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I am submitting herewith a thesis written by Irene Jannette Lackey entitled "Energy Consumption of Pressure Saucepans at 5-, 10- and 15-Pounds Pressure in Relation to Source of Heat When Held for 5, 15 and 25 Minutes." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Home Management, Equipment and Family Economics.

Lyle Mamer

Lyle Mamer, Major Professor

We have read this thesis and recommend its acceptance:

Accepted for the Council:

L. Evans Rath

Vice Chancellor
Graduate Studies and Research

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ENERGY CONSUMPTION OF PRESSURE SAUCEPANS AT 5-, 10- AND 15-POUNDS PRESSURE IN RELATION TO SOURCE OF HEAT WHEN HELD FOR 5, 15 AND 25 MINUTES

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Irene Jannette Lackey

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DEDICATION

This thesis is dedicated to my parents, Mr. Fred H. Lackey and the late Mrs. Irene W. Lackey, for their never failing love, interest and moral support for both their daughters. They struggled and overcame great odds to attain their educations and were inspirations to continue beyond the Bachelor of Science level. This parental concern was illustrated throughout the pursuit of a Master of Science degree, including this thesis.

ACKNOWLEDGMENTS

To Miss Lyle Mamer, Associate Professor, Crafts, Interior Design and Housing, the writer wishes to express sincere appreciation for her guidance in establishing the testing procedure and securing the controlled laboratory and for her patience and encouragement in compiling the results.

Sincere thanks is also expressed to Dr. Robbie Blakemore, Professor and Head, Crafts, Interior Design and Housing, and Dr. Roger Swagler, Associate Professor, Child and Family Studies. They sacrificed valuable time to assist with this thesis. Dr. William Sanders, Statistician, Agriculture Experiment Station Administration, provided the valuable service of programming the experimental data for statistical analysis and Mrs. Viola Gibbons, Programmer Analysis, Agriculture Experiment Station Administration, drafted the graphs. Additional acknowledgment is given to Mr. Clyde Cupp of the Physics Department for adding a steam gauge to one of the pressure saucepan lids.

Above all, she is appreciative to her family for their interest and encouragement, especially her father for sealing a leaking valve in the testing unit and securing the water analysis.

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ABSTRACT

This experiment was designed to evaluate the preheat time and watt-hour consumption of electric and nonelectric pressure saucepans heated on smooth-top and tubular encased surface units. Data was collected in three replications.

The experiment was completed in an environmentally controlled laboratory. The controlled factors were quantity and hardness of water, voltage of circuit, size and position of the surface unit on the range, placement of the pressure saucepans on the surface units and holding time.

Significant differences at 5-, 10- and 15-pounds pressure in preheating time between electric and nonelectric pressure saucepans heated on smooth-top and tubular encased surface units were hypothesized. Significant watt-hour consumptions while preheating and holding the pressures for 5, 15 and 25 minutes were also hypothesized.

The nonelectric Mirro-Matic heated on the tubular unit was the quickest to preheat and the slowest on the smooth-top surface unit. The electric Presto required the least watt-hours at 5- and 10-pounds pressure. The electric Presto and nonelectric Mirro-Matic on the smooth-top surface unit consumed less energy and were significant from the nonelectric Mirro-Matic or nonelectric Presto on the tubular encased surface unit and the nonelectric Presto on the smooth-top surface unit.

CHAPTER I

INTRODUCTION

Pressure saucepans can be used to prepare one or several foods in one-fourth to one-third the time required by conventional methods of surface cookery (3:48-49, 17:66). Shorter cooking periods conserve energy. Several events made consumers of the 1970's conscious of energy conservation. They recall the long lines to purchase gasoline for their automobiles which began in the fall of 1973. Coal shortages at the power plants that winter brought threats of brownouts in the Rural Electrification Areas and memories of the "real" brownout in New York a few years earlier.

