the highest level of built-in

convenience had the lowest preparation cost and time.

Energy Consumption. Traub and Odland (1979) compared the amount of energy needed to prepare convenience foods and their home-prepared counterparts. They calculated the cost of gas and electricity needed to cook 59 convenience and 35 home-prepared foods, and reported that the cost of fuel was less for 63% and more for 15% of the convenience foods. Twenty-two percent of the convenience foods had about the same fuel cost as the home-prepared foods.

Cost. Comparisons have been made between the food cost of convenience foods and the food cost of their home-prepared counterparts. Weiss (1954) compared the cost of a day's meals for a family of four, using home-prepared, partially prepared, and ready-to-serve versions of the same menu. Food for the meals cost most in the ready-to-serve form and least when it was home-prepared. Paul et al. (1954) prepared yellow and white cakes from fresh ingredients, frozen batter, home-prepared mix, commercially prepared mix, and stored frozen baked cakes. For the yellow cakes, the commercial mix was most expensive and the home-prepared mix the least expensive; for white cakes the home-prepared mix was most expensive and the fresh ingredients were least expensive. Asp et al. (1957) studied cakes, cookies, biscuits, and pie crust made from raw ingredients, from a homemade mix, and from a commercial mix. The

commercial mixes were most expensive in all cases, and the homemade mixes were least expensive.

In 1955 researchers found that one day's ready-to-serve meals for a family of four cost $6.70 while the same home-prepared meals cost $4.90 (U.S. Dept. Agric., 1961). Results of a study in Washington, D.C., showed that 54% of convenience foods cost more than the home-prepared counterparts. However, the average homemaker paid only one percent more for the "serviced" foods which were more expensive (Anonymous, 1958). Other researchers reported that, of convenience foods studied, 27% were less expensive than home-prepared foods (U.S. Dept. Agric., 1962). Some of the foods that were less expensive, such as frozen orange juice, were those most readily accepted by the consumer and therefore mass produced (Miller, 1962). King et al. (1962) found that convenience potato products cost more per serving than products made from fresh potatoes if no value was placed on the food preparer's time. Products with high sales volumes, such as frozen french fries and dehydrated potatoes, cost less per unit than other convenience potato products.

Harp and Dunham (1963) found that 73% of convenience foods studied were more expensive than their fresh or home-prepared counterparts. The foods which were less expensive tended to be those with high sales volumes. Meats, dairy

products, and baked goods tended to be more expensive in the convenience form, but most convenience forms of fruits and vegetables were less expensive than the home-prepared versions.

Woolsey and Tinklin (1966) studied the cost of brownies made from basic ingredients, from a packaged dry mix, and from refrigerated dough, as well as frozen and ready-to-eat bakery products. Cost per 20-gram serving was calculated using the actual cost of ingredients. Homemade brownies were least expensive in this case, while frozen brownies were most expensive. In another study, convenience forms of beef dinners, turkey dinners, pizza, hash brown potatoes, and apple pie were all found to cost more than equivalent home-prepared items (Anonymous, 1967). In addition, beef stew, fried chicken, macaroni and cheese, cherry pie, and tossed vegetable salad were all found to cost more in the convenience form (Quam et al., 1967).

When Peterkin and Cromwell (1971) priced convenience and home-prepared items in Washington, D.C., they found that frozen ready-to-heat dinners (meat loaf, fried chicken, or turkey) cost from 25% to 110% more than home-prepared when the same proportions of meat and vegetables were used. Prices for main dish items (meat pies, frozen chow mein, pizza mix, and frozen pizza) depended on the brand and on how much meat or poultry the products contained. Costs

ranged from three-fourths as much as home-prepared to 15% more. Costs for bakery products ranged from slightly less than home-prepared (apple pie, pound cake, biscuits from a mix) to three times as much (frozen waffles). Brownies and sugar cookies cost about the same as home-prepared.

During the 1970's a greater number of convenience foods began to cost less than their home-prepared counterparts. In a 1974 survey in Washington, D.C., 59% of the convenience foods studied cost less than or the same as homemade (Traub, 1974a). Lower cost brands of convenience skillet main dishes cost less than the same products prepared at home (Cromwell and Odland, 1974). Isom (1979) reported that frozen plate dinners cost from 13% to 105% more than homemade, and 83% of convenience entrees also cost more than homemade. Most of these items also contained a smaller amount of main ingredients (meat, cheese, or vegetable) than home-prepared recipes.

As reported in the preliminary results of a national survey, 36% of convenience foods studied cost less than home-prepared (Traub and Odland, 1976). Baked products from mixes, frozen fish sticks and crab cakes, most canned and frozen vegetables, many frozen fruits and juices, and frozen french fries were less expensive than homemade. However, ready-to-serve baked goods, frozen pizzas, cholesterol-free egg substitutes, frozen entrees and dinners, most

convenience chicken products, frozen fish casseroles, dehydrated potatoes, and frozen vegetable side dishes were more expensive than homemade. In the final version of that same work Traub and Odland (1979) reported that 58% of 166 convenience foods were more expensive than similar home-prepared foods, 24 percent were less expensive, and 18 percent were within one cent of home-prepared items in cost. Most (75%) convenience foods introduced since 1960 were more expensive than home-prepred products. When these same data were updated using the Consumer Price Index, Traub and Odland (1980) found that 28% of 166 convenience foods cost less than their home-prepared counterparts, and 13% cost about the same.

Nutrient Content. One of the major concerns about convenience foods, especially among consumer advocates, is their nutrient content. Parrish (1971) cited the increased use of limited variety convenience foods as one factor contributing to a decline in quality of American diets. The large number of additives which improve product shelf life but do little to improve the nutritive value of the food may also be of concern. The majority of convenience foods examined have been found to contain additives (Traub, 1974a). However, many convenience products also contain added nutrients such as the B vitamins, vitamin C, and iron (Traub and Odland, 1979).

Miller, Wang, and Beuchat (1979) analyzed the protein content of 11 multi-component convenience foods which are used as significant sources of protein. The nitrogen content varied from 0.3% (chicken-vegetable baby food) to 3.9% (ground beef). All but four of the items had protein efficiency ratios equal to or better than casein.

The fat content of convenience foods appears to vary greatly. Standal, Bassett, Policar, and Thom (1970) analyzed 22 commonly used convenience foods and found that foods of the same name do not necessarily contain the same type or amount of lipid. The various types and amounts of fats and oils used and the individual practices of the producers caused fatty acid and cholesterol levels to differ among different brands of the same product. Similarly, Kovacs, Ackman, and Ke (1978) found that canning oils greatly affected the type and amount of lipid in canned fish. Breaded and fried fish also contained a different and higher lipid content than the raw fish.

DeRitter, Osadca, Scheiner, and Keating (1974) assayed various frozen dinners for carotene, vitamin A, vitamin E, thiamin, riboflavin, vitamin B6, vitamin B12, niacin, and ascorbic acid. The vitamin contents varied considerably, both within and between products, and ranged from 0% to 50% of the U.S. RDA per dinner. Selenium was found to be only marginally adequate in several frozen pies and dinners

(Levander, 1975), and folacin was found to be low in 30 types of frozen dinners (Hoppner, Lampi, and Perrin, 1973).

Sensory Quality. The sensory quality of convenience foods may be an important factor in whether or not a person chooses to use them. Consumers expect good quality foods - ones which look right, taste good, and have the desired texture (Harp and Dunham, 1963). When convenience foods were relatively new on the market, researchers reported mixed results when comparing the sensory quality of convenience and home-prepared foods. Weiss (1954) served home-prepared, partially prepared, and ready-to-serve meals to a four-member panel. The home-prepared meals received the highest scores and the ready-to-serve meals received the lowest scores. Paul et al. (1954) found that with yellow cakes, the freshly made cake was the most palatable and the cake from a commercial mix the least palatable form tested. However, with white cakes those made from a mix were the most palatable and those from frozen batter the least palatable. Brownies were scored for color, texture, flavor, and preference (Woolsey and Tinklin, 1966). Brownies made from a dry mix were scored higher on all factors than were the other forms, while brownies made from refrigerated dough received the lowest scores.

In other studies, convenience foods have been compared favorably to their home-prepared counterparts. Frozen,

dehydrated, and canned potato products were found to be comparable to the fresh products by a five-member panel (King et al., 1962). Harp and Dunham (1963) also found the quality of a variety of convenience products tested to be comparable to home products. Quam et al. (1967) found no significant differences between the quality of convenience and nonconvenience foods scored by an eight-member sensory panel. Consumers rated convenience products with more services added to them, such as ready-to-eat puddings, relatively low in taste, while products with more services still to be performed, such as packaged cake mixes, were rated much higher (Handy and Pfaff, 1975). Farthing and Cassilly (1976) asked elderly citizens to evaluate three convenience chicken products for appearance, flavor, tenderness, moisture, and overall quality. All the products were scored around four on a five-point scale. Most evaluators indicated a willingness to buy the products if the price was reasonable.

Traub and Odland (1979) used a sensory panel to evaluate the eating quality of 34 convenience and 19 home-prepared foods on a five-point scale for appearance, texture, flavor, and overall quality. Foods were judged relative to a "standard." All the home-prepared products but one and 76% of the convenience foods were rated at least 4 on all factors. These workers pointed out that sensory

evaluation can give an indication of eating quality but not necessarily of consumer acceptability, since other factors such as time savings or cost may enter into a purchase decision.

Summary. Convenience foods have been defined and classified in a variety of ways. Various authors agree that convenience foods have had some sort of processing or preparation done to them prior to being used in the home. Convenience food use has increased among various subgroups in the United States in the last several decades, and population groups that use a large number of convenience foods have been identified. The convenience foods most commonly used, as well as some reasons for their use, have also been reported. The reported comparative yield of convenience and home-prepared foods has depended on the products studied. A majority of convenience foods studied have been shown to require less preparation time than their home-prepared counterparts and to cost less for fuel. Many convenience foods studied have also been shown to be more expensive than their home-prepared counterparts, although convenience foods with high sales volumes and those which have been on the market for a long period of time have been frequently shown to be less expensive than home-prepared products. Many convenience foods contain additives, but they may also contain added nutrients. The nutrient content

of convenience foods varies greatly according to both the food and the nutrient being analyzed. Convenience foods vary in acceptability according to the food tested. Many convenience foods have been reported to be similar to home-prepared foods in sensory quality.

Electric Ranges and Microwave Ovens

Operation. Microwaves are a form of electromagnetic radiation which are reflected by metal; are able to pass through glass, paper, and plastic; and are absorbed by foods. These qualities make microwaves suitable for cooking foods, and the most common consumer use of microwaves is in the home microwave oven (U.S. Dept. HHS, 1980).

In a microwave oven microwaves are produced by a magnetron, enter the cooking cavity, and are absorbed by food. Dipolar molecules, such as water, in the food rotate and attempt to align with the charge created by the microwaves. The rapid rotation creates friction, which produces heat which cooks the food. For this reason, foods with a high water content can be heated more quickly than other foods (U.S. Dept. HHS, 1980).

In a microwave oven heat is generated in a food product immediately. By contrast, with an electric range either a surface unit or the oven cavity is first heated, and then the heat is transferred to the food by conduction or

convection (Mandigo and Janssen, 1982). Thermal effects are sufficient to explain most if not all action of microwaves on foods since microwaves fall short by several orders of magnitude of breaking chemical bonds (Rosen, 1972).

Although microwaves penetrate into foods, the greatest heating takes place at the surface and heat is transferred to the center of the food by conduction (Olson and Olson, 1981). Foods heated in a microwave oven generally do not brown, due in part to the lack of ambient heat in the oven and to the cooling effect of evaporation (Schiffmann, 1982a). However, excessive drying or toughening may occur at the interior of baked products since moisture moves toward the surface and the interior of the product may reach temperatures higher than those normally occurring in baking (Schiffmann, 1982b).

Microwave ovens are available with from 650 to 2000 watts output, and may need from 1500 to 4300 watts input. At any given wattage a constant amount of energy is entering the cooking cavity, and is divided among the food molecules. Thus the larger the food load, the longer it takes to cook (Michael, 1979). Some microwave ovens are equipped with variable power. The cycling of energy on and off allows food temperature to equilibrate and helps to prevent overdoneness (Van Zante, 1973). Field stirrers and turntables are generally used to help minimize uneven

heating (Schiffmann, 1982a), and browning grills or elements may be used to give foods a brown color and a crisp texture.

A free-standing electric range generally contains an oven with broiling and baking elements, and a cooking top with four surface units. The broiling unit may vary from 2500 to 3800 watts, and the baking unit from 2000 to 3950 watts. Small (6-inch) surface units range from 1250 to 1600 watts, while large (8-inch) surface units may be rated from 2000 to 2700 watts (Peet, Pickett, and Arnold, 1979).

Use. Households most likely to include microwave ovens are those in the western United States, those with higher incomes, those with more family members, and those where the female head of household is employed (Murray, 1977). Drew, Rhee, and Stubbs (1977) reported that wives and teenagers used microwave ovens most often, and husbands used them least often. Microwave ovens were reported to be used predominently for warming and defrosting items (Gast, Seperich, and Lytle, 1980), and were used most often to prepare weekday dinners and lunches and least often to prepare baby foods (Drew, Rhee, and Stubbs, 1978; Murray, 1977). Vegetables were the food item most frequently prepared in microwave ovens (Gast et al., 1980; Murray, 1977; McConnell, 1973), although bacon, various types of sandwiches, leftovers, casseroles, convenience meat items, warmed bakery products, and beverages were also often heated

in microwave ovens (Drew et al., 1978). Meat, except for hamburger, was generally not cooked in the microwave oven (Drew et al., 1977).

Although 63% of microwave oven owners surveyed reported little or no change in selection and preparation of food since owning a microwave oven (Gast et al., 1980), Murray (1977) reported that home-frozen items were used more often and microwave oven owners frequently purchased more convenience items, ingredients for casseroles,and disposable kitchen items (Drew et al., 1977).

Drew et al. (1977) found that microwave oven users wanted foods and utensils specifically designed for microwave ovens. They were particularly interested in having industry put microwave instructions on existing packages, standardize terminology and directions, offer products in microwave-compatible packages, reformulate products to give better results in the microwave oven, and develop new convenience foods that could go from the frozen state to the table after being heated in the microwave oven (Schiffmann, 1982a; Schiffmann, 1978; Schiffmann, 1977; McConnell, 1973).

Consumers have perceived advantages of microwave ovens to include savings in time and energy, ease of cleaning, ease of thawing foods, less need for planning, greater ability to use leftovers, and ease of preparing small

servings. Disadvantages included the degree of browning with and without browning dishes, and uneven cooking and defrosting (Drew et al., 1977; Murray, 1977). These and other disadvantages may be related to a lack of uniformity of the microwave field within an oven, lack of uniformity between ovens, lack of standardization of nomenclature and power levels, excessive rate of heating at high power settings, and lack of ambient heat in the microwave oven cavity (Schiffmann, 1982a).

Heating Time. Heating times in microwave ovens depend both on food factors and on appliance factors. The size and distribution of the food load, the starting and ending temperatures of the food, the type of food, its shape, its specific and latent heats, and its dielectric properties all affect cooking time, as do the power setting of the oven, the shape and composition of the utensil, standing time, shielding, and the depth of the microwave penetration (Olson and Olson, 1981; Drew, Rhee, and Carpenter, 1980; Van Zante, 1973).

Researchers have found that a microwave oven requires less time than a conventional range to heat many items (Laughon, 1980), but that the timesaving advantage decreases as the size of the load is increased (Michael, 1979; Drew and Rhee, 1978). Carucci (1974) found that nine convenience foods took less time to prepare in a microwave than in an

electric oven. Britten and Trevino (1980) prepared baked potatoes and Voris and Van Duyne (1979) prepared top round roasts with conventional electric and microwave ovens. Both items took less time to prepare in the microwave oven. Extra time was needed for cooking beef patties in the microwave oven using various browning methods (Drew and Rhee, 1979). When entire meals were prepared instead of individual items, a microwave oven combined with a conventional range took less time than other combinations tested (Lovingood and Goss, 1980; Davis, Pratt, Reber, and Klockow, 1971).

Energy Consumption. A microwave oven may use less energy than a conventional electric range to cook foods, especially those with a high content of moisture, fat, or sugar (Bennett, 1975). McConnell (1974) heated 127 items in a microwave oven and with a conventional range, and found that the microwave oven used less energy to heat 100 of the items. The median energy savings was 62.5%. Drew and Rhee (1978) found that the energy savings for foods cooked with a microwave compared to an electric oven ranged from 45% for beef roasts to 92% for beef patties. Voris and Van Duyne (1979) reported significant energy savings in cooking beef roasts in a microwave rather than a conventional oven. Thawed or frozen roasts, cooked on either "simmer" or "high" in a microwave oven, used the same amounts of energy; all

took 30% less energy than similar roasts heated in an electric oven (Drew et al., 1980). Similarly, Korschgen, Berneking, and Baldwin (1980) found that the microwave oven was the most energy efficient method of preparing rib roasts. Baker, Darfler, and Rekkugler (1981) prepared chicken using 10 different appliances and found that the microwave oven used less energy than all appliances but one brand of slow-cooker.

Dense foods have been reported to require a longer heating time, and thus a greater amount of energy, than light or porous foods both with the electric range and in the microwave oven (General Electric, 1977). Butel (1975a) pointed out that the microwave oven offers the greatest energy savings for small to medium amounts of concentrated foods such as meats, potatoes, and desserts. Vegetables frequently take more energy to cook in a microwave oven than with an electric range. Butel (1975b) reported that for three items (baked potatoes, TV dinner, and a casserole) heated in an electric range and in a microwave oven the microwave offered energy savings of from 58.4% to 79.3%. However, for three types of vegetables cooked on an electric range surface unit and in a microwave oven the microwave used from 30.2% to 54.0% more energy than did the range. Similarly, Carucci (1974) found that, of nine convenience foods tested, only frozen mixed vegetables, the only

vegetable tested, took more energy to heat in a microwave oven than with an electric range. Badenhop (1975) reported that when heating times on an electric range surface unit and in a microwave oven were approximately the same the energy consumption for the two appliances was also similar. Rhee and Drew (1977) found surface units and microwave ovens to be comparable in energy consumption for cooking beef patties. Addition of a browning unit in cooking beef patties by microwave increased energy consumption 53% to 87% over the microwave oven alone (Drew and Rhee, 1979). And Laughon (1980) found that for operations normally done in a saucepan on a burner an electric range required less energy or approximately the same amount of energy as a microwave oven.

Hassoun (1982) pointed out that reported variation among studies in results for energy consumption may be due to different appliances, different recipes and menus analyzed, the amount of water used, and the number of experimental replications. In general, however, a microwave oven uses as much or more energy than an electric range surface unit, and a conventional oven uses more energy than a microwave oven except in preparation of a complete meal.

Sensory Quality. The sensory quality of foods prepared in microwave and in conventional ovens has been studied. Davis et al. (1971) compared meals of chicken, baked

potatoes, and peas in microwave ovens and in microwave-electric combinations and found no significant differences in texture or moistness. The flavor of the potatoes prepared in the combination oven was better, however, and the peas prepared in the microwave oven had a better appearance. Similarly, Britten and Trevino (1980) found no significant differences in preference or acceptability between microwave and conventionally baked potatoes. Nine convenience products tested were generally acceptable when prepared in a microwave oven although meat and cherry pies received low scores due to flattening when taken out of their metal containers (Carucci, 1974). And although Hill and Reagan (1982) reported that yellow butter cakes baked in a conventional oven were rated superior for appearance, tenderness, mouth feel, flavor, and texture to those baked in a microwave oven, they also reported that the cakes baked in the microwave oven were considered "satisfactory."

Quality of meats cooked in microwave ovens is somewhat lower than that of meat cooked in conventional ovens. Drew and Rhee (1978) reported low sensory scores for flavor, tenderness, appearance, and overall acceptability of three beef products heated in a microwave oven. Beef patties cooked in the microwave had the lowest sensory scores of four cooking methods tested (Rhee and Drew, 1977). Various combinations of browning grills and elements had varying

effects on appearance, juiciness, and tenderness of beef patties (Drew and Rhee, 1979). Arm and rib roasts were less tender, juicy, and flavorful than conventionally cooked roasts when heated in the microwave oven (Ream, Wilcox, Taylor, and Bennett, 1974) although Voris and Van Duyne (1979) reported similar tenderness, juiciness, and internal color scores for roasts heated in the two types of ovens. Roasts heated in the microwave oven were scored lower on aroma, flavor, and external color. Roasts heated in a microwave oven on "high" power were scored lower on all sensory attributes except flavor than were roasts heated on "simmer" (Drew et al., 1980).

Summary. The method of heating food is different in a microwave oven than with an electric range. For this reason products prepared in a microwave oven frequently have different characteristics than products prepared with an electric range. Households most likely to own a microwave oven have been identified, and foods most likely to be prepared in a microwave oven have been listed. Advantages and disadvantages of microwave heating have been described. A microwave oven frequently requires less cooking time than does an electric range. However, the time advantage decreases as the size of the load is increased, and extra time may be needed for various browning methods. A microwave oven has been shown to use less energy than an

electric range to prepare many types of foods. However, for items normally heated on an electric range surface unit, a microwave oven may require more energy than an electric range. Food characteristics such as density may affect the heating efficiency of both the electric range and the microwave oven. The sensory quality of many foods heated in a microwave oven has been shown to be similar to foods prepared with an electric range, although meats have generally been rated lower when prepared in the microwave oven.

Sensory Evaluation

Overview. Sensory evaluation is concerned with the human evaluation and measurement of physical stimuli (Larmond, 1973). It is a scientific discipline used to measure reactions to foods as perceived by the senses (Civille, 1980). The major purpose of sensory evaluation is to provide information about what, if any, effect an experimental treatment of a product has on a human population. The effect is usually described as changes or differences in response which are measured and analyzed (Sidel and Stone, 1976).

Many consumers purchase products on the basis of one or more sensory characteristics, so historically sensory evaluation has been used a great deal in food product development (Civille, 1978). Frequently, attempts are made

to correlate sensory data with one or more objective tests. These attempts may or may not be successful since sensory evaluation is very complex, involving many qualities at once (Sawyer, 1971). In addition, sensory evaluation depends on human judgment which is individual and not always consistent (Campbell, Penfield, and Griswold, 1979).

Selection of the correct type of sensory test is important. An overview of the different types of sensory tests has been published by IFT (1981). Difference tests establish whether a perceived difference exists between or among products. Overall differences or differences of a specific attribute can be measured (Hirsh, 1974). Descriptive tests measure quantitative and/or qualitative characteristics of products, while affective tests evaluate preference, acceptance, and/or opinions (Dethmers, 1979). With affective tests a subject is asked to express his degree of liking a product by marking a scale ranging from unacceptable to acceptable. When two or more products are evaluated on the same scale, preference can be inferred by examining the mean scores (Civille, 1980). This method of evaluation relies on the ability of the subjects to express their feelings of like and dislike about the products being evaluated (IFT, 1981). Adding a preference question onto a difference or descriptive test questionnaire is generally not reliable since there must be a difference to be a

preference, and since the preferred sample will likely be scored higher due to a "halo" effect (Hirsh, 1974).

Selection of Panel Members. Since most sensory evaluation panels are designed in part to determine the acceptability of a product, it is helpful if at least part of the panel consists of people who would typically be consuming that product (Hirsh, 1975). The panel should be large enough to overcome day-to-day variability (Amerine, Pangborn, and Roessler, 1965). Too few panelists may require large differences among samples for statistical significance, while too many panelists may cause very small differences to be significant (Sidel and Stone, 1976).

Judges for sensory panels can be men or women, but they should be available for the entire experiment, interested, willing to serve, and not dislike the food to be tested (Campbell et al., 1979). In addition they should be in good health, have normal taste acuity, be able to deal analytically with a complex test situation, have a stable personality, and be able to verbalize and describe the food tasted (Zook and Wessman, 1977). Dawson, Brogdon, and McManus (1963a) also recommended that panelists be able to detect fine differences in specific attributes of foods and be able to give reproducible judgments. Although sex, age, and smoking habits appear to have little effect on ability to discriminate tastes (Martin, 1973; Amerine et al., 1965),

the ASTM (1968a) recommended asking judges to refrain from eating a meal for at least 60 minutes before a testing session, and from smoking or chewing gum for at least 20 minutes beforehand.

Training of Panel Members. The amount of training a sensory panel receives depends on the degree of acuity required, and varies from none for consumer panels to extensive, year long texture and flavor analyses for some industry panelists (Martin, 1973). Training of panel members increases sensory acuity, makes certain the panel has uniform understanding of the properties to be evaluated and the system of evaluation, and minimizes the effects of irrelevant factors (Dawson et al., 1963a). In addition, training generally leads to more precise and uniform judgments, increases the ability of judges to recognize and identify sensory parameters, and familiarizes panelists with the test process (Martin, 1973). Training is also a time when panelists can be motivated by explaining to them enough of the research problem to arouse their interest without revealing information that might lead to bias in their responses (Campbell et al., 1979).

Testing Environment. Every effort must be made in sensory evaluation to control the effect of environment on judgment. The researcher needs to provide the panelists with an optimal setting for unbiased judgments (Larmond,

1973). Interruptions and distractions should be avoided. A special room for sensory evaluation is recommended, with controlled humidity, temperature, neutral background, adequate light, comfortable seating, and adequate space for samples and for writing (Amerine et al., 1965). A room other than the preparation room is recommended, and it should be free of odors (Campbell et al., 1979). Colored lights are used occasionally to mask colors. Panelists should be visually isolated from each other, with no time limit placed on their evaluation (Swartz and Furia, 1977). Many times of day have been used successfully for sensory evaluation, but it is generally recommended that testing take place at least one hour after a meal and at the same time each day (Amerine et al., 1965).

Preparation and Presentation of Samples. Panelists should not be presented with more samples than they can comfortably evaluate in one session. In general, more samples can be evaluated for color or texture than for flavor, and more bland than strong flavors can be evaluated (Sidel and Stone, 1976). Samples consisting of at least one-half ounce of liquid or one ounce of solid should be given, and the amount should be consistent (Larmond, 1973). Samples need to be typical of the product, and as nearly uniform as possible except for the variable being tested (Dawson, Brogdon, and McManus, 1963b). All the samples

should be the same temperature; actual serving temperature is ideal, but the temperature should be at least between 7°C and 77°C (ASTM, 1968a). Some items may be served with a carrier food, but the influence of the carrier must be considered. Results are usually less consistent when a carrier is used (Larmond, 1973).

Serving utensils should all be the same size, shape, and color. White or clear utensils are generally used to allow the color of the food to show. The containers should not impart flavor or odor to the foods (Campbell et al., 1979). The order of sample presentation should be random or balanced, and three-digit code numbers used to hide the identity of the samples. Panelists may be given taste-neutral water at room temperature, unsalted crackers, apples, or other items to clear the mouth between samples (Larmond, 1973).

Scoring. Sensory evaluation panelists normally score the product they are evaluating on a rating scale. A numerical scale is appropriate if a large number of items must be evaluated, when the characteristic to be evaluated is specific and easily understood, and when the dimension of differences can be predetermined and arranged on a numerically graduated scale. The number of gradations on the scale will depend on the number of intervals a panelist can distinguish. A type of ranking is often used when the

characteristic to be evaluated is not specific, when the dimension of a characteristic is desired, or when actual values are not needed or are difficult to provide (ASTM, 1968b; Dawson et al., 1963b). The response form may ask for open-end responses or may ask judges to make selection responses or scaled responses (Sidel and Stone, 1976). A reference standard - mental, photographic, written, fresh product, or stored product - may be used (Wolfe, 1979).

Sources of Invalidity. Every effort should be made to ensure that results of sensory evaluation are both reliable and valid. Reliability in a study is normally assumed; invalidity can lead to inefficiency and misleading information (Schutz, 1971). Possible sources of invalidity include selection and training of judges, interaction among judges, extraneous cues, coding symbols that cause bias, sequential effects, motivational factors, discriminability and value judgments, learning effects, attentional factors, and how well the test predicts the criterion of actual use (Hirsh, 1975; ASTM, 1968b).

CHAPTER III

METHODS

Introduction

The data for this study were collected in the household equipment laboratory and in the sensory evaluation room at Virginia Polytechnic Institute and State University between November 1981 and May 1982. In this chapter are described the procedure used to select food items for laboratory analysis; general laboratory procedures; equipment and pretests used; methods for measuring or calculating weight, time, energy consumption, and cost; and procedures for dealing with products with component ingredients. The methods for relating the food characteristics density, moisture content, and fat content of a food to the energy and heating time required for preparation, as well as the methods for relating the degree-of-readiness of a food to the required amount of energy and total and active preparation time are also described. This is followed by the methods used to calculate nutrient content and to evaluate sensory quality, and the chapter ends with a description of the methods which were used to analyze the data.

Selection of Foods for Laboratory Analysis

For the purposes of this study the definition of convenience foods was that of Traub and Odland (1979, page 3): "fully or partially prepared foods in which a significant amount of preparation time, culinary skills, or energy inputs have been transferred from the home kitchen to the food processor and distrubutor," was accepted. Convenience foods were further classified as (1) basic: items where convenience is primarily a preservation method, or items which have a single or limited number of ingredients, or items which contain time or energy inputs but no culinary expertise; (2) complex: multi-ingredient prepared mixtures, or foods with a high level of time saving and/or energy inputs and culinary expertise built in; or (3) manufactured: foods with no home-prepared counterpart (Havlicek, Capps, and Axelson, 1982a).

The twenty foods selected for laboratory analysis were "complex" convenience foods used by at least one percent of households surveyed in the spring portion of the 1977-78 U.S. Department of Agriculture Nationwide Food Consumption Survey (Table 1). Foods were selected only if it was possible to prepare a home-prepared version using an electric range and a microwave oven.

General Laboratory Procedures

Fifteen of the twenty food products chosen for

Table 1
Foods Selected for Laboratory Analysis

Food	Percent of Households[1]
White bread, RTE[2]	70.4
Whole wheat bread, RTE	18.5
White soft rolls, RTE	17.5
Chocolate chip cookies, RTE	14.0
Chicken noodle soup, canned condensed	11.2
Pancake mix, dry enriched	8.9
Macaroni and cheese mix, dry	8.2
Cream of mushroom soup, canned condensed	7.8
Biscuits, refrigerated	6.2
Sweet rolls, RTE	3.8
Yellow cake mix, dry	3.5
Vanilla pudding mix, dry, regular	3.5
Meat/cheese pizza, frozen	3.1
Spaghetti sauce, canned	2.7
Chocolate cake mix, dry	2.7
Chicken pot pie, frozen	2.6
Apple pie, frozen	1.7
Fried chicken "TV" dinner, frozen	1.6
Cornbread mix, dry	1.4
Broccoli spears in butter sauce, frozen	1.2

1. Percent of households surveyed in the Spring portion of the 1977-78 U.S. Department of Agriculture Nationwide Food Consumption Survey who consumed each food.
2. RTE = Ready-to-eat

laboratory analysis were prepared in convenience and in home-prepared form using both a microwave oven and a conventional electric range. For five products (cookies, white bread, whole wheat bread, white rolls, and sweet rolls) the convenience product was ready to eat as purchased. Therefore the home-prepared versions of these products were prepared with the electric range and in the microwave oven and were compared to the ready-to-eat convenience products.

Ingredients for three replications of a product were purchased at one time in a local market. Ingredients were stored in a two-door refrigerator/freezer (3°C/-18°C) if perishable or at ambient temperature in cupboards.

When more than one brand or size of a convenience product was available on the market a nationally advertised brand of medium price and container size was chosen for analysis. The brands of convenience foods used are shown in Appendix A. Convenience foods were prepared according to package directions for both electric range and microwave oven. If no microwave directions were given on the package, reference was made to a microwave cookbook. Home-prepared recipes, chosen from commonly used cookbooks, "were selected to be typical of foods prepared in the home and were not altered to duplicate the amounts of ingredients found in the convenience product. When possible, however, the same types

of ingredients were used in the home-prepred food as were contained in the convenience product" (Traub and Odland, 1979). The same ingredients were used for the home-prepared items heated with the electric range and in the microwave oven except for preparation using the microwave which required an additional ingredient such as margarine for the browning grill. Recipes used for home-prepared foods are shown in Appendix B.

Each analysis was done in triplicate and medians were identified. Replicate analyses for measuring preparation time, energy consumption, and yield were made rrom one to three days apart. Separate replications were done for the sensory analysis. General laboratory procedures followed the guidelines of Lovingood and Goss (1980) for use in measuring electric energy used by major cooking appliances:

1. All water used in this study was tap water from the Blacksburg water system and was tempered to 20°C ± 1°C unless otherwise specified. Blacksburg water is naturally about three grains hard and undergoes no treatment except purification and chlorination.

2. Whenever possible, cooking utensils were covered with tight-fitting lids.

3. Foods such as soups, puddings, and sauces were heated to specific endpoint temperatures.

4. Doneness was usually determined by cooking time. However a visual test for doneness was necessary for products such as pancakes and sausage.

5. Electric range unit controls were turned on as soon as a food item was placed on the unit, and remained turned on until the food was completely cooked. The electric oven was preheated to the desired temperature and the food was placed in the oven as soon as the indicator light went off. No attempt was made to finish cooking using retained heat by turning the controls off prior to the end of the cooking period. The microwave oven was turned on after the food was placed in the oven and the door was closed.

6. Cooking utensils were appropriate in size for each appliance and were of materials or design recommended by the manufacturer of each appliance.

7. Appliances and utensils were at room temperature for the start of each analysis.

Equipment and Pretests

Appliances. The electric range used in this study was a 30-inch (76 cm) free standing model with two 6-inch (15 cm) surface units (1500 watts, 240 volts each), two 8-inch (20 cm) surface units (2600 watts, 240 volts each), and a self-cleaning oven (Whirlpool, Model RFE3630). The

microwave oven used was a countertop model with input of 1600 watts, 120 volts; rated output of 650 watts at full power; frequency of 2450 megahertz; and 10 variable power settings with ten percent less wattage for each descending power setting (Litton, Model 1041). These appliances were determined, on the basis of national sales volumes, to be representative of models currently in use (Anonymous, 1980a).

Cookware. Medium gauge aluminum cookware was used on the electric range surface units. The utensils included:

2-liter covered saucepan
3-liter covered saucepan
5-liter covered saucepan
20 cm diameter skillet
50x29 cm griddle

Aluminum and heat resistant glass cookware was used in the oven of the electric range. The baking sheets were aluminum, while the remaining utensils were heat-resistant glass. The utensils included:

39x30 cm baking sheets
1-liter loaf pans
20 cm diameter pie plates
23 cm diameter pie plates
23 cm diameter round cake pans
2-liter covered casserole

In the microwave oven, heat resistant glass and glass-ceramic cookware was used. The utensils included:

170 ml custard cups
1-liter covered casserole
1.5-liter covered casserole

2-liter covered casserole
1-liter loaf pans
340 ml round dish
20 cm diameter pie plates
23 cm diameter pie plates
23 cm round cake pans
29x20 cm browning grill
37x29 cm browning grill

Pretests. The actual output wattage of the microwave oven was measured. One liter of water was placed in a white plastic bowl in the center of the oven and was heated at full power for one minute. The difference between starting and ending temperatures was multiplied by a factor of 70 to give the output wattage. The microwave oven used for this Based on three replications of this test, the microwave oven used for this study was found to have an actual output of 595 watts.

Each food item in this study was prepared at least once, and up to three times, on a "trial" basis before the beginning of replications during which data were collected. This was done to determine the amount of time necessary for cooking, and to reduce variability in total and active preparation time.

Weight

Weight, rounded to the nearest gram after measurement on a Harvard trip balance, was determined for each food before and after cooking. Baked products which were not entrees (biscuits, cornbread, yellow cake, chocolate cake,

apple pie, cookies, white bread, whole wheat bread, white rolls, and sweet rolls) were cooled 30 minutes after baking before being weighed. The other foods were weighed immediately after cooking was completed.

Yield was determined using the convenience food prepared with the electric range, or the ready-to-eat convenience food, as a standard. This food was weighed to the nearest gram and the weight was divided by the suggested number of servings (or by a "reasonable" number if no number was suggested) to give a weight per serving. The weight of each of the other versions of the same product was divided by the weight per serving of the standard product to determine the number of equal weight servings produced.

Time

"Total time," the amount of time needed for all steps from the beginning to the end of product formulation, and "active time," the amount of time for those steps which required full or partial attention of the worker, were measured (Traub and Odland, 1979). The amount of actual heating time for each food was also noted. Timing was started after all ingredients, equipment, and utensils were assembled in one place. Time for cleanup was not recorded. Timing was done using two stopwatches, one measuring total time and the other measuring active time. Times were measured in minutes and hundredths of minutes and rounded to

the nearest half minute.

Energy Consumption

Energy consumption of each appliance was measured using a single stator watthour meter (Duncan, Lafayette, IN). Energy consumption of small portable appliances, such as electric mixers, and energy for refrigerated storage were not measured. Energy consumption was expressed in kilowatt hours and in British Thermal Units (BTUs) to facilitate comparison of electrical energy with other forms of energy in other studies.

Cost

Cost was computed for food, fuel, and active preparation time for each food item. The food cost included the cost of ingredients needed to make the home-prepared items or the cost of the convenience items plus any additional food items needed for completion of preparation. Food costs, listed as money value per pound, were obtained from the spring portion of the 1977-78 USDA Nationwide Food Consumption Survey tapes. The money value per pound was converted to money value per amount of each ingredient used. The 1977 ingredient costs were then updated to 1981 levels by multiplying the 1977 cost by a ratio of the 1981 annual average Consumer Price Index (CPI) for the appropriate commodity group (U.S. Dept. Labor, 1982) to the 1977 annual average CPI for the same commodity group (U.S. Dept.

Agriculture, 1981). The commodity groups used and their 1981:1977 ratios are shown in Table 2. Money values for several food items, primarily spices and herbs, were not available from the USDA tapes. Cost for these items was determined by starting with 1974 prices reported by Traub and Odland (1979) and adjusting these prices to 1981 levels by multiplying by the 1981:1974 ratio for all foods at home (Table 2). The 1981 ingredient costs were added to determine a food cost for the total convenience or home-prepared product (Appendix C) and divided by the number of servings to establish a cost per serving.

Cost of fuel was calculated by multiplying the kilowatt hours of electricity used by 4.97¢, the national average electric rate per kilowatt hour in 1981 which is used in appliance energy guide labeling. The cost was divided by the number of servings to determine an energy cost per serving.

Two values were calculated for the cost of active preparation time. The first value was obtained by multiplying active time by the minimum wage, $3.35 per hour or 5.58¢ per minute. The second value was obtained by multiplying active time by the wage rate of a cook, included in the category of production or nonsupervisory workers on private nonagricultural payrolls (U.S. Dept. Labor, 1973). Since wage increases are frequently tied to increases in the

Table 2

Consumer Price Index For Commodity Groups Used in Cost Calculations

Commodity Group	1981 CPI	1977 CPI	1981/1977
Cereals and bakery products	270.5	183.5	1.474
Meats, poultry, fish, and eggs	252.3	187.4	1.346
Dairy products	243.6	173.9	1.401
Fruits and vegetables	273.2	191.6	1.426
Fats and oils	267.4	191.4	1.397
All foods at home (misc)	269.3	190.2	1.416
Items not on 1977 tape (All foods at home 1974-75)	269.3	169.1	1.592

CPI, the 1974-75 wage figures reported by Traub and Odland (1979) were multiplied by a ratio of the 1981 CPI for all items (U.S. Dept. Labor, 1982) divided by the 1974-75 CPI for all items (U.S. Dept. Agric., 1980a). This ratio, 272.3/154.4 = 1.764, was multiplied by the 1974-75 wage rate to establish a 1981 cook's wage of $8.34 per hour or 13.91¢ per minute. Again, time costs were divided by the number of servings to give a cost per serving.

In addition to reporting the costs of food, fuel, and active time alone, costs were reported as cost of food plus fuel; cost of food, fuel, and active time at minimum wage; and cost of food, fuel, and active time at a cook's wage.

Products with Component Ingredients

For three home-prepared food items (pizza, chicken noodle soup, and chicken pot pie) two values were calculated for energy consumption, total and active preparation time, and/or cost. One value assumed that certain basic ingredients (tomato sauce or chicken broth) had already been prepared and that the energy consumption, preparation time, and cost of time and of energy for these products was zero. The other value reported included the energy, time, and cost of energy and time needed in the preparation of the basic ingredients. For one food product (home-prepared TV dinner) energy and time measurements were made for the total product and for each component.

Food Characteristics

Density, calculated as specific gravity, was determined by weighing 250 ml of the finished product to the nearest gram and dividing by the weight of 250 ml of water. When the finished product consisted of two or more separable items a proportional density was calculated by measuring the volume of each component, determining its proportion compared to the total volume of the food item, and placing a proportional amount of each component in the 250 ml measure to be weighed.

Moisture and fat, as a percent of the total raw weight of each food item, were determined from USDA Handbook 8 (Watt and Merrill, 1963) and its subsequent revisions, and from the Consumer Nutrition Center nutritive value data set (U.S. Dept. Agric., 1980b) as described in the methods section entitled "Nutrient Content." The percent moisture could not be determined for five convenience foods (broccoli, macaroni and cheese, spaghetti sauce, pizza, and pudding); these foods were therefore assigned the same percent moisture as their home-prepared counterparts. Three home-prepared foods (macaroni and cheese, pizza, and TV dinner) were divided into two or more component parts before the calculations for density, moisture, and fat were computed.

The foods were grouped according to whether they had

high or low values for density, moisture, and fat. High density foods were those with densities greater than 0.800, while low density foods had values less than or equal to 0.800. High moisture foods were comprised of more than 75% moisture, while low moisture foods contained 75% moisture or less. Foods which contained more than 10% fat were called high fat foods, while low fat foods contained 10% fat or less.These groupings were similar to those used by Laughon (1980).

The characteristics "low" and "high" were identified by the numbers 1 and 2, respectively (Laughon, 1980). Eight possible categories based on the food characteristic combinations were then identified. These categories were 111: low density, low moisture, low fat; 112: low density, low moisture, high fat; 121: low density, high moisture, low fat; 122: low density, high moisture, high fat; 211: high density, low moisture, low fat; 212: high density, low moisture, high fat; 221: high density, high moisture, low fat; and 222: high density, high moisture, high fat. Each preparation form of each food was placed in one of the eight categories.

For each food, the energy consumption and heating time were divided by the raw weight to establish the energy consumption and heating time per gram of food. Mean values for foods prepared with the electric range and in the

microwave oven in each of the eight categories were then computed.

Degree-of-Readiness

Convenience foods were grouped according to a degree-of-readiness classification scheme described by Matthews, Capps, and Axelson (1982b). The categories in this scheme, listed in descending order from "most ready" to "least ready" were:

00 Eat as is
01 Ready to use
02 Cut, slice, shell
03 Thaw
04 Hydrate
05 Ready to heat
06 Thaw then heat
07 Hydrate then heat
08 Ready to cook
09 Thaw then cook
10 Hydrate then cook
11 Cut, peel then cook
12 Add other ingredients then cook
13 Eviscerate, prepare for cooking, then cook

Foods in this study fell into six of the 13 categories. For each food, total preparation time, active preparation time, and energy consumption were divided by the raw weight of the food to establish the total time, active time, and energy consumption per gram. Mean values for convenience foods and for home-prepared foods in each of the six categories were then computed.

Nutrient Content

The nutrient content of convenience foods and of home-

prepared foods was compared. However, since little information has been published on the nutrient content of a wide variety of foods heated by microwaves, a comparison was not made between foods prepared with an electric range and in a microwave oven.

Nutrient information on water, food energy, protein, fat, crude fiber, calcium, phosphorus, iron, sodium, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid was obtained from USDA Handbook 8 (Watt and Merrill, 1963) and from Handbooks 8-1 (Posati and Orr, 1976), 8-2 (Marsh, Moss, and Murphy, 1977), 8-4 (Reeves and Weihrauch, 1979), 8-5 (Posati, 1979), 8-6 (Marsh, 1980), and 8-7 (Richardson, Posati, and Anderson, 1980). Data for five convenience items (broccoli in sauce, macaroni and cheese mix, spaghetti sauce, frozen sausage pizza, and vanilla pudding mix) were not available from these sources. Nutrient information on these foods was obtained from the Consumer Nutrition Center nutritive value data set "Nutritive Values of Foods Used in the Nationwide Food Consumption Survey, Basic Individual, 1977-78" (U.S. Dept. Agric., 1980b). The tapes did not provide data on water, fiber, or sodium and so the tapes were not used for all foods.

Nutrient data were calculated for the foods as prepared. For the foods which were not listed as already prepared in the sources of nutrient information, nutrient

data were first calculated for each raw ingredient and then cooking losses for water, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid were calculated and subtracted. Loss of water was assumed to be the difference in weight between the raw product and the cooked product. Vitamin losses were calculated using a table listing factors used to estimate the vitamin retention in cooked foods (Merrill, Adams, and Fincher, 1966). All nutrient data were expressed on a per-serving basis.

In order to obtain a single number which would be an indication of the nutrient content of each food a modified version of the Mean Adequacy Ratio (MAR) described by Crocetti and Guthrie (1981) was developed. To calculate the MAR for each food, the per-serving amount of each of nine nutrients - protein, calcium, phosphorus, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid - was divided by the U.S. RDA for that nutrient and then listed as a percent of the U.S. RDA.[1] Any nutrient which met or exceeded the U.S. RDA was given a value of 100.0. A mean value for the nine nutrients was then calculated. A comparison was

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[1] United States Recommended Daily Allowance, developed by the Food and Drug Administration for use in nutrition labeling. The following U.S. RDA values were used: protein- 45 g if the Protein Efficiency Ratio (PER) was ≥ casein, or 65 g if the PER was < casein; calcium- 1.0 g; phosphorus- 1.0 g; iron- 18 mg; vitamin A- 5000 I.U.; thiamin- 1.5 mg; riboflavin- 1.7 mg; niacin- 20 mg; ascorbic acid- 60 mg (U.S. Dept. HEW, 1976).

made between the MAR for each food in its convenience and home-prepared form. Since nutrients for which there is no U.S. RDA are also of interest, a comparison was made between the amount of food energy, fat, percent of calories from fat, sodium, and crude fiber in the convenience and home-prepared versions of each food.

Sensory Evaluation

Fifteen of the twenty food items analyzed in this study (biscuits, pancakes, cornbread, yellow cake, chocolate cake, macaroni and cheese, pizza, pudding, mushroom soup, chicken noodle soup, chocolate chip cookies, white bread, whole wheat bread, white rolls, and sweet rolls) were evaluated by a sensory panel. Each food was evaluated in its four preparation forms, and four replications of each product form, separate from the replications used for time, energy, and yield analyses, were prepared for sensory evaluation. For analysis of ready-to-eat convenience products, both a national brand and a house brand were evaluated. Baked items (biscuits, cornbread, cakes, cookies, breads, and rolls) were made ahead and frozen at -18°C for up to three weeks. Ready-to-eat convenience items were frozen under the same conditions for the same length of time. The baked items were allowed to come to room temperature before serving. The pudding was made 24 hours before serving and allowed to chill at 3°C until served. Items which were

served hot (pancakes, macaroni and cheese, pizza, and the soups) were prepared immediately before serving and were kept hot by holding over a water bath. Because one electric range and one microwave oven were used to prepare both the convenience and home-prepared foods, the following preparation schedule for hot items was followed to eliminate possible differences due to length of holding.

	C-ER	HP-ER	C-MW	HP-MW[2]
Rep 1	1st	2nd	2nd	1st
Rep 2	2nd	1st	1st	2nd
Rep 3	2nd	1st	2nd	1st
Rep 4	1st	2nd	1st	2nd

A panel of 26 judges was selected from faculty, staff, and graduate students in the College of Human Resources at Virginia Polytechnic Institute and State University. Of these 26, 14 judges completed the sensory evaluation, and the results from these 14 judges are reported. The judges selected were asked to refrain from eating a meal for at least 60 minutes before a testing session and from smoking or chewing gum for at least 20 minutes beforehand (ASTM, 1968a).

During a training session prior to the start of the

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[2] C= Convenience food; HP= Home-prepared food; ER= Electric range; MW= Microwave oven.

sensory evaluation, the factors to be scored were defined and the judges were given a chance to practice using the score sheets by evaluating a product that was not actually used in the study. The judges were not paid but were given a token reward at the end of the study.

Sensory evaluation took place twice a week at 10:00 a.m. for nine weeks and twice a week at 2:00 p.m. for six weeks. The panel was held in an evaluation room equipped with eight individual, neutral gray booths. Additional booths were set up in an adjoining room. Warm white 15-watt fluorescent lighting was used. Each booth was equipped with a pencil, glass of distilled water at room temperature, spit cup, napkin, and fork or spoon if needed.

When a judge was seated, a plate was presented containing the four versions of a food product (C-ER, C-MW, HP-ER, and HP-MW; or C-NB, C-HB, HP-ER, and HP-MW).[3] The foods were identified by random three-digit code numbers. Procedures for selection, coding, and presentation of the samples were those suggested by ASTM (1968a) and by Amerine et al. (1965). The judge rated each sample for appearance, texture, flavor, and overall quality using a nine-point scale with descriptors at each of the nine points (Appendix D). The plate was then returned and the judge was given a

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[3] NB = National brand; HB = House brand.

second plate identical to the first but with different code numbers. The samples were ranked in order of preference and the factors responsible for that order of preference were noted (Appendix E). Two food products were evaluated each day. The foods were paired at random although only one hot item was served on any given day. Half of the judges evaluated one product first and the remaining judges evaluated the other product first.

Data Analysis

Three replications of each version of each food product were prepared, and total and active preparation time, energy consumption, and yield were measured. The Kruskal-Wallis test (Hollander and Wolfe, 1973), with tabulated values of the test statistic from Iman, Quade, and Alexander (1975) was used to test for differences among treatments for each food item. This test is used with small samples when there is reason to doubt the assumptions of normality. The test uses the median; both median and mean values are reported. All subsequent analyses were based on median values.

Four replications of each preparation method of fifteen foods were evaluated for sensory quality. Analysis of variance and Duncan's Multiple Range test were used to test for differences among treatment groups for each variable for each food.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

For this study selected convenience foods and their home-prepared counterparts were prepared with an electric range and with a microwave oven. The results for weight and yield, total and active preparation time, energy consumption, cost, food characteristics, degree-of-readiness, nutrient content, and sensory quality are reported and discussed in this chapter.

Weight and Yield

Weight loss during cooking is largely due to evaporation of water (Merrill et al., 1966). The microwave oven heats foods more rapidly and may lead to a greater evaporation of water, and thus greater weight loss, than conventional heating even though heating time in the microwave oven is generally shorter than with the electric range. Foods in which weight retention with the microwave oven was greater than weight retention with the electric range included those which had an ingredient added to the microwave version which was not used for the electric range version (biscuits); those which were fully or partially uncovered during heating with the electric range but were

covered in the microwave oven (pudding, macaroni and cheese); and those where the baking form and amount of surface area were more conducive to evaporation with the electric range than in the microwave oven (cookies). Convenience apple pie and chicken pot pie weighed more when prepared with the electric range than in the microwave oven, but the home-prepared pies weighed more after microwave preparation. This may have been due to the fact that the convenience pies were frozen at the start of heating, and the thawing/evaporation leading to weight loss took place more rapidly in the microwave oven than with the electric range.

Median and mean total product cooked weight for the different preparation forms of each food item are shown in Table 3. Ten items prepared with the electric range (biscuits, pancakes, cornbread, broccoli, pizza, mushroom soup, cookies, white bread, whole wheat bread, and sweet rolls) weighed significantly more ($p<.10$) in the home-prepared than in the convenience version. Eight foods prepared in the microwave oven (biscuits, pancakes, pizza, chicken pot pie, apple pie, cookies, white bread, and sweet rolls) also weighed significantly more ($p<.10$) when prepared from a home recipe. Two microwave-prepared items (chicken noodle soup and fried chicken) weighed significantly more ($p<.10$) in convenience than in home-prepared form. In

Table 3

Median and Mean Weight of Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

	Convenience				Home-Prepared			
	Electric Range		Microwave Oven		Electric Range		Microwave Oven	
	Median (g)	Mean ± SD (g)	Median (g)	Mean ± SD (g)	Median (g)	Mean ± SD (g)	Median (g)	Mean ± SD (g)
Biscuits	266.0^{a}	265.7± 4.5	287.0^{ab}	284.3± 5.5	474.0^{bc}	474.0±10.0	505.0^{c}	507.7± 8.3
Pancakes	276.0^{ab}	277.3± 5.1	239.0^{a}	239.7± 7.0	419.0^{c}	420.0±10.5	343.0^{bc}	341.7± 4.2
Cornbread	509.0^{ab}	510.3± 5.1	500.0^{a}	500.7±12.0	594.0^{b}	597.7± 7.2	581.0^{ab}	584.3± 6.7
Yellow cake	812.0^{a}	805.0±26.2	661.0^{b}	661.7±23.0	771.0^{a}	780.3±22.5	702.0^{ab}	707.3±13.8
Chocolate cake	840.0^{ab}	830.7±19.7	680.0^{a}	680.0±12.0	955.0^{b}	954.7±13.5	826.0^{ab}	827.3±6.1
Broccoli	275.0^{a}	276.0± 2.6	269.0^{a}	270.0± 8.5	335.0	333.0± 3.5	299.0^{ab}	300.3± 7.1
Macaroni & cheese	643.0^{a}	644.3± 2.3	716.0^{ab}	717.0±15.5	681.0^{ab}	685.0±20.3	802.0^{b}	800.3± 5.7
Spaghetti sauce	427.0^{a}	425.7± 4.2	415.0^{ab}	415.7± 8.0	404.0^{ab}	408.7±13.6	354.0^{b}	349.3± 9.0
Pizza	360.0^{ab}	364.7± 9.0	322.0^{a}	315.3±23.7	777.0^{c}	776.7±12.5	745.0^{bc}	743.0± 5.3
Pudding	510.0^{a}	511.0± 4.6	574.0^{ab}	574.3± 4.5	551.0^{ab}	555.0±19.3	587.0^{b}	586.7±10.5
Mushroom soup	568.0^{a}	567.0± 1.7	566.0^{a}	567.3± 7.1	818.0^{b}	823.7±13.4	814.0^{ab}	809.7± 9.3
Chicken noodle soup	607.0^{a}	602.3±14.6	590.0^{a}	585.7± 7.5	503.0^{ab}	504.0± 4.6	484.0^{b}	483.3±16.0
Chicken pot pie	220.0^{ab}	218.0± 7.2	196.0^{a}	200.0± 7.8	863.0^{bc}	863.3±11.5	903.0^{c}	909.7±15.1
Apple pie	561.0^{ab}	559.3± 6.7	514.0^{a}	500.7±27.5	1083.0^{bc}	1083.3± 9.6	1113.0^{c}	1110.7±18.6
TV dinner	320.0^{a}	324.3±24.8	292.0^{ab}	297.7±23.0	303.0^{ab}	302.0± 9.5	263.0^{b}	265.3± 4.9
Carrots	62.0^{a}	62.7± 3.1	48.0^{b}	47.7± 2.5	66.0^{a}	66.0± 1.0	59.0^{ab}	58.7± 1.5
Potatoes	103.0^{a}	103.0± 1.0	95.0^{a}	94.7± 2.5	107.0^{a}	103.0± 7.8	97.0^{a}	95.7± 3.2
Fried chicken	156.0^{a}	158.7±27.1	145.0^{a}	155.3±24.2	129.0^{ab}	131.7± 4.6	110.0^{b}	111.0± 5.6
	Ready-to-Eat							
	Median (g)		Mean ± SD (g)					
Cookies	387.0^{a}		388.7± 3.8		575.0^{b}	575.7± 2.1	605.0^{b}	604.0± 2.6
White bread	458.0^{a}		454.0±12.5		615.0^{b}	620.0±23.9	603.0^{b}	601.3±11.6
Whole wheat bread	475.0^{a}		472.0± 7.0		782.0^{b}	786.0± 8.7	758.0^{ab}	760.0± 8.2
White rolls	362.0^{a}		363.0± 8.5		371.0^{a}	369.0± 7.2	359.0^{a}	357.7± 8.1
Sweet rolls	317.0^{a}		315.0± 6.2		860.0^{b}	856.0±10.6	822.0^{b}	823.0±12.5

a,b,c Within a row, medians with different letters are significantly different ($p < .10$) using the Kruskal-Wallis test.

addition, two convenience foods (yellow cake and carrots) weighed significantly more ($p<.10$) when prepared with the electric range than in the microwave oven.

A comparison of percentage difference in cooked weight between convenience and home-prepared products is shown in Table 4. Thirty-six foods (18 prepared with the electric range and 18 in the microwave oven) weighed more in the home-prepared than in the convenience form. The weight difference expressed as percentage ranged from 2.4% - 74.5% for the items prepared with the electric range, and from 2.1% - 78.3% for the microwave-prepared foods. Weight was greater for ten convenience foods (5 prepared with the electric range and 5 in the microwave oven) than for their home-prepared counterparts. The range of weight difference expressed as percentage was from 5.0% to 17.3% for items prepared with the electric range, and from 0.8% - 24.1% for items prepared in the microwave oven. Traub and Odland (1979) also reported that "many" of the convenience foods analyzed in their study provided fewer servings than their home-prepared counterparts.

As shown in Table 5, thirty-two food items (15 convenience and 17 home-prepared) weighed more when prepared with the electric range than in the microwave oven. The percentage difference in weight ranged from 0.4% to 22.6% for the convenience items and from 0.5% to 18.1% for the

Table 4

Comparison of Total Product Weight Between Convenience and Home-Prepared Foods

HP[1] > C[2]				C > HP			
Electric Range	HP WT[3]	C WT	% Diff[4]	Electric Range	C WT	HP WT	% Diff
White rolls	371	362	2.4	Yellow cake	812	771	5.0
Potatoes	107	103	3.7	TV dinner	320	303	5.3
Macaroni & cheese	681	643	5.6	Spaghetti sauce	427	404	5.4
Carrots	66	62	6.0	Chicken noodle soup	607	503	17.1
Pudding	551	510	7.4	Fried chicken	156	129	17.3
Chocolate cake	955	840	12.0				
*Cornbread	594	509	14.3	Microwave Oven			
*Broccoli	335	274	17.9				
*White bread	615	458	25.5	White rolls	362	359	0.8
*Mushroom soup	818	568	30.6	TV dinner	292	263	9.9
*Cookies	575	387	32.7	Spaghetti sauce	415	354	14.7
*Pancakes	419	275	34.1	*Chicken noodle soup	590	484	18.0
*Whole wheat bread	782	475	39.2	*Fried chicken	145	110	24.1
*Biscuits	474	266	43.9				
Apple pie	1083	561	48.2				
*Pizza	777	360	53.7				
*Sweet rolls	860	317	63.1				
Chicken pot pie	863	220	74.5				
Microwave Oven							
Potatoes	97	95	2.1				
Pudding	587	574	2.2				
Yellow cake	702	661	5.8				
Broccoli	299	269	10.0				
Macaroni & cheese	802	716	10.7				
Cornbread	581	500	13.9				
Chocolate cake	826	680	17.7				
Carrots	59	48	18.6				
*White bread	603	458	24.0				
*Pancakes	343	239	30.3				
Mushroom soup	814	566	30.5				
*Cookies	605	387	36.0				
Whole wheat bread	758	475	37.3				
*Biscuits	505	287	43.2				
*Apple pie	1113	514	53.8				
*Pizza	745	322	56.8				
*Sweet rolls	822	317	61.4				
*Chicken pot pie	903	196	78.3				

1. HP = Home-prepared food
2. C = Convenience food
3. WT = Weight in grams
4. % Difference = $\frac{\text{Larger value-smaller value}}{\text{Larger value}} \times 100$

* Food for which difference significant ($p < .10$) using the Kruskal-Wallis test.

Table 5

Comparison of Total Product Weight Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[1] > MW[2]				MW > ER			
Convenience	ER WT[3]	MW WT	% Diff[4]	Convenience	MW WT	ER WT	% Diff
Mushroom soup	568	566	0.4	Biscuits	287	266	7.3
Cornbread	509	500	1.8	Macaroni & cheese	716	643	10.2
Broccoli	275	269	2.2	Pudding	574	510	11.1
Spaghetti sauce	427	415	2.8				
Chicken noodle soup	607	590	2.8	Home-Prepared			
Fried chicken	156	145	7.0				
Potatoes	103	95	7.8	Apple pie	1113	1083	2.7
Apple pie	561	514	8.4	Chicken pot pie	903	863	4.4
TV dinner	320	292	8.8	Cookies	605	575	5.0
Pizza	360	322	10.6	Pudding	587	551	6.1
Chicken pot pie	220	196	10.9	Biscuits	505	474	6.1
Pancakes	276	239	13.4	Macaroni & cheese	802	681	15.1
*Yellow cake	812	661	18.6				
Chocolate cake	840	640	19.0				
*Carrots	62	48	22.6				
Home-Prepared							
Mushroom soup	818	814	0.5				
White bread	615	603	2.0				
Cornbread	594	581	2.2				
Whole wheat bread	782	758	3.1				
White rolls	371	359	3.2				
Chicken noodle soup	503	484	3.8				
Pizza	777	745	4.1				
Sweet rolls	860	822	4.4				
Yellow cake	771	702	8.9				
Potatoes	107	97	9.3				
Carrots	66	59	10.6				
Broccoli	335	299	10.7				
Spaghetti sauce	404	354	12.4				
TV dinner	303	263	13.2				
Chocolate cake	955	826	13.5				
Fried chicken	129	110	14.7				
Pancakes	419	343	18.1				

1. ER = Electric Range
2. MW = Microwave Oven
3. WT = Weight in grams
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$

* Food for which difference significant ($p < .10$) using the Kruskal-Wallis test.

home-prepared foods. Conversely, nine items (3 convenience and 6 home-prepared) had higher weights when prepared in the microwave oven. For convenience products the percentage weight difference ranged from 7.3% to 11.1%, while for home-prepared items the percentage weight difference ranged from 2.7% to 15.1%.

In summary, the majority (78.3%) of home-prepared foods yielded more equal-weight servings than did convenience foods. This trend was significant ($p<.10$) for 43.5% of foods prepared with the electric range and for 34.8% of foods prepared with the microwave oven. However 8.7% of foods prepared with the microwave oven weighed significantly more ($p<.10$) in the convenience form. Seventy-eight percent of foods prepared with the electric range weighed more than foods prepared with the microwave oven. This trend was significant ($p<.10$) for 11.1% of convenience foods.

For subsequent cost and nutrient analyses, comparisons among the preparation forms for each food product were based on the number of equal weight servings in the product. Table 6 shows the number of servings for each preparation form of each food product. The majority of convenience foods were packaged to yield fewer servings than were the home-prepared counterparts.

Total Time

One of the advantages of convenience foods, as

Table 6

Number of Equal Weight Servings for Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

	Convenience		Home-Prepared	
	Electric Range	Microwave Oven	Electric Range	Microwave Oven
Biscuits (53.2)[1]	5.0	5.4	8.9	9.5
Pancakes (92.0)	3.0	2.6	4.6	3.7
Cornbread (84.8)	6.0	5.9	7.0	6.8
Yellow Cake (67.7)	12.0	9.8	11.4	10.4
Chocolate Cake (70.0)	12.0	9.7	13.6	11.8
Broccoli (68.8)	4.0	3.9	4.9	5.0
Macaroni & cheese (161.0)	4.0	4.4	4.2	5.0
Spaghetti sauce (106.8)	4.0	3.9	3.8	3.3
Pizza (180.0)	2.0	1.8	4.3	4.1
Pudding (127.5)	4.0	4.5	4.3	4.6
Mushroom soup (284.0)	2.0	2.0	2.9	2.9
Chicken noodle soup incl. broth (303.5)	2.0	1.9	1.6	1.6
Chicken pot pie (220.0)	1.0	0.9	3.9	4.1
Apple pie (93.5)	6.0	5.5	11.6	11.9
TV dinner (320.0)	1.0	0.9	0.9	0.8

1. Numbers in parentheses after each food represent the weight in grams of one serving.

Table 6 (Continued)

Number of Equal Weight Servings for Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

	Convenience		Home-Prepared	
	Electric Range	Microwave Oven	Electric Range	Microwave Oven
Carrots (62.0)	1.0	0.8	1.1	1.0
Potatoes (103.0)	1.0	0.9	1.0	0.9
Fried chicken (156.0)	1.0	0.9	0.8	0.7
	Ready-to-Eat			
Cookies (22.8)	17.0		25.2	26.5
White Bread (57.2)	8.0		10.8	10.5
Whole wheat bread (59.4)	8.0		13.1	12.8
White rolls (36.2)	10.0		10.2	9.9
Sweet rolls (39.6)	8.0		21.7	20.8

perceived by consumers, is that convenience foods save time (Tinklin et al., 1972). The time saving may be very great, as when the convenience product is purchased ready-to-eat, or it may be relatively small, as with some mixes that require the addition of other ingredients before cooking. The majority (91.3%) of convenience foods tested in this study required less total preparation time than their home-prepared counterparts. Convenience products which took more total preparation time than the same foods made from raw ingredients included two items where the convenience product required a longer heating time to achieve the same degree of doneness (yellow cake and pudding prepared in the microwave oven); and one item in which the convenience form was frozen at the start of heating and which had a relatively short cooking time (broccoli prepared with the electric range). One item (cornbread prepared with the electric range) took more total time in the convenience form but the time difference was less than one minute.

Median and mean total preparation time for the different versions of each food item are shown in Table 7. Sixteen items prepared with the electric range (biscuits, chocolate cake, macaroni and cheese, spaghetti sauce, pizza with and without sauce time, pudding, mushroom soup, chicken noodle soup with and without broth time, chicken pot pie with broth time, cookies, white bread, whole wheat bread,

Table 7

Median and Mean Total Preparation Time for Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

	Convenience				Home-Prepared			
	Electric Range		Microwave Oven		Electric Range		Microwave Oven	
	Median (min)	Mean ± SD (min)	Median (min)	Mean ± SD (min)	Median (min)	Mean ± SD (min)	Median (min)	Mean ± SD (min)
Biscuits	17.0^{ab}	17.0± 0.5	14.5^{a}	14.5± 0.5	29.0^{c}	29.2± 0.8	20.5^{bc}	20.3± 0.8
Pancakes	8.5^{a}	8.7± 0.8	20.0^{bc}	19.8± 0.3	11.5^{ac}	11.5± 0.5	29.5^{b}	29.7± 0.3
Cornbread	24.0^{a}	23.8± 0.3	13.0^{b}	13.0± 0.0	23.5^{a}	23.7± 0.3	15.0^{ab}	15.2± 0.3
Yellow cake	39.0^{ab}	39.0± 1.0	38.5^{ab}	38.2± 1.0	42.0^{a}	41.7± 0.6	37.0^{b}	36.7± 0.6
Chocolate cake	40.5^{ab}	40.8± 1.0	34.0^{a}	30.8± 5.9	57.0^{c}	57.0± 1.0	48.0^{bc}	48.0± 1.0
Broccoli	22.5^{a}	22.5± 0.5	10.0^{b}	10.2± 0.3	12.0^{bc}	12.2± 0.3	15.5^{ac}	15.3± 0.3
Macaroni & cheese	20.0^{a}	19.8± 0.3	26.0^{ab}	26.0± 0.5	59.0^{c}	58.7± 0.6	42.5^{bc}	42.5± 1.0
Spaghetti sauce	7.5^{a}	7.5± 0.5	8.0^{a}	8.0± 0.0	58.0^{b}	58.0± 1.0	32.5^{ab}	32.3± 0.8
Pizza	18.0^{ab}	17.8± 0.3	12.5^{a}	12.3± 0.3	99.0^{c}	99.0± 0.0	82.0^{bc}	81.8± 0.8
Pizza incl. sauce	18.0^{ab}	17.8± 0.3	12.5^{b}	12.3± 0.3	157.0^{c}	157.0± 1.0	115.0^{ac}	114.2± 1.4
Pudding	12.0^{a}	11.3± 0.8	15.5^{bc}	15.5± 0.5	35.0^{b}	36.0± 1.7	14.5^{ac}	14.5± 0.5
Mushroom soup	12.0^{a}	12.0± 0.5	21.5^{ab}	21.2± 0.6	48.5^{c}	48.8± 0.6	25.0^{bc}	25.3± 1.0
Chicken noodle soup	5.0^{a}	5.0± 0.0	9.0^{ab}	9.0± 0.0	20.5^{bc}	20.3± 0.3	23.0^{c}	23.3± 0.6
Chicken noodle soup incl. broth	5.0^{a}	5.0± 0.0	9.0^{ab}	9.0± 0.0	100.0^{c}	100.7± 1.2	75.5^{bc}	75.5± 0.5
Chicken pot pie	44.5^{ab}	44.3± 0.3	8.0^{b}	8.2± 0.3	55.0^{a}	55.3± 1.0	31.0^{bc}	31.3± 0.6
Chicken pot pie incl. broth	44.5^{ab}	44.3± 0.3	8.0^{a}	8.2± 0.3	136.0^{c}	136.0± 0.5	83.0^{bc}	83.5± 1.3
Apple pie	39.0^{ab}	39.2± 0.3	13.5^{c}	13.7± 0.3	67.0^{a}	67.3± 0.6	37.0^{bc}	37.2± 0.3
TV dinner	43.0^{ab}	43.2± 0.3	9.0^{c}	8.8± 0.3	57.0^{a}	56.8± 0.8	42.5^{bc}	42.3± 0.3
Carrots	-	-	-	-	14.0^{a}	14.0± 0.0	10.0^{b}	10.0± 0.0
Potatoes	-	-	-	-	21.0^{a}	20.7± 0.6	12.0^{b}	11.8± 0.3
Fried chicken	-	-	-	-	22.0^{a}	22.2± 0.3	20.5^{b}	20.5± 0.5
	Ready-to-Eat							
	Median	Mean ± SD						
Cookies	0.0^{a}	0.0± 0.0			30.0^{b}	30.2± 0.3	18.5^{b}	18.5± 0.5
White bread	0.0^{a}	0.0± 0.0			192.0^{b}	192.0± 1.0	173.0^{b}	173.3± 1.0
Whole wheat bread	0.0^{a}	0.0± 0.0			188.0^{b}	187.3± 2.1	168.0^{b}	167.3± 2.1
White rolls	0.0^{a}	0.0± 0.0			167.5^{b}	167.7± 0.8	153.5^{b}	153.7± 0.8
Sweet rolls	0.0^{a}	0.0± 0.0			175.5^{b}	175.3± 1.3	165.5^{b}	165.3± 1.3

a,b,c Within a row, medians with different letters are significantly different ($p<.10$) using the Kruskal-Wallis test.

white rolls, and sweet rolls) took significantly more total time ($p<.10$) in home-prepared than in convenience form, while one convenience food prepared with the electric range (broccoli) required significantly more total time ($p<.10$) than its home-prepared counterpart. Twelve items prepared in the microwave oven (biscuits, chocolate cake, broccoli, pizza with and without sauce time, chicken noodle soup without broth time, chicken pot pie with broth time, cookies, white bread, whole wheat bread, white rolls, and sweet rolls) took significantly more total preparation time ($p<.10$) in home-prepared than in convenience form.

Foods heated in a microwave oven frequently require less total preparation time than those heated with an electric range since a microwave oven may heat foods more efficiently (Van Zante, 1973). The majority (78.0%) of items tested in this study took more total preparation time with the electric range than in the microwave oven. Items which required more total time in the microwave than in the electric range (convenience spaghetti sauce, pudding, macaroni and cheese, mushroom soup, chicken noodle soup, and pancakes, and home-prepared chicken noodle soup, broccoli, and pancakes) were all ones which were prepared on a surface unit of the electric range. Laughon (1980) also found that a majority of items required less cooking time with a microwave oven than with an electric range, althougn she

reported that some items required longer to heat in the microwave than on an electric range surface unit.

As indicated in Table 7, five convenience foods (cornbread, broccoli, chicken pot pie, apple pie, and TV dinner) required significantly more total preparation time ($p<.10$) when prepared with the electric range than in the microwave oven. Two convenience items (pancakes and pudding) took significantly more total time ($p<.10$) in the microwave oven than on an electric range surface unit. Eight home-prepared items (yellow cake, pudding, chicken pot pie, apple pie, TV dinner, carrots, mashed potatoes, and fried chicken) required significantly more total preparation time ($p<.10$) with the electric range than in the microwave oven, while one home-prepared food (pancakes) took significantly more total preparation time ($p<.10$) in the microwave oven than on an electric range surface unit.

A comparison of percentage difference in total preparation time between home-prepared and convenience products is shown in Table 8. Forty-two items (21 electric range and 21 microwave oven) required more total preparation time in the home-prepared than in the convenience form. The percentage time difference ranged from 7.1% - 100.0% for items prepared with the electric range, and from 13.3% - 100.0% for items prepared in the microwave oven. Four items (2 electric range and 2 microwave oven) required more total

Table 8

Comparison of Total Preparation Time Between Convenience and Home-Prepared Foods

HP[1] > C[2]				C > HP			
Electric Range	HP TT[3]	C TT	% Diff[4]	Electric Range	C TT	HP TT	% Diff
Yellow cake	42.0	39.0	7.1	Cornbread	24.0	23.5	2.1
Chicken pot pie	55.0	44.5	19.1	*Broccoli	22.5	12.0	46.7
TV dinner	57.0	43.0	24.6				
Pancakes	11.5	8.5	26.1	Microwave Oven			
*Chocolate cake	57.0	40.5	28.9				
*Biscuits	29.0	17.0	41.4	Yellow cake	38.5	37.0	3.9
Apple pie	67.0	39.0	41.8	Pudding	15.5	14.5	6.4
*Pudding	35.0	12.0	65.7				
*Macaroni & cheese	59.0	20.0	66.1				
*Chicken pot pie incl. broth	136	44.5	67.3				
*Mushroom soup	48.5	12.0	75.2				
*Chicken noodle soup	20.5	5.0	75.6				
*Pizza	99.0	18.0	81.8				
*Spaghetti sauce	58.0	7.5	87.1				
*Pizza incl. sauce	157.0	18.0	88.5				
*Chicken noodle soup	100.0	5.0	95.0				
*Cookies	30.0	0.0	100.0				
*White bread	192.0	0.0	100.0				
*Whole wheat bread	188.0	0.0	100.0				
*White rolls	167.0	0.0	100.0				
*Sweet rolls	175.0	0.0	100.0				
Microwave Oven							
Cornbread	15.0	13.0	13.3				
Mushroom soup	25.0	21.5	14.0				
*Chocolate cake	48.0	34.0	29.2				
*Biscuits	20.5	14.5	29.3				
Pancakes	29.5	20.0	32.2				
*Broccoli	15.5	10.0	35.5				
Macaroni & cheese	42.5	26.0	38.8				
*Chicken noodle soup	23.0	9.0	60.9				
Apple pie	37.0	13.5	63.5				
Chicken pot pie	31.0	8.0	74.2				
Spaghetti sauce	32.5	8.0	75.4				
TV dinner	42.5	9.0	78.8				
*Pizza	82.0	12.5	84.8				
Chicken noodle soup incl. broth	75.5	9.0	88.1				
*Pizza incl. sauce	115.0	12.5	89.1				
*Chicken pot pie incl broth	83.0	8.0	90.4				
*Cookies	18.5	0.0	100.0				
*White bread	173.0	0.0	100.0				
*Whole wheat bread	168.0	0.0	100.0				
*White rolls	153.5	0.0	100.0				
*Sweet rolls	165.5	0.0	100.0				

1. HP = Home-prepared food
2. C = Convenience food
3. TT = Total preparation time in minutes
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$

* Food for which difference significant ($p < .10$) using the Kruskal-Wallis test.

time in the convenience than in the home-prepared form. The range of percentage time difference was from 2.1% - 46.7% for the items prepared with the electric range, and from 3.9% - 6.4% for the microwave-prepared foods.

Table 9 shows a comparison of percentage difference in total preparation time between items prepared with the electric range and items prepared in the microwave oven. Thirty-two foods (9 convenience and 23 home-prepared) required more total time when prepared with the electric range than in the microwave oven. The range of percentage time difference was from 1.3 - 82.0% for the convenience items, and from 5.7% - 58.6% for the home-prepared products. Nine items (6 convenience and 3 home-prepared) took more total time when prepared in the microwave oven than with the electric range. The percentage time difference ranged from 6.2% - 57.5% for the convenience items, and from 10.9% - 61.0% for the home-prepared foods.

To summarize, the majority (91.3%) of home-prepared foods required more total preparation time than did convenience foods. This finding was significant ($p<.10$) for 69.6% of foods prepared with the electric range and for 52.2% of foods prepared with the microwave oven. However, 4.3% of foods prepared with the electric range required significantly more total preparation time ($p<.10$) in convenience than in home-prepared form. Most foods prepared

Table 9

Comparison of Total Preparation Time Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[1] > MW[2]				MW > ER			
Convenience	ER TT[3]	MW TT	% Diff[4]	Convenience	MW TT	ER TT	% Diff
Yellow cake	39.0	38.5	1.3	Spaghetti sauce	8.0	7.5	6.2
Biscuits	17.0	14.5	14.7	*Pudding	15.5	12.0	22.6
Chocolate cake	40.5	34.0	16.0	Macaroni & cheese	26.0	20.0	23.1
Pizza	18.0	12.5	30.6	Mushroom soup	21.5	12.0	44.2
*Cornbread	24.0	13.0	45.8	Chicken noodle soup	9.0	5.0	44.4
*Broccoli	22.5	10.0	55.6	*Pancakes	20.0	8.5	57.5
*Apple pie	39.0	13.5	65.4				
*TV dinner	43.0	9.0	79.1	Home-Prepared			
*Chicken pot pie	44.5	8.0	82.0				
				Chicken noodle soup	23.0	20.5	10.9
Home-Prepared				Broccoli	15.5	12.0	22.6
				*Pancakes	29.5	11.5	61.0
Sweet rolls	175.5	165.5	5.7				
*Fried chicken	22.0	20.5	6.8				
White rolls	167.5	153.5	8.4				
White bread	192.0	173.0	9.9				
Whole wheat bread	188.0	168.0	10.6				
*Yellow cake	42.0	37.0	11.9				
Chocolate cake	57.0	48.0	15.8				
Pizza	99.0	82.0	17.2				
Chicken noodle soup incl broth	100.0	75.5	24.5				
*TV dinner	57.0	42.5	25.4				
Pizza incl. sauce	157.0	115.0	26.8				
Macaroni & cheese	59.0	42.5	28.0				
*Carrots	14.0	10.0	28.6				
Biscuits	29.0	20.5	29.3				
Cornbread	23.5	15.0	36.2				
Cookies	30.0	18.5	38.3				
Chicken pot pie incl. broth	136.0	83.0	39.0				
*Potatoes	21.0	12.0	42.8				
*Chicken pot pie	55.0	31.0	43.6				
Spaghetti sauce	58.0	32.5	44.0				
*Apple pie	67.0	37.0	44.8				
Mushroom soup	48.5	25.0	48.4				
*Pudding	35.0	14.5	58.6				

1. ER = Electric Range
2. MW = Microwave Oven
3. TT = Total preparation time in minutes
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$

* Food for which difference significant ($p < .10$) using the Kruskal-Wallis test.

with the electric range (78.0%) required more total preparation time than did foods prepared with the microwave oven. This trend was significant ($p<.10$) for 33.3% of convenience foods and for 30.8% of home-prepared foods. However, 13.3% of convenience foods and 3.8% of home-prepared foods required more total preparation time when heated with the microwave oven.

Active Time

Active preparation time may be more important to a food preparer than total preparation time since active time consists of the time requiring the actual attention of the worker. Convenience foods would be expected to take less active preparation time than their home-prepared counterparts, and in this study all convenience foods tested, whether prepared with the electric range or the microwave oven, did take less active time to prepare than the same foods prepared from raw ingredients. These results are similar to those reported by Traub and Odland (1979), Quam et al. (1967), Woolsey and Tinklin (1966), and King et al. (1962).

Median and mean active preparation time for the different versions of each food product are shown in Table 10. All items tested required more active preparation time in the home-prepared than in the convenience form. Sixteen items prepared with the electric range (biscuits, pancakes,

Table 10

Median and Mean Active Preparation Time for Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

	Convenience				Home-Prepared			
	Electric Range		Microwave Oven		Electric Range		Microwave Oven	
	Median (min)	Mean ± SD (min)	Median (min)	Mean ± SD (min)	Median (min)	Mean ± SD (min)	Median (min)	Mean ± SD (min)
Biscuits	2.5^{a}	2.3± 0.3	9.5^{ab}	9.5± 0.5	11.5^{bc}	11.5± 0.5	18.5^{c}	18.2± 0.6
Pancakes	8.5^{a}	8.7± 0.8	10.5^{ab}	10.3± 0.3	11.5^{bc}	11.5± 0.5	19.5^{c}	19.3± 0.3
Cornbread	4.5^{a}	4.3± 0.3	4.5^{ab}	4.5± 0.0	6.5^{b}	6.5± 0.0	6.5^{b}	6.5± 0.0
Yellow cake	11.5^{a}	11.8± 0.6	12.0^{ab}	12.0± 0.5	16.5^{b}	16.3± 0.8	16.5^{b}	16.2± 1.0
Chocolate cake	10.0^{a}	10.0± 0.0	10.0^{a}	9.8± 0.3	21.0^{ab}	21.0± 1.0	21.5^{b}	21.8± 1.0
Broccoli	2.5^{a}	2.3± 0.3	2.5^{a}	2.3± 0.3	6.0^{ab}	6.2± 0.3	6.5^{b}	6.5± 0.5
Macaroni & cheese	6.0^{a}	5.8± 0.3	5.0^{a}	5.2± 0.3	24.0^{b}	24.5± 1.3	15.5^{ab}	15.5± 0.5
Spaghetti sauce	1.0^{a}	1.2± 0.3	2.0^{ab}	2.0± 0.0	12.5^{b}	12.7± 0.3	11.5^{b}	11.7± 0.8
Pizza	2.0^{a}	2.0± 0.0	2.0^{a}	2.0± 0.0	30.0^{b}	30.0± 1.0	26.0^{ab}	25.8± 0.8
Pizza incl. sauce	2.0^{a}	2.0± 0.0	2.0^{a}	2.0± 0.0	43.0^{b}	42.7± 1.0	37.5^{ab}	37.5± 1.0
Pudding	12.0^{ab}	11.8± 0.8	4.0^{c}	4.0± 0.0	18.0^{a}	18.3± 0.6	7.5^{bc}	7.5± 0.5
Mushroom soup	5.5^{ab}	5.7± 0.3	4.0^{a}	3.8± 0.3	12.0^{bc}	11.7± 0.6	16.0^{c}	15.7± 0.6
Chicken noodle soup	1.0^{a}	1.0± 0.0	1.0^{a}	1.0± 0.0	1.5^{b}	1.5± 0.0	1.5^{b}	1.5± 0.0
Chicken noodle soup incl. broth	1.0^{a}	1.0± 0.0	1.0^{a}	1.0± 0.0	17.5^{ab}	17.8± 1.0	20.0^{b}	20.2± 0.8
Chicken pot pie	1.5^{a}	1.5± 0.0	1.5^{a}	1.5± 0.0	24.0^{ab}	24.2± 0.8	27.0^{b}	26.8± 0.8
Chicken pot pie incl. broth	1.5^{a}	1.5± 0.0	1.5^{a}	1.5± 0.0	39.5^{ab}	40.5± 1.7	45.5^{b}	46.0± 1.3
Apple pie	1.5^{a}	1.5± 0.0	2.0^{ab}	2.0± 0.0	27.0^{b}	27.2± 0.3	27.0^{b}	27.0± 0.5
TV dinner	1.0^{a}	1.0± 0.0	2.0^{ab}	1.8± 0.3	12.0^{bc}	12.0± 0.0	12.5^{c}	12.5± 0.0
Carrots	-	-	-	-	3.0^{a}	3.0± 0.0	3.5^{b}	3.5± 0.0
Potatoes	-	-	-	-	4.0^{a}	4.0± 0.0	4.0^{a}	4.0± 0.0
Fried chicken	-	-	-	-	5.0^{a}	5.0± 0.0	5.0^{a}	5.0± 0.0
	Ready-to-Eat							
	Median (min)	Mean ± SD (min)						
Cookies	0.0^{a}	0.0± 0.0			22.0^{b}	22.0± 0.5	13.0^{b}	13.3± 0.6
White bread	0.0^{a}	0.0± 0.0			22.0^{b}	22.3± 1.0	22.0^{b}	22.3± 1.0
Whole wheat bread	0.0^{a}	0.0± 0.0			33.0^{b}	32.5± 1.3	33.0^{b}	32.5± 1.3
White bread	0.0^{a}	0.0± 0.0			22.5^{b}	22.7± 0.8	22.5^{b}	22.7± 0.8
Sweet rolls	0.0^{a}	0.0± 0.0			35.5^{b}	35.3± 1.3	35.5^{b}	35.3± 1.3

a,b,c Within a row, medians with different letters are significantly different ($p < .10$) using the Kruskal-Wallis test.

cornbread, yellow cake, macaroni and cheese, spaghetti sauce, pizza with and without sauce time, chicken noodle soup without broth time, apple pie, TV dinner, cookies, white bread, whole wheat bread, white rolls, and sweet rolls) required significantly more active preparation time ($p<.10$) in the home-prepared than in the convenience form. Fifteen foods prepared in the microwave oven (biscuits, pancakes, chocolate cake, broccoli, mushroom soup, chicken noodle soup with and without broth time, chicken pot pie with and without broth time, TV dinner, cookies, white bread, whole wheat bread, white rolls, and sweet rolls) took significantly more active preparation time ($p<.10$) in the home-prepared form.

Although, in general, foods prepared in the microwave oven required less total preparation time than those prepared with the electric range, the reverse was true for active preparation time. The majority (78.0%) of items tested either required more active preparation time in the microwave oven than with the electric range, or the active preparation time was equal for the two appliances. Many of the items prepared in the microwave oven required turning or stirring part way through cooking or required an extra step such as removal from their original container. In addition, a browning grill, which required preheating, was used to prepare several items in the microwave. All of these

additional steps contributed to the greater active preparation time required for these microwave products.

As shown in Table 10, one convenience item (pudding) required significantly more active preparation time ($p<.10$) with the electric range than in the microwave oven. Home-prepared pudding also took significantly more active time ($p<.10$) when prepared with the electric range. In both cases the pudding required more stirring on the electric range than in the microwave oven. One home-prepared food (carrots) took significantly more active preparation time ($p<.10$) in the microwave oven, although the difference between the median values for the two appliances was less than one minute.

A comparison of percentage difference in active preparation time between convenience and home-prepared foods is shown in Table 11. Forty-six items (23 electric range and 23 microwave oven) took more active preparation time in the home-prepared than in the convenience form. The percentage time difference ranged from 26.1% - 100.0% for items prepared with the electric range, and from 27.3% - 100.0% for items prepared in the microwave oven.

The percentage difference in active time between items prepared with the electric range and in the microwave oven is shown in Table 12. Nine items (3 convenience and 6 home-prepared) required more active time when prepared with the

Table 11

Comparison of Active preparation Time Between Convenience and Home-Prepared Foods

	HP[1] > C[2]		
Electric Range	HP AT[3]	C AT	% Diff[4]
*Pancakes	11.5	8.5	26.1
*Yellow cake	16.5	11.5	30.3
*Cornbread	6.5	4.5	30.8
Pudding	18.0	12.0	33.3
*Chicken noodle soup	1.5	1.0	33.3
Chocolate cake	21.0	10.0	47.6
Mushroom soup	12.0	5.5	54.2
Broccoli	6.0	2.5	58.3
*Macaroni & cheese	24.0	6.0	75.0
*Biscuits	11.5	2.5	78.3
*TV dinner	12.0	1.0	91.7
*Spaghetti sauce	12.5	1.0	92.0
*Pizza	30.0	2.0	93.3
Pot pie	24.0	1.5	93.8
Chicken noodle soup incl. broth	17.5	1.0	94.3
*Apple pie	27.0	1.5	94.4
*Pizza incl. sauce	43.0	2.0	95.3
Chicken pot pie incl. broth	39.5	1.5	96.2
*Cookies	22.0	0.0	100.0
*White bread	22.0	0.0	100.0
*Whole wheat bread	33.0	0.0	100.0
*White rolls	22.5	0.0	100.0
*Sweet rolls	35.5	0.0	100.0
Microwave Oven			
Yellow cake	16.5	12.0	27.3
Cornbread	6.5	4.5	30.8
*Chicken noodle soup	1.5	1.0	33.3
*Pancakes	19.5	10.5	46.2
Pudding	7.5	4.0	46.7
*Biscuits	18.5	9.5	48.6
*Chocolate cake	21.5	10.0	53.5
*Broccoli	6.5	2.5	61.5
Macaroni & cheese	15.5	5.0	67.7
*Mushroom soup	16.0	4.0	75.0
Spaghetti sauce	11.5	2.0	82.6
*TV dinner	12.5	2.0	84.0
Pizza	26.0	2.0	92.3
Apple pie	27.0	2.0	92.6
*Chicken pot pie	27.0	1.5	94.4
Pizza incl. sauce	37.5	2.0	94.7
*Chicken noodle soup incl. broth	20.0	1.0	95.0
*Chicken pot pie incl broth	45.5	1.5	96.7
*Cookies	13.0	0.0	100.0
*White bread	22.0	0.0	100.0
*Whole wheat bread	33.0	0.0	100.0
*White rolls	22.5	0.0	100.0
*Sweet rolls	35.0	0.0	100.0

1. HP = Home-prepared food
2. C = Convenience food
3. AT = Active preparation time in minutes
4. % Difference = $\frac{\text{Larger value-smaller value}}{\text{Larger value}} \times 100$

* Food for which difference significant ($p<.10$) using the Kruskal-Wallis test.

Table 12

Comparison of Active Preparation Time Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[1] > MW[2]				MW > ER			
Convenience	ER AT[3]	MW AT	% Diff[4]	Convenience	MW AT	ER AT	% Diff
Macaroni & cheese	6.0	5.0	16.7	Yellow cake	12.0	11.5	4.2
Mushroom soup	5.5	4.0	27.3	Pancakes	10.5	8.5	19.0
*Pudding	12.0	4.0	66.7	Apple pie	2.0	1.5	25.0
				Spaghetti sauce	2.0	1.0	50.0
Home-Prepared				TV dinner	2.0	1.0	50.0
				Biscuits	9.5	2.5	73.7
Spaghetti sauce	12.5	11.5	8.0				
Pizza incl. sauce	42.7	37.5	12.2	Home-Prepared			
Pizza	30.0	25.8	14.0				
Macaroni & cheese	24.0	15.5	35.4	Chocolate cake	21.5	21.0	2.3
Cookies	22.0	13.0	40.9	TV dinner	12.5	12.0	4.0
*Pudding	18.0	7.5	58.3	Broccoli	6.5	6.0	7.7
				Chicken pot pie	27.0	24.0	11.1
ER = MW				Chicken noodle soup incl. broth	20.0	17.5	12.5
Convenience				Chicken pot pie incl. broth	45.5	39.5	13.2
				*Carrots	3.5	3.0	14.3
Chicken noodle soup	1.0	1.0	0.0	Mushroom soup	16.0	12.0	25.0
Chicken pot pie	1.5	1.5	0.0	Biscuits	18.5	11.5	37.8
Pizza	2.0	2.0	0.0	Pancakes	19.5	11.5	41.0
Broccoli	2.5	2.5	0.0				
Cornbread	4.5	4.5	0.0				
Chocolate cake	10.0	10.0	0.0				
Home-Prepared							
Chicken noodle soup	1.5	1.5	0.0				
Potatoes	4.0	4.0	0.0				
Fried chicken	5.0	5.0	0.0				
Cornbread	6.5	6.5	0.0				
Yellow cake	16.5	16.5	0.0				
White bread	22.0	22.0	0.0				
White rolls	22.5	22.5	0.0				
Apple pie	27.0	27.0	0.0				
Whole wheat bread	33.0	33.0	0.0				
Sweet rolls	35.5	35.5	0.0				

1. ER = Electric Range
2. MW = Microwave Oven
3. AT = Active Preparation Time in minutes
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$

* Food for which difference significant ($p<.10$) using the Kruskal-Wallis test.

electric range. The percentage time difference ranged from 16.7% - 66.7% for the convenience items and from 8.0% - 58.3% for home-prepared products. Sixteen items (6 convenience and 10 home-prepared) took more active time when prepared in the microwave oven. The range of percentage time difference was from 4.2% - 73.7% for convenience items and from 2.3% to 41.0% for home-prepared items. Sixteen foods (6 convenience and 10 home-prepared) required the same amount of active time when prepared with either the electric range or the microwave oven.

In summary, all home-prepared foods tested (100.0%) required more active preparation time than the convenience counterparts. The difference in amount of time required was significant ($p<.10$) for 69.6% of foods prepared with the electric range and for 65.2% of foods prepared with the microwave oven. A trend was seen for foods prepared with the microwave oven to require more active preparation time (39.0% of foods tested) or the same amount of active time (39.0% of foods tested) as foods prepared with the electric range. This trend was significant ($p<.10$) for 3.8% of home-prepared foods. However 6.7% of convenience foods and 3.8% of home-prepared foods required significantly more active preparation time ($p<.10$) when heated with the electric range.

Energy Consumption

Convenience foods as purchased are fully or partially prepared and would thus be expected to take less energy for completion of preparation than would the same foods made from raw ingredients. In this study the majority (78.3%) of convenience foods tested did take less energy to prepare than their home-prepared counterparts, in agreement with previous work by Traub and Odland (1979). Foods where the convenience product required more preparation energy than the home-prepared product included the convenience foods frozen at the start of heating and those that required a higher temperature and/or longer heating time than the home-prepared product (broccoli, pizza, apple pie, and TV dinner). In addition, convenience products not frozen at the start of heating, but requiring a longer heating time to achieve the same degree of doneness in the convenience than in the home-prepared form (yellow cake, pudding, mushroom soup), took more preparation energy in convenience than in home-prepared form.

Median and mean total product energy consumption for the different preparation forms of each food item are shown in Table 13. Eight items prepared with the electric range (macaroni and cheese, spaghetti sauce, chicken noodle soup including broth, cookies, white bread, whole wheat bread, white rolls, and sweet rolls) required significantly more

Table 13

Median and Mean Energy Consumption for Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

	Convenience				Home-Prepared			
	Electric Range		Microwave Oven		Electric Range		Microwave Oven	
	Median (wh)	Mean ± SD (wh)	Median (wh)	Mean ± SD (wh)	Median (wh)	Mean ± SD (wh)	Median (wh)	Mean ± SD (wh)
Biscuits	602.0^{ab}	601.7± 7.5	198.0^{b}	197.0± 1.7	768.0^{a}	766.7± 8.1	199.0^{b}	198.7± 1.5
Pancakes	302.0^{ab}	310.0±17.4	266.0^{a}	266.3± 0.6	335.0^{ab}	334.0± 5.6	372.0^{b}	371.7± 2.5
Cornbread	757.0^{ab}	760.0±78.5	151.0^{b}	151.3± 1.5	792.0^{a}	797.3±34.3	151.0^{b}	151.7± 1.2
Yellow cake	579.0^{a}	568.0±21.7	403.0^{ab}	403.0± 0.0	573.0^{a}	572.7±18.5	310.0^{b}	311.0± 5.6
Chocolate cake	312.0^{ab}	312.0± 9.6	406.0^{c}	404.3± 6.7	975.0^{a}	982.3±33.6	506.0^{bc}	505.0± 3.6
Broccoli	318.0^{a}	317.0± 4.6	196.0^{b}	196.0± 3.0	152.0^{b}	151.7± 1.5	241.0^{ab}	242.7± 2.9
Macaroni & cheese	302.0^{a}	300.7± 9.1	315.0^{ab}	315.0± 4.0	1179.0^{c}	1172.3±20.8	396.0^{bc}	396.0± 0.0
Spaghetti sauce	62.0^{a}	62.0± 3.0	116.0^{ab}	116.0± 2.0	209.0^{bc}	204.0± 15.1	394.0^{c}	393.7±15.3
Pizza	822.0^{a}	817.7±15.0	262.0^{b}	262.7± 0.6	585.0^{ac}	586.3±10.1	353.0^{bc}	354.7± 5.7
Pizza incl. sauce	822.0^{a}	817.7±15.0	262.0^{b}	261.7± 0.6	794.0^{a}	790.3±24.7	747.0^{ab}	748.3± 7.1
Pudding	111.0^{a}	109.3± 5.7	215.0^{b}	215.3± 0.6	137.0^{ac}	137.0± 3.0	144.0^{bc}	145.0± 2.6
Mushroom soup	113.0^{a}	112.7± 3.5	239.0^{b}	240.3± 3.2	164.0^{ac}	163.0± 3.6	218.0^{bc}	219.0± 1.7
Chicken noodle soup	120.0^{a}	118.3± 7.6	190.0^{ab}	190.7± 1.2	189.0^{ab}	190.3± 7.1	348.0^{b}	347.7± 0.6
Chicken noodle soup incl. broth	120.0^{a}	118.3± 7.6	190.0^{ab}	190.7± 1.2	887.0^{c}	909.0±44.3	844.0^{bc}	844.0± 2.0
Chicken pot pie	942.0^{ab}	946.0±12.5	142.0^{c}	142.3± 1.5	1114.0^{a}	1115.0±29.5	344.0^{bc}	344.0± 1.0
Chicken pot pie incl. broth	942.0^{ab}	946.0±12.5	142.0^{c}	142.3± 1.5	1827.0^{a}	1833.7±20.8	840.0^{bc}	840.3± 0.6
Apple pie	948.0^{a}	949.3± 5.1	279.0^{ab}	278.7± 1.5	947.0^{a}	949.0±12.1	241.0^{b}	242.0± 2.6
TV dinner	892.0^{a}	892.3±26.5	170.0^{b}	169.7± 0.6	447.0^{bc}	448.3± 5.1	707.0^{ac}	707.7± 3.1
Carrots	-	-	-	-	97.0^{a}	95.7± 5.1	139.0^{b}	138.3± 2.1
Potatoes	-	-	-	-	117.0^{a}	117.3± 5.5	140.0^{b}	140.3± 0.6
Fried chicken	-	-	-	-	235.0^{a}	235.3± 5.0	429.0^{b}	429.0± 1.0
	Ready-to-Eat							
	Median (wh)	Mean ± SD (wh)						
Cookies	0.0^{a}	0.0±0			740.0^{b}	743.0±10.8	130.0^{b}	131.3± 2.3
White bread	0.0^{a}	0.0±0			677.0^{b}	680.3±11.4	186.0^{b}	186.0± 1.0
Whole wheat bread	0.0^{a}	0.0±0			786.0^{b}	785.7± 5.5	185.0^{b}	185.0± 1.0
White rolls	0.0^{a}	0.0±0			601.0^{b}	602.3±13.0	85.0^{b}	85.0± 1.0
Sweet rolls	0.0^{a}	0.0±0			525.0^{b}	525.0± 7.0	134.0^{b}	134.3± 0.6

a,b,c Within a row, medians with different letters are significantly different ($p<.10$) using the Kruskal-Wallis test.

energy for preparation ($p<.10$) in home-prepared than in convenience form. However, two items prepared with the electric range (broccoli and TV dinner) used significantly more energy ($p<.10$) in the convenience form than in the home-prepared form. Eight items prepared in the microwave oven (pancakes, spaghetti sauce, TV dinner, cookies, white bread, whole wheat bread, white rolls, and sweet rolls) required significantly more energy for preparation ($p<.10$) in home-prepared than in convenience form.

A microwave oven heats many foods more efficiently than an electric range since the microwave energy is converted to heat within the foods whereas with the electric range heat is transferred to the interior of the food by conduction (Van Zante, 1973). The majority (63.4%) of food items in this study required more energy to prepare with the electric range than in the microwave oven, in agreement with previous studies (Baker et al., 1981; Drew et al., 1980; Voris and Van Duyne, 1979; Drew and Rhee, 1978; McConnell, 1974). However, a number of items (convenience pancakes, broccoli, macaroni and cheese, spaghetti sauce, pudding, mushroom soup, and chicken noodle soup, and the home-prepared TV dinner and its individual components) required more energy to prepare in the microwave oven than with the electric range. All of these items were ones which were heated entirely on a surface unit of the electric range. Hassoun

(1982), Laughon (1980), Rhee and Drew (1977), Butel (1975b), and Carucci (1974) also reported that items prepared on an electric range surface unit required less energy or approximately the same amount of energy as the same items prepared in a microwave oven.

As shown in Table 13, five convenience foods (chocolate cake, broccoli, pizza, chicken pot pie, and TV dinner) used significantly more energy ($p<.10$) when prepared in the electric range than in the microwave oven. Similarly, seven home-prepared items (biscuits, cornbread, yellow cake, chocolate cake, chicken pot pie with and without broth, and apple pie) required significantly more energy ($p<.10$) to prepare with the electric range. Two convenience foods (pudding and mushroom soup) took significantly more energy ($p<.10$) to prepare in the microwave oven than with the electric range, and three home-prepared items (carrots, potatoes, and fried chicken) also required significantly more energy ($p<.10$) to prepare in the microwave oven.

A comparison of percentage difference in total product energy consumption between convenience and home-prepared items is shown in Table 14. Thirty-five food items (17 prepared using an electric range and 18 using a microwave oven) required more energy in home-prepared than in convenience form. The percentage difference in energy consumption ranged from 4.4% - 100.0% for items prepared

Table 14

Comparison of Energy Consumption Between Convenience and Home-Prepared Foods

HP[1] > C[2]				C > HP			
Electric Range	HP EN[3]	C EN	% Diff[4]	Electric Range	C EN	HP EN	% Diff
Cornbread	792	757	4.4	Apple pie	948	947	0.1
Pancakes	335	302	9.8	Yellow cake	579	573	1.0
Chicken pot pie	1114	942	15.4	Pizza incl. sauce	822	794	3.4
Chocolate cake	975	816	16.3	Pizza	822	585	28.8
Pudding	137	111	19.0	*TV dinner	892	447	49.9
Biscuits	768	602	21.6	*Broccoli	318	152	52.2
Mushroom soup	164	113	31.1				
Chicken noodle soup	189	120	36.5	Microwave Oven			
Chicken pot pie incl. broth	1827	942	48.4				
				Mushroom soup	239	218	8.8
*Spaghetti sauce	209	62	70.3	Apple pie	279	241	13.6
*Macaroni & cheese	1179	302	74.4	Yellow cake	403	310	23.1
*Chicken noodle soup incl. broth	887	120	86.5	Pudding	215	144	33.0
*Cookies	740	0	100.0				
*White bread	677	0	100.0				
*Whole wheat bread	786	0	100.0				
*White rolls	601	0	100.0				
*Sweet rolls	525	0	100.0				
Microwave Oven							
Cornbread	151	151	0.0				
Biscuits	199	198	0.1				
Broccoli	241	196	18.7				
Chocolate cake	506	406	19.8				
Macaroni & cheese	396	315	20.4				
Pizza	353	262	25.8				
*Pancakes	372	266	28.5				
Chicken noodle soup	348	190	45.4				
Chicken pot pie	344	142	58.7				
Pizza incl. sauce	747	262	64.9				
*Spaghetti sauce	394	116	70.6				
*TV dinner	707	170	76.0				
Chicken noodle soup incl. broth	844	190	77.5				
Chicken pot pie incl. broth	840	142	83.1				
*Cookies	130	0	100.0				
*White bread	186	0	100.0				
*Whole wheat bread	185	0	100.0				
*White rolls	85	0	100.0				
*Sweet rolls	134	0	100.0				

1. HP = Home-Prepared food
2. C = Convenience food
3. EN = Energy consumption in Watthours
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$

* Food for which difference significant ($p<.10$) using the Kruskal-Wallis test.

with the electric range, and from 0.1% - 100.0% for the microwave-prepared items. Ten food items (6 prepared with the electric range oven and 4 in the microwave oven) used more energy for preparation in convenience than in home-prepared form. The range of percentage difference was from 0.1% - 52.2% for items prepared with the electric range, and from 8.8% - 33.0% for foods prepared in the microwave oven.

Percentage difference in total product energy consumption between items prepared with the electric range and items prepared in the microwave oven is shown in Table 15. Twenty-six foods (10 convenience and 16 home-prepared) used more energy when prepared with the electric range than in the microwave oven. The percentage difference in energy consumption ranged from 11.9% - 84.9% for the convenience items and from 4.8% - 85.8% for the home-prepared foods. Conversely, fifteen items (5 convenience and 10 home-prepared) used more energy when prepared in the microwave oven. The percentage difference in energy consumption ranged from 4.1% - 52.7% for the convenience items and from 4.9% - 72.7% for the home-prepared foods.

In summary, most home-prepared foods (78.3%) required more energy to prepare than did convenience foods. For 34.8% of foods prepared with the electric range and for 34.8% of foods prepared with the microwave oven the difference was significant ($p<.10$). However 8.7% of foods

Table 15

Comparison of Energy Consumption Between Foods Prepared with The Electric Range and with the Microwave Oven

ER[1] > MW[2]				MW > ER			
Convenience	ER EN[3]	MW EN	% Diff[4]	Convenience	MW EN	ER EN	% Diff
Pancakes	302	266	11.9	Macaroni & cheese	315	302	4.1
Yellow cake	579	403	30.4	Chicken noodle soup	190	120	36.8
*Broccoli	318	196	38.4	Spaghetti sauce	116	62	46.6
*Chocolate cake	816	406	50.2	*Pudding	215	111	48.4
Biscuits	602	198	67.1	*Mushroom soup	239	113	52.7
*Pizza	822	262	68.1				
Apple pie	948	279	70.6	Home-Prepared			
Cornbread	757	151	80.0				
*TV dinner	892	170	80.9	Pudding	144	137	4.9
*Chicken pot pie	942	142	84.9	Pancakes	372	335	9.9
				*Potatoes	140	117	16.4
Home-Prepared				Mushroom soup	218	164	24.8
				*Carrots	139	97	30.2
Chicken noodle soup	887	844	4.8	TV dinner	707	447	36.8
Pizza incl. sauce	794	747	5.9	Broccoli	241	152	36.9
Pizza	585	353	39.6	Chicken noodle soup	348	189	45.7
*Yellow cake	573	310	46.0	Spaghetti sauce	394	209	47.0
*Chocolate cake	975	506	48.1	*Fried chicken	429	235	72.7
*Chicken pot pie incl. broth	1827	840	54.0				
Macaroni & cheese	1179	396	66.4				
*Chicken pot pie	1114	344	69.1				
White bread	677	186	72.5				
*Biscuits	768	199	74.1				
Sweet rolls	525	134	74.5				
*Apple pie	947	241	74.6				
Whole wheat bread	786	185	76.5				
*Cornbread	792	151	80.9				
Cookies	740	130	82.4				
White rolls	601	85	85.8				

1. ER = Electric Range
2. MW = Microwave Oven
3. EN = Energy consumption in watthours
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$

* Food for which difference significant ($p < .10$) using the Kruskal-Wallis test.

prepared with the electric range required significantly more energy to prepare ($p<.10$) in convenience than in home-prepared form. A majority of foods (63.4%) required more energy to prepare with the electric range than with the microwave oven. This trend was significant ($p<.10$) for 33.3% of convenience and for 26.9% of home-prepared foods. However 13.3% of convenience foods and 11.5% of home-prepared foods required more energy to prepare with the microwave oven than with the electric range. These were foods which, in the electric range version, were heated entirely on a surface unit.

Energy consumption values for the different preparation forms of each food, expressed in BTUs, are listed in Appendix F. This was done to facilitate comparison of these results with those of other researchers where different forms of energy were used.

Cost

The cost for the various preparation forms of each food item, expressed as cents per equal weight serving, is shown in Table 16. Cost was calculated for food, fuel, active preparation time at minimum wage, and active preparation time at a cook's wage. Combined costs are reported for food plus fuel; food, fuel, and preparation cost at minimum wage; and food, fuel, and preparation cost at a cook's wage.

Table 16

Cost per Equal Weight Serving for Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

Product	Food Cost(A) (cents)	Fuel[1] Cost(B) (cents)	Preparation Cost: Min[2] Wage(C) (cents)	Preparation Cost: Cook's[3] Wage(D) (cents)	Total: A+B (cents)	Total: A+B+C (cents)	Total: A+B+D (cents)
Biscuits							
C-ER[4,5]	7.00	0.60	2.79	6.96	7.60	10.39	14.56
C-MW[6]	7.22	0.18	9.82	24.47	7.40	17.22	31.87
HP-ER[7]	4.27	0.43	7.21	17.97	4.70	11.91	22.67
HP-MW	4.42	0.10	10.87	27.09	4.52	15.39	31.61
Pancakes							
C-ER	8.33	0.50	15.81	39.41	8.83	24.64	48.24
C-MW	8.85	0.51	22.53	56.18	9.36	31.89	65.54
HP-ER	8.91	0.36	13.95	34.78	9.27	23.22	44.05
HP-MW	10.54	0.50	29.41	73.31	11.04	40.45	84.35
Cornbread							
C-ER	11.33	0.63	4.18	10.43	11.96	16.14	22.39
C-MW	11.52	0.13	4.26	10.61	11.65	15.91	22.26
HP-ER	7.71	0.56	5.18	12.92	8.27	13.45	21.19
HP-MW	7.94	0.11	5.33	13.30	8.05	13.38	21.35
Yellow cake							
C-ER	9.75	0.24	5.35	13.33	9.99	15.34	23.32
C-MW	11.94	0.20	6.83	17.03	12.14	18.97	29.17
HP-ER	9.30	0.25	8.08	20.13	9.55	17.63	29.68
HP-MW	10.19	0.15	8.85	22.07	10.34	19.19	32.41
Chocolate cake							
C-ER	9.50	0.34	4.65	11.59	9.84	14.49	21.43
C-MW	11.75	0.21	5.75	14.34	11.96	17.71	26.30
HP-ER	12.20	0.36	8.62	21.48	12.56	21.18	34.04
HP-MW	14.07	0.21	10.17	25.34	14.28	24.45	39.62
Broccoli							
C-ER	21.00	0.40	3.49	8.69	21.40	24.89	30.09
C-MW	21.54	0.25	3.58	8.92	21.79	25.37	30.71
HP-ER	15.31	0.15	6.83	17.03	15.46	22.29	32.49
HP-MW	17.44	0.28	8.43	21.03	17.72	26.15	38.75
Macaroni & Cheese							
C-ER	12.75	0.38	8.37	20.86	13.13	21.50	33.99
C-MW	11.59	0.36	6.34	15.81	11.95	18.29	27.76
HP-ER	25.48	1.39	31.88	79.48	26.87	58.75	106.35
HP-MW	21.40	0.39	17.30	43.12	21.79	39.09	64.91
Spaghetti sauce							
C-ER	21.75	0.08	1.40	3.48	21.83	23.23	25.31
C-MW	22.31	0.15	2.86	7.13	22.46	25.32	29.59
HP-ER	24.21	0.27	18.36	45.76	24.48	42.84	76.24
HP-MW	27.88	0.59	19.44	48.47	28.47	47.91	76.94

Table 16 (continued)

Cost per Equal Weight Serving for Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

Product	Food Cost(A) (cents)	Fuel Cost(B) (cents)	Preparation Cost Min Wage(C) (cents)	Preparation Cost Cook's Wage(D) (cents)	Total A+B (cents)	Total A+B+C (cents)	Total A+B+D (cents)
Pizza							
C-ER	69.50	2.04	5.58	13.91	71.54	77.12	85.45
C-MW	77.22	0.72	6.20	15.46	77.94	84.14	93.40
HP-ER	44.42	0.68	38.93	97.05	45.10	84.03	142.15
HP-MW	46.58	0.43	35.38	88.21	47.01	82.39	135.22
Pizza incl. sauce							
C-ER	69.50	2.04	5.58	13.91	71.54	77.12	85.45
C-MW	77.22	0.72	6.20	15.46	77.94	84.14	93.40
HP-ER	44.42	0.92	55.80	139.10	45.34	101.14	184.44
HP-MW	46.58	0.90	51.04	127.22	47.48	98.52	174.70
Pudding							
C-ER	17.25	0.14	16.74	41.73	17.39	34.13	59.12
C-MW	15.33	0.24	4.96	12.36	15.57	20.53	27.93
HP-ER	12.32	0.16	23.36	58.23	12.48	35.84	70.71
HP-MW	11.52	0.16	9.10	22.68	11.68	20.78	34.36
Mushroom soup							
C-ER	26.00	0.28	15.34	38.25	26.28	41.62	64.53
C-MW	26.00	0.59	11.16	27.82	26.59	37.75	54.41
HP-ER	28.28	0.28	23.09	57.56	28.56	51.65	86.12
HP-MW	28.28	0.37	30.79	76.74	28.65	59.44	105.39
Chicken noodle soup							
C-ER	17.00	0.30	2.79	6.96	17.30	20.29	24.26
C-MW	17.89	0.50	2.94	7.32	18.39	21.33	25.71
HP-ER	14.38	0.59	5.23	13.04	14.97	20.20	28.01
HP-MW	14.38	1.08	5.23	13.04	15.46	20.69	28.50
Chicken noodle soup incl. broth							
C-ER	17.00	0.30	2.79	6.96	17.30	20.09	24.26
C-MW	17.89	0.50	2.94	7.32	18.39	21.33	25.71
HP-ER	43.75	2.76	61.03	152.14	46.51	107.54	198.65
HP-MW	43.75	2.62	69.75	173.88	46.37	116.12	220.25
Chicken pot pie							
C-ER	55.00	4.68	8.37	20.86	59.68	68.05	80.54
C-MW	61.11	0.78	9.30	23.18	61.89	71.19	85.07
HP-ER	32.82	1.42	34.34	85.60	34.24	68.58	119.84
HP-MW	31.22	0.42	36.75	91.60	31.64	68.39	123.24
Chicken pot pie incl. broth							
C-ER	55.00	4.68	8.37	20.86	59.68	68.05	80.54
C-MW	61.11	0.78	9.30	23.18	61.89	71.19	85.07
HP-ER	38.97	2.33	56.51	140.88	41.30	97.81	182.18
HP-MW	37.07	1.02	61.92	154.37	38.09	100.01	192.46
Apple pie							
C-ER	23.83	0.78	1.40	3.48	24.61	26.01	28.09
C-MW	26.00	0.25	2.03	5.06	26.25	28.28	31.31
HP-ER	11.55	0.40	12.99	32.38	11.95	24.94	44.33
HP-MW	11.26	0.10	12.66	31.56	11.36	24.02	42.92

Table 16 (continued)

Cost per Equal Weight Serving for Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

Product	Food Cost(A) (cents)	Fuel Cost(B) (cents)	Preparation Cost		Total		
			Min Wage(C) (cents)	Cook's Wage(D) (cents)	A+B (cents)	A+B+C (cents)	A+B+D (cents)
TV dinner							
C-ER	96.00	4.43	5.58	13.91	100.43	106.01	114.34
C-MW	106.67	0.94	12.40	30.91	107.61	120.01	138.52
HP-ER	72.22	2.47	74.40	185.47	74.69	149.09	260.16
HP-MW	60.00	4.39	87.19	217.34	64.39	151.58	281.73
Cookies							
C-RTE[8]	6.41	0.00	0.00	0.00	6.41	6.41	6.41
HP-ER	6.82	0.14	4.87	12.14	6.96	11.83	19.10
HP-MW	6.49	0.02	2.74	6.82	6.51	9.25	13.33
White bread							
C-RTE	7.00	0.00	0.00	0.00	7.00	7.00	7.00
HP-ER	3.33	0.31	11.37	28.34	3.64	15.01	31.98
HP-MW	3.43	0.09	11.69	29.14	3.52	15.21	32.66
Whole wheat bread							
C-RTE	9.75	0.00	0.00	0.00	9.75	9.75	9.75
HP-ER	5.15	0.30	13.95	34.78	5.45	19.40	40.23
HP-MW	5.31	0.07	14.38	35.86	5.38	19.76	41.24
White rolls							
C-RTE	8.10	0.00	0.00	0.00	8.10	8.10	8.10
HP-ER	3.04	0.29	12.31	30.68	3.33	15.64	34.01
HP-MW	3.13	0.04	12.68	31.61	3.17	15.85	34.78
Sweet rolls							
C-RTE	9.88	0.00	0.00	0.00	9.88	9.88	9.88
HP-ER	4.24	0.12	9.13	22.76	4.36	13.49	27.12
HP-MW	4.42	0.03	9.52	23.74	4.45	13.97	28.19

1. Fuel cost: Kilowatt hours of electricity x 4.97¢
2. Minimum wage: $3.35 per hour
3. Cook's wage: $8.34 per hour
4. C = Convenience food
5. ER = Electric range
6. MW = Microwave Oven
7. HP = Home-prepared food
8. RTE = Ready-to-eat

Convenience Foods and Home-Prepared Foods

Food. The percentage difference in food cost between convenience and home-prepared foods is shown in Table 17. Fourteen foods (7 prepared with the electric range and 7 in the microwave oven) cost more per serving in the home-prepared than in the convenience form, although for three of these items (2 electric range and one microwave) the difference in cost was less than one cent per serving. The percentage difference in cost ranged from 6.0% - 61.6% for items prepared with the electric range, and from 1.2% - 59.1% for items prepared in the microwave oven. Thirty-two foods (16 prepared with the electric range and 16 in the microwave oven) cost more in convenience than in home-prepared form. The cost difference for one electric range item was less than one cent per serving. The percentage difference in cost ranged from 4.6% - 62.5% for foods prepared with the electric range, and from 14.6% - 61.4% for foods prepared in the microwave oven.

Fuel. The percentage difference in cost of fuel used for food preparation between convenience and home-prepared foods is reported in Table 18. Twenty-five items (12 prepared with the electric range and 13 in the microwave oven) cost more per serving for fuel in home-prepared than in convenience form. The fuel cost per serving was very small, however, and for 21 items (10 electric range and 11

Table 17

Food Cost per Equal Weight Serving: Comparison Between Convenience and Home-Prepared Foods

HP[1] > C[2]				C > HP			
Electric Range	HP Cost[3]	C Cost	% Diff[4]	Electric Range	C Cost	HP Cost	% Diff
✓Cookies[5]	6.82	6.41	6.0	✓Yellow cake	9.75	9.30	4.6
✓Pancakes	8.91	8.33	6.5	Chicken noodle soup	17.00	14.38	15.4
Mushroom soup	28.28	26.00	8.1	TV dinner	96.00	72.22	24.8
Spaghetti sauce	24.21	21.75	10.2	Broccoli	21.00	15.31	27.1
Chocolate cake	12.20	9.50	22.1	Pudding	17.25	12.32	28.6
Macaroni & cheese	25.48	12.75	50.0	Chicken pot pie incl. broth	55.00	38.97	29.1
Chicken noodle soup incl. broth	43.75	12.75	61.6	Cornbread	11.33	7.71	32.0
				Pizza	69.50	44.42	36.1
Microwave Oven				Pizza incl. sauce	69.50	44.42	36.1
				Biscuits	7.00	4.27	39.0
✓Cookies	6.49	6.41	1.2	Chicken pot pie	55.00	32.82	40.3
Mushroom soup	28.28	8.85	16.0	Whole wheat bread	9.75	5.15	47.2
Pancakes	10.54	8.85	16.0	Apple pie	23.83	11.55	51.5
Chocolate cake	14.7	11.75	16.5	White bread	7.00	3.33	52.4
Spaghetti sauce	27.88	22.31	20.0	Sweet rolls	9.88	4.24	57.1
Macaroni & cheese	21.40	11.59	45.8	White rolls	8.10	3.04	62.5
Chicken noodle soup incl. broth	43.75	17.89	59.1	Microwave Oven			
				Yellow cake	11.94	10.19	14.6
				Broccoli	21.54	17.44	19.0
				Chicken noodle soup	17.89	14.38	19.6
				Pudding	15.33	11.52	24.8
				Cornbread	11.52	7.94	31.1
				Biscuits	7.22	4.42	38.8
				Chicken pot pie incl. broth	61.11	37.07	39.3
				Pizza	77.22	46.58	39.7
				Pizza incl. sauce	77.22	46.58	39.7
				TV dinner	106.67	60.00	43.8
				Whole wheat bread	9.75	5.31	45.5
				Chicken pot pie	61.11	31.22	48.9
				White bread	7.00	3.43	51.0
				Sweet rolls	9.88	4.42	55.3
				Apple pie	26.00	11.26	56.7
				White rolls	8.10	3.13	61.4

1. HP = Home-prepared food
2. C = Convenience food
3. Cents per serving
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
5. ✓ = Difference ≤ 1 cent

Table 18

Fuel Cost[1] per Equal Weight Serving: Comparison Between Convenience and Home-Prepared Foods

HP[2] > C[3]				C > HP			
Electric Range	HP Cost[4]	C Cost	% Diff[5]	Electric Range	C Cost	HP Cost	% Diff
√Yellow cake[6]	0.25	0.24	4.0	√Cornbread	0.63	0.56	11.1
√Chocolate cake	0.36	0.34	5.6	√Pancakes	0.50	0.36	28.0
√Pudding	0.16	0.14	12.5	√Biscuits	0.60	0.43	28.3
√Chicken noodle soup	0.59	0.30	49.2	TV dinner	4.43	2.47	44.2
√Spaghetti sauce	0.27	0.08	70.4	√Apple pie	0.78	0.40	48.7
Macaroni & cheese	1.39	0.38	72.7	Chicken pot pie incl. broth	4.68	2.33	50.2
Chicken noodle soup incl. broth	2.76	0.30	89.1	Pizza incl. sauce	2.04	0.92	54.9
√Cookies	0.14	0.0	100.0	√Broccoli	0.40	0.15	62.7
√White bread	0.31	0.0	100.0	Pizza	2.04	0.68	66.7
√Whole wheat bread	0.30	0.0	100.0	Chicken pot pie	4.68	1.42	69.6
√White rolls	0.29	0.0	100.0				
√Sweet rolls	0.12	0.0	100.0				
Microwave Oven				Microwave Oven			
√Macaroni & cheese	0.39	0.36	7.7	√Pancakes	0.51	0.50	2.0
√Broccoli	0.28	0.25	10.7	√Cornbread	0.13	0.11	15.4
√Pizza incl. sauce	0.90	0.72	20.0	√Yellow cake	0.20	0.15	25.0
√Chicken pot pie incl. broth	1.02	0.78	23.5	√Pudding	0.24	0.16	33.3
√Chicken noodle soup	1.08	0.50	53.7	√Mushroom soup	0.59	0.37	37.3
√Spaghetti sauce	0.59	0.15	74.6	√Pizza	0.72	0.43	40.3
TV dinner	4.39	0.94	78.6	√Biscuits	0.18	0.10	44.4
Chicken noodle soup incl. broth	2.62	0.50	80.0	√Chicken pot pie	0.78	0.42	46.2
√Cookies	0.02	0.0	100.0	√Apple pie	0.25	0.10	60.0
√White bread	0.09	0.0	100.0				
√Whole wheat bread	0.07	0.0	100.0				
√White rolls	0.04	0.0	100.0				
√Sweet rolls	0.03	0.0	100.0				
HP = C							
Electric Range							
Mushroom soup	0.28	0.28	0.0				
Microwave Oven							
Chocolate cake	0.21	0.21	0.0				

1. Fuel cost: kilowatt hours of electricity x 4.97¢
2. HP = Home-prepared food
3. C = Convenience food
4. Cents per serving
5. % Difference = $\frac{\text{Larger Value - smaller value}}{\text{Larger value}} \times 100$
6. √ = Difference ≤ 1 cent

microwave oven) the difference in cost was less than one cent per serving. The percentage difference in cost of fuel ranged from 4.0% - 100.0% for items prepared with the electric range, and from 7.7% - 100.0% for microwave-prepared foods. Nineteen items (10 prepared with the electric range and 9 in the microwave oven) cost more per serving for fuel in convenience than in home-prepared form, although the cost difference for 14 items (5 electric range and 9 microwave oven) was less than one cent per serving. The percentage difference in cost ranged from 11.1% - 69.6% for foods prepared with the electric range, and from 2.0% - 60.0% for foods prepared in the microwave oven. Two foods, one prepared with the electric range and one prepared in the microwave oven, had the same fuel cost per serving whether prepared in convenience or in home-prepared form.

Active Time at Minimum Wage. The percentage difference in cost of active preparation time at minimum wage between convenience and home-prepared foods is reported in Table 19. One food prepared with the electric range cost more per serving to prepare in convenience than in home-prepared form; the percentage difference in cost was 11.8%. The remaining foods (22 prepared with the electric range and 23 in the microwave oven) cost more per serving to prepare in the home-prepared form. The cost difference was equal to one cent for one item prepared with the electric range. The

Table 19

Cost per Equal Weight Serving of Active Time at Minimum Wage:[1] Comparison Between Convenience and Home-Prepared Foods

HP[2] > C[3]				C > HP			
Electric Range	HP Cost[4]	C Cost	% Diff[5]	Electric Range	C Cost	HP Cost	% Diff
✓Cornbread[6]	5.18	4.18	19.3	Pancakes	15.81	13.95	11.8
Pudding	23.36	16.74	28.3				
Mushroom soup	23.09	15.34	33.6				
Yellow cake	8.08	5.35	33.8				
Chocolate cake	8.62	4.65	46.0				
Chicken noodle soup	5.23	2.79	46.6				
Broccoli	6.83	3.49	48.9				
Biscuits	7.21	2.79	61.3				
Macaroni & cheese	31.88	8.37	73.7				
Chicken pot pie	34.34	8.37	75.6				
Chicken pot pie incl. broth	56.51	8.37	85.2				
Pizza	38.93	5.58	85.7				
Apple pie	12.99	1.40	89.2				
Pizza incl. sauce	55.80	5.58	90.0				
Spaghetti sauce	18.36	1.40	92.4				
TV dinner	74.40	5.58	92.5				
Chicken noodle soup	61.03	2.79	95.4				
Cookies	4.87	0.00	100.0				
White bread	11.37	0.00	100.0				
Whole wheat bread	13.95	0.00	100.0				
White rolls	12.31	0.00	100.0				
Sweet rolls	9.13	0.00	100.0				
Microwave Oven							
Biscuits	10.87	9.82	9.6				
Cornbread	5.33	4.26	20.1				
Yellow cake	8.85	6.83	22.8				
Pancakes	29.41	22.53	23.4				
Chocolate cake	10.17	5.75	43.5				
Chicken noodle soup	5.23	2.94	43.8				
Pudding	9.10	4.96	45.5				
Broccoli	8.43	3.58	57.5				
Macaroni & cheese	17.30	6.34	63.4				
Mushroom soup	30.79	11.16	63.8				
Chicken pot pie	36.75	9.30	74.7				
Pizza	35.38	6.20	82.5				
Apple pie	12.66	2.03	84.0				
Chicken pot pie incl. broth	61.92	9.30	85.0				
Spaghetti sauce	19.44	2.86	85.3				
TV dinner	87.19	12.40	85.8				
Pizza incl. sauce	51.04	6.20	87.8				
Chicken noodle soup incl. broth	69.75	2.94	95.8				
Cookies	2.74	0.0	100.0				
White bread	11.69	0.0	100.0				
Whole wheat bread	14.38	0.0	100.0				
White rolls	12.68	0.0	100.0				
Sweet rolls	9.52	0.0	100.0				

1. Minimum wage: $3.35 per hour
2. HP = Home-prepared food
3. C = Convenience food
4. Cents per serving
5. % Difference = $\frac{\text{Larger value-smaller value}}{\text{Larger value}} \times 100$
6. ✓ = Difference ≤ 1 cent

percentage difference in cost ranged from 19.3% - 100.0% for the electric range items, and from 9.6% - 100.0% for items prepared in the microwave oven.

Active Time at a Cook's Wage. Similar results for the percentage difference in cost of active preparation time at a cook's wage are shown in Table 20. Although the actual costs reported are greater than those reported in Table 19 for minimum wage, the percentage differences in cost were essentially the same. Slight differences in percentage between the two tables are due to rounding.

Food Plus Fuel. The percentage difference in the combined cost of food and fuel between convenience and home-prepared foods is shown in Table 21. Fourteen foods (7 prepared with the electric range and 7 in the microwave oven) cost more per serving in home-prepared than in convenience form. For three of these items (2 electric range and 1 microwave oven) the difference was less than or equal to one cent. The percentage difference in cost ranged from 4.7% - 62.8% for items prepared with the electric range, and from 1.5% - 60.3% for items prepared in the microwave oven. Thirty-two foods (16 prepared with the electric range and 16 in the microwave oven) cost more for food and fuel in convenience than in home-prepared form; the difference in cost for one item with the electric range was less than one cent per serving. The percentage difference

Table 20

Cost per Equal Weight Serving of Active Time at a Cook's Wage:[1] Comparison Between Convenience and Home-Prepared Foods

HP[2] > C[3]				C > HP			
Electric Range	HP Cost	C Cost	% Diff	Electric Range	C Cost	HP Cost	% Diff
Cornbread	12.92	10.43	19.3	Pancakes	39.41	34.78	11.7
Pudding	58.23	41.73	28.3				
Mushroom soup	57.56	38.25	33.5				
Yellow cake	20.13	13.33	33.8				
Chocolate cake	21.48	11.59	46.0				
Chicken noodle soup	13.04	6.96	46.6				
Broccoli	17.03	8.69	49.0				
Biscuits	17.97	6.96	61.3				
Macaroni & cheese	79.48	20.86	73.8				
Chicken pot pie	85.60	20.86	75.6				
Chicken pot pie incl. broth	140.88	20.86	85.2				
Pizza	97.05	13.91	85.7				
Apple pie	32.38	3.48	89.2				
Pizza incl. sauce	139.10	13.91	90.0				
Spaghetti sauce	45.76	3.48	92.4				
TV dinner	185.47	13.91	92.5				
Chicken noodle soup incl. broth	152.14	6.96	95.4				
Cookies	12.14	0.0	100.0				
White bread	28.34	0.0	100.0				
Whole wheat bread	34.78	0.0	100.0				
White rolls	30.68	0.0	100.0				
Sweet rolls	22.76	0.0	100.0				
Microwave Oven							
Biscuits	27.09	24.47	9.7				
Cornbread	13.30	10.61	20.2				
Yellow cake	22.07	17.03	22.8				
Pancakes	73.31	56.18	23.4				
Chocolate cake	25.34	14.34	43.4				
Chicken noodle soup	13.04	7.32	43.9				
Pudding	22.68	12.36	45.5				
Broccoli	21.03	8.92	57.6				
Macaroni & cheese	43.12	15.81	63.3				
Mushroom soup	76.74	27.82	63.7				
Chicken pot pie	91.60	23.18	74.7				
Pizza	88.21	15.46	82.5				
Apple pie	31.56	5.06	84.0				
Chicken pot pie incl. broth	154.37	23.18	85.0				
Spaghetti sauce	48.47	7.13	85.3				
TV dinner	217.34	30.91	85.8				
Pizza incl. sauce	127.22	15.46	87.8				
Chicken noodle soup incl. broth	173.88	7.32	95.8				
Cookies	6.82	0.0	100.0				
White bread	29.14	0.0	100.0				
Whole wheat bread	35.86	0.0	100.0				
White rolls	31.61	0.0	100.0				
Sweet rolls	23.74	0.0	100.0				

1. Cook's Wage: $8.34 per hour
2. HP = Home-prepared food
3. C = Convenience food
4. Cents per serving
5. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$

Table 21

Cost per Equal Weight Serving of Food and Fuel:[1] Comparison Between Convenience and Home-Prepared Food

HP[2] > C[3]				C > HP			
Electric Range	HP Cost[4]	C Cost	% Diff[5]	Electric Range	C Cost	HP Cost	% Diff
√Pancakes[6]	9.27	8.83	4.7	√Yellow cake	9.99	9.55	4.4
√Cookies	6.96	6.41	7.9	Chicken noodle soup	17.30	14.97	13.5
Mushroom soup	28.56	26.28	8.0	TV dinner	100.43	74.69	25.6
Spaghetti sauce	24.48	21.83	10.8	Broccoli	21.40	15.46	27.8
Chocolate cake	12.56	9.84	21.6	Pudding	17.39	12.48	28.2
Macaroni & cheese	26.87	13.13	51.1	Cornbread	11.96	8.27	30.8
Chicken noodle soup incl. broth	46.51	17.30	62.8	Chicken pot pie incl. broth	59.68	41.30	30.8
				Pizza incl. sauce	71.54	45.34	36.6
Microwave Oven				Pizza	71.54	45.10	37.0
				Biscuits	7.60	4.70	38.2
√Cookies	6.51	6.41	1.5	Chicken pot pie	59.68	34.24	42.6
Mushroom soup	28.65	26.59	7.2	Whole wheat bread	9.75	5.45	44.1
Pancakes	11.04	9.36	15.2	White bread	7.00	3.64	48.0
Chocolate cake	14.28	11.96	16.2	Apple pie	24.61	11.95	51.4
Spaghetti sauce	28.47	22.46	21.1	Sweet rolls	9.88	4.36	55.9
Macaroni & cheese	21.79	11.95	45.2	White rolls	8.10	3.33	58.9
Chicken noodle soup incl. broth	46.37	18.39	60.3				
				Microwave Oven			
				Yellow cake	12.14	10.34	14.8
				Chicken noodle soup	18.39	15.46	15.9
				Broccoli	21.79	17.72	18.7
				Pudding	15.57	11.68	25.0
				Cornbread	11.65	8.05	30.9
				Chicken pot pie incl. broth	61.89	38.09	38.4
				Biscuits	7.40	4.52	38.9
				Pizza incl. sauce	79.94	47.48	39.1
				Pizza	77.94	47.01	39.7
				TV dinner	107.61	64.39	40.2
				Whole wheat bread	9.75	5.38	44.8
				Chicken pot pie	61.89	31.64	48.9
				White bread	7.00	3.52	49.7
				Sweet rolls	9.88	4.45	55.0
				Apple pie	26.25	11.36	56.7
				White rolls	8.10	3.17	60.9

1. Fuel cost: Kilowatt hours of electricity x 4.97¢
2. HP = Home-prepared food
3. C = Convenience food
4. Cents per serving
5. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
6. √ = Difference ≤ 1 cent

in cost ranged from 4.4% - 58.9% for foods prepared with the electric range, and from 14.8% - 60.9% for foods prepared in the microwave oven.

Food, Fuel, and Active Time at Minimum Wage. As shown in Table 22 the combined cost of food, fuel, and active preparation time at minimum wage was greater for 36 foods (19 prepared with the electric range and 17 in the microwave oven) in home-prepared than in convenience form. The cost difference for 5 items (2 electric range and 3 microwave oven) was less than one cent per serving. The percentage difference in this combined cost ranged from 0.5% - 81.3% for foods prepared with the electric range, and from 1.1% - 81.6% for foods prepared in the microwave oven. The cost for 10 items (4 prepared with the electric range and 6 in the microwave oven) was greater in convenience than in home-prepared form. One microwave-prepared food had a cost difference of less than one cent per serving. The percentage difference in cost ranged from 4.1% - 16.7% for foods prepared with the electric range, and from 2.1% - 15.9% for foods prepared in the microwave oven.

Food, Fuel, and Active Time at a Cook's Wage. The percentage difference in composite cost of food, fuel, and active preparation time at a cook's wage between convenience and home-prepared foods is shown in Table 23. The cost was greater for 42 items (21 prepared with the electric range

Table 22

Cost per Equal Weight Serving of Food, Fuel,[1] and Active Time at Minimum Wage:[2] Comparison Between Convenience and Home-Prepared Foods

HP[3] > C[4]				C > HP			
Electric Range	HP Cost[5]	C Cost	% Diff[6]	Electric Range	C Cost	HP Cost	% Diff
✓Chicken noodle soup[7]	20.20	20.09	0.5	Apple pie	26.01	24.94	4.1
✓Chicken pot pie	68.58	68.05	0.8	Pancakes	24.64	23.22	5.8
Pudding	35.84	34.13	4.8	Broccoli	24.89	22.29	10.4
Pizza	84.03	77.12	8.2	Cornbread	16.14	13.45	16.7
Biscuits	11.91	10.39	12.8				
Yellow cake	17.63	15.34	13.0	Microwave Oven			
Mushroom soup	51.65	41.62	19.4				
Pizza incl. sauce	101.14	77.12	23.7	Pizza	84.14	82.39	2.1
Sweet rolls	13.49	9.88	26.8	✓Chicken noodle soup	21.33	20.69	3.0
TV dinner	149.09	106.01	28.9	Chicken pot pie	71.19	68.39	3.9
Chicken pot pie incl. broth	97.81	68.05	30.4	Biscuits	17.22	15.39	10.6
				Apple pie	28.28	24.02	15.1
Chocolate cake	21.18	14.49	31.6	Cornbread	15.91	13.38	15.9
Spaghetti sauce	42.84	23.23	45.8				
Cookies	11.83	6.41	45.8				
White rolls	15.64	8.10	48.2				
Whole wheat bread	19.40	9.75	49.7				
White bread	15.01	7.00	53.4				
Macaroni & cheese	58.75	21.50	63.4				
Chicken noodle soup incl. broth	107.54	20.09	81.3				
Microwave Oven							
✓Yellow cake	19.19	18.97	1.1				
✓Pudding	20.78	20.53	1.2				
✓Broccoli	26.15	25.37	3.0				
Pizza incl. sauce	98.52	84.14	14.6				
TV dinner	151.58	120.01	20.8				
Pancakes	40.45	31.89	21.2				
Chocolate cake	24.45	17.71	27.6				
Chicken pot pie incl. broth	100.01	71.19	28.8				
Sweet rolls	13.97	9.88	29.3				
Cookies	9.25	6.41	30.7				
Mushroom soup	59.44	37.75	36.5				
Spaghetti sauce	47.91	25.32	47.2				
White rolls	15.85	8.10	48.9				
Whole wheat bread	19.76	9.75	50.6				
Macaroni & cheese	39.09	18.29	53.2				
White bread	15.21	7.00	54.0				
Chicken noodle soup incl. broth	116.12	21.33	81.6				

1. Fuel cost: Kilowatt hours of electricity x 4.97¢
2. Minimum wage: $3.35 per hour
3. HP = Home-prepared food
4. C = Convenience food
5. Cents per serving
6. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
7. ✓ = Difference ≤ 1 cent

Table 23

Cost per Equal Weight Serving of Food, Fuel,[1] and Active Time at a Cook's Wage[2] Comparison Between Convenience and Home-prepared Foods

HP[3] > C[4]				C > HP			
Electric Range	HP Cost[5]	C Cost	% Diff[6]	Electric Range	C Cost	HP Cost	% Diff
Broccoli	32.49	30.09	7.4	Cornbread	22.39	21.19	5.4
Chicken noodle soup	28.01	24.26	13.4	Pancakes	48.24	44.05	8.7
Pudding	70.71	59.12	16.4				
Yellow cake	29.68	23.32	21.4	Microwave Oven			
Mushroom soup	86.12	64.53	25.1				
Chicken pot pie	119.84	80.54	32.8	✓Biscuits[7]	31.87	31.61	0.8
Biscuits	22.67	14.56	35.8	✓Cornbread	22.26	21.35	4.1
Apple pie	44.33	28.09	36.6				
Chocolate cake	34.04	21.43	37.0				
Pizza	142.15	85.45	39.9				
Pizza incl. sauce	184.44	85.45	53.7				
Chicken pot pie incl. broth	182.18	80.54	55.8				
TV dinner	260.16	114.34	56.0				
Sweet rolls	27.12	9.88	63.6				
Spaghetti sauce	70.24	25.31	64.0				
Cookies	19.10	6.41	66.4				
Macaroni & cheese	106.35	33.99	68.0				
Whole wheat bread	40.23	9.75	75.8				
White rolls	34.01	8.10	76.2				
White bread	31.98	7.00	78.1				
Chicken noodle soup incl. broth	198.65	24.26	87.8				
Microwave Oven							
Chicken noodle soup	28.50	25.71	9.8				
Yellow cake	32.41	29.17	10.0				
Pudding	34.36	27.93	18.7				
Broccoli	38.75	30.71	20.7				
Pancakes	84.35	65.54	22.3				
Apple pie	42.92	31.31	27.0				
Pizza	135.22	93.40	30.9				
Chicken pot pie	123.24	85.07	31.0				
Chocolate cake	39.62	26.30	33.6				
Pizza incl. sauce	174.70	93.40	46.5				
Mushroom soup	105.39	54.41	48.4				
TV dinner	281.73	138.52	50.8				
Cookies	13.33	6.41	51.9				
Chicken pot pie incl. broth	192.46	85.07	55.8				
Macaroni & cheese	64.91	27.76	57.2				
Spaghetti sauce	76.94	29.59	61.5				
Sweet rolls	28.19	9.88	65.0				
Whole wheat bread	41.24	9.75	76.4				
White rolls	34.78	8.10	76.7				
White bread	32.66	7.00	78.6				
Chicken noodle soup incl. broth	220.25	25.71	88.3				

1. Fuel cost: Killowatt hours of electricity x 4.97¢
2. Cook's wage: $8.34 per hour
3. HP = Home-prepared food
4. C = Convenience food
5. Cents per serving
6. % Difference = $\frac{\text{Larger value-smaller value}}{\text{Larger value}} \times 100$
7. ✓ = Difference ≤ 1 cent

and 21 in the microwave oven) in home-prepared than in convenience form. The percentage difference ranged from 7.4% - 87.8% for items prepared with the electric range, and from 9.8% - 88.3% for items prepared in the microwave oven. Four foods (2 prepared with the electric range and 2 in the microwave oven) had a greater cost in convenience than in home-prepared form, although the difference for both microwave-prepared items was less than one cent per serving. The percentage difference in cost ranged from 5.4% - 8.7% for foods prepared with the electric range, and from 0.8% - 4.1% for foods prepared in the microwave oven.

Summary: Convenience Foods and Home-Prepared Foods. To summarize the per-serving cost difference between convenience and home-prepared foods, the majority of the foods tested (69.6%) cost more for food alone in the convenience than in the home-prepared form. By contrast, the majority of home-prepared foods (54.3%) cost more for fuel alone. However, the cost of fuel was very small, and when the food and fuel costs were combined 69.6% of the foods were more expensive in the convenience form. For cost of active preparation time alone at either minimum wage or at a cook's wage, the majority of home-prepared foods (97.8%) cost more per serving. When cost of time at minimum wage was added to the food and fuel cost, 78.3% of the home-prepared items were more expensive per serving than their

convenience counterparts. And when cost of time at a cook's wage was added to the food and fuel cost, 91.3% of the foods cost more per serving in the home-prepared version.

For foods prepared with the electric range, 69.6% in the convenience form were more expensive for food alone, while 52.2% of the home-prepared foods cost more for fuel alone. When the cost of food and fuel was combined, 69.6% of convenience foods were more expensive. For cost of preparation time, 95.6% of the foods were more expensive in home-prepared than in convenience form. When food, fuel, and cost of time at minimum wage were added, 82.6% of the home-prepared foods were more expensive, while for the cost of food, fuel, and preparation time at a cook's wage, 91.3% of the foods were more expensive in the home-prepared version.

Of the foods prepared in the microwave oven, 69.6% of the convenience foods cost more for the food alone, but 56.5% of home-prepared foods cost more for fuel alone. The combined cost of food and fuel was greater for 69.6% of the convenience foods. All (100.0%) of the home-prepared foods had a greater cost for active preparation time. The combined cost for food, fuel, and active time at minimum wage was greater for 73.9% of home-prepared items, and the combined cost of food, fuel, and active time at a cook's wage was greater for 91.3% of home-prepared foods.

The higher food cost of the majority of convenience foods used might be expected since these foods have a certain degree of culinary expertise built in. Foods where the home-prepared version was more expensive were not easily sorted into any particular grouping, although several were foods which contained at least one relatively expensive ingredient such as chocolate chips, cheese, or mushrooms. Cost of fuel per serving for any item was so small that it did not affect the overall results. However it is possible that if the cost differences between convenience and home-prepared foods were applied to the amount of food eaten by a household over a period of time, fuel costs might be an important part of the total cost of food preparation.

The time needed to prepare food cannot necessarily be considered to be free of charge, and the cost of active preparation time greatly affected the results in this study. When the cost of time was not included in the total food cost, the majority of the convenience foods were more expensive. However since home-prepared foods in general took more active preparation time, when the cost of time was included in the total food cost the majority of home-prepared foods became more expensive. As the value of time was increased, the number of home-prepared foods which became more expensive also increased.

Electric Range and Microwave Oven

Food. Table 24 shows the percentage difference in food cost per serving for foods prepared with the electric range and in the microwave oven. Nine foods (2 convenience and 7 home-prepared) had a higher food cost when prepared with the electric range, although the cost difference for three of the home-prepared foods was less than one cent. The percentage difference in cost ranged from 9.1% - 11.1% for convenience foods, and from 2.5% - 16.9% for home-prepared foods. Twenty-five items (12 convenience and 13 home-prepared) had a higher food cost when prepared in the microwave oven. The cost difference for 13 foods (6 convenience and 7 home-prepared) was less than one cent per serving. The range in percentage cost difference was from 1.6% - 19.1% for convenience foods and from 2.9% - 15.5% for home-prepared foods. One convenience food and three home-prepared foods had the same food cost per serving whether prepared with the electric range or the microwave oven.

Fuel. The percentage difference in cost per serving for fuel between foods prepared with the electric range and in the microwave oven is shown in Table 25. Twenty-six foods (10 convenience and 16 home-prepared) cost more per serving for fuel when prepared with the electric range, although the cost difference was less than or equal to one cent for 22 items (7 convenience and 15 home-prepared). The

Table 24

Food Cost per Equal Weight Serving: Comparison Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[1] > MW[2]				MW > ER			
Convenience	ER Cost[3]	MW Cost	% Diff[4]	Convenience	MW Cost	ER Cost	% Diff
Macaroni & cheese	12.75	11.59	9.1	✓Cornbread	11.52	11.33	1.6
Pudding	17.25	15.33	11.1	✓Broccoli	21.54	21.00	2.5
				✓Spaghetti sauce	22.31	21.75	2.5
Home-Prepared				✓Biscuits	7.22	7.00	3.0
				✓Chicken noodle soup	17.89	17.00	5.0
✓Apple pie[5]	11.55	11.26	2.5	✓Pancakes	8.85	8.33	5.9
✓Cookies	6.82	6.49	4.8	Apple pie	26.00	23.83	8.3
Chicken pot pie incl. broth	38.97	37.07	4.9	Pizza	77.22	69.50	10.0
				Chicken pot pie	61.11	55.00	10.0
Chicken pot pie	32.82	31.22	4.4	TV dinner	106.67	96.00	10.0
✓Pudding	12.32	11.52	6.5	Yellow cake	11.94	9.75	18.3
Macaroni & cheese	25.48	21.40	16.0	Chocolate cake	11.75	9.50	19.1
TV dinner	72.22	60.00	16.9				
				Home-Prepared			
ER = MW							
				✓Cornbread	7.94	7.71	2.9
Convenience				✓White rolls	3.13	3.04	2.9
				✓White bread	3.43	3.33	2.9
✓Mushroom soup	26.00	26.00	0.0	✓Whole wheat bread	5.31	5.15	3.0
				✓Biscuits	4.42	4.27	3.4
Home-Prepared				✓Sweet rolls	4.42	4.24	4.1
				Pizza	46.58	44.42	4.6
✓Mushroom soup	28.28	28.28	0.0	Pizza incl. sauce	46.58	44.42	4.6
✓Chicken noodle soup	14.38	14.38	0.0	✓Yellow cake	10.19	9.30	8.7
✓Chicken noodle soup incl. broth	43.75	43.75	0.0	Broccoli	17.44	15.31	12.2
				Spaghetti sauce	27.88	24.21	13.2
				Chocolate cake	14.07	12.20	13.3
				Pancakes	10.54	8.91	15.5

1. ER = Electric Range
2. MW = Microwave Oven
3. Cents per serving
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
5. ✓ = Difference ≤ 1 cent

Table 25

Fuel Cost[1] per Equal Weight Serving: Comparison Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[2] > MW[3]				MW > ER			
Convenience	ER Cost[4]	MW Cost	% Diff[5]	Convenience	MW Cost	ER Cost	% Diff
✓Macaroni & cheese[6]	0.38	0.36	5.3	✓Pancakes	0.51	0.50	2.0
✓Yellow cake	0.24	0.20	16.7	✓Chicken noodle soup	0.50	0.30	40.0
✓Broccoli	0.40	0.25	37.5	✓Pudding	0.24	0.14	41.7
✓Chocolate cake	0.34	0.21	38.2	✓Spaghetti sauce	0.15	0.08	46.7
Pizza	2.04	0.72	64.7	✓Mushroom soup	0.59	0.28	52.5
✓Apple pie	0.78	0.25	67.9				
✓Biscuits	0.60	0.18	70.0	Home-Prepared			
TV dinner	4.43	0.94	78.8				
✓Cornbread	0.63	0.13	79.4	✓Mushroom soup	0.37	0.28	24.3
Chicken pot pie	4.68	0.78	83.3	✓Pancakes	0.50	0.36	28.0
				TV dinner	4.39	2.47	43.7
Home-Prepared				✓Chicken noodle soup	1.08	0.59	45.4
				✓Broccoli	0.28	0.15	54.2
✓Pizza incl. sauce	0.92	0.90	2.2	✓Spaghetti sauce	0.59	0.27	54.2
✓Chicken noodle soup incl. broth	2.76	2.62	5.1				
✓Pizza	0.68	0.43	36.8				
✓Yellow cake	0.25	0.15	40.0				
✓Chocolate cake	0.36	0.21	41.7				
Chicken pot pie incl. broth	2.33	1.02	56.2				
✓Chicken pot pie	1.42	0.42	70.4				
✓White bread	0.31	0.09	71.0				
✓Macaroni & cheese	1.39	0.39	71.9				
✓Sweet rolls	0.12	0.03	75.0				
✓Apple pie	0.40	0.10	75.0				
✓Biscuits	0.43	0.10	76.7				
✓Whole wheat bread	0.30	0.07	76.7				
✓Cornbread	0.56	0.11	80.4				
✓Cookies	0.14	0.02	85.7				
✓White rolls	0.29	0.04	86.2				
ER = MW							
Home-Prepared							
✓Pudding	0.16	0.16	0.0				

1. Fuel cost: Kilowatt hours of electricity x 4.97¢
2. ER = Electric Range
3. MW = Microwave Oven
4. Cents per serving
5. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
6. ✓ = Difference ≤ 1 cent

percentage difference in fuel cost ranged from 5.3% - 83.3% for convenience items, and from 2.2% - 86.2% for home-prepared foods. Eleven items (5 convenience and 6 home-prepared) had a greater fuel cost when prepared in the microwave oven. However the cost difference for all these items, except one prepared in the electric range, was less than one cent per serving. The percentage difference in cost ranged from 2.0% - 52.5% for the convenience foods, and from 24.3% - 54.2% for the home-prepared items. One home-prepared product had the same fuel cost per serving whether prepared with the electric range or the microwave oven.

Active Time at Minimum Wage. A comparison of the percentage difference in the cost per serving of active preparation time at minimum wage is reported in Table 2o. Nine items (3 convenience and 6 home-prepared) had a higher cost when prepared with the electric range than in the microwave oven, although the cost difference for one home-prepared food was less than one cent. The percentage difference in cost ranged from 24.2% - 70.4% for convenience foods and from 2.5% - 61.0% for home-prepared foods. Twenty-eight foods (12 convenience and 16 home-prepared) had a higher preparation cost at minimum wage when heated in the microwave oven than with the electric range. The cost difference was less than one cent for 12 of these items (6 convenience and 6 home-prepared). The range of percentage

Table 26

Cost per Equal Weight Serving of Active Time at Minimum Wage:[1] Comparison Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[2] > MW[3]				MW > ER			
Convenience	ER Cost[4]	MW Cost	% Diff[5]	Convenience	MW Cost	ER Cost	% Diff
Macaroni & cheese	8.37	6.34	24.2	✓Cornbread	4.26	4.18	1.9
Mushroom soup	15.34	11.16	27.2	✓Broccoli	3.58	3.49	2.5
Pudding	16.74	4.96	70.4	✓Chicken noodle soup	2.94	2.79	5.1
				✓Pizza	6.20	5.58	10.0
Home-Prepared				✓Chicken pot pie	9.30	8.37	10.0
				Chocolate cake	5.75	4.65	19.1
✓Apple pie[6]	12.99	12.66	2.5	Yellow cake	6.83	5.35	21.7
Pizza incl. sauce	55.80	51.04	8.5	Pancakes	22.53	15.81	29.8
Pizza	38.93	35.38	9.1	✓Apple pie	2.03	1.40	31.0
Cookies	4.87	2.74	43.7	Spaghetti sauce	2.86	1.40	51.0
Macaroni & cheese	31.88	17.30	45.7	TV dinner	12.40	5.58	55.0
Pudding	23.36	9.10	61.0	Biscuits	9.82	2.79	71.6
ER = MW				Home-Prepared			
Home-Prepared				✓White bread	11.69	11.37	2.7
				✓Cornbread	5.33	5.18	2.8
✓Chicken noodle soup	5.23	5.23	0.0	✓White rolls	12.68	12.31	2.9
				✓Whole wheat bread	14.38	13.95	3.0
				✓Sweet rolls	9.52	9.13	4.1
				Spaghetti sauce	19.44	18.36	5.6
				Chicken pot pie	36.75	34.34	6.6
				Chicken pot pie incl. broth	61.92	56.51	8.7
				✓Yellow cake	8.85	8.08	8.7
				Chicken noodle soup incl. broth	69.75	61.03	12.5
				TV dinner	87.19	74.40	14.7
				Chocolate cake	10.17	8.62	15.2
				Broccoli	8.43	6.83	19.0
				Mushroom soup	30.79	23.09	25.0
				Biscuits	10.87	7.21	33.7
				Pancakes	29.41	13.95	52.6

1. Minimum Wage: $3.35 per hour
2. ER = Electric Range
3. MW = Microwave Oven
4. Cents per serving
5. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
6. ✓ = Difference ≤ 1 cent

cost difference was from 1.9% - 71.6% for convenience foods and from 2.7% - 52.6% for home-prepared foods. Preparation cost was the same for one item whether prepared with the electric range or the microwave oven.

Active Time at a Cook's Wage. The percentage difference in cost of active preparation time at a cook's wage between foods prepared with the electric range and in the microwave oven is shown in Table 27. The actual cost figures are greater than those reported in Table 26 since a higher wage rate was used, but the percentage figures are essentially the same in both tables. Small differences are due to rounding.

Food Plus Fuel. The percentage difference in the combined cost per serving of food and fuel between foods prepared with the electric range and in the microwave oven is shown in Table 28. Seventeen foods (4 convenience and 13 home-prepared) cost more when prepared with the electric range than in the microwave oven. The cost difference for 11 of these items (2 convenience and 9 home-prepared) was less than one cent per serving. The percentage difference in cost ranged from 2.6% - 10.5% for convenience foods and from 0.3% - 18.9% for home-prepared foods. Twenty-one foods (11 convenience and 10 home-prepared) had a higher cost when prepared in the microwave oven than with the electric range. The cost difference for 8 of these items (4 convenience and

Table 27

Cost per Equal Weight Serving of Active Time at a Cook's Wage:[1] Comparison Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[2] > MW[3]				MW > ER			
Convenience	ER Cost[4]	MW Cost	% Diff[5]	Convenience	MW Cost	ER Cost	% Diff
Macaroni & cheese	20.86	15.81	24.2	✓Cornbread	10.61	10.43	1.7
Mushroom soup	38.25	27.82	27.3	✓Broccoli	8.92	8.69	2.6
Pudding	41.73	12.36	70.4	✓Chicken noodle soup	7.32	6.96	4.9
				Pizza	15.46	13.91	10.0
Home-Prepared				Chicken pot pie	23.18	20.86	10.0
				Chocolate cake	14.34	11.59	19.2
✓Apple pie[6]	32.38	31.56	2.5	Yellow cake	17.03	13.33	21.7
Pizza incl. sauce	139.10	127.22	8.5	Pancakes	56.18	39.41	29.8
Pizza	97.05	88.21	9.1	Apple pie	5.06	3.48	31.2
Cookies	12.14	6.82	43.8	Spaghetti sauce	7.13	3.48	51.2
Macaroni & cheese	79.48	43.12	45.7	TV dinner	30.91	13.91	55.0
Pudding	58.23	22.68	61.0	Biscuits	24.47	6.96	71.6
ER = MW				Home-Prepared			
Home-Prepared							
				✓White bread	29.14	28.34	2.7
				✓Cornbread	13.30	12.92	2.8
✓Chicken noodle soup	13.04	13.04	0.0	✓White rolls	31.61	30.68	2.9
				Whole wheat bread	35.86	34.78	3.0
				✓Sweet rolls	23.74	22.76	4.1
				Spaghetti sauce	48.47	45.76	5.6
				Chicken pot pie	91.60	85.60	6.6
				Chicken pot pie incl. broth	154.37	140.88	8.7
				Yellow cake	22.07	20.13	8.8
				Chicken noodle soup incl. broth	173.88	152.14	12.5
				TV dinner	217.34	185.47	14.7
				Chocolate cake	25.34	21.48	15.2
				Broccoli	21.03	17.03	19.0
				Mushroom soup	76.74	57.56	25.0
				Biscuits	27.09	17.97	33.7
				Pancakes	73.31	34.78	52.6

1. Cook's Wage: $8.34 per hour
2. ER = Electric Range
3. MW = Microwave Oven
4. Cents per serving
5. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
6. ✓ = Difference ≤ 1 cent

Table 28

Cost per Equal Weight Serving of Food and Fuel:[1] Comparison Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[2] > MW[3]				MW > ER			
Convenience	ER Cost[4]	MW Cost	% Diff[5]	Convenience	MW Cost	ER Cost	% Diff
✓Biscuits[6]	7.60	7.40	2.6	✓Mushroom soup	26.59	26.28	1.2
✓Cornbread	11.96	11.65	2.6	✓Broccoli	21.79	21.40	1.8
Macaroni & cheese	13.13	11.95	9.0	✓Spaghetti sauce	22.46	21.83	2.8
Pudding	17.39	15.57	10.5	Chicken pot pie	61.89	59.68	3.6
				✓Pancakes	9.36	8.83	5.7
Home-Prepared				Chicken noodle soup	18.39	17.30	5.9
				Apple pie	26.25	24.61	6.2
✓Chicken noodle soup incl. broth	46.51	46.37	0.3	TV dinner	107.61	100.43	6.7
				Pizza	77.94	71.54	8.2
✓Whole wheat bread	5.45	5.38	1.3	Yellow cake	12.14	9.99	17.7
✓Cornbread	8.27	8.05	2.7	Chocolate cake	11.96	9.84	17.7
✓White bread	3.64	3.52	3.3				
✓Biscuits	4.70	4.52	3.8	Home-Prepared			
✓White rolls	3.33	3.17	4.8				
✓Apple pie	11.95	11.36	4.9	✓Mushroom soup	28.65	28.56	0.3
✓Pudding	12.48	11.68	6.4	✓Sweet rolls	4.45	4.36	2.0
✓Cookies	6.96	6.51	6.5	✓Chicken noodle soup	15.46	14.97	3.2
Chicken pot pie	34.24	31.64	7.6	Pizza	47.01	45.10	4.1
Chicken pot pie incl. broth	41.30	38.09	7.8	Pizza incl. sauce	47.48	45.34	4.5
				✓Yellow cake	10.34	9.55	7.6
TV dinner	74.69	64.39	13.8	Chocolate cake	14.28	12.56	12.0
Macaroni & cheese	26.87	21.79	18.9	Broccoli	17.72	15.46	12.8
				Spaghetti sauce	28.47	24.48	14.0
				Pancakes	11.04	9.27	16.0

1. Fuel cost: Kilowatt hours of electricity x 4.97¢
2. ER = Electric Range
3. MW = Microwave Oven
4. Cents per serving
5. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
6. ✓ = Difference ≤1 cent

4 home-prepared) was less than one cent. The range of percentage cost difference was from 1.2% - 17.7% for convenience foods and from 0.3% - 16.0% for home-prepared foods.

Food, Fuel, and Active Time at Minimum Wage. As shown in Table 29, the combined cost of food, fuel, and active preparation time at minimum wage was greater with the electric range than in the microwave oven for 12 foods (4 convenience and 8 home-prepared). The difference in cost for 4 of these items (1 convenience and 3 home-prepared) was less than one cent. The percentage difference in cost ranged from 1.4% - 39.8% for convenience foods and from 0.3% - 42.0% for home-prepared foods. Twenty-six foods (11 convenience and 15 home-prepared) had a higher cost when prepared in the microwave oven than with the electric range, although the cost difference for six items (1 convenience and 5 home-prepared) was less than one cent per serving. The range in percentage difference in cost was from 1.9% - 39.7% for convenience foods and from 1.3% - 42.6% for home-prepared foods.

Food, Fuel, and Active Time at a Cook's Wage. The percentage difference per serving in the combined cost of food, fuel, and active preparation time at a cook's wage between foods prepared with the electric range and in the microwave oven is shown in Table 30. Ten foods (4

Table 29

Cost per Equal Weight Serving of Food, Fuel,[1] and Active Time at Minimum Wage:[2] Comparison Between Food Prepared with the Electric Range and with the Microwave Oven

ER[3] > MW[4]				MW > ER			
Convenience	ER Cost[5]	MW Cost	% Diff[6]	Convenience	MW Cost	ER Cost	% Diff
✓Cornbread[7]	16.14	15.91	1.4	✓Broccoli	25.37	24.89	1.9
Mushroom soup	41.62	37.75	9.3	Chicken pot pie	71.19	68.05	4.4
Macaroni & cheese	21.50	18.29	14.9	Chicken noodle soup	21.33	20.09	5.8
Pudding	34.13	20.53	39.8	Apple pie	28.28	26.01	8.0
				Spaghetti sauce	25.32	23.23	8.2
Home-Prepared				Pizza	84.14	77.12	8.3
				TV dinner	120.01	106.01	11.7
✓Chicken pot pie	68.58	68.39	0.3	Chocolate cake	17.71	14.49	18.2
✓Cornbread	13.45	13.38	0.5	Yellow cake	18.97	15.34	19.1
Pizza	84.03	82.39	2.0	Pancakes	31.89	24.64	22.7
Pizza incl. sauce	101.14	98.52	2.6	Biscuits	17.22	10.39	39.7
✓Apple pie	24.94	24.02	3.7				
Cookies	11.83	9.25	21.8	Home-Prepared			
Macaroni & cheese	58.75	39.09	33.5				
Pudding	35.84	20.78	42.0	✓White bread	15.21	15.01	1.3
				✓White rolls	15.85	15.64	1.3
				TV dinner	151.58	149.09	1.6
				✓Whole wheat bread	19.76	19.40	1.8
				Chicken pot pie incl. broth	100.01	97.81	2.2
				✓Chicken noodle soup	20.69	20.20	2.4
				✓Sweet rolls	13.97	13.49	3.4
				Chicken noodle soup incl. broth	116.12	107.54	7.4
				Yellow cake	19.19	17.63	8.1
				Spaghetti sauce	47.91	42.84	10.6
				Mushroom soup	59.44	51.65	13.1
				Chocolate cake	24.45	21.18	13.4
				Broccoli	26.15	22.29	14.8
				Biscuits	15.39	11.91	22.6
				Pancakes	40.45	23.22	42.6

1. Fuel cost: Kilowatt hours of electricity x 4.97¢
2. Minimum Wage: $3.35 per hour
3. ER = Electric Range
4. MW = Microwave Oven
5. Cents per serving
6. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
7. ✓ = Difference ≤ 1 cent

Table 30

Cost per Equal Weight Serving of Food, Fuel,[1] and Active Time at a Cook's Wage:[2] Comparison Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[3] > MW[4]				MW > ER			
Convenience	ER Cost[5]	MW Cost	% Diff[6]	Convenience	MW Cost	ER Cost	% Diff
✓ Cornbread[7]	22.39	22.26	0.6	✓ Broccoli	30.71	30.09	2.0
Mushroom soup	64.53	54.41	15.7	Chicken pot pie	85.07	80.54	5.3
Macaroni & cheese	33.99	27.76	18.3	Chicken noodle soup	25.71	24.26	5.6
Pudding	59.12	27.93	52.8	Pizza	93.40	85.45	8.5
				Apple pie	31.31	28.09	10.3
Home-Prepared				Spaghetti sauce	29.59	25.31	14.5
				TV dinner	138.52	114.34	17.4
Apple pie	44.33	42.92	3.2	Chocolate cake	26.30	21.43	18.5
Pizza	142.15	135.22	4.9	Yellow cake	29.17	23.32	20.0
Pizza incl. sauce	184.44	174.70	5.3	Pancakes	65.54	48.24	26.4
Cookies	19.10	13.33	30.2	Biscuits	31.87	14.56	54.3
Macaroni & cheese	106.35	64.91	39.0				
Pudding	70.71	34.36	51.4	Home-Prepared			
				✓ Cornbread	21.35	21.19	0.7
				✓ Chicken noodle soup	28.50	28.01	1.7
				✓ White bread	32.66	31.98	2.1
				✓ White rolls	34.78	34.01	2.2
				Whole wheat bread	41.24	40.23	2.4
				Chicken pot pie	123.24	119.84	2.8
				Sweet rolls	28.19	27.12	3.8
				Chicken pot pie incl. broth	192.46	182.18	5.3
				TV dinner	281.73	260.16	7.6
				Yellow cake	32.41	29.68	8.4
				Spaghetti sauce	76.94	70.24	8.7
				Chicken noodle soup incl. broth	220.25	198.65	9.8
				Chocolate cake	39.62	34.04	14.1
				Broccoli	38.75	32.49	16.2
				Mushroom soup	105.39	86.12	18.3
				Biscuits	31.61	22.67	28.3
				Pancakes	84.35	44.05	47.8

1. Fuel cost: Kilowatt hours of electricity x 4.97¢
2. Cook's wage: $8.34 per hour
3. ER = Electric Range
4. MW = Microwave Oven
5. Cents per serving
6. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
7. ✓ = Difference ≤ 1 cent

convenience and 6 home-prepared) had a higher cost per serving when prepared with the electric range than in the microwave oven; the cost difference for one convenience food was less than one cent. The percentage difference in cost ranged from 0.6% - 52.8% for convenience foods, and from 3.2% - 51.4% for home-prepared foods. Twenty-eight foods (11 convenience and 17 home-prepared) had a higher cost when prepared in the microwave oven, although the cost difference for 5 of these items (1 convenience and 4 home-prepared) was less than one cent per serving. The range of percentage difference in cost was from 2.0% - 54.3% for convenience foods and from 0.7% - 47.8% for home-prepared foods.

Summary: Electric Range and Microwave Oven. In summary, 65.8% of the foods tested cost more per serving for food alone when prepared in the microwave oven than with the electric range. For fuel alone, 68.4% of the foods cost more when prepared in the electric range. When food and fuel costs were combined, 55.3% of the foods were more expensive when prepared in the microwave oven. In general the microwave-prepared products required more active preparation time per serving, and this was reflected in the cost of active time. At both minimum wage and at a cook's wage, 73.7% of the foods had a higher preparation cost when prepared in the microwave oven. When food, fuel, and active time at minimum wage were combined, 68.4% of the foods cost

more per serving when prepared in the microwave oven. When the costs of food, fuel, and active time at a cook's wage were added, 73.7% of the foods had a higher preparation cost in the microwave oven.

For convenience foods alone, 80.8% cost more per serving for food alone when prepared in the microwave oven, while for the cost of fuel alone 66.7% of the foods cost more when prepared with the electric range. When food and fuel costs were combined, 73.3% of the foods cost more to prepare in the microwave oven. For active preparation time at both minimum wage and at a cook's wage 80.0% of the convenience foods had a higher preparation cost in the microwave oven. When the cost of food, fuel, and active time at minimum wage were combined, 73.3% of the convenience foods cost more to prepare in the microwave oven, and the same 73.3% also had a higher preparation cost in the microwave oven when the cost of food, fuel, and time at a cook's wage were combined.

When home-prepared foods are considered, 56.5% cost more for food alone when prepared in the microwave oven than with the electric range. However, fuel cost was higher for 69.6% of these foods when prepared with the electric range. When the food and fuel costs were combined, 56.5% of the home-prepared foods cost more to prepare with the electric range. Cost of active time at both minimum wage and at a

cook's wage was greater for 78.3% of the microwave-prepared items. The combined cost of food, fuel, and active time at minimum wage was greater for 65.2% of the foods when prepared in the microwave oven. When costs of food, fuel, and active time at a cook's wage were added, 73.9% of the home-prepared foods were more expensive to prepare in the microwave oven.

Nearly all the foods used in this study had an equal total product food cost regardless of the appliance used for preparation (Appendix C), so the differences in the food cost per serving were due to the different number of servings obtained from the two appliances. When food and fuel costs were combined, the majority of all foods cost more per serving to prepare in the microwave oven, although the majority of home-prepared foods cost slightly more to prepare with the electric range. Cost of preparation time was again an important part of the total food cost; since active preparation time was frequently greater for foods prepared in the microwave oven, cost of active time was a factor that made microwave-prepared foods more expensive. As the cost of time increased, so did the number of foods which became more expensive to prepare in the microwave oven.

Food Characteristics

In Table 31, foods are listed by categories of food characteristic combinations. The actual values for density, percent moisture, percent fat, energy consumption per gram, and heating time per gram are shown in Appendix G.

More energy was required to prepare foods with the electric range than in the microwave oven for foods in four categories (Table 32). For foods with high density, low moisture, and low fat, the electric range used 36.9% more energy than did the microwave oven. The electric range also used 40.0% more energy for foods with low density and moisture but high fat, 68.7% more energy for foods in which all three characteristics were low, and 74.0% more energy for foods of high density, low moisture, and high fat.

The microwave oven required more energy than the electric range for the preparation of foods in three categories (Table 32). For the category of foods with high density and moisture but low fat, the microwave oven required 24.1% more energy than did the electric range. The microwave oven required 36.7% more energy for foods with low density but high moisture and fat, and 51.1% more energy for foods with low density, high moisture, and low fat.

As shown in Table 33 the electric range required more heating time or the same amount of heating time per gram as did the microwave oven for all categories of food

Table 31

Categories of Foods by Food Characteristic Combinations

Category Code		Cooking Appliance: Electric Range	Cooking Appliance: Microwave Oven
111[1]	Low density Low moisture Low fat	Cornbread-C[2] Cornbread-HP[3] Yellow cake-C Chocolate cake-C TV dinner-C White bread-HP Whole wheat bread-HP Sweet rolls-HP	Pancakes-C Cornbread-C Cornbread-HP Yellow cake-C Chocolate cake-C TV dinner-C White bread-HP Whole wheat bread-HP Sweet rolls-HP
112	Low density Low moisture High fat	Biscuits-C Biscuits-HP Pancakes-C Pancakes-HP Yellow cake-HP Chocolate cake-HP Pizza-C TV dinner-Hp Fried chicken-HP Sausage-HP Cookies-HP White rolls-HP	Biscuits-C Biscuits-HP Pancakes-HP Yellow cake-HP Chocolate cake-hp Pizza-C Fried chicken-HP Sausage-HP Cookies-HP White rolls-HP
121	Low density High moisture Low fat	Broccoli-C Carrots-HP Macaroni-HP	Broccoli-C Carrots-HP Macaroni-HP TV dinner-HP
122	Low density High moisture High fat	Broccoli-HP	Broccoli-HP
211	High density Low moisture Low fat	Macaroni & cheese-C Macaroni & cheese-HP Pudding-C Pudding-HP Pizza-HP Pizza incl. sauce-HP	Macaroni & cheese-C Macaroni & cheese-HP Pudding-C Pudding-HP Pizza-HP Pizza incl. sauce-HP

Table 31 (continued)

Categories of Foods by Food Characteristic Combinations

Category Code		Cooking Appliance: Electric Range	Cooking Appliance: Microwave Oven
212	High density Low moisture High fat	Chicken pot pie-C Chicken pot pie-HP Chicken pot pie incl. broth-HP Apple pie-C Apple pie-HP	Chicken pot pie-C Chicken pot pie-HP Chicken pot pie incl. broth-HP Apple pie-C Apple pie-HP
221	High density High moisture Low fat	Spaghetti sauce-C Spaghetti sauce-HP Mushroom soup-C Mushroom soup-HP Chicken noodle soup-C Chicken noodle soup-HP Chicken noodle soup incl. broth-HP Potatoes-HP	Spaghetti sauce-C Spaghetti sauce-HP Mushroom soup-C Mushroom soup-HP Chicken noodle soup-C Chicken noodle soup-HP Chicken noodle soup incl. broth-HP Potatoes-HP
222	High density High moisture High fat	No foods in this category	No foods in this category

Note: Convenience pancakes contained less fat when prepared in the microwave because margarine was used to grill the microwave pancakes while oil was used for the pancakes prepared on the electric range. Oil is 100% fat while margarine is not. Similarly, home-prepared TV dinner contained more moisture and less fat when prepared in the microwave oven since margarine was used to fry the chicken, while oil was used on the electric range.

1. Category code, L to R: 1st digit=density, 2nd=% moisture, 3rd=% fat 1=low level characteristic 2=high level characteristic
2. C= Convenience food
3. HP = Home-prepared food

Table 32

Energy Consumption per Gram by Category of Food Characteristic Combinations: Comparison Between Electric Range and Microwave Oven

Category		Electric Range N	Electric Range Mean (wh/g)	Microwave Oven N	Microwave Oven Mean (wh/g)	Percentage Difference[1]
			ER[2] > MW[3]			
211[4]	High Density Low Moisture Low Fat	6	0.65	6	0.41	36.9
112	Low Density Low Moisture High Fat	12	1.10	10	0.66	40.0
111	Low Density Low Moisture Low Fat	8	1.15	9	0.36	68.7
212	High Density Low Moisture High Fat	5	1.92	5	0.50	74.0
			MW > ER			
221	High Density High Moisture Low Fat	8	0.44	8	0.58	24.1
122	Low Density High Moisture High Fat	1	0.38	1	0.60	36.7
121	Low Density High Moisture Low Fat	3	0.45	4	0.92	51.1

1. Percentage Difference = $\frac{\text{Larger value-smaller value}}{\text{Larger value}} \times 100$
2. ER = Electric Range
3. MW = Microwave Oven
4. Category code, L to R: 1st digit=density, 2nd=% moisture, 3rd=% fat 1=low level characteristic 2=high level characteristic

Table 33

Heating Time per Gram by Category of Food Characteristic Combinations: Comparison Between Electric Range and Microwave Oven

Category		Electric Range N	Electric Range Mean (wh/g)	Microwave Oven N	Microwave Oven Mean (wh/g)	Percentage Difference[1]
			ER[2] > MW[3]			
122[4]	Low Density High Moisture High Fat	1	0.028	1	0.025	10.7
112	Low Density Low Moisture High Fat	12	0.040	10	0.030	25.0
221	High Density High Moisture Low Fat	8	0.041	8	0.028	31.7
111	Low Density Low Moisture Low Fat	8	0.050	9	0.021	58.0
211	High Density Low Moisture Low Fat	6	0.046	6	0.019	58.7
212	High Density Low Moisture High Fat	5	0.077	5	0.018	76.6
			ER = MW			
121	Low Density High Moisture Low Fat	3	0.042	4	0.042	0.0

1. Percentage Difference = $\frac{\text{Larger value-smaller value}}{\text{Larger value}} \times 100$
2. ER = Electric Range
3. MW = Microwave Oven
4. Category code, L to R: 1st digit=density, 2nd=% moisture, 3rd=% fat 1=low level characteristic 2=high level characteristic

characteristic combinations. The electric range required from 10.7% more heating time for foods with low density but high moisture and fat, to 76.6% more heating time for foods with high density, low moisture, and high fat. The two appliances required the same amount of heating time per gram for foods with low density, high moisture, and low fat.

Appliance manufacturers have stated that as the density of a food increases the energy and time required to cook the food will also increase. For foods prepared with the electric range, those with a high density did require more energy and heating time per gram than foods with a low density (Table 34). However the reverse was true for foods prepared in the microwave oven. Laughon (1980) reported that as food density increased the energy and time required decreased for foods prepared with both the electric range and the microwave oven.

Bennett (1975) and Laughon (1980) reported that, as moisture content of foods increased, less energy and time were required to cook the food. The findings of this study were similar for foods prepared with the electric range. However, for foods prepared in the microwave oven, as moisture content increased both energy and heating time required also increased (Table 34).

Bennett (1975) also stated that as fat content of a food increases, the cooking time, and thereby the energy

Table 34

Mean Energy Consumption and Heating Time by Appliance and by Low or High Values For Density, Percent Moisture, and Percent Fat

	Density		% Moisture		% Fat	
	Low[1]	High[2]	Low[3]	High[4]	Low[5]	High[6]
Electric Range						
Mean Energy Consumption (wh/g)	0.77	1.00	1.20	0.42	0.67	1.13
Mean Heating Time (min/g)	0.040	0.055	0.053	0.037	0.045	0.048
Microwave Oven						
Mean Energy Consumption (wh/g)	0.64	0.50	0.48	0.70	0.57	0.59
Mean Heating Time (min/g)	0.030	0.022	0.022	0.032	0.028	0.024

1. Low density: ≤0.800; categories 111, 112, 121, 122
2. High density: > 0.800; categories 211, 212, 221
3. Low moisture: ≤ 75%; categories 111, 112, 211, 212
4. High moisture: > 75%; categories 121, 122, 221
5. Low fat: ≤ 10%; categories 111, 121, 211, 221
6. High fat: > 10%; categories 112, 122, 212

required, should decrease. This is thought to be due to the fact that most fats have a low specific heat and thus increase in temperature faster than water when the same amount of energy is applied (Van Zante, 1973). Laughon (1980), however, reported that as fat content increased energy consumption and time also tended to increase. In this study as fat content increased the energy required by the electric range also increased (Table 34). The energy required by the microwave oven and the heating time required by both appliances stayed about the same as fat content increased.

It should be noted that although density, heating time, and energy consumption were measured in the laboratory, moisture content and fat content were based on tabulated values. These values may not have been precisely representative of the foods prepared in the laboratory. In addition, category 122 (low density, high moisture, high fat) contained only one food. The results for that food may not be representative of other foods in that category. In this study no foods were in category 222, foods high in all characteristics.

In summary, foods with a high density required more energy and heating time per gram than foods with a low density when prepared with the electric range. However the reverse was seen for foods prepared with the microwave oven.

Foods with a high moisture content required less energy and heating time per gram than foods with a low moisture content when prepared with the electric range. Again, however, the reverse was true for foods prepared with the microwave oven. Foods with a high fat content required more energy per gram than foods with a low fat content when prepared with the electric range. Fat content did not appreciably affect the energy per gram required for foods prepared with the microwave oven, or the heating time per gram required for foods prepared with either appliance.

Degree-of-Readiness

The convenience foods used in this study are listed by category of readiness in Table 35. Home-prepared foods were given the same classification as their convenience counterparts. Values for energy consumption per gram, total preparation time per gram, and active preparation time per gram are shown in Appendix G.

As shown in Table 36, convenience foods in three categories required more energy per gram to prepare than did their home-prepared counterparts. Convenience foods in category 10 (hydrate then cook) required 14.3% more energy per gram than home-prepared foods in the same category; convenience foods which were ready to heat required 16.1% more energy per gram, while ready-to-cook convenience foods required 46.4% more energy per gram than home-prepared

Table 35

Convenience Foods Categorized by Degree-of-Readiness

Category	Foods
00 Eat as is	Cookies, ready-to-eat White bread, ready-to-eat Whole wheat bread, ready-to-eat White rolls, ready-to-eat Sweet rolls, ready-to-eat
05 Ready to heat	Spaghetti sauce, canned TV dinner, frozen
07 Hydrate then heat	Mushroom soup, canned condensed Chicken noodle soup, canned condensed
08 Ready to cook	Biscuits, refrigerated Pizza, frozen Pot pie, frozen Apple pie, frozen Broccoli, frozen
10 Hydrate then cook	Pancake mix, complete Pudding mix, regular
12 Add other ingredients then cook	Macaroni & cheese mix Yellow cake mix Chocolate cake mix Cornbread mix

Table 36

Energy Consumption per Gram by Degree-of-Readiness Category: Comparison of Convenience and Home-Prepared Foods

Category	Convience N	Convience Mean (wh/g)	Home-Prepared N	Home-Prepared Mean (wh/g)	Percentage Difference[1]
		C[2] > HP[3]			
10 Hydrate then cook	4	0.56	4	0.48	14.3
05 Ready to heat	4	0.93	4	0.84	16.1
08 Ready to cook	10	1.38	14	0.74	46.4
		HP > C			
12 Add other ingredients then cook	8	0.55	8	0.73	24.6
07 Hydrate then heat	4	0.27	6	0.70	61.4
00 Eat as is	5	0.00	10	0.61	100.0

1. Percentage Difference = $\frac{\text{Larger Value-smaller value}}{\text{Larger value}} \times 100$
2. C = Convenience food
3. HP = Home-prepared Food

products. Conversely, home-prepared foods in three categories required more energy per gram to prepare than their convenience counterparts. Home-prepared foods in category 12 (add other ingredients then cook) took 24.6% more energy per gram than convenience foods. Home-prepared foods which required hydration before heating took 61.4% more energy per gram, while home-prepared foods in the category "eat as is" required 100.0% more energy per gram than the convenience foods in that category.

Home-prepared foods in all categories required more total time per gram to prepare than did convenience foods (Table 37). The percentage difference in amount of total time required ranged from 19.0% for foods in category 10 (hydrate then cook) to 100.0% for foods in category 00 (eat as is). Similarly, home-prepared foods in all categories required more active preparation time per gram than convenience foods (Table 38). The percentage difference in active time ranged from 18.5% for foods in category 10 (hydrate then cook) to 100.0% for foods in category 00 (eat as is).

Because convenience foods are fully or partially prepared as purchased it might be expected that convenience foods would require less energy to prepare than foods made from raw ingredients, and that the percentage difference between convenience and home-prepared foods would be

Table 37

Total Preparation Time per Gram by Degree-of-Readiness Category: Comparison of Convenience and Home-Prepared Foods

Category	Convenience		Home-Prepared		Percentage Difference[1]
	N	Mean (minutes/gram) (min/g)	N	Mean (minutes/gram) (min/g)	
		HP[2], C[3]			
10 Hydrate then cook	4	0.034	4	0.042	19.0
08 Ready to cook	10	0.058	14	0.075	22.7
12 Add other ingredients then cook	8	0.033	8	0.046	28.3
05 Ready to heat	4	0.050	4	0.084	40.5
07 Hydrate then heat	4	0.019	6	0.075	74.7
00 Eat as is	5	0.000	10	0.217	100.00

1. Percentage Difference = $\frac{\text{Larger value-smaller value}}{\text{Larger value}} \times 100$
2. HP = Home-prepared food
3. C = Convenience food

Table 38

Active Preparation Time per Gram by Degree-of-Readiness Category: Comparison of Convenience and Home-Prepared Foods

Category	Convenience N	Convenience Mean (min/g)	Home-Prepared N	Home-Prepared Mean (min/g)	Percentage Difference[1]
		HP[2], C[3]			
10 Hydrate then cook	4	0.022	4	0.027	18.5
12 Add other ingredients then cook	8	0.009	8	0.018	50.0
07 Hydrate then heat	4	0.005	6	0.016	68.8
08 Ready to cook	10	0.008	14	0.030	73.3
05 Ready to heat	4	0.004	4	0.022	81.8
00 Eat as is	5	0.000	10	0.038	100.0

1. Percentage Difference = $\frac{\text{Larger value-smaller value}}{\text{Larger value}} \times 100$
2. HP = Home-prepared food
3. C = Convenience food

smallest for categories in which convenience foods were "least ready." However, in this study convenience foods in three categories required more preparation energy than home-prepared foods. Many of the convenience foods in those categories were either frozen at the start of heating or required a longer heating time to achieve the same degree of doneness as their home-prepared counterparts.

It might also be expected that the percentage difference in total and active preparation time would be largest between home-prepared foods and convenience foods in those categories where the convenience foods were "most ready." While the results of this study did not strictly confirm that expectation, in general the percentage difference in preparation time was greater for foods which required just heating than for foods which required cooking. The percentage difference in preparation time was greatest when the convenience foods could be eaten as purchased.

It should be noted that not all degree-of-readiness categories were represented in this study. In addition, three categories (ready to heat, hydrate then heat, and hydrate then cook) contained only two foods each. These foods may not be representative of other foods in these categories.

Nutrient Content

Comparisons between convenience and home-prepared foods of Mean Adequacy Ratio (MAR), calories per serving, grams fat per serving, percent calories from fat, milligrams sodium per serving, and grams crude fiber per serving are shown in Table 39.

Nine convenience foods (biscuits, cornbread, chocolate cake, pizza, pudding, mushroom soup, TV dinner, white bread, and whole wheat bread) had a higher MAR than their home-prepared counterparts. Of these foods, the percentage difference in the MAR ranged from 0.2% for TV dinner to 27.8% for mushroom soup. One food (white rolls) had the same MAR in convenience and in home-prepared form. The remaining ten foods had a higher MAR in home-prepared than in convenience form, with the percentage difference ranging from 17.1% for yellow cake to 67.6% for apple pie. For each food, the amount of each nutrient per serving and the percent U.S. RDA are shown in Appendix H.

In calculating the MAR, all nine nutrients used were given equal weight. A food such as macaroni and cheese, therefore, which is high in protein and calcium but low in some of the vitamins might appear to have a relatively low MAR. The MAR also does not identify specifically which nutrients are present in large or small amounts. However, since comparison was made only between the convenience and

Table 39

Comparison of Nutrient Data[1] Between Convenience and Home-Prepared Foods: Mean Adequacy Ratio, Calories per Serving, Grams Fat per Serving, Percent Calories from Fat, Milligrams Sodium per Serving, and Grams Fiber per Serving

	Mean Adequacy Ratio			Calories Per Serving[3]			Grams Fat per Serving[3]			% Calories From Fat			Milligrams Sodium Per Serving[3]			Grams Fiber Per Serving[3]		
	C[4]	H-P[5]	% Diff[6]	C	H-P	% Diff	C	H-P	% Diff	C	H-P	% Diff	C	H-P	% Diff	C	H-P	% Diff
Biscuits	6.8	6.5	4.4	157.34	195.27	19.4	9.66	8.54	11.6	55.26	39.36	28.8	493.02	330.17	33.0	.11	.09	18.2
Pancakes	4.6	9.5	51.6	133.76	246.22	25.4	12.62	12.42	1.6	61.31	45.40	26.5	253.80	335.21	24.3	.04	.09	55.6
Cornbread	9.8	8.9	9.2	275.25	233.54	15.2	9.13	6.34	30.6	29.85	24.43	18.2	680.45	267.43	60.7	.17	.15	11.8
Yellow cake	3.4	4.1	17.1	204.79	262.57	22.0	6.57	10.60	38.0	28.87	36.33	20.5	189.56	272.43	30.4	.04	.04	0.0
Chocolate cake	2.9	2.6	10.3	190.79	252.91	24.6	6.05	10.02	39.6	28.54	35.66	20.0	211.44	171.02	19.1	.13	.14	7.1
Broccoli	13.6	16.9	19.5	31.62	101.69	68.9	1.79	9.61	81.4	50.95	85.05	40.1	NA	262.85	NA	NA	.86	NA
Macaroni & cheese	12.8	17.1	25.1	262.80	353.86	25.7	12.24	18.13	32.5	41.92	46.11	9.1	NA	721.30	NA	NA	.14	NA
Spaghetti sauce	8.4	12.8	34.4	84.33	145.69	42.1	4.48	11.46	60.9	47.31	70.79	32.5	NA	394.40	NA	NA	.76	NA
Pizza	29.6	23.0	22.3	507.60	425.74	16.1	23.94	19.42	18.9	42.45	41.05	3.3	NA	957.65	NA	NA	.63	NA
Pudding	6.4	6.2	3.1	141.47	180.89	21.8	4.97	9.07	45.2	31.62	45.13	29.9	NA	199.65	NA	NA	.01	NA
Mushroom soup	11.5	8.3	27.8	252.89	229.16	9.4	16.79	21.13	19.7	59.75	82.98	28.0	1312.95	873.98	33.5	.30	.46	34.8
Chicken noodle soup	6.7	20.1	66.7	94.55	221.59	57.3	3.11	7.78	60.0	29.60	31.60	6.3	1399.95	1028.75	26.5	.30	.07	76.7
Chicken pot pie	13.7	25.5	46.3	494.94	554.59	10.7	25.99	34.63	24.9	47.26	56.24	16.0	928.86	676.93	27.1	.90	.45	50.0
Apple pie	1.2	3.7	67.6	237.49	283.17	16.1	9.44	13.81	31.6	35.77	43.89	18.5	199.16	154.68	22.3	.23	.36	22.2
TV dinner	39.1	39.0	0.2	565.85	699.61	19.1	30.08	49.20	38.9	47.84	63.29	24.4	845.75	1461.73	42.1	1.09	1.26	13.5
Cookies	1.2	1.6	25.0	107.22	115.52	7.2	4.78	6.33	24.5	40.12	49.32	18.6	79.22	85.72	7.6	.09	.09	0.0
White bread	5.4	4.9	9.2	154.58	166.12	6.9	1.83	3.69	50.4	10.65	19.99	46.7	290.26	201.66	30.5	.11	.11	0.0
Whole Wheat bread	6.6	6.2	6.1	144.28	170.71	15.5	1.78	4.25	58.1	11.10	22.41	50.5	312.90	327.01	4.3	1.42	.51	64.1
White rolls	3.2	3.2	0.0	107.88	133.35	19.1	2.03	5.62	63.9	16.94	37.93	55.3	133.17	67.33	52.3	.07	.06	14.3
Sweet rolls	2.1	2.8	25.0	103.97	137.24	20.6	1.15	2.68	57.1	9.50	17.58	46.0	152.16	95.54	37.2	.08	.09	11.1

1. Nutrient data from USDA Handbook 8 and its updates, and from the CNC Nutritive Value Data Set
2. Mean of values for 9 nutrients (protein, calcium, phosphorus, iron, vitamin A, thiamin, riboflavin, niacin, and absorbic acid) divided divided by their respective U.S. RDA values.
3. Based on equal weight servings
4. C = Convenience Food
5. HP = Home-Prepared Food
6. % Difference = $\frac{\text{Larger value} - \text{Smaller value}}{\text{Larger value}} \times 100$

home-prepared forms of the same food item, it was assumed that the same nutrients were present in the two forms of any food item although the amounts differed. Of the foods studied, approximately half had a greater nutrient content per serving in the convenience form, and half contained more nutrients in the home-prepared form.

Three convenience foods (cornbread, pizza, and mushroom soup) had a greater number of calories per serving than did their home-prepared counterparts, with the percentage difference ranging from 9.4% for mushroom soup to 16.1% for pizza (Table 39). The remaining foods contained more calories per serving in home-prepared form, and the percentage difference in calories ranged from 6.9% for white bread to 68.9% for broccoli. Four convenience foods (biscuits, pancakes, cornbread, and pizza) contained more fat per serving than did their home-prepared counterparts, and the percentage difference ranged from 1.6% for pancakes to 30.6% for cornbread. These same four convenience foods also contained a higher percentage of calories from fat than did the same foods made from raw ingredients, with the percentage difference ranging from 3.3% for pizza to 28.8% for biscuits. The remaining foods contained more fat and a higher percentage of calories from fat in the home-prepared version. For fat, the percentage difference between home-prepared and convenience foods ranged from 19.7% for

mushroom soup to 81.4% for broccoli. (This high value for broccoli was due to the added fat.) For percent of calories from fat the percentage difference ranged from 6.3% for chicken noodle soup to 55.3% for white rolls.

Ten convenience foods (biscuits, cornbread, chocolate cake, mushroom soup, chicken noodle soup, chicken pot pie, apple pie, white bread, white rolls, and sweet rolls) contained more sodium per serving than did their home-prepared counterparts (Table 39). The percentage difference in sodium content ranged from 19.1% for chocolate cake to 60.7% for cornbread. Five foods (pancakes, yellow cake, TV dinner, cookies, and whole wheat bread) contained more sodium in the home-prepared version, with the percentage difference ranging from 4.3% for whole wheat bread to 42.1% for TV dinner. For five convenience foods (broccoli, macaroni and cheese, spaghetti sauce, pizza, and pudding) information on sodium was not available so no comparison with the home-prepared products could be made. Similarly, data on dietary fiber were not available for five convenience products. Of the fifteen foods for which there was information on crude fiber, six (biscuits, cornbread, chicken noodle soup, chicken pot pie, whole wheat bread, and white rolls) contained more fiber per serving in the convenience form. The percentage difference in fiber content ranged from 11.8% for cornbread to 76.7% for chicken

noodle soup. Six other products (pancakes, chocolate cake, mushroom soup, apple pie, TV dinner, and sweet rolls) contained more fiber in the home-prepared version, with the percentage difference ranging from 7.1% for chocolate cake to 55.6% for pancakes. Three products (yellow cake, cookies, and white bread) contained the same amount of fiber in both the convenience and the home-prepared forms.

Americans have been advised that to stay healthy it may be wise to adjust caloric intake to maintain ideal weight, to limit fat and sodium intakes, and to eat an adequate amount of fiber (U.S. Dept. Agric. and U.S. Dept. HEW, 1980). Comparisons of nutrient content between convenience and home-prepared foods in this study show that the majority (85%) of home-prepared foods contained more calories per serving than did their convenience counterparts. Eighty percent of home-prepared foods contained more fat per serving, and the same 80% contained a higher percentage of calories from fat. Of the foods for which sodium and fiber data were available, 66.7% contained more sodium in convenience than in home-prepared form. Forty percent of convenience foods contained more fiber per serving, 40% of home-prepared foods contained more fiber, and 20% of the foods had the same amount of fiber in both preparation forms. Therefore, although the majority of convenience foods studied contained more sodium per serving than their

home-prepared counterparts, the majority of convenience foods were also lower in fat and calories and had a lower percentage of calories from fat.

Although the recipes for home-prepared foods were chosen to be typical of those which might be used in an American home, a particular consumer could modify the recipes to contain fewer calories, less fat and salt, or more fiber. This option would not generally be open to users of convenience foods.

The nutrient information presented here is only as accurate as the tables from which it came. The information on convenience foods in the tables was based on more than one brand of each product, and may or may not be representative of any one particular brand.

Sensory Quality

The sensory panel members evaluated each preparation form of each food on a 9-point scale (9= like extremely, 1= dislike extremely) for appearance, texture, flavor, and overall quality (Appendix D). Two categories of foods were evaluated for sensory quality: those which were prepared in convenience and home-prepared form with both an electric range and a microwave oven, and those which were prepared in home-prepared form with the electric range and microwave oven but which came ready-to-eat in the convenience form. For the five foods in this second category (cookies, white

bread, whole wheat bread, white rolls, and sweet rolls) two brands of the ready-to-eat convenience product, a national brand and a house brand, were evaluated for sensory quality.

As shown in Table 40 all convenience foods prepared with the electric range except mushroom soup and pizza were scored at least 5 on the nine-point scale for all quality factors. Mushroom soup was rated lower in texture, and pizza was rated lower in flavor and overall quality. Convenience foods prepared in the microwave oven, except macaroni and cheese and pudding, were rated at least 5 for all factors. Macaroni and cheese was rated lower for appearance, and pudding was rated lower on texture and overall quality. All ready-to-eat convenience foods which were national brands were rated at least 5 for all factors, while all ready-to-eat house brand convenience foods except cookies also received scores of at least 5 for all factors. Cookies were rated lower for overall quality.

All home-prepared foods prepared with the electric range, except pudding, were rated at least 5 for all factors (Table 40). Pudding was rated lower for appearance, texture, flavor, and overall quality. Home-prepared foods prepared in the microwave oven were scored at least 5 except pudding, which was scored lower for appearance, texture, and overall quality; biscuits, scored lower for appearance, flavor, and overall quality; white bread, scored lower for

Table 40

Sensory Quality of Convenience and Home-Prepared Foods Heated in Electric Range and Microwave Oven: Mean Values[1] for Appearance, Texture, Flavor, and Overall Quality

	Appearance	Texture	Flavor	Overall Quality
Biscuits				
C-ER[2 3]	6.2±0.8[a]	6.1±0.9[a]	6.2±1.1[a]	5.8±1.4[a]
C-MW[4]	5.2±1.3[b]	5.5±1.0[a]	6.2±0.9[a]	5.5±1.0[a]
HP-ER[5]	6.6±0.6[a]	6.1±0.7[a]	5.7±1.4[ab]	5.7±1.1[a]
HP-MW	4.5±1.1[b]	5.1±1.1[a]	4.7±1.6[b]	4.4±1.3[b]
Pancakes				
C-ER	6.6±0.9[a]	6.8±0.6[a]	6.5±0.7[a]	6.6±0.6[a]
C-MW	6.8±0.5[a]	6.7±0.4[a]	6.6±0.6[a]	6.5±0.6[a]
HP-ER	6.4±0.6[a]	6.3±0.7[a]	6.2±1.0[a]	6.2±0.7[a]
HP-MW	5.7±0.7[b]	4.3±0.9[b]	5.8±1.0[a]	4.9±1.1[b]
Cornbread				
C-ER	7.0±1.0[a]	7.1±0.7[a]	6.1±1.2[a]	6.6±0.6[a]
C-MW	5.2±0.7[b]	5.8±0.9[b]	5.7±0.6[a]	5.9±0.6[bc]
HP-ER	6.9±0.8[a]	6.7±0.9[a]	6.1±1.2[a]	6.4±1.0[ab]
HP-MW	5.5±0.9[b]	5.8±1.1[b]	5.7±1.1[a]	5.5±0.7[c]
Yellow cake				
C-ER	6.7±0.6[a]	7.0±0.7[a]	6.8±0.7[a]	6.9±0.8[a]
C-MW	6.4±0.9[ab]	6.3±0.8[a]	6.6±0.6[ab]	6.1±0.8[b]
HP-ER	6.9±0.8[a]	7.0±0.7[a]	7.1±0.6[a]	6.9±0.6[a]
HP-MW	5.8±0.9[b]	5.5±1.0[b]	6.0±1.0[b]	5.3±1.1[c]
Chocolate cake				
C-ER	7.0±0.6[a]	6.8±0.7[a]	7.0±0.7[a]	7.0±0.8[a]
C-MW	7.3±0.4[a]	6.1 1.1[a]	6.9±0.5[a]	6.7±0.5[a]
HP-ER	7.1±0.7[a]	7.0±0.6[a]	6.8±0.7[a]	6.8±0.7[a]
HP-MW	5.5±0.8[b]	3.0±1.0[b]	5.7±1.2[b]	3.9±1.0[b]

Table 40 (continued)

Sensory Quality of Convenience and Home-Prepared Foods Heated in Electric Range and Microwave Oven: Mean Values[1] for Appearance, Texture, Flavor, and Overall Quality

	Appearance	Texture	Flavor	Overall Quality
Macaroni & cheese				
C-ER	5.1±1.2[a]	6.2±1.0[a]	5.7±1.0[a]	5.3±1.2[a]
C-MW	4.8±1.2[a]	5.4±1.3[a]	6.2±1.0[a]	5.6±1.1[a]
HP-ER	6.4±1.3[b]	6.2±1.5[a]	5.9±1.6[a]	6.0±1.5[a]
HP-MW	6.6±1.4[b]	6.3±1.1[a]	6.4±1.2[a]	6.2±1.5[a]
Pizza				
C-ER	5.6±0.6[a]	5.4±0.9[a]	4.8±0.8[a]	4.9±0.8[a]
C-MW	5.7±0.5[a]	5.2±1.0[a]	5.0±0.9[a]	5.0±0.9[a]
HP-ER	7.6±0.8[b]	7.1±0.8[b]	7.0±0.8[b]	6.8±0.7[b]
HP-MW	7.3±0.7[b]	6.6±0.8[b]	6.7±0.6[b]	6.6±0.8[b]
Pudding				
C-ER	6.6±0.9[a]	6.8±0.8[a]	6.6±0.9[a]	6.7±0.5[a]
C-MW	5.3±1.3[b]	4.8±0.9[b]	5.7±0.8[b]	4.9±1.0[b]
HP-ER	3.4±0.7[c]	4.3±1.3[bc]	4.9±1.0[b]	4.2±1.1[bc]
HP-MW	4.7±1.0[b]	3.8±1.1[c]	5.0±0.6[b]	4.0±0.7[c]
Mushroom soup				
C-ER	5.0±1.1[a]	4.9±1.2[a]	5.3±1.0[a]	5.0±0.9[a]
C-MW	5.2±1.1[a]	5.3±1.1[a]	5.5±0.8[a]	5.2±0.8[a]
HP-ER	6.2±1.0[b]	6.9±0.9[b]	7.8±0.7[b]	7.2±0.8[b]
Chicken noodle soup				
C-ER	5.6±0.9[a]	5.5±1.0[a]	5.7±1.1[a]	5.5±0.8[a]
C-MW	5.6±1.0[a]	5.2±1.3[a]	5.7±1.0[a]	5.2±0.8[a]
HP-ER	7.5±0.8[b]	7.6±0.9[b]	7.3±0.7[b]	7.3±0.7[b]
HP-MW	7.7±0.6[b]	7.6±0.6[b]	7.6±0.6[b]	7.4±0.6[b]

Table 40 (continued)

Sensory Quality of Convenience and Home-Prepared Foods Heated in Electric Range and Microwave Oven: Mean Values[1] for Appearance, Texture, Flavor, and Overall Quality

	Appearance	Texture	Flavor	Overall Quality
Cookies				
C-NB[6]	5.5±1.3[a]	5.9±1.3[a]	5.8±1.1[a]	5.8±1.2[a]
C-HB[7]	5.4±0.9[a]	5.0±0.9[a]	5.2±1.1[a]	4.9±0.8[a]
HP-ER	7.7±0.5[b]	7.7±0.6[b]	7.9±0.7[b]	7.9±0.6[b]
HP-MW	6.1±1.1[a]	7.0±1.4[a]	7.4±1.6[b]	7.0±1.5[b]
White bread				
C-NB	7.0±0.9[a]	6.7±0.9[a]	6.5±1.1[ab]	6.6±0.8[a]
C-HB	5.8±1.4[bc]	5.3±1.6[b]	5.9±1.2[a]	5.6±1.4[bc]
HP-ER	6.2±1.0[ab]	6.0±1.0[ab]	6.9±0.6[b]	6.4±0.9[ab]
HP-MW	4.9±1.0[c]	4.2±1.2[c]	5.8±1.0[a]	4.7±1.2[c]
Whole wheat bread				
C-NB	7.2±0.7[a]	7.3±0.6[a]	6.8±0.7[a]	7.0±0.6[a]
C-HB	7.2±0.3[a]	7.0±0.5[a]	7.0±0.7[a]	7.0±0.5[a]
HP-ER	6.1±0.8[a]	6.8±0.6[a]	6.8±0.6[a]	6.3±0.7[b]
HP-MW	5.2±0.5[c]	4.4±1.0[b]	6.1±0.7[b]	4.9±1.0[c]
White rolls				
C-NB	5.7±0.8[ab]	5.9±1.1[a]	6.1±0.7[a]	6.1±1.1[a]
C-HB	6.6±0.6[bc]	6.4±0.6[ab]	6.3±0.8[a]	6.6±0.6[ab]
HP-ER	7.5±0.9[c]	7.2±1.0[b]	7.4±0.7[b]	7.3±0.7[b]
HP-MW	5.4±1.3[a]	6.0±1.4[a]	6.9±0.7[ab]	6.2±0.9[a]
Sweet rolls				
C-NB	5.7±0.9[a]	6.5±1.1[a]	5.9±1.1[a]	5.6±1.2[ab]
C-HB	5.8±1.2[a]	5.4±0.9[b]	5.4±1.2[a]	5.2±1.2[a]
HP-ER	7.1±1.0[b]	6.6±1.0[a]	7.4±0.7[b]	6.9±0.9[c]
HP-MW	6.2±0.8[a]	5.6±1.4[ab]	7.3±0.9[b]	6.3±0.9[bc]

Table 40 (continued)

Sensory Quality of Convenience and Home-Prepared Foods Heated in Electric Range and Microwave Oven: Mean Values[1] for Appearance, Texture, Flavor, and Overall Quality

1. Mean of 4 replications by 14 judges.
2. C = Convenience food
3. ER = Electric range
4. MW = Microwave oven
5. HP = Home-Prepared food
6. NB = National brand
7. HB = House brand

a, b, c, For each food, means within a column with different letters are significantly different ($p < .01$) using the analysis of variance procedure.

appearance, texture, and overall quality; and chocolate cake, pancakes, and whole wheat bread, which were all scored lower for texture and overall quality.

Appearance. In a comparison of convenience and home-prepared foods, four items (mushroom soup, macaroni and cheese, chicken noodle soup, and pizza) were scored significantly higher for appearance ($p<.01$) in the home-prepared form whether prepared with the electric range or in the microwave oven (Table 41). One food prepared with the electric range (pudding) was rated significantly higher ($p<.01$) for appearance in the convenience form, and two microwave-prepared foods (pancakes and chocolate cake) also were scored significantly higher for appearance ($p<.01$) in the convenience form.

Home-prepared sweet rolls, white rolls, and cookies prepared with the electric range were rated significantly higher ($p<.01$) for appearance than the national brand convenience products, although the national brand whole wheat bread was rated significantly higher ($p<.01$) than the home-prepared product prepared with the electric range (Table 41). The national brand versions of whole wheat bread and white bread were scored significantly higher ($p<.01$) than the home-prepared product prepared in the microwave oven. Home-prepared sweet rolls and cookies baked in the electric range were rated significantly higher

Table 41

Mean[1] Sensory Appearance Scores: Comparison Between Convenience and Home-Prepared Foods

HP[2] > C	Mean HP	Mean C	% Diff
ER[5] Chocolate cake	7.1	7.0	1.4
Yellow cake	6.9	6.7	2.9
Biscuits	6.6	6.2	6.1
*Mushroom soup	6.2	5.0	19.4
* Macaroni & cheese	6.4	5.1	20.3
*Chicken noodle soup	7.5	5.6	25.3
*Pizza	7.6	5.6	26.3
MW[6] Cornbread	5.5	5.2	5.4
*Mushroom soup	6.3	5.2	17.5
*Pizza	7.3	5.7	21.9
*Macaroni & cheese	6.6	4.8	27.3
*Chicken noodle soup	7.7	5.6	27.3
C > HP			
ER Cornbread	6.9	7.0	1.4
Pancakes	6.4	6.6	3.0
*Pudding	3.4	6.6	48.5
MW Yellow cake	5.8	6.4	9.4
Pudding	4.7	5.3	11.3
Biscuits	4.5	5.2	13.5
*Pancakes	5.7	6.8	16.2
*Chocolate cake	5.5	7.3	24.6

HP > C-HB[8]	Mean HP	Mean CHB	% Diff
ER White bread	6.2	5.8	6.4
White rolls	7.5	6.6	12.0
*Sweet rolls	7.1	5.8	18.3
*Cookies	7.7	5.4	29.9
MW Sweet rolls	6.2	5.8	6.4
Cookies	6.1	5.4	11.5
C-HB > HP			
ER *Whole wheat bread	6.1	7.2	15.3
MW White bread	4.9	5.8	15.5
*White rolls	5.4	6.6	18.2
*Whole wheat bread	5.2	7.2	27.8

HP > C-NB	Mean HP	Mean CNB	% Diff
ER *Sweet rolls	7.1	5.7	19.7
*White rolls	7.5	5.7	24.0
*Cookies	7.7	5.5	28.6
MW Sweet rolls	6.2	5.7	8.1
Cookies	6.1	5.5	9.8
C-NB > HP			
ER White bread	6.2	7.0	11.4
*Whole wheat bread	6.1	7.2	15.3
MW White rolls	5.4	5.7	5.3
*Whole wheat bread	5.2	7.2	27.8
*White bread	4.9	7.0	30.0

C-NB > C-HB	Mean CNB	Mean CHB	% Diff
Cookies	5.5	5.4	1.8
*White bread	7.0	5.8	17.1
C-HB > C-NB			
Sweet rolls	5.7	5.8	1.7
White rolls	5.7	6.6	13.6
C-NB = C-HB			
Whole wheat bread	7.2	7.2	0.0

1. Mean of 4 replications by 14 judges
2. HP = Home-Prepared food
3. C = Convenience food
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
5. ER = Electric range
6. MW = Microwave Oven
7. NB = National brand
8. HB = House brand

* Food for which difference significant ($p < .01$) using the analysis of various procedure.

($p<.01$) than the house brand convenience foods. However the house brand whole wheat bread was scored significantly higher for appearance ($p<.01$) than the home-prepared product prepared with either the electric range or the microwave oven, and the house brand white rolls were rated significantly higher ($p<.01$) than the home-prepared product prepared in the microwave oven. One national brand convenience food (white bread) was scored significantly higher for appearance ($p<.01$) than the house brand counterpart.

As shown in Table 42, three convenience foods (biscuits, pudding, and cornbread) were scored significantly higher for appearance ($p<.01$) when prepared with the electric range than in the microwave oven, and ten home-prepared items (pancakes, sweet rolls, whole wheat bread, yellow cake, cornbread, cookies, white bread, chocolate cake, white rolls, and biscuits) were also rated significantly higher ($p<.01$) when prepared with the electric range. One home-prepared food (pudding) was rated significantly higher ($p<.01$) when prepared in the microwave oven.

Texture. As shown in Table 43, when convenience and home-prepared foods were scored for texture three home-prepared foods (pizza, chicken noodle soup, and mushroom soup) were scored significantly higher ($p<.01$) than their

Table 42

Mean[1] Sensory Appearance Scores: Comparison Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[2] > MW[3]		Mean ER	Mean MW	% Diff[4]
C[5]	Yellow cake	6.7	6.4	4.5
	Macaroni & cheese	5.1	4.8	5.9
	*Biscuits	6.2	5.2	16.1
	*Pudding	6.6	5.3	19.7
	*Cornbread	7.0	5.2	25.7
HP[6]	Pizza	7.6	7.3	3.9
	*Pancakes	6.4	5.7	10.9
	*Sweet rolls	7.1	6.2	12.7
	*Whole wheat bread	6.1	5.2	14.8
	*Yellow cake	6.9	5.8	15.9
	*Cornbread	6.9	5.5	20.3
	*Cookies	7.7	6.1	20.8
	*White bread	6.2	4.9	21.0
	*Chocolate cake	7.1	5.5	22.5
	*White rolls	7.5	5.4	28.0
	*Biscuits	6.6	4.5	31.8
MW > ER				
C	Pizza	5.6	5.7	1.8
	Pancakes	6.6	6.8	2.9
	Mushroom soup	5.0	5.2	3.8
	Chocolate cake	7.0	7.3	4.1
HP	Mushroom soup	6.2	6.3	1.6
	Macaroni & cheese	6.4	6.6	3.0
	*Pudding	3.4	4.7	27.6
ER = MW				
C	Chicken noodle soup	5.6	5.6	0.0

1. Mean of 4 replications by 14 judges
2. ER = Electric Range
3. MW = Microwave Oven
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
5. C = Convenience food
6. HP = Home-prepared food

* Food for which difference significant ($P < .01$) using the analysis of variance procedure.

Table 43

Mean[1] Sensory Texture Scores: Comparison Between Convenience and Home-Prepared Foods

HP[2] > C[3]	Mean HP	Mean C	% Diff[4]
ER[5] Chocolate cake	7.0	6.8	2.8
*Pizza	7.1	5.4	23.9
*Chicken noodle soup	7.6	5.5	27.6
*Mushroom soup	6.9	4.9	29.0
MW[6] Macaroni & cheese	6.3	5.4	14.3
*Pizza	6.6	5.2	21.2
*Mushroom soup	6.8	5.3	22.0
*Chicken noodle soup	7.6	5.2	31.6
C > HP			
ER Cornbread	6.7	7.1	5.6
Pancakes	6.3	6.8	7.4
*Pudding	4.3	6.8	36.8
MW Biscuits	5.2	5.5	5.4
*Yellow cake	5.5	6.3	12.7
*Pudding	3.8	4.8	20.8
*Pancakes	4.3	6.7	35.8
*Chocolate cake	3.0	6.1	50.8
C = HP			
ER Biscuits	6.1	6.1	0.0
Macaroni & cheese	6.2	6.2	0.0
Yellow cake	7.0	7.0	0.0
MW Cornbread	5.8	5.8	0.0

HP > C-HB[8]	Mean HP	Mean CHB	% Diff
ER White rolls	7.2	6.4	11.1
White bread	6.0	5.3	11.7
*Sweet rolls	6.6	5.4	18.2
*Cookies	7.7	5.0	35.1
MW Sweet rolls	5.6	5.4	3.6
Cookies	7.0	5.0	28.6
C-HB > HP			
ER Whole wheat bread	6.8	7.0	2.8
MW White rolls	6.0	6.4	6.2
*White bread	4.2	5.3	20.8
*Whole wheat bread	4.4	7.0	37.1

HP > C-NB[7]	Mean HP	Mean CNB	% Diff
ER Sweet rolls	6.6	6.5	1.5
*White rolls	7.2	5.9	18.0
*Cookies	7.7	5.9	23.4
MW White rolls	6.0	5.9	1.7
Cookies	7.0	5.9	15.7
C-NB > HP			
ER Whole wheat bread	6.8	7.3	6.8
White bread	6.0	6.7	10.4
MW Sweet rolls	5.6	6.5	13.8
*White bread	4.2	6.7	37.3
*Whole wheat bread	4.4	7.3	39.7

C-NB > C-HB	Mean CNB	Mean CHB	% Diff
Whole wheat bread	7.3	7.0	4.1
Cookies	5.9	5.0	15.2
*Sweet rolls	6.5	5.4	16.9
*White bread	6.7	5.3	20.9
C-HB > C-NB			
White rolls	5.9	6.4	7.8

1. Mean of 4 replications by 14 judges.
2. HP = Home-Prepared food
3. C = Convenience food
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
5. ER = Electric Range
6. MW = Microwave Oven
7. NB = National brand
8. HB = House brand

* Food for which difference significant ($p < .01$) using the analysis of variance procedure.

convenience counterparts whether prepared with the electric range or the microwave oven. One convenience food (pudding) was rated significantly higher ($p<.01$) for texture than the same home-prepared food whether prepared in the electric range or in the microwave oven. Three other microwave-prepared foods (yellow cake, pancakes, and chocolate cake) were rated significantly higher ($p<.01$) for texture in the convenience form.

Home-prepared white rolls and cookies prepared with the electric range were scored significantly higher ($p<.01$) for texture than the national brand convenience products (Table 43). However, national brand white bread and whole wheat bread were scored significantly higher for texture ($p<.01$) than their home-prepared counterparts prepared in the microwave oven. Home-prepared sweet rolls and cookies prepared with the electric range were scored significantly higher for texture ($p<.01$) than the convenience foods which were house brands, although the house brand white bread and whole wheat bread were rated significantly higher for texture ($p<.01$) than the home-prepared products prepared in the microwave oven. National brand sweet rolls and white bread were rated significantly higher for texture ($p<.01$) than the comparable house brand products.

Two convenience products (cornbread and pudding) were scored significantly higher for texture ($p<.01$) when

prepared with the electric range than in the microwave oven (Table 44). Similarly, eight home-prepared foods (cookies, cornbread, white rolls, yellow cake, white bread, pancakes, whole wheat bread, and chocolate cake) were scored significantly higher for texture ($p<.01$) when prepared with the electric range.

Flavor. A comparison of scores for flavor is shown in Table 45. Three foods (chicken noodle soup, pizza, and mushroom soup) were scored significantly higher ($p<.01$) in home-prepared than in convenience form, whether prepared with the electric range or the microwave oven. One food prepared with the electric range (pudding) was scored significantly higher for flavor ($p<.01$) in the convenience form, and microwave-prepared chocolate cake and biscuits were scored significantly higher for flavor ($p<.01$) in the convenience form.

Home-prepared white rolls, sweet rolls, and cookies prepared with the electric range were scored significantly higher for flavor ($p<.01$) than the national brand convenience versions of these products (Table 45). Home-prepared sweet rolls and cookies prepared in the microwave oven were also rated significantly higher ($p<.01$) than the comparable national brands. However the national brand whole wheat bread was scored significantly higher for flavor ($p<.01$) than the home-prepared product prepared in the

Table 44

Mean[1] Sensory Texture Scores: Comparison Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[2] > MW[3]		Mean ER	Mean MW	% Diff[4]
C[5]	Pancakes	6.8	6.7	1.5
	Pizza	5.4	5.2	3.7
	Chicken noodle soup	5.5	5.2	5.4
	Biscuits	6.1	5.5	9.8
	Yellow cake	7.0	6.3	10.0
	Chocolate cake	6.8	6.1	10.3
	Macaroni & cheese	6.2	5.4	12.9
	*Cornbread	7.1	5.8	18.3
	*Pudding	6.8	4.8	29.4
HP[6]	Mushroom soup	6.9	6.8	1.4
	Pizza	7.1	6.6	7.0
	*Cookies	7.7	7.0	9.1
	Pudding	4.3	3.8	11.6
	*Cornbread	6.7	5.8	13.4
	Biscuits	6.1	5.2	14.8
	Sweet rolls	6.6	5.6	15.2
	*White rolls	7.2	6.0	16.7
	*Yellow cake	7.0	5.5	21.4
	*White bread	6.0	4.2	30.0
	*Pancakes	6.3	4.3	31.7
	*Whole wheat bread	6.8	4.4	35.3
	*Chocolate cake	7.0	3.0	57.1
MW > ER				
C	Mushroom soup	4.9	5.3	7.5
HP	Macaroni & cheese	6.2	6.3	1.6
ER = MW				
HP	Chicken noodle soup	7.6	7.6	0.0

1. Mean of 4 replications by 14 judges
2. ER = Electric Range
3. MW = Microwave Oven
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
5. C = Convenience food
6. HP = Home-prepared food

* Food for which difference significant ($p \leq .01$) using the analysis of variance procedure.

Table 45

Mean[1] Sensory Flavor Scores: Comparison Between Convenience and Home-Prepared Foods

HP[2] > C[3]	Mean HP	Mean C	% Diff[4]
ER[5] Macaroni & Cheese	5.9	5.7	3.4
Yellow cake	7.1	6.8	4.2
*Chicken noodle soup	7.3	5.7	21.9
*Pizza	7.0	4.8	31.4
*Mushroom soup	7.8	5.3	32.0
MW[6] Macaroni & cheese	6.4	6.2	3.1
*Chicken noodle woup	7.6	5.7	25.0
*Pizza	6.7	5.0	25.4
*Mushroom soup	7.5	5.5	26.7
C > HP			
ER Chocolate cake	6.8	7.0	2.8
Pancakes	6.2	6.5	4.6
Biscuits	5.7	6.2	8.1
*Pudding	4.9	6.6	25.8
MW Yellow cake	6.0	6.6	9.1
Pancakes	5.8	6.6	12.1
Pudding	5.0	5.7	12.3
*Chocolate cake	5.7	6.9	17.4
*Biscuits	4.7	6.2	24.2
C=HP			
ER Cornbread	6.1	6.1	0.0
MW Cornbread	5.7	5.7	0.0

HP > C-HB[8]	Mean HP	Mean CHB	% Diff
ER *White bread	6.9	5.9	14.5
*White rolls	7.4	6.3	14.9
*Sweet rolls	7.4	5.4	27.0
*Cookies	7.9	5.2	34.2
MW White rolls	6.9	6.3	8.7
*Sweet rolls	7.3	5.4	26.0
*Cookies	7.4	5.2	29.7
C-HB > HP			
ER Whole wheat bread	6.8	7.0	2.8
MW White bread	5.8	5.9	1.7
*Whole wheat bread	6.1	7.0	12.8

HP > C-NB[7]	Mean HP	Mean CNB	% Diff
ER White bread	6.9	6.5	5.8
*White rolls	7.4	6.1	17.6
*Sweet rolls	7.4	5.9	20.3
*Cookies	7.9	5.8	26.6
MW White rolls	6.9	6.1	11.6
*Sweet rolls	7.3	5.9	19.2
*Cookies	7.4	5.8	21.6
C-NB > HP			
MW *Whole wheat bread	6.1	6.8	10.3
White bread	5.8	6.5	10.8
C-NB = HP			
ER Whole wheat bread	6.8	6.8	0.0

C-NB > C-HB	Mean CNB	Mean CHB	% Diff
Sweet rolls	5.9	5.4	8.5
White bread	6.5	5.9	9.2
Cookies	5.8	5.2	10.3
C-HB > C-NB			
Whole wheat bread	6.8	7.0	2.8
White rolls	6.1	6.3	3.2

1. Mean of 4 replications by 14 judges
2. HP = Home-Prepared food
3. C = Convenience food
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
5. ER = Electric Range
6. MW = Microwave Oven
7. NB = National brand
8. HB = House brand

* Food for which difference significant ($p < .01$) using the analysis of variance procedure.

microwave oven. Home-prepared white bread, white rolls, sweet rolls, and cookies prepared with the electric range were rated significantly higher ($p<.01$) than house brand counterparts, and microwave-prepared sweet rolls and cookies also were scored significantly higher for flavor ($p<.01$) than the house brand products. However, the house brand whole wheat bread was rated significantly higher ($p<.01$) than its home-prepared counterpart prepared in the microwave oven.

One convenience food (pudding) and four home-prepared foods (whole wheat bread, yellow cake, white bread, and chocolate cake) were rated significantly higher for flavor ($p<.01$) when prepared with the electric range than in the microwave oven (Table 46).

Overall Quality. As shown in Table 47, three home-prepared foods (chicken noodle soup, pizza, and mushroom soup) were scored significantly higher for overall quality ($p<.01$) than the convenience counterparts, whether prepared with the electric range or the microwave oven. One convenience food prepared with the electric range (pudding) was scored significantly higher ($p<.01$) than the home-prepared version of that product, and five microwave-prepared foods (yellow cake, pudding, biscuits, pancakes, and chocolate cake) were also rated significantly higher ($p<.01$) in the convenience than in the home-prepared form.

Table 46

Mean[1] Sensory Flavor Scores: Comparison Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[2] > MW[3]		Mean ER	Mean MW	% Diff[4]
C[5]	Chocolate cake	7.0	6.9	1.4
	Yellow cake	6.8	6.6	2.9
	Cornbread	6.1	5.7	6.6
	*Pudding	6.6	5.7	13.6
HP[6]	Sweet rolls	7.4	7.3	3.8
	Mushroom soup	7.8	7.5	3.8
	Pizza	7.0	6.7	4.3
	Cookies	7.9	7.4	6.3
	Pancakes	6.2	5.8	6.4
	Cornbread	6.1	5.7	6.6
	White rolls	7.4	6.9	6.8
	*Whole wheat bread	6.8	6.1	10.3
	*Yellow cake	7.1	6.0	12.7
	*White bread	6.9	5.8	15.9
	*Chocolate cake	6.8	5.7	16.2
	Biscuits	5.7	4.7	17.5
MW > ER				
C	Pancakes	6.5	6.6	1.5
	Mushroom soup	5.3	5.5	3.6
	Pizza	4.8	5.0	4.0
	Macaroni & cheese	5.7	6.2	8.1
HP	Pudding	4.9	5.0	2.0
	Chicken noodle soup	7.3	7.6	3.9
	Macaroni & cheese	5.9	6.4	7.8
ER = MW				
C	Chicken noodle soup	5.7	5.7	0.0
	Biscuits	6.2	6.2	0.0

1. Mean of 4 replications by 14 judges
2. ER = Electric Range
3. MW = Microwave Oven
4. % Difference = $\frac{\text{Larger value-smaller value}}{\text{Larger value}} \times 100$
5. C = Convenience food
6. HP = Home-prepared food

* Food for which difference significant ($p<.01$) using the analysis of variance procedure.

Table 47

Mean[1] Overall Quality Scores: Comparison Between Convenience and Home-Prepared Foods

HP[2] > C[3]	Mean HP	Mean C	% Diff[4]
ER[5] Macaroni & cheese	6.0	5.3	11.7
*Chicken noodle soup	7.3	5.5	24.6
*Pizza	6.8	4.9	27.9
*Mushroom soup	7.2	5.0	30.6
MW[6] Macaroni & cheese	6.2	5.6	9.7
*Pizza	6.6	5.0	24.2
*Mushroom soup	7.0	5.2	25.7
*Chicken noodle soup	7.4	5.2	29.7
C > HP			
ER Biscuits	5.7	5.8	1.7
Chocolate cake	6.8	7.0	2.8
Cornbread	6.4	6.6	3.0
Pancakes	6.2	6.6	6.1
*Pudding	4.2	6.7	37.3
MW Cornbread	5.5	5.9	6.8
*Yellow cake	5.3	6.1	13.1
*Pudding	4.0	4.9	18.4
*Biscuits	4.4	5.5	20.0
*Pancakes	4.9	6.5	24.6
*Chocolate cake	3.9	6.7	41.8
C = HP			
ER Yellow cake	6.9	6.9	0.0

HP > C-HB[8]	Mean HP	Mean CHB	% Diff
ER White rolls	7.3	6.6	9.6
White bread	6.4	5.6	12.5
*Sweet rolls	6.9	5.2	24.6
*Cookies	7.9	4.9	38.0
MW *Sweet rolls	6.3	5.2	17.5
*Cookies	7.0	4.9	30.0
C-HB > HP			
ER *Whole wheat bread	6.3	7.0	10.0
MW White rolls	6.2	6.6	6.1
White bread	4.7	5.6	16.1
*Whole wheat bread	4.9	7.0	30.0

HP > C-NB[7]	Mean HP	Mean C-NB	% Diff
ER *White rolls	7.3	6.1	16.4
*Sweet rolls	6.9	5.6	18.8
*Cookies	7.9	5.8	26.6
MW White rolls	6.2	6.1	1.6
Sweet rolls	6.3	5.6	11.1
*Cookies	7.0	5.8	17.1
C-NB > HP			
ER White bread	6.4	6.6	3.0
*Whole wheat bread	6.3	7.0	10.0
MW *White bread	4.7	6.6	28.8
*Whole wheat bread	4.9	7.0	30.0

C-NB > C-HB	Mean CNB	Mean CHB	% Diff
Sweet rolls	5.6	5.2	7.1
*White bread	6.6	5.6	15.2
Cookies	5.8	4.9	15.5
C-HB > C-NB			
White rolls	6.1	6.6	7.6
C-NB = C-HB			
Whole wheat bread	7.0	7.0	0.0

1. Mean of 4 replications by 14 judges
2. HP = Home-Prepared food
3. C = Convenience food
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}} \times 100$
5. ER = Electric range
6. MW = Microwave Oven
7. NB = National brand
8. HB = House brand

* Food for which difference significant ($p < .01$) using the analysis of variance procedure.

Three home-prepared foods prepared with the electric range (white rolls, sweet rolls, and cookies) were scored significantly higher ($p<.01$) than the national brand convenience counterparts (Table 47). The home-prepared cookies prepared in the microwave oven were also scored significantly higher ($p<.01$) than the national brand convenience cookies. National brand white bread was scored significantly higher ($p<.01$) than the home-prepared version prepared in the microwave oven, while the national brand whole wheat bread was scored significantly higher for overall quality ($p<.01$) than the home-prepared product baked in either the electric range or in the microwave oven. Home-prepared sweet rolls and cookies were scored significantly higher for overall quality ($p<.01$) than the house brand versions of the same products, whether baked in the electric range or in the microwave oven. However, for whole wheat bread the house brand convenience version was rated significantly higher ($p<.01$) than the home-prepared product prepared with either the electric range or the microwave oven. The national brand white bread was rated significantly better for overall quality ($p<.01$) than the house brand white bread.

Three convenience foods (cornbread, yellow cake, and pudding) and eight home-prepared foods (cornbread, white rolls, pancakes, whole wheat bread, biscuits, yellow cake,

white bread, and chocolate cake) were scored significantly higher for overall quality ($p<.01$) when prepared with the electric range than in the microwave oven (Table 48).

Overview. Some of the results were particularly striking. When convenience and home-prepared foods were compared, pizza, mushroom soup, and chicken noodle soup, whether prepared with the electric range or in the microwave oven, were rated significantly higher on all quality factors in the home-prepared than in the convenience form. However the convenience forms of pudding and pancakes were rated higher on all quality factors regardless of the appliance used for preparation. In addition, microwave-prepared chocolate cake and biscuits were scored higher for all factors in the convenience than in the home-prepared form. Home-prepared cookies, whether prepared with the electric range or in the microwave oven, were scored higher for all factors than their national brand convenience counterparts, while home-prepared white rolls and sweet rolls prepared with the electric range were also rated higher on all factors than the national brand products. However the national brands of white bread and whole wheat bread were scored higher for all factors except flavor than the home-prepared products prepared with the electric range, and for all factors than the home-prepared products prepared in the microwave oven. Home-prepared cookies, white bread, white

Table 48

Mean[1] Overall Quality Scores: Comparison Between Foods Prepared with the Electric Range and with the Microwave Oven

ER[2] > MW[3]		Mean ER	Mean MW	% Diff[4]
C[5]	Pancakes	6.6	6.5	1.5
	Chocolate cake	7.0	6.7	4.3
	Biscuits	5.8	5.5	5.2
	Chicken noodle soup	5.5	5.2	5.4
	*Cornbread	6.6	5.9	10.6
	*Yellow cake	6.9	6.1	11.6
	*Pudding	6.7	4.9	26.9
HP[6]	Mushroom soup	7.2	7.0	2.8
	Pizza	6.8	6.6	2.9
	Sweet rolls	6.9	6.3	8.7
	Cookies	7.9	7.0	11.4
	*Cornbread	6.4	5.5	14.1
	*White rolls	7.3	6.2	15.1
	*Pancakes	6.2	4.9	21.0
	*Whole wheat bread	6.3	4.9	22.2
	*Biscuits	5.7	4.4	22.8
	*Yellow cake	6.9	5.3	23.2
	*White bread	6.4	4.7	26.6
	*Chocolate cake	6.8	3.9	42.6
MW > ER				
C	Pizza	4.9	5.0	2.0
	Mushroom soup	5.0	5.2	3.8
	Macaroni & cheese	5.3	5.6	5.4
HP	Chicken noodle soup	7.3	7.4	1.4
	Macaroni & cheese	6.0	6.2	3.2

1. Mean of 4 replications by 14 judges
2. ER = Electric Range
3. MW = Microwave Oven
4. % Difference = $\frac{\text{Larger value - smaller value}}{\text{Larger value}}$
5. C = Convenience food
6. HP = Home-prepared food

* Food for which difference significant ($p < .01$) using the analysis of variance procedure.

rolls, and sweet rolls prepared in the electric range, and home-prepared cookies and sweet rolls prepared in the microwave oven were scored higher on all quality factors than the house brand convenience counterparts. However the house brand whole wheat bread was scored higher on all factors than the home-prepared version prepared with the electric range, and the house brand white and whole wheat breads both were scored higher on all factors than the comparable home-prepared breads prepared in the microwave oven. National brand cookies and white bread were scored higher for all sensory characteristics than their house brand counterparts, although for white rolls the house brand product received higher scores for all quality factors.

It is difficult to describe a general pattern of preference for either convenience or home-prepared foods tested in this study. Other researchers have also reported mixed results in comparisons of convenience and home-prepared foods, depending on the products being compared.

In a comparison of foods prepared with the electric range and in the microwave oven, three convenience foods (cornbread, yellow cake, and pudding) and eleven home-prepared foods (biscuits, pancakes, cornbread, yellow cake, chocolate cake, pizza, cookies, white bread, whole wheat bread, white rolls, and sweet rolls) prepared with the electric range were rated higher on all quality factors than

the same foods prepared in the microwave oven. However convenience mushroom soup and home-prepared macaroni and cheese were scored higher when prepared in the microwave oven, although the differences were slight. Convenience pizza prepared in the microwave oven was scored higher for all factors except texture than the pizza prepared with the electric range.

All but one of the foods (pudding) which were rated higher on all quality factors when prepared with the electric range were dough or batter products. These foods normally are baked or heated on a griddle to achieve a brown crust and a characteristic cooked flavor. With the exception of foods heated on a browning grill (biscuits, pancakes, and pizza) foods prepared in the microwave oven did not brown. Biscuits and pancakes had a somewhat oily appearance and flavor since margarine was used on the browning grill, and the panelists preferred the more conventional appearance and flavor of the products prepared with the electric range. The products prepared in the microwave oven tended to be dry and somewhat spongy, perhaps due to rapid expansion of the dough or batter early in heating and to a larger loss of water by evaporation than occurred in the products prepared with the electric range.

Interestingly, both pizza and pancakes appeared on a list of foods which "cannot be adapted" for microwave

preparation (Anonymous, 1980b). In this study both of those foods were prepared on a browning grill, which was not discussed in the article. The convenience pancakes were scored higher for appearance and flavor when prepared in the microwave oven, while the convenience pizza prepared in the microwave oven was rated higher for appearance, flavor, and overall quality. The home-prepared products, however, were scored higher on all quality factors when prepared with the electric range.

To summarize, most convenience foods (83.3%) and most home-prepared foods (76.7%) were scored at least 5 on a nine-point scale for appearance, texture, flavor, and overall quality. No general trend of preference was seen for either convenience or home-prepared foods. The majority of foods prepared with the electric range (88.0%) and the majority of foods prepared with the microwave oven (68.0%) were scored at least 5 on a nine-point scale for appearance, texture, flavor, and overall quality. Batter and dough products tended to be scored higher when prepared with the electric range than when prepared with the microwave oven.

Preference Analysis. In addition to rating the foods on a 9-point scale, the sensory panelists were instructed to rank the four preparation forms of each food in order of preference, and to indicate which factor(s) - i.e. appearance, texture, flavor, or overall quality - most

influenced the ranking (Appendix E). However, several of the panelists did not understand how to complete the second score sheet, even after attending a second training session. The results of the preference analysis could not be meaningfully interpreted, and therefore are not included.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

Twenty convenience foods used by at least one percent of households surveyed in the spring portion of the U.S. Department of Agriculture's 1977-78 Nationwide Food Consumption Survey were prepared, along with their home counterparts, with an electric range and with a countertop microwave oven. Yield, total and active preparation time, energy consumption, cost per serving, and sensory quality of the foods were determined. Nutrient content was calculated from tables of food composition. In addition, relationships were assessed between the density, moisture content, and fat content of a food and the energy and heating time required for preparation; and between the degree-of-readiness of a food and the required amount of energy, total preparation time, and active preparation time.

Conclusions

Based on the foods tested the following conclusions were reached:

1. The majority (78.3%) of home-prepared foods yielded more equal-weight servings than did convenience foods. This trend was significant ($p<.10$) for 43.5% of foods prepared

with the electric range and for 34.8% of foods prepared with the microwave oven. However 8.7% of foods prepared with the microwave oven weighed significantly more ($p<.10$) in the convenience form.

2. Seventy-eight percent of foods prepared with the electric range weighed more than foods prepared with the microwave oven. This trend was significant ($p<.10$) for 11.1% of convenience foods.

3. The majority (91.3%) of home-prepared foods required more total preparation time than did convenience foods. This finding was significant ($p<.10$) for 69.6% of foods prepared with the electric range and for 52.2% of foods prepared with the microwave oven. However, 4.3% of foods prepared with the electric range required significantly more total preparation time ($p<.10$) in convenience than in home-prepared form.

4. Most foods prepared with the electric range (78.0%) required more total preparation time than did foods prepared with the microwave oven. This trend was significant ($p<.10$) for 33.3% of convenience foods and for 30.8% of home-prepared foods. However, 13.3% of convenience foods and 3.8% of home-prepared foods required more total preparation time when heated with the microwave oven.

5. All home-prepared foods tested (100.0%) required more active preparation time than the convenience

counterparts. The difference in amount of time required was significant ($p<.10$) for 69.6% of foods prepared with the electric range and for 65.2% of foods prepared with the microwave oven.

6. A trend was seen for foods prepared with the microwave oven to require more active preparation time (39.0% of foods tested) or the same amount of active time (39.0% of foods tested) as foods prepared with the electric range. This trend was significant ($p<.10$) for 3.8% of home-prepared foods. However 6.7% of convenience foods and 3.8% of home-prepared foods required significantly more active preparation time ($p<.10$) when heated with the electric range.

7. Most home-prepared foods (78.3%) required more energy to prepare than did convenience foods. For 34.8% of foods prepared with the electric range and for 34.8% of foods prepared with the microwave oven the difference was significant ($p<.10$). However 8.7% of foods prepared with the electric range required significantly more energy to prepare ($p<.10$) in convenience than in home-prepared form.

8. A majority of foods (63.4%) required more energy to prepare with the electric range than with the microwave oven. This trend was significant ($p<.10$) for 33.3% of convenience and for 26.9% of home-prepared foods. However 13.3% of convenience foods and 11.5% of home-prepared foods

required more energy to prepare with the microwave oven than with the electric range. These were foods which, in the electric range version, were heated entirely on a surface unit.

9. The majority of convenience foods (69.6%) cost more per serving for food alone than did the home-prepared counterparts. However 54.3% of home-prepared foods cost more for fuel alone. For cost of active preparation time at either minimum wage or at a cook's wage, 97.8% of home-prepared foods cost more per serving than did convenience foods. When food and fuel costs were combined, 69.6% of convenience foods cost more per serving than did home-prepared foods. However when the cost of active preparation time was added to the food and fuel cost, home-prepared foods became more expensive. The combined cost for food, fuel, and active preparation time at minimum wage was greater for 78.3% of home-prepared foods than for convenience foods, and the combined cost when time was valued at a cook's wage was greater for 91.3% of home-prepared foods.

10. Due to the fact that some foods prepared with the microwave oven weighed less than foods prepared with the electric range, a majority of microwave-prepared products (65.8%) cost more per equal-weight serving for food alone. However most foods prepared with the electric range (68.4%)

cost more per serving for fuel alone. For cost of active preparation time at either minimum wage or at a cook's wage 73.7% of foods prepared with the microwave oven cost more per serving than foods prepared with the electric range. When the costs of food and fuel were combined, 55.3% of foods cost more to prepare in the microwave oven. When cost of active preparation time at minimum wage was added, 68.4% of foods cost more per serving when prepared with the microwave oven. When cost of active time at a cook's wage was added to the food and fuel costs, 73.7% of foods cost more per serving to prepare with the microwave oven than with the electric range.

11. Foods with a high density required more energy and heating time per gram than foods with a low density when prepared with the electric range. However the reverse was seen for foods prepared with the microwave oven. Foods with a high moisture content required less energy and heating time per gram than foods with a low moisture content when prepared with the electric range. Again, however, the reverse was true for foods prepared with the microwave oven. Foods with a high fat content required more energy per gram than foods with a low fat content when prepared with the electric range. Fat content did not appreciably affect the energy per gram required for foods prepared with the microwave oven, or the heating time per gram required for

foods prepared with either appliance.

12. Energy consumption was not related to how "ready" a convenience product was. In general the difference in total and active preparation time between convenience and home-prepared foods was greater for foods that required just heating than for foods which required cooking. The difference between convenience and home-prepared foods was greatest when the convenience foods could be eaten as purchased.

13. The calculated Mean Adequacy Ratio (MAR) for nine nutrients was higher for 50.0% of the foods in home-prepared than in convenience form. For 5.0% of foods the MAR was equal between convenience and home-prepared forms, while for the remaining 45.0% of products the MAR was higher for the convenience version. The majority (85.0%) of home-prepared foods contained more calories per serving, 80.0% contained more fat per serving, and 80.0% contained a higher percentage of calories from fat than did convenience items. However 66.7% of the convenience foods contained more sodium per serving than similar home-prepared products. When crude fiber was considered, 40.0% of convenience foods contained more fiber per serving, 40.0% of home-prepared foods contained more fiber, and 20.0% of foods contained the same amount of fiber in both preparation forms.

14. Most convenience foods (83.3%) and most home-prepared foods (76.7%) were scored at least 5 on a nine-point scale for appearance, texture, flavor, and overall quality. No general trend of preference was seen for either convenience or home-prepared foods.

15. The majority of foods prepared with the electric range (88.0%) and the majority of foods prepared with the microwave oven (68.0%) were scored at least 5 on a nine-point scale for appearance, texture, flavor, and overall quality. Batter and dough products tended to be scored higher when prepared with the electric range than when prepared with the microwave oven.

Implications

Consumers may base a decision of whether or not to use convenience foods on many factors. Among these factors are the yield, total and active preparation time required, energy consumption, cost, nutrient content, and sensory quality of convenience foods as compared to their home-prepared counterparts.

Most convenience foods in this study were packaged to yield fewer servings than similar home-prepared products. While this may not appeal to some consumers it may be advantageous for others, particularly for small households. Convenience foods in general required less total and active preparation time than home-prepared foods; this fact might

encourage persons with limited time or a dislike of cooking to use convenience foods. Convenience foods also generally required less energy to prepare than did home-prepared foods. While the amount of fuel saved on any one food was slight, over time the amount might add up to a noticeable savings.

Most of the convenience foods studied cost more per serving for the food alone than did their home-prepared counterparts. However, when the cost of active preparation time was included, convenience foods tended to become less expensive. As the value of time was increased, the number of convenience foods which were less expensive to prepare also increased. Thus a decision, based on cost, of whether or not to use convenience foods would have to include the value of the food preparer's time.

The nutrient content for half of the convenience foods studied was equal to or better than that of the home-prepared foods. Convenience foods tended to contain more sodium than home-prepared foods, which would be of concern to persons interested in limiting their intake of this mineral. Convenience foods contained fewer calories, less fat, and a lower percentage of calories from fat than did the home-prepared foods in this study. However consumers would have less control over modifying their intake of fat and calories if they used convenience foods than if they

prepared the foods from home recipes.

For many consumers, the ultimate decision of whether or not to use a convenience food may be based on the food's sensory qualities. Results of this study indicated that many of the convenience foods tested were similar in quality to home-prepared foods. No general pattern of preference for either convenience or home-prepared foods was noted. Therefore an individual consumer would need to evaluate different convenience products to determine whether or not they were acceptable.

The decision of whether or not to use a microwave oven to prepare foods may similarly be based on many factors. Foods in this study which were prepared with the microwave oven tended to yield fewer equal weight servings than foods prepared with the electric range. However the difference was significant for only a small percentage of the foods. While most foods prepared with the microwave oven required less total preparation time than foods heated with the electric range, the active preparation time required for a majority of foods prepared with the microwave oven was the same as or greater than the active time required for foods prepared with the electric range. Persons basing a decision of whether or not to use a microwave oven on its time-saving capabilities would need to consider the two kinds of preparation time described here and the different results

concerning time which were obtained. The microwave oven did require less energy than the electric range to prepare most foods, although for foods which would normally be prepared on a surface unit of an electric range the microwave oven required more energy. Consumers interested in saving energy with kitchen appliances would want to consider this fact when deciding which foods to heat in a microwave oven.

For most foods the total product food cost was the same whether the food was prepared with the electric range or with the microwave oven. However since the foods prepared with the microwave oven tended to yield fewer servings, the food cost per serving was greater for microwave-prepared foods. Fuel cost was less for most foods when prepared with the microwave oven. The difference was small for individual foods, but might be important over time. Microwave-prepared foods frequently required more active preparation time than foods prepared with the electric range, and thus the cost of foods prepared with the microwave oven was greater than the cost of foods prepared with the electric range when the cost of time was included. As the value of time increased the number of foods which were more expensive to prepare with the microwave oven also increased. A decision, based on cost, of whether or not to use a microwave oven would need to consider the value of the food preparer's time.

Consumers may base a decision of whether or not to use

a microwave oven on the sensory quality of foods heated in the oven. Results of this study indicated that some foods prepared with the microwave oven were similar in quality to those prepared with the electric range. Baked products, however, tended to be scored higher when prepared with the electric range. Consumers wishing to bake such foods in a microwave oven may want to use a method of covering the top crust, such as frosting a cake, to improve the appearance of the products.

Recommendations for Further Research

The number of foods tested in this study was limited. Further research is needed to determine whether the findings hold true for other foods.

One electric range and one microwave oven were used in this study. Additional research could be done using gas ranges as well as different brands and models of electric ranges and microwave ovens.

One brand of each convenience food was chosen for laboratory analysis. Further research is needed to determine whether the findings of this study can be applied to other brands of convenience foods.

The small sample size taken for analysis of yield, total and active preparation time, and energy consumption necessitated the use of a nonparametric statistical test which had low power. Use of a larger sample size in future

research might cause differences among treatment groups to be shown as significant more often and with higher power.

The sample of convenience foods selected inadvertently contained a large number of baked products. Further research is needed to determine whether the findings of this study are valid for a wider variety of food products.

The nutrient data and the values for moisture content and fat content were taken from published tables. Therefore, the values may not have been precisely representative of the foods prepared in the laboratory. Future researchers may want to determine their own nutrient, moisture, and fat data.

All categories of food characteristic combinations were not represented in the analysis of the effect of density, moisture, and fat on energy consumption and heating time. The number of foods in each category was also limited. A future study could build on this work by testing a larger and more representative group of foods in each category.

Definitions of "high" and "low" values for density, percent moisture, and percent fat were not found in the literature. Standard definitions for these terms need to be developed. In addition, further work is needed to validate the method of measuring density used in this study.

All degree-of-readiness categories were not represented in the analysis of how degree-of-readiness affects energy

consumption and total and active preparation time. The number of foods in each category was also limited. A future study, using a representative group of foods in each category, could build on the work begun here.

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Appendix A

Brands of Convenience Foods Used in Laboratory Analysis

Food Item	National Brand	House Brand
Biscuits, refrigerated	Pillsbury Hungry Jack, 10 oz.	
Pancake mix, complete	Aunt Jemima, 32 oz.	
Cornbread mix	Flako, 12 oz.	
Yellow cake mix	Duncan Hines, 18.5 oz.	
Chocolate cake mix	Duncan Hines, 18.5 oz.	
Broccoli spears in butter sauce, frozen	Green Giant, 10 oz.	
Macaroni & cheese mix	Kraft, 7.25 oz.	
Spaghetti sauce, canned	Ragu 100% Natural, 15.5 oz.	
Sausage pizza, frozen	Totino's party pizza, 12.5 oz.	
Vanilla pudding mix, regular	Jello Pudding & Pie Filling, 3.12 oz.	
Cream of mushroom soup, canned condensed	Campbell's, 10.75 oz.	
Chicken noodle soup, canned condensed	Campbell's, 10.75 oz.	
Chicken pot pie, frozen	Banquet, 8 oz.	
Apple pie, frozen	Banquet, 20 oz.	
Fried Chicken TV dinner	Banquet American Favorites, 11 oz.	
Chocolate chip cookies	Chips Ahoy, 13 oz.	Country Oven, 18 oz.
White bread, enriched	Pepperidge Farm, 16 oz.	Kroger, 20 oz.
Whole wheat bread	Pepperidge Farm, 16 oz.	Kroger, 16 oz.
White rolls	Pepperidge Farm, 12.25 oz.	Country Oven, 13 oz.
Sweet rolls (raisin)	Rainbo, 10 oz.	Country Oven, 13 oz.

Appendix B

Recipes for Home-Prepared Foods

The electric range used in this study was a 30-inch (76cm) free standing model with two 6-inch (15cm) surface units, two 8-inch (20cm) surface units, and a self-cleaning oven. The surface unit controls had the following settings: High, Med-High, Med, Med-Lo, Lo, and Off. The oven settings ranged from 150°F (66°C) to 500°F (260°C) in 25°F increments. The microwave oven was a countertop model having the following 10 variable power settings with ten percent less wattage at each descending power setting: Full power: 100%; Saute: 90%; Reheat: 80%; Med High: 70%; Bake: 60%; Medium: 50%; Braise: 40%; Defrost: 30%; Low: 20%; Warm: 10%.

Abbreviations used in this appendix include: ER = Electric Range; MW = Microwave Oven.

BISCUITS

CONVENIENCE

Refrigerated biscuits	284g
Margarine (MW only)	28g

ER - Preheat oven to 204°C. Place biscuits on ungreased baking sheet. Bake 8 minutes.

MW - Heat margarine 1 minute on High. Preheat 37x29 cm browning grill 5 minutes on High. Dip biscuits into margarine to coat all sides. Arrange on preheated grill. Heat on High 45 seconds. Turn biscuits over. Heat on High 1.5 minutes.

HOME - PREPARED

Flour	280g
Salt	5g

Baking powder	11g
Shortening	67g
Milk	185g
Margarine (MW only)	28g

Combine flour, salt, and baking powder. Cut in shortening with pastry blender. Add milk and stir with a fork until dough forms a ball. Turn out onto floured board. Knead 15 times. Roll 1cm thick. Cut with 5cm cutter. Reroll and cut scraps.

ER - Preheat oven to 218°C. Bake on ungreased sheet 12 minutes.

MW - Heat margarine 1 minute on High. Preheat 37x29 cm browning grill 5 minutes on High. Dip biscuits in margarine to coat all sides. Arrange on preheated grill. Heat on High 45 seconds. Turn biscuits over. Heat on High 1.5 minutes.

PANCAKES

CONVENIENCE

Complete pancake mix	135g
Water	190g
Oil (ER only)	28g
Margarine (MW only)	28g

ER - Combine mix and water. Preheat 50x29 cm griddle on High using 2 burners. Reduce heat to Med High. Oil griddle. Measure out 50ml batter for each pancake. Cook 6 pancakes at a time, flipping once halfway through cooking.

MW - Combine mix and water. Preheat 37x29 cm browning grill 5 minutes on High. Spread 14g margarine on grill. Measure out 50ml batter for each pancake, cooking 4 at one time. Heat 45 seconds on High. Turn pancakes over. Heat 1 minute on High. Preheat grill 2.5 minutes on High and spread with more margarine between batches.

HOME - PREPARED

Flour	140g
Salt	2g
Baking powder	7g
Sugar	4g
Milk	244g
Egg	50g
Oil	14g
Oil (ER only)	28g
Margarine (MW only)	28g

Combine flour, salt, baking powder, and sugar. Beat together milk, egg, and oil. Add to dry ingredients. Mix until just combined.

ER - Preheat 50x29 cm griddle 2 minutes on High using 2 burners. Reduce heat to Med High. Oil griddle. Measure out 50ml batter for each pancake. Cook 6 pancakes at one time, flipping once halfway through cooking.

MW - Preheat 37x29 cm browning grill 5 minutes on High. Spread 14g margarine on grill. Measure out 50ml batter for each pancake, cooking 4 at one time. Heat 45 seconds on High. Turn pancakes over. Heat 1 minute on High. Preheat grill 2.5 minutes on High and spread with more margarine between batches.

CORNBREAD

CONVENIENCE

Dry cornbread mix	340g
Egg	50g
Milk	170g

ER - Preheat oven to 204°C. Line 23-cm round glass pan with wax paper. Combine mix, egg, and milk and place in pan. Bake 15 minutes.

MW - Line 23-cm round glass pan with wax paper. Combine

mix, egg, and milk and place in pan. Heat on Med 5 minutes. Turn. Heat on High 3.5 minutes.

HOME - PREPARED

Yellow cornmeal	104g
Flour	140g
Sugar	67g
Baking powder	11g
Salt	2g
Milk	244g
Egg	50g
Oil	28g

Combine cornmeal, flour, sugar, baking powder, and salt. Beat together milk, egg, and oil. Add liquid ingredients to dry ingredients and combine. Line 23-cm round glass pan with wax paper.

ER - Preheat oven to 218°C. Pour batter into pan and bake 15 minutes.

MW - Pour batter into pan. Heat on Med 5 minutes. Turn. Heat on High 3.5 minutes.

YELLOW CAKE

CONVENIENCE

Dry cake mix	525g
Egg	100g
Water	330g

Combine mix, eggs, and water in bowl. Beat 2 minutes at medium speed with hand mixer. Line two 23-cm round glass cake pans with wax paper. Divide batter into pans.

ER - Preheat oven to 177°C. Bake cakes 25 minutes.

MW - Heat one layer 8 minutes on Med. Turn. Heat on High 4 minutes. Repeat for second layer.

HOME - PREPARED

Cake flour	280g
Salt	5g
Baking powder	11g
Sugar	200g
Shortening	100g
Milk	244g
Vanilla	3g
Egg	100g

Combine flour, salt, baking powder, and sugar in bowl. Add shortening, milk, and vanilla. Beat 2 minutes on medium speed with hand mixer. Add eggs. Beat 2 minutes on medium speed. Line two 23-cm round glass cake pans with wax paper. Divide batter into pans.

ER - Preheat oven to 177°C. Bake cakes 25 minutes.

MW - Heat 1 layer 8 minutes on Med. Turn. Heat on High 2 minutes. Repeat for second layer.

CHOCOLATE CAKE

CONVENIENCE

Dry cake mix	525g
Egg	100g
Water	375g

Combine mix, eggs, and water in bowl. Beat 2 minutes at medium speed of hand mixer. Line two 23-cm round glass cake pans with wax paper. Divide batter into pans.

ER - Preheat oven to 177°C. Bake cakes 30 minutes.

MW - Heat 1 layer 8 minutes on Med. Turn. Heat 4 minutes on High. Repeat for second layer.

HOME - PREPARED

Unsweetened chocolate	56g
Butter	115g
Sugar	300g
Egg	100g
Vanilla	7g
Cake flour	280g
Baking soda	4g
Salt	2g
Ice water (40°C)	250g

Melt chocolate (ER - 5 minutes on Med Low; MW - 2 minutes on High). Cream butter and sugar 1 minute on low speed of hand mixer. Add eggs and vanilla. Mix 1 minute on medium speed. Add chocolate and mix 30 seconds on Low. Combine flour, soda, and salt. Add to first mixture. Mix 1.5 minutes on Med. Add ice water. Mix 1 minute on Low, then 1 minute on Med. Line 2 23-cm round glass cake pans with wax paper. Divide batter into pans.

ER - Preheat oven to 177°C. Bake cakes 35 minutes.

MW - Heat 1 layer 8 minutes on Med. Turn. Heat 5 minutes on High. Repeat for second layer.

BROCCOLI SPEARS IN BUTTER SAUCE

CONVENIENCE

Water (ER only)	500g
Frozen broccoli in sauce	284g

ER - Bring water to boil on High in covered 2-liter saucepan. Put unopened pouch into boiling water in uncovered pan. Bring water to second boil. Cook 10 minutes on Med. Cut open pouch and pour into bowl.

MW - Make small slit in center of pouch and place in covered 1-liter casserole dish. Heat 6 minutes on High. Cut open pouch and pour into bowl.

HOME - PREPARED

Broccoli	454g
Water	62g
Salt	2g
Butter	57g

ER - Cut broccoli into spears 1-2cm thick. Heat water and salt to boiling on High in covered 2-liter saucepan. Add broccoli. Cook 8 minutes on Med. Drain. Melt butter on Med. Add to broccoli.

MW - Cut broccoli into spears 1-2cm thick. Place in covered 1-liter casserole dish, spears to outside, with water and salt. Heat on High 5 minutes. Stir. Heat on High 4 minutes. Drain. Heat butter on High 1 minute. Pour over broccoli.

MACARONI AND CHEESE

CONVENIENCE

Water	500 or 1500g
Salt	5g
Margarine	57g
Milk	62g
Box dinner	206g

ER - Bring 1500g water and salt to boiling on High in covered 3-liter saucepan. Add macaroni and bring to second boil on High. Boil on Med, stirring occasionally, for 10 minutes. Drain. Add margarine, milk, and cheese sauce mix. Mix well.

MW - Heat 500g water and salt in covered 2-liter glass casserole 7 minutes on High. Add margarine, milk, macaroni, and cheese sauce mix. Heat on Med 6 minutes. Stir. Heat

on Med 5 minutes. Let stand, covered, 3 minutes.

HOME - PREPARED

Water	500 or 1500g
Salt	2g
Oil	7g
Elbow macaroni	146g
Medium cheddar cheese	113g
Margarine	21g
Flour	12g
Salt	2g
Pepper	1g
Milk	386g

ER - Bring 1500g water to boil on High in covered 3-liter saucepan with salt and oil. Add macaroni and bring to second boil on High. Cook on Med, covered, 7 minutes. Drain. Grate cheese. Melt margarine on Med; blend in flour, salt, and pepper. Remove from heat and add milk. Return to Med-High heat and stir until sauce reaches 60°C. Add cheese, stir to blend. Add macaroni. Bake in uncovered 2-quart glass casserole dish 25 minutes at 204°C.

MW - Heat 500g water on High 7 minutes with salt and oil in covered 2-liter glass casserole. Grate cheese. Add macaroni to water. Heat on Defrost 10 minutes. Drain. Combine cheese, margarine, flour, salt, pepper, and milk. Add to macaroni. Heat, covered, on Med 5 minutes. Stir. Heat on Med 5 minutes. Let stand, covered, 5 minutes.

SPAGHETTI SAUCE

CONVENIENCE

Canned spaghetti sauce	440g

ER - Heat sauce on Med High to 70°C in covered 2-liter saucepan. Stir occasionally.

MW - Heat sauce on Reheat 3 minutes in covered 1-liter glass

casserole dish. Stir. Heat 3 minutes on Reheat to 70°C.

HOME - PREPARED

Garlic	3g
Onion	42g
Olive oil	14g
Canned tomatoes	301g
Tomato paste	98g
Sugar	2g
Pepper	1g
Basil	2g
Butter	35g
Salt	2g

ER - Peel and chop garlic and onion. Heat oil in 2-liter saucepan 1 minute on High. Cook onion and garlic, covered, 3 minutes on Med. Chop tomatoes. Add tomatoes, tomato paste, sugar, pepper, and basil to onion and garlic. Heat to 80°C on High. Reduce heat to Med Low. Cook 45 minutes, covered. Add butter and salt.

MW - Peel and chop garlic and onion. Heat with oil 3 minutes on High in covered 2-liter glass casserole dish. Chop tomatoes. Add tomatoes, tomato paste, sugar, pepper, and basil to onion and garlic. Heat on High, covered, 5 minutes to 80°C. Stir. Heat on Med 8 minutes. Stir. Heat on Med 7 minutes. Add butter and salt.

SAUSAGE PIZZA

CONVENIENCE

Frozen pizza	354g

ER - Preheat oven to 232°C. Place pizza on oven rack. Bake 7 minutes.

MW - Preheat 37x29 cm browning grill 5 minutes on High. Heat pizza on grill 6 minutes on High.

HOME - PREPARED

Flour	420g
Sugar	7g
Salt	10g
Active dry yeast	7g
Hot tap water (50°C)	250g
Oil	28g
Shortening	25g
Mild pork sausage	228g
Mozzarella cheese	226g
Tomato sauce	540g
Oregano	3g

Combine 140g flour, sugar, salt, and yeast in bowl of Kitchen Aid mixer. Add water and oil. Using dough hook, mix 30 seconds on speed '2'. Scrape bowl. Mix 30 seconds on speed '2'. Add rest of flour on speed '2' to make a soft dough. Mix 5 minutes on speed '2'. Turn out of bowl. Grease bowl with shortening. Return dough to bowl; cover with plastic wrap. Let rise 45 minutes. Punch down. Divide in half by weight. Form each half into a 25cm circle. Prick all over with fork.

ER - Brown 114g sausage on Med High in 20-cm skillet. Grate 113g cheese. Spread 270g tomato sauce on one pizza. Add sausage and 1.5g oregano. Top with cheese. Preheat oven to 177°C. Bake pizza on baking sheet 25 minutes.

MW - Heat 114g sausage 1.5 minutes on High in covered 1-liter casserole dish. Turn. Heat 1.5 minutes on High. Grate 113g cheese. Spread 270g tomato sauce on one pizza. Add sausage and 1.5g oregano. Top with cheese. Preheat 37x29 cm Browning grill 5 minutes on High. Heat pizza on grill 7 minutes on High.

VANILLA PUDDING

CONVENIENCE

Dry pudding mix	88g
Milk	488g

ER - Combine mix and milk in 2-liter saucepan. Heat and stir on Med High until mixture reaches 95°C. Chill.

MW - Combine mix and milk in covered 2-liter casserole dish. Heat on High 4 minutes. Stir. Heat on High 5 minutes until mixture reaches 95°C. Chill.

HOME - PREPARED

Milk	488g
Cornstarch	24g
Sugar	50g
Salt	1g
Vanilla	3g
Butter	28g

ER - heat 440g milk to 50°C on Med High in 2-liter covered saucepan. Combine remaining milk, cornstarch, sugar, and salt. Add to heated milk. Heat on Med, stirring constantly, until mixture reaches 75°C. Reduce heat to Med Low and cook, covered, 15 minutes. Remove from heat and add vanilla and butter. Chill.

MW - Combine cornstarch, sugar, and salt. Gradually add milk. Heat on High 3 minutes in covered 2-liter glass casserole. Stir. Heat on High 3 minutes until mixture reaches 75°C. Add vanilla and butter. Chill.

CREAM OF MUSHROOM SOUP

CONVENIENCE

Canned condensed soup	305g
Milk	314g

ER - Combine soup and milk in 2-liter covered saucepan. Heat on Med High, stirring occasionally, to 93°C.

MW - Combine soup and milk in 1.5-liter covered casserole dish. Heat on Med 6 minutes. Stir. Heat on Med 5 minutes.

Stir. Heat on Med 6 minutes to 93°C.

HOME - PREPARED

Onion	42g
Mushrooms	114g
Margarine	57g
Flour	8g
Chicken bouillon	500g
Half and half	128g
Pepper	1g

ER - Chop onion and mushrooms. Melt margarine on Med in 2-liter saucepan. Add vegetables. Cook, covered, on low heat, stirring occasionally, for 5 minutes. Add flour and blend. Add bouillon. Heat, stirring occasionally, on Med High to 93°C. Reduce heat to Low and cook 20 minutes. Remove from heat and stir in half and half and pepper.

MW - Chop onion and mushrooms. Heat margarine and vegetables on High 1 minute in covered 1.5-liter casserole dish. Stir. Heat on High 2 minutes. Stir flour into some bouillon. Add this, remaining bouillon, half and half, and pepper to vegetables. Heat on High 3 minutes. Stir. Heat on High 3 minutes.

CHICKEN NOODLE SOUP

CONVENIENCE

Canned condensed soup	305g
Water	305g

ER - Combine soup and water in 2-liter covered saucepan. Heat on High to 93°C.

MW - Combine soup and water in 1.5-liter covered casserole dish. Heat on High 8 minutes to 93°C.

HOME - PREPARED

Chicken broth	500g
Narrow noodles	28g
Cooked chicken	70g

ER - Heat broth to 93°C on High in covered 2-liter saucepan. Add chicken and noodles. Cook on Med 15 minutes.

MW - Heat broth 6 minutes on High in covered 1.5-liter casserole dish. Add chicken and noodles. Heat on Med 15 minutes.

CHICKEN POT PIE

CONVENIENCE

Frozen pot pie	226g

ER - Preheat oven to 218°C. Cut slits in top pie crust. Place pie, in own pan, on baking sheet. Bake 35 minutes.

MW - Remove pie from pan and put in 340-ml glass dish. Cut slits in top crust. Heat on High 3 minutes. Turn. Heat on High 3 minutes.

HOME - PREPARED

Flour	110g
Salt	1g
Shortening	50g
Water	30g
Butter	42g
Flour	26g
Chicken broth	250g
Half and half	128g
Pepper	1g
Salt	2g
Cooked chicken	280g
Onion	21g

Carrots	40g
Frozen peas	36g

Combine flour and salt. Cut in shortening with pastry blender. Add water and stir to make a ball. Roll out crust.

ER - Melt butter in 2-liter saucepan on Med High. Stir in flour. Cook on Low 2 minutes. Add broth, half and half, pepper, and salt. Cook with stirring on Med High to 80°C. Put chicken in 1-liter glass casserole dish. Preheat oven to 218°C. Peel and chop onions and carrots. Add onions, carrots, and peas to chicken. Cover with sauce, then with crust. Cut vents in crust. Bake 25 minutes.

MW - Melt butter 1 minute on High in 1-liter glass casserole dish. Add flour and heat 1 minute on High. Add broth, half and half, pepper, and salt. Heat on High 2 minutes. Stir. Heat on High 2 minutes to 80°C. Peel and chop onions and carrots. Add vegetables and chicken to sauce. Cover with crust. Cut vents in crust. Heat on High 4 minutes. Turn. Heat on High 4 minutes.

CHICKEN BROTH

HOME - PREPARED

Whole chicken (raw)	1362g
Onion	63g
Carrots	134g
Celery	126g
Water	500g
Bay leaf	1g
Pepper	2g
Thyme	1g
Salt	10g

ER - Cut chicken in half. Peel, trim, and cut up onion, carrots, and celery. Put all ingredients in covered 5-liter pot. Bring to boil on High. Reduce heat to Med. Cook until chicken reaches an internal temperature of 85°C in the breast muscle. Strain broth and remove fat. Take chicken off bone.

MW - Cut chicken in half. Peel, trim, and cut up onion, carrots, and celery. Put all ingredients in covered 3-liter glass dish. Heat on High 10 minutes. Heat on Med until chicken reaches an internal temperature of 85°C in the breast muscle. Strain broth and remove fat. Take chicken off bone.

APPLE PIE

CONVENIENCE

Frozen pie	567g

ER - Preheat oven to 218°C. Cut slits in top pie crust. Place pie, in own pan, on cookie sheet. Bake 30 minutes.

MW - Remove pie from metal pan; place in 20-cm glass pie pan. Cut slits in top crust. Heat on High 6 minutes. Turn. Heat on High 6 minutes.

HOME - PREPARED

Flour	280g
Salt	2g
Shortening	133g
Water	80g
Sugar	150g
Salt	2g
Cinnamon	2g
Nutmeg	1g
Flour	12g
Apples	600g
Butter	28g

Combine flour and salt. Cut in shortening with pastry blender. Sprinkle with water. Mix with fork until dough forms a ball. Roll half of pastry out on floured board. Line 23-cm glass pie pan with pastry. Mix sugar, salt, cinnamon, nutmeg, and flour in bowl. Peel, core, and slice apples; toss with sugar mixture. Place in lined pan and dot with butter. Roll out top crust and cover pie. Make slits in top crust. Crimp edges.

ER - Preheat oven to 218°C. Bake pie 10 minutes. Reduce heat to 177°C. Bake 30 minutes.

MW - Heat pie on High 5 minutes. Turn. Heat on High 5 minutes.

FRIED CHICKEN TV DINNER

CONVENIENCE

Frozen dinner	311g

ER - Preheat oven to 204°C. Remove dinner from carton. Fold back foil from chicken. Bake 35 minutes in own container.

MW - Remove dinner from metal container and place in 23-cm round glass dish. Cover carrots and potatoes with wax paper. Heat on High 7 minutes.

HOME - PREPARED

Carrots	70g
Water	62g
Salt	1g
Margarine	5g
Potatoes	100g
Water	125g
Margarine	5g
Salt	1g
Milk	15g
Oil (ER only)	250g
Flour	8g
Salt	1g
Pepper	1g
Egg	7g
Milk	15g
Margarine (MW only)	14g
Chicken pieces (raw)	133g

ER - Pare and slice carrots. Bring water to boil on high in

covered 1-liter pan. Add carrots and salt. Cook on Med 10 minutes. Drain. Add margarine. Pare and quarter potatoes. Add water. Bring to boil on High in covered 1-liter pan. Cook on Med 15 minutes. Drain. Add margarine, salt, and milk. Mash with fork. Whisk until light and fluffy. Heat oil on high in covered 2-liter pan to 185°C. Combine flour, salt, pepper, egg, and milk to form batter. Dip chicken in batter. Fry in oil 15 minutes.

MW - Pare and slice carrots. Heat carrots, water, and salt on High 5 minutes in covered 340-ml dish. Stir. Heat 5 minutes on High. Drain. Add margarine. Pare and quarter potatoes. Heat potatoes and water 3 minutes on High in covered 340-ml dish. Stir. Heat 5 minutes on High. Drain. Add margarine, salt, and milk. Mash with fork. Whisk until light and fluffy. Preheat 29x20cm browning grill 6 minutes on High. Combine flour, salt, pepper, egg and milk to form batter. Spread grill with margarine. Dip chicken in batter and arrange on grill. Heat 5 minutes on High. Turn chicken over. Heat 5 minutes on High.

CHOCOLATE CHIP COOKIES

HOME - PREPARED

Margarine	113g
Sugar	100g
Brown sugar	55g
Egg	50g
Vanilla	2g
Flour	156g
Baking soda	2g
Salt	2g
Semisweet chocolate chips	170g

Cream margarine, sugars, egg, and vanilla 3 minutes on low speed of hand mixer. Combine flour, soda, and salt and add to first mixture. Mix 1 minute on medium speed. Stir in chocolate chips.

ER - Preheat oven to 190°C. Drop dough by spoonfuls onto 2 baking sheets, forming 21 cookies on each sheet. Bake 7 minutes.

MW - Place dough in 23-cm round glass cake pan. Heat on High 2.5 minutes. Turn. Heat on high 3 minutes.

WHITE BREAD

HOME - PREPARED

Water	375g
Milk	125g
Margarine	42g
Bread flour	770g
Sugar	36g
Salt	10g
Active dry yeast	14g
Shortening	25g

Heat water, milk, and margarine to 50°C (ER - 8 minutes on Med; MW - 2 minutes on Med). Combine 280g flour, sugar, salt, and yeast in bowl of Kitchen Aid mixer. Add liquid ingredients to dry ingredients. Using dough hook, mix on speed '2' 1 minute, then speed '5' 2 minutes. Gradually add more flour on speed '2' until dough forms a ball around hook and no longer sticks to sides of bowl. Mix 5 minutes on speed '2'. Turn out of bowl. Grease bowl with shortening. Return dough to bowl, cover with plastic wrap. Let rise one hour. Punch down; let rest 15 minutes. Divide in half by weight. Form into 2 loaves. Let rise one hour.

ER - Preheat oven to 190°C. Bake 25 minutes.

MW - Heat on Med 5 minutes. Turn. Heat on Med 6 minutes.

WHOLE WHEAT BREAD

HOME - PREPARED

Water	375g
Milk	190g
Molasses	110g
Margarine	76g
Whole wheat flour	540g

Bread flour	360g
Sugar	36g
Salt	20g
Active dry yeast	14g
Shortening	25g

Heat water, milk, molasses, and margarine to 50°C (ER - 6 minutes on Med; MW - 2 minutes on Med). Combine flours. Mix 350g flour mixture, sugar, salt, and yeast in bowl of Kitchen Aid mixer. Add liquid ingredients. Using dough hook, mix on speed '2' 1 minute, then on speed '5' 2 minutes. Add more flour mixture on speed '2' until dough forms a ball around hook and no longer sticks to bowl. Mix 5 minutes on speed '2'. Turn out of bowl. Grease bowl with shortening. Return dough to bowl and cover with plastic wrap. Let rise one hour. Punch down and divide in half by weight. Form into 2 loaves.

ER - Preheat oven to 190°C. Bake 20 minutes.

MW - Heat on Med 5 minutes. Turn. Heat on Med 6 minutes.

WHITE SOFT ROLLS

HOME - PREPARED

Bread flour	411g
Sugar	50g
Salt	2g
Active dry yeast	7g
Margarine, softened	70g
Hot water (50°C)	165g
Egg	50g
Shortening	25g
Margarine	28g

Combine 105g flour, sugar, salt, and yeast in bowl of Kitchen Aid mixer. Add margarine and water. Using dough hook, beat 1 minute on speed '2'. Scrape bowl. Beat 1 minute on '4'. Add egg and 70g flour. Beat 1 minute on '6'. Scrape bowl. Beat 1 minute on '8'. Add remaining flour on speed '2' to form a soft dough. Beat 5 minutes on '2'. Turn out of bowl. Grease bowl with shortening. Return

dough to bowl, cover with plastic wrap. Let rise 1 hour. Punch down and divide in half by weight. Shape each half into 10 rolls. Put rolls in 23-cm round glass pans. Let rise 1 hour. Melt margarine (ER - 2 minutes on Med; MW - 1 minute on High). Brush rolls with margarine.

ER - Preheat oven to 190°C. Bake rolls 10 minutes.

MW - Heat rolls 3 minutes on Med. Turn. Heat 3 minutes on Med.

SWEET ROLLS

HOME - PREPARED

Milk	125g
Water	125g
Margarine	56g
Flour	700g
Sugar	100g
Salt	7g
Active dry yeast	14g
Egg	100g
Shortening	25g
Sugar	300g
Cinnamon	5g
Raisins	100g
Margarine	28g
Powdered sugar	120g
Water	20g

Heat milk, water, and margarine to 50°C (ER - 8 minutes on Med; MW - 2 minutes on Med). Combine 245g flour, sugar, salt, and yeast in bowl of Kitchen Aid Mixer. Add liquid ingredients to dry ingredients. Using dough hook, mix 1 minute on speed '4'. Scrape bowl. Mix 1 minute on speed '4'. Add eggs and 70g flour. Mix 1 minute on speed '8'. Scrape bowl. Mix 1 minute on speed '8'. Add remaining flour on speed '2' to make a soft dough. Beat 5 minutes on speed '2'. Turn out of bowl. Grease bowl with shortening. Return dough to bowl, cover with plastic wrap. Let rise 1 hour. Punch down and divide in half by weight. Combine sugar, cinnamon, and raisins. Melt margarine (ER - 2 minutes on Med; MW - 1 minute on High). Roll each half of

dough into a 30x46cm rectangle. Brush with melted margarine. Sprinkle each rectangle with half of sugar mixture. Roll up jelly roll style. Cut into 10 pieces. Place, cut side up, in 23-cm round glass pan. Let rise 1 hour. After baking combine powdered sugar and water. Drizzle over warm rolls.

ER - Preheat oven to 177°C. Bake rolls 15 minutes.

MW - Heat rolls 5 minutes on Med. Turn. Heat 5 minutes on Med.

Appendix C

Total Product Food Cost for Convenience and Home-Prepared Foods

Abbreviations used in this appendix include: ER= Electric Range; MW= Microwave Oven; NC= No Cost.

BISCUITS

CONVENIENCE

		ER	MW
Refrigerated biscuits	284g	.35	.35
Margarine (MW only)	28g	--	.04
Total		.35	.39

HOME - PREPARED

Flour	280g	.14	.14
Salt	5g	.00	.00
Baking powder	11g	.03	.03
Shortening	67g	.11	.11
Milk	185g	.10	.10
Margarine (MW only)	28g	--	.04
Total		.38	.42

PANCAKES

CONVENIENCE

		ER	MW
Complete pancake mix	135g	.19	.19
Water	190g	NC	NC
Oil (ER only)	28g	.06	--
Margarine (MW only)	28g	--	.04
Total		.25	.23

HOME - PREPARED

Flour	140g	.07	.07
Salt	2g	.00	.00
Baking powder	7g	.02	.02
Sugar	4g	.00	.00
Milk	244g	.14	.14
Egg	56g	.09	.09
Oil	14g	.03	.03
Oil (ER only)	28g	.06	--
Margarine (MW only)	28g	--	.04
Total		.41	.39

CORNBREAD

CONVENIENCE

		ER&MW
Dry mix	340g	.49
Egg	56g	.09
Milk	170g	.10
Total		.68

HOME - PREPARED

Yellow corn meal	104g	.10
Flour	140g	.07
Sugar	67g	.05
Baking powder	11g	.03
Salt	2g	.00
Milk	244g	.14
Egg	56g	.09
Oil	28g	.06
Total		.54

YELLOW CAKE

CONVENIENCE

		ER&MW
Cake mix	525g	1.00
Egg	112g	.17
Water	330g	NC
Total		1.17

HOME - PREPARED

Cake flour	280g	.32
Salt	5g	.00
Baking powder	11g	.03
Sugar	200g	.14
Shortening	100g	.16
Milk	244g	.14
Vanilla	3g	.10
Egg	112g	.17
Total		1.06

CHOCOLATE CAKE

CONVENIENCE

		ER&MW
Cake mix	525g	.97
Egg	112g	.17
Water	375g	NC
Total		1.14

HOME - PREPARED

Unsweetened chocolate	56g	.32
Butter	115g	.42
Sugar	300g	.21
Egg	112g	.17
Vanilla	7g	.22
Cake flour	280g	.32
Baking soda	4g	.00

Salt	2g	.00
Water	250g	NC
Total		1.66

BROCCOLI SPEARS IN BUTTER SAUCE

CONVENIENCE

		ER&MW
Water	500g	NC
Frozen broccoli in sauce	284g	.84
Total		.84

HOME - PREPARED

Broccoli	454g	.54
Water	62g	NC
Salt	2g	.00
Butter	57g	.21
Total		.75

MACARONI AND CHEESE

CONVENIENCE

		ER&MW
Water	500g	NC
Salt	5g	.00
Margarine	57g	.09
Milk	62g	.03
Box dinner	206g	.39
Total		.51

HOME - PREPARED

Water	500g	NC
Salt	2g	.00
Oil	7g	.04

Elbow macaroni	146g	.22
Medium cheddar cheese	113g	.56
Margarine	21g	.03
Flour	12g	.01
Salt	2g	.00
Pepper	1g	.00
Milk	386g	.21
Total		1.07

SPAGHETTI SAUCE

CONVENIENCE

		ERoMW
Canned spaghetti sauce	440g	.87
Total		.87

HOME - PREPARED

Garlic	3g	.03
Onion	46g	.04
Olive oil	14g	.04
Canned tomatoes	301g	.37
Tomato paste	98g	.16
Sugar	2g	.00
Pepper	1g	.00
Basil	2g	.13
Butter	35g	.13
Salt	2g	.00
Total		.92

SAUSAGE PIZZA

CONVENIENCE

		ERoMW
Frozen pizza	354g	1.39
Total		1.39

HOME - PREPARED

Flour	210g	.11
Sugar	4g	.00
Salt	5g	.00
Active dry yeast	4g	.04
Water	125g	NC
Oil	14g	.03
Shortening	13g	.02
Mild pork sausage	114g	.41
Mozzarella cheese	113g	.61
Tomato sauce	270g	.65
Oregano	2g	.04
Total		1.91

VANILLA PUDDING

CONVENIENCE

		±R&MW
Dry mix	88g	.42
Milk	488g	.27
Total		.69

HOME - PREPARED

Milk	488g	.27
Cornstarch	24g	.03
Sugar	50g	.03
Salt	1g	.00
Vanilla	3g	.10
Butter	28g	.10
Total		.53

CREAM OF MUSHROOM SOUP

CONVENIENCE

		ER&MW
Canned condensed soup	305g	.35
Milk	314g	.17
Total		.52

HOME - PREPARED

Onion	46g	.04
Mushrooms	117g	.47
Margarine	57g	.09
Flour	8g	.00
Chicken bouillon cubes	8g	.05
Water	500g	NC
Half and half	128g	.17
Pepper	1g	.00
Total		.82

CHICKEN NOODLE SOUP

CONVENIENCE

		ER&MW
Canned condensed soup	305g	.34
Water	305g	NC
Total		.34

HOME - PREPARED

Chicken broth	500g	NC
Narrow noodles	28g	.06
Chicken (raw)	93g	.17
Total		.23

CHICKEN NOODLE SOUP (WITH BROTH COST)

HOME - PREPARED

		ER&MW
Chicken broth	500g	.47
Narrow noodles	28g	.06
Chicken (raw)	93g	.17
Total		.70

CHICKEN POT PIE

CONVENIENCE

		ER&MW
Frozen pie	226g	.55
Total		.55

HOME - PREPARED

Flour	110g	.06
Salt	1g	.00
Shortening	50g	.08
Water	30g	NC
Butter	42g	.15
Flour	26g	.01
Chicken broth	250g	NC
Half and half	128g	.17
Pepper	1g	.00
Salt	2g	.00
Chicken (raw)	372g	.68
Onion	23g	.02
Carrots	47g	.05
Frozen peas	36g	.06
Total		1.28

CHICKEN POT PIE (WITH BROTH COST)

HOME - PREPARED

		ER&Mw
Flour	110g	.06
Salt	1g	.00
Shortening	50g	.08
Water	30g	NC
Butter	42g	.15
Flour	26g	.01
Chicken broth	250g	.24
Half and half	125g	.17
Pepper	1g	.00
Salt	2g	.00
Chicken (raw)	372g	.68
Onion	23g	.02
Frozen peas	36g	.06
Carrots	47g	.05
Total		1.52

CHICKEN BROTH

HOME - PREPARED

		ER&Mw
Water	500g	NC
Onion	63g	.07
Carrots	134g	.13
Celery	126g	.15
Whole chicken	1362g	2.50
Bay leaf	1g	.06
Pepper	2g	.00
Thyme	1g	.06
Salt	10g	.00
Total		2.97
Total (Broth)		.47

APPLE PIE

CONVENIENCE

		ER&MW
Frozen pie	567g	1.43
Total		1.43

HOME - PREPARED

Flour	280g	.14
Salt	2g	.00
Shortening	133g	.22
Water	80g	NC
Sugar	150g	.11
Salt	2g	.00
Cinnamon	2g	.05
Nutmeg	1g	.03
Flour	12g	.01
Apples	600g	.68
Butter	28g	.10
Total		1.34

FRIED CHICKEN TV DINNER

CONVENIENCE

		ER&MW
Frozen dinner	311g	.96
Total		.96

HOME - PREPARED

		ER	MW
Carrots	70g	.07	.07
Water	62g	NC	NC
Salt	1g	.00	.00
Margarine	5g	.01	.01
Potatoes	100g	.04	.04
Water	125g	NC	NC
Margarine	5g	.01	.01

Salt	1g	.00	.00
Milk	15g	.01	.01
Oil (ER only)	85g	.19	--
Flour	8g	.00	.00
Salt	1g	.00	.00
Pepper	1g	.00	.00
Egg	8g	.01	.01
Milk	15g	.01	.01
Margarine (MW only)	14g	--	.02
Chicken (raw)	160g	.30	.30
Total		.65	.48

CHOCOLATE CHIP COOKIES

CONVENIENCE

		ER&MW
Ready to eat cookies	369g	1.09
Total		1.09

HOME - PREPARED

Margarine	113g	.18
Sugar	100g	.07
Brown sugar	55g	.08
Egg	56g	.09
Vanilla	2g	.08
Flour	156g	.08
Baking soda	2g	.00
Salt	2g	.00
Semisweet chocolate chips	170g	1.14
Total		1.72

WHITE BREAD

CONVENIENCE

		ER&MW
Ready to eat bread	454g	.56
Total		.56

HOME - PREPARED

Water	187g	NC
Milk	62g	.03
Margarine	21g	.03
Bread flour	385g	.20
Sugar	18g	.01
Salt	5g	.00
Active dry yeast	7g	.07
Shortening	13g	.02
Total		.36

WHOLE WHEAT BREAD

CONVENIENCE

		ERGMW
Ready to eat bread	454g	.78
Total		.78

HOME - PREPARED

Water	187g	NC
Milk	95g	.05
Molasses	55g	.13
Margarine	38g	.06
Whole wheat flour	270g	.24
Bread flour	190g	.10
Sugar	18g	.01
Salt	10g	.00
Active dry yeast	7g	.07
Shortening	13g	.02
Total		.68

WHITE SOFT ROLLS

CONVENIENCE

		ERGMW
Ready to eat rolls	347g	.81
Total		.81

HOME - PREPARED

Bread flour	205g	.11
Sugar	25g	.02
Salt	1g	.00
Active dry yeast	4g	.04
Margarine	35g	.06
Water	83g	NC
Egg	28g	.04
Shortening	13g	.02
Margarine	14g	.02
Total		.31

SWEET ROLLS

CONVENIENCE

		ER&MW
Ready to eat rolls	284g	.79
Total		.79

HOME - PREPARED

Milk	62g	.03
Water	62g	NC
Margarine	28g	.04
Flour	350g	.18
Sugar	50g	.03
Salt	4g	.00
Active dry yeast	7g	.07
Egg	56g	.09
Shortening	13g	.02
Sugar	150g	.11
Cinnamon	2g	.06
Raisins	50g	.18
Margarine	14g	.02
Powdered sugar	60g	.09
Water	10g	NC
Total		.92

Appendix D

EVALUATION CARD

Judge # _____ Product _____ Date _____

Please rate each sample on each of the four characteristics. Rate each sample on its own merits. Do not compare samples.

Sample #	Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely
1. Appearance									
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1
2. Texture									
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1
3. Flavor									
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1
4. Overall Quality									
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1
___	9	8	7	6	5	4	3	2	1

Appendix E

PREFERENCE CARD

Judge # _____ Product _____ Date _____

Please rank the four samples in decreasing order of preference. Then indicate which characteristic(s) made you choose that ranking.

	Sample #	Appearance	Texture	Flavor	Overall Quality
1st	_____	____	____	____	____
2nd	_____	____	____	____	____
3rd	_____	____	____	____	____
4th	_____	____	____	____	____

Appendix F

Energy, Expressed as British Thermal Units,[1] Used to Prepare Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

	Convenience		Home-Prepared	
	Electric Range (BTU)	Microwave Oven (BTU)	Electric Range (BTU)	Microwave Oven (BTU)
Biscuits	2054.6	675.8	2621.2	679.2
Pancakes	1030.7	907.8	1143.4	1269.6
Cornbread	2583.6	515.4	2703.1	515.4
Yellow cake	1976.1	1266.6	1955.6	1058.0
Chocolate cake	2785.0	1385.7	3327.7	1727.0
Broccoli	1085.3	668.9	518.8	822.5
Macaroni & cheese	1030.7	1075.1	4023.9	1351.5
Spaghetti sauce	211.6	395.9	713.3	1344.7
Pizza	2805.5	894.2	1996.6	1204.8
Pizza incl. sauce	2805.5	894.2	2709.9	2549.5
Pudding	378.8	733.8	467.6	491.5
Mushroom soup	385.7	815.7	559.7	744.0
Chicken noodle soup	409.6	648.5	645.0	1187.7
Chicken noodle soup incl. broth	409.6	648.5	3017.3	2880.6
Chicken pot pie	3215.0	484.6	3802.1	1174.1
Chicken pot pie incl. broth	3215.0	484.6	6235.6	2866.9
Apple pie	3235.5	452.2	3232.1	822.5
TV dinner	3044.4	580.2	1525.6	2413.0
Carrots	-	-	331.1	474.4
Potatoes	-	-	399.3	477.8

Appendix F (continued)

Energy, Expressed as British Thermal Units,[1] Used to Prepare Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

	Convenience		Home-Prepared	
	Electric Range (BTU)	Microwave Oven (BTU)	Electric Range (BTU)	Microwave Oven (BTU)
Fried chicken	-	-	802.0	1464.2
	Ready-To-Eat (BTU)			
Cookies	0.0		2525.6	443.7
White bread	0.0		2310.6	634.8
Whole wheat bread	0.0		2682.6	631.4
White rolls	0.0		2051.2	290.1
Sweet rolls	0.0		1791.8	457.3

1. British Thermal Units: Watthours x 3.413

Appendix G

Density, Percent Moisture, Percent Fat, Energy per Gram, Heating Time per Gram, Total Time per Gram, and Active Time per Gram: Values for Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

		Density	% Moisture	% Fat	Energy/ gram (min)	Heating Time/ gram (min)	Total Time/ gram (min)	Active Time/ gram (min)
Biscuits	C-ER[1,2]	0.312	37.50	17.00	2.12	0.053	0.060	.0.009
	C-MW[3]	0.340	35.54	22.70	0.63	0.026	0.046	0.030
	HP-ER[4]	0.332	35.93	13.87	1.40	0.036	0.053	0.021
	HP-MW	0.432	34.95	17.10	0.34	0.014	0.036	0.032
Pancakes	C-ER	0.412	73.18	10.72	0.86	0.024	0.024	0.024
	C-MW	0.404	74.42	9.18	0.75	0.042	0.057	0.030
	HP-ER	0.460	54.99	11.68	0.68	0.024	0.024	0.024
	HP-MW	0.456	55.89	10.56	0.76	0.031	0.060	0.040
Cornbread	C-ER	0.448	36.82	9.78	1.35	0.039	0.043	0.008
	C-MW	0.384	36.82	9.78	0.27	0.015	0.023	0.008
	HP-ER	0.452	43.62	6.87	1.23	0.036	0.036	0.010
	HP-MW	0.376	43.62	6.87	0.23	0.013	0.023	0.010
Yellow cake	C-ER	0.320	44.18	8.26	0.61	0.032	0.041	0.012
	C-MW	0.276	44.18	8.26	0.42	0.025	0.040	0.012
	HP-ER	0.336	33.35	12.82	0.61	0.033	0.044	0.017
	HP-MW	0.320	33.35	12.82	0.33	0.021	0.039	0.017
Chocolate cake	C-ER	0.344	47.00	7.26	0.82	0.036	0.040	0.010
	C-MW	0.260	47.00	7.26	0.41	0.024	0.034	0.010
	HP-ER	0.338	34.04	12.24	0.88	0.037	0.051	0.019
	HP-MW	0.340	34.04	12.24	0.45	0.023	0.043	0.019
Broccoli	C-ER	0.796	NA[5]	0.91	0.40	0.028	0.029	0.003
	C-MW	0.768	NA	2.52	0.69	0.028	0.035	0.009
	HP-ER	0.656	79.83	11.30	0.38	0.028	0.030	0.015
	HP-MW	0.672	79.83	11.30	0.60	0.025	0.039	0.016
Macaroni & cheese	C-ER	0.980	NA	2.68	0.16	0.010	0.011	0.003
	C-MW	0.908	NA	5.90	0.38	0.022	0.031	0.006
	HP-ER	0.988	64.68	8.80	1.83	0.079	0.075	0.030
	HP-MW	0.984	64.68	8.80	0.26	0.020	0.054	0.020
Macaroni	HP-ER	0.560	91.39	0.53	0.16	0.008	-	-
	HP-MW	0.560	76.78	1.33	0.51	0.033	-	-
Spaghetti sauce	C-ER	1.068	NA	4.20	0.14	0.016	0.018	0.002
	C-MW	1.068	NA	4.20	0.27	0.014	0.019	0.005
	HP-ER	1.068	80.12	8.71	0.42	0.108	0.116	0.025
	HP-MW	1.038	80.12	8.71	0.79	0.046	0.065	0.023
Pizza	C-ER	0.540	NA	13.30	2.28	0.043	0.050	0.006
	C-MW	0.500	NA	13.30	0.73	0.030	0.035	0.006
	HP-ER	0.980	57.90	9.26	0.57	0.034	0.110	0.033
	HP-MW	0.992	57.90	9.26	0.32	0.013	0.091	0.029
Pizza incl. sauce	HP-ER	0.980	57.90	9.26	0.88	0.076	0.174	0.048
	HP-MW	0.992	57.90	9.26	0.83	0.032	0.127	0.042
Sausage	HP-ER	0.766	44.52	40.29	0.63	0.044	-	-
	HP-MW	0.756	44.52	40.29	0.59	0.026	-	-
Pudding	C-ER	1.068	NA	3.90	0.22	0.022	0.024	0.024
	C-MW	1.060	NA	3.90	0.42	0.018	0.030	0.008
	HP-ER	1.100	73.56	6.57	0.23	0.052	0.059	0.030
	HP-MW	1.100	73.56	6.57	0.24	0.010	0.024	0.013
Mushroom soup	C-ER	0.992	84.60	5.42	0.18	0.018	0.019	0.009
	C-MW	0.996	84.60	5.42	0.39	0.029	0.035	0.006
	HP-ER	0.996	87.82	7.14	0.19	0.036	0.056	0.014
	HP-MW	0.980	87.82	7.14	0.25	0.010	0.029	0.019

Appendix G (continued)

Density, Percent Moisture, Percent Fat, Energy per Gram, Heating Time per Gram, Total Time per Gram, and Active Time per Gram: Values for Convenience and Home-Prepared Foods in Electric Range and Microwave Oven

		Density	% Moisture	% Fat	Energy/ gram (min)	Heating Time/ gram (min)	Total Time/ gram (min)	Active Time/ gram (min)
Chicken noodle soup	C-ER	1.024	91.99	1.02	0.20	0.006	0.008	0.002
	C-MW	1.024	91.99	1.02	0.31	0.013	0.015	0.002
	HP-ER	1.048	87.28	2.08	0.32	0.032	0.034	0.002
	HP-MW	1.036	87.28	2.08	0.58	0.035	0.038	0.002
Chicken noodle soup incl. broth	HP-ER	1.048	87.28	2.08	1.43	0.057	0.167	0.029
	HP-MW	1.036	87.28	2.08	1.41	0.048	0.126	0.033
Chicken pot pie	C-ER	1.008	57.80	11.50	4.17	0.190	0.197	0.007
	C-MW	1.016	57.80	11.50	0.63	0.026	0.035	0.007
	HP-ER	0.988	62.59	13.28	1.10	0.040	0.054	0.024
	HP-MW	1.040	62.59	13.28	0.34	0.014	0.030	0.026
Chicken pot pie incl. broth	HP-ER	0.983	62.59	13.28	1.80	0.048	0.134	0.039
	HP-MW	1.040	62.59	13.28	0.82	0.018	0.082	0.045
Apple pie	C-ER	0.960	47.30	10.10	1.69	0.068	0.070	0.003
	C-MW	1.060	47.30	10.10	0.50	0.021	0.024	0.004
	HP-ER	0.980	51.16	13.33	0.82	0.041	0.058	0.023
	HP-MW	1.040	51.16	13.83	0.21	0.009	0.032	0.023
TV dinner	C-ER	0.791	66.74	9.37	1.78	0.131	0.134	0.003
	C-MW	0.775	66.74	9.37	0.53	0.022	0.028	0.006
	HP-ER	0.733	54.89	37.05	0.58	0.064	0.074	0.016
	HP-MW	0.735	80.31	7.85	1.34	0.057	0.080	0.024
Carrots	HP-ER	0.666	90.28	3.36	0.79	0.089	-	-
	HP-MW	0.666	90.28	3.36	1.13	0.049	-	-
Potatoes	HP-ER	0.850	89.70	2.03	0.52	0.070	-	-
	HP-MW	0.883	89.70	2.03	0.62	0.026	-	-
Fried chicken	HP-ER	0.700	25.71	65.84	0.56	0.052	-	-
	HP-MW	0.680	61.55	18.32	2.40	0.100	-	-
Cookies	C-NB[6]	-	-	-	0.00	-	0.000	0.000
	HP-ER	0.492	11.75	24.55	1.14	0.021	0.046	0.034
	HP-MW	0.756	11.75	24.55	0.20	0.008	0.028	0.020
White bread	C-NB	-	-	-	0.00	-	0.000	0.000
	HP-ER	0.208	16.25	5.71	0.97	0.056	0.275	0.032
	HP-MW	0.192	16.25	5.71	0.27	0.019	0.248	0.032
Whole wheat bread	C-NB	-	-	-	0.00	-	0.000	0.000
	HP-ER	0.284	18.00	6.35	0.89	0.039	0.213	0.037
	HP-MW	0.316	18.00	6.35	0.21	0.015	0.190	0.037
White rolls	C-NB	-	-	-	0.00	-	0.000	0.000
	HP-ER	0.252	12.66	14.16	1.48	0.046	0.414	0.056
	HP-MW	0.268	12.66	14.16	0.21	0.017	0.379	0.056
Sweet rolls	C-NB	-	-	-	0.00	-	0.000	0.000
	HP-ER	0.426	16.68	6.40	0.58	0.032	0.193	0.039
	HP-MW	0.456	16.68	6.40	0.15	0.013	0.182	0.039

1. C = Convenience Food
2. ER = Electric Range
3. MW = Microwave Oven
4. HP = Home-prepared food
5. NA = Data not available
6. NB = National Brand Convenience Food

Appendix H

Nutrient Data for Convenience and Home-Prepared Foods: Values Per Serving[1] and Percent U.S. RDA[2]

	Protein Per Serving (g)	% U.S. RDA	CA Per Serving (mg)	% U.S. RDA	P Per Serving (mg)	% U.S. RDA	Fe Per Serving (mg)	% U.S. RDA	Vit. A Per Serving (IU)	% U.S. RDA
Biscuits - C[4]	4.15	6.4	30.10	3.0	282.30	28.2	0.97	5.4	T[6]	0.0
Biscuits - HP[5]	3.99	6.1	108.85	10.9	163.39	16.3	0.92	5.1	26.25	0.5
Pancakes - C	3.24	5.0	96.75	9.7	117.00	11.7	0.40	2.2	101.25	2.0
Pancakes - HP	6.24	9.6	170.73	17.1	239.00	23.9	1.14	6.3	123.36	2.5
Cornbread - C	6.18	9.5	54.25	5.4	309.95	31.0	1.60	8.9	242.23	4.8
Cornbread - HP	5.28	8.1	148.96	15.0	225.69	22.6	1.18	6.6	139.90	2.8
Yellow cake - C	2.76	4.2	65.92	6.6	133.12	13.3	0.26	1.4	43.33	0.9
Yellow cake - HP	3.08	4.7	95.15	9.5	139.57	14.0	0.30	1.7	72.58	1.4
Chocolate cake - C	3.11	4.8	39.67	4.0	67.50	6.8	0.70	3.9	43.33	0.9
Chocolate cake - HP	2.95	4.5	13.23	1.3	46.02	4.6	0.57	3.2	299.29	6.0
Broccoli - C	1.92	3.0	36.44	3.6	37.81	3.8	0.48	2.7	1801.25	36.0
Broccoli - HP	2.16	3.3	62.68	6.3	47.25	4.7	0.65	3.6	1784.30	35.7
Macaroni & cheese - C	10.80	24.0	217.80	21.8	192.60	19.3	1.45	8.0	585.00	11.7
Macaroni & cheese - HP	14.44	32.1	318.81	31.9	283.64	28.4	1.39	7.7	566.50	11.3
Spaghetti sauce - C	4.59	7.1	34.16	3.4	50.17	5.0	1.07	5.9	1113.40	22.3
Spaghetti sauce - HP	2.06	3.2	30.75	3.1	43.87	4.4	1.69	9.4	1821.45	36.4
Pizza - C	23.22	51.6	338.40	33.8	369.00	36.9	3.60	20.0	990.00	19.8
Pizza - HP	16.31	36.2	209.89	21.0	187.04	18.7	3.03	16.8	1324.30	26.5
Pudding - C	4.46	9.9	149.12	14.9	115.98	11.6	0.00	0.0	203.93	4.1
Pudding - HP	3.81	8.5	137.20	13.7	107.04	10.7	0.08	0.4	342.12	6.8
Mushroom soup - C	7.62	16.9	226.57	22.6	197.93	19.8	0.72	4.0	197.92	4.0
Mushroom soup - HP	4.03	9.0	60.71	6.1	100.08	10.0	0.60	3.3	846.96	16.9
Chicken noodle soup - C	5.12	11.4	21.35	2.1	45.75	4.6	0.98	5.4	899.75	18.0
Chicken noodle soup - HP	37.16	82.6	23.61	2.4	215.02	21.5	1.79	9.9	87.50	1.8
Chicken pot pie - C	15.14	33.6	24.86	2.5	113.00	11.3	2.26	12.6	185.09	3.7
Chicken pot pie - HP	28.57	63.5	64.48	6.4	365.24	36.5	2.56	14.2	1636.86	32.7
Apple pie - C	1.78	2.7	7.48	0.7	19.64	2.0	0.28	1.6	9.35	0.2
Apple pie - HP	4.64	7.1	10.18	1.0	26.75	2.7	0.94	5.2	86.45	1.7
TV dinner - C	37.57	83.5	78.97	7.9	304.28	30.4	3.13	17.4	6799.28	100.0[7]
TV dinner - HP	33.40	74.2	108.64	10.9	346.88	34.7	3.10	17.2	7228.84	100.0
Cookies - C	1.23	1.9	8.88	0.9	25.95	2.6	0.41	2.3	27.32	0.5
Cookies - HP	1.21	1.9	7.52	0.8	20.52	2.0	0.48	2.6	159.96	3.2
White bread - C	4.98	7.7	48.09	4.8	55.53	5.6	1.43	7.9	T	0.0
White bread - HP	4.19	6.4	14.57	1.4	45.16	4.5	1.14	6.3	71.54	1.4
Whole wheat bread - C	6.23	9.6	58.78	5.9	135.38	13.5	1.36	7.6	T	0.0
Whole wheat bread - HP	4.69	7.2	34.35	3.4	105.69	10.6	1.43	7.9	104.27	2.1
White rolls - C	2.97	4.6	26.79	2.7	30.77	3.1	0.69	3.8	T	0.0
White rolls - HP	2.60	4.0	6.44	0.6	28.06	2.8	0.70	3.9	171.61	3.4
Sweet rolls - C	2.73	4.2	29.72	3.0	36.06	3.6	0.55	3.0	T	0.0
Sweet rolls - HP	2.26	3.5	11.02	1.1	27.83	2.8	0.70	3.9	80.29	1.6

Appendix H (continued)

Nutrient Data for Convenience and Home-Prepared Foods: Values Per Serving[1] and Percent U.S. RDA[2]

	Thiamin Per Serving (mg)	% U.S. RDA	Riboflavin Per Serving (mg)	% U.S. RDA	Niacin Per Serving (mg)	% U.S. RDA	Asorbic Acid Per Serving (mg)	% U.S. RDA	NAR[3]
Biscuits - C	0.12	7.9	0.09	5.4	1.07	5.4	T[6]	0.0	6.8
Biscuits - HP	0.12	7.9	0.11	6.5	1.01	5.0	0.15	0.2	
Pancakes - C	0.05	3.6	0.10	16.0	0.32	1.6	T	0.0	4.6
Pancakes - HP	0.13	8.9	0.19	11.3	1.01	5.0	0.37	0.6	9.5
Cornbread - C	0.16	11.0	0.18	10.8	1.35	6.8	0.20	0.3	9.8
Cornbread - HP	0.14	9.3	0.16	9.6	1.13	5.6	0.24	0.4	8.9
Yellow cake - C	0.01	0.8	0.05	3.1	0.12	0.6	T	0.0	3.4
Yellow cake - HP	0.02	1.2	0.06	3.8	0.13	0.7	0.15	0.2	4.1
Chocolate cake - C	0.02	1.1	0.06	3.4	0.20	1.0	0.00	0.0	2.9
Chocolate cake - HP	0.01	0.8	0.04	2.2	0.20	1.0	0.00	0.0	2.6
Broccoli - C	0.04	2.7	0.08	4.8	0.34	1.7	38.50	64.2	13.6
Broccoli - HP	0.05	3.3	0.12	7.2	0.47	2.3	51.66	86.1	16.9
Macaroni & cheese - C	0.13	8.7	0.25	14.7	1.44	7.2	0.00	0.0	12.8
Macaroni & cheese - HP	0.20	13.6	0.35	20.6	1.44	7.2	0.66	1.1	17.1
Spaghetti sauce - C	0.04	2.9	0.16	9.4	1.07	5.4	8.54	14.2	8.4
Spaghetti sauce - HP	0.09	6.2	0.06	3.8	1.42	7.1	24.71	41.2	12.8
Pizza - C	0.43	28.8	0.45	26.5	4.32	21.6	16.20	27.0	29.6
Pizza - HP	0.36	23.8	0.32	19.1	3.43	17.2	16.48	27.5	23.0
Pudding - C	0.04	2.5	0.20	12.0	0.13	0.6	1.27	2.1	6.4
Pudding - HP	0.04	2.6	0.19	10.9	0.10	0.5	0.80	1.3	6.2
Mushroom soup - C	0.09	6.0	0.36	20.9	1.12	5.6	2.48	4.1	11.5
Mushroom soup - HP	0.06	4.1	0.24	14.0	1.57	7.8	2.10	3.5	8.3
Chicken noodle soup - C	0.07	4.7	0.08	4.7	1.75	8.8	0.30	0.5	6.7
Chicken noodle soup - HP	0.14	9.2	0.26	15.2	7.72	38.6	0.00	0.0	20.1
Chicken pot pie - C	0.18	12.3	0.30	17.9	2.84	14.2	9.04	15.1	13.7
Chicken pot pie - HP	0.24	16.3	0.37	21.8	6.82	34.1	2.25	3.7	25.5
Apple pie - C	0.02	1.2	0.02	1.1	0.19	0.9	T	0.0	2.1
Apple pie - HP	0.10	6.6	0.07	4.2	0.84	4.2	0.61	1.0	3.7
TV dinner - C	0.27	18.1	0.37	21.6	12.02	60.1	7.84	13.1	39.1
TV dinner - HP	0.22	14.9	0.27	15.7	9.77	48.8	20.64	34.4	39.0
Cookies - C	0.01	0.7	0.02	1.2	0.09	0.4	T	0.0	1.2
Cookies - HP	0.02	1.6	0.03	1.7	0.16	0.8	0.01	0.0	1.6
White bread - C	0.14	9.3	0.12	7.0	1.37	6.8	T	0.0	5.4
White bread - HP	0.14	9.5	0.13	7.8	1.37	6.8	0.04	0.1	4.9
Whole wheat bread - C	0.15	10.0	0.07	4.1	1.66	8.3	T	0.0	6.6
Whole wheat bread - HP	0.16	10.4	0.10	6.2	1.50	7.5	0.06	0.1	6.2
White rolls - C	0.10	6.7	0.06	3.8	0.80	4.0	T	0.0	3.2
White rolls - HP	0.08	5.5	0.08	4.7	0.78	3.9	0.01	0.0	3.2
Sweet rolls - C	0.02	1.6	0.04	2.4	0.28	1.4	T	0.0	2.1
Sweet rolls - HP	0.07	4.7	0.07	4.2	0.64	3.2	0.08	0.1	2.8

Appendix H (continued)

Nutrient Data For Convenience and Home-Prepared Foods: Values Per Serving[1] and Percent U.S. RDA[2]

1. Based on equal weight servings.
2. Rounded to the nearest 0.1 percent.
3. MAR = Mean Adequacy Ratio: mean of nine nutrients divided by their respective U.S. RDAs.
4. C = Convenience food
5. HP - Home-prepared food.
6. T = Trace amounts of nutrient
7. Values that met or exceeded the U.S. RDA were listed as 100.0%.

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CONVENIENCE FOODS AND HOME-PREPARED FOODS HEATED WITH AN ELECTRIC RANGE AND A MICROWAVE OVEN

BY

Suzanne Richardson

(ABSTRACT)

Twenty convenience foods used by at least one percent of households surveyed in the spring portion of the 1977-78 Nationwide Food Consumption Survey were prepared, along with their home counterparts, with an electric range and with a microwave oven. Yield, total and active preparation time, energy consumption, cost per serving, and sensory quality of the foods were determined, and nutrient content was calculated from tabulated values. Relationships were assessed between the density, moisture content, and fat content of a food and the amount of energy and heating time required for preparation; and between the degree-of-readiness of a food and the required amount of energy and

preparation time.

The majority (78%) of home-prepared foods yielded more servings than did convenience foods, and 78% of foods prepared with the electric range weighed more than microwave-prepared foods. The majority (91%) of home-prepared foods required more total preparation time than did convenience foods, while all home-prepared foods required more active preparation time than the convenience counterparts. Most foods (78%) required more total preparation time with the electric range than with the microwave oven. However 78% required more active preparation time or the same amount of active time when prepared with the microwave oven. Most home-prepared foods (78%) required more energy to prepare than did convenience foods; 63% of foods required more energy to prepare with the electric range than with the microwave oven. The food cost per serving was greater for convenience than for home-prepared foods. However, including the cost of active preparation time made home-prepared foods more expensive. Foods cost more per serving prepared with the microwave oven than with the electric range. No preference trend was seen for either convenience or home-prepared foods; baked products were scored higher when prepared with the electric range. Convenience and home-prepared foods contained similar amounts of nutrients. Trends were not seen relating

density, moisture content, or fat content to energy consumption or heating time, and degree-of-readiness was not necessarily related to energy consumption or preparation time.