The principle for cooking food under pressure was first recognized by Denis Papin. He developed a primitive form of the pressure saucepan called a digestor around the turn of the eighteenth century (8:21). Pressure saucepans, as we know them today, were introduced to the American consumer prior to the World War II. Their popularity increased during the early 1940's. The patriotic consumer was concerned not only with preparing nutritious meals but also with conserving time and energy (5:viii). Electric pressure saucepans were available by the mid-1950's.

According to Consumer Reports pressure saucepans are currently being sold by two manufacturers. There were 20

brands in 1949 (14:54). Although pressure saucepan safety and performance have been investigated and rated periodically. However, this has not been the case with efficiency research. Demands to conserve energy indicates a need for this information.

I. STATEMENT OF THE PROBLEM

The purpose of this investigation was to compare the energy consumed by electric and nonelectric pressure saucepans in relation to (1) heat source, (2) preheat time, (3) holding time, and (4) contact surface. The nonelectric pressure saucepans were heated on smooth-top and tubular encased surface units of electric ranges.

II. HYPOTHESES

The following hypotheses were tested:

1. There is a difference in the time required to obtain 5-pounds pressure in an electric pressure saucepan and in two nonelectric pressure saucepans using smooth-top and tubular encased surface units as the heat sources.

2. There is a difference in the time required to obtain 10-pounds pressure in an electric pressure saucepan and in two nonelectric pressure saucepans using smooth-top and tubular encased surface units as the heat sources.

3. There is a difference in the time required to obtain 15-pounds pressure in an electric pressure saucepan and in two nonelectric pressure saucepans using smooth-top and tubular encased surface units as the heat sources.

4. There is a difference in the energy required to obtain 5-pounds pressure in an electric pressure saucepan and in two nonelectric pressure saucepans using smooth-top and tubular encased surface units as the heat sources.

5. There is a difference in the energy required to obtain 10-pounds pressure in an electric pressure saucepan and in two nonelectric pressure saucepans using smooth-top and tubular encased surface units as the heat sources.

6. There is a difference in the energy required to obtain 15-pounds pressure in an electric pressure saucepan and in two nonelectric pressure saucepans using smooth-top and tubular encased surface units as the heat sources.

7. There is a difference in the energy required to hold 5-pounds pressure for 5, 15, and 25 minutes in an electric pressure saucepan and in two nonelectric pressure saucepans using a smooth-top and tubular encased surface unit as the heat sources.

8. There is a difference in the energy required to hold 10-pounds pressure for 5, 15 and 25 minutes in an electric pressure saucepan and in two nonelectric pressure saucepans using a smooth-top and tubular encased surface unit as the heat sources.

9. There is a difference in the energy required to hold 15-pounds pressure for 5, 15 and 25 minutes in an electric pressure saucepan and in two nonelectric pressure saucepans using a smooth-top and tubular encased surface unit as the heat sources.

III. DEFINITIONS OF TERMS

1. A probe thermostat has liquid silicone in a tube which expands when heated and activates a piston that exerts pressure against the electric contacts and opens them (17:77-78, 13:169).

2. A smooth-top surface unit consists of a resistance wire heated by current located under an unbroken surface (2:32, 17:128).

3. A surface unit is a heating unit mounted in a horizontal surface on which utensils are placed for cooking (2:32, 9:131).

4. A tubular encased surface unit consists of completely insulated resistance wire(s) enclosed in a tube of metal alloy (2:35, 9:133, 17:120).

CHAPTER II

REVIEW OF LITERATURE

I. DESCRIPTION

Pressure saucepans are usually aluminum or stainless steel pans (6:46) with a dome shaped lid which slides into grooves on the rim of the pan (13:65). The lid is in the correct position when the heat resistant handles of the lid and pan are parallel. A gasket or sealing ring along the inside rim of the lid prevents steam from escaping (14:54, 56). The lid has a safety vent which blows out or a safety fuse that melts when the pressure becomes excessive (6:68, 9:86, 13:66, 10:11).

A pressure regulator, a calibrated weight (5:12) maintains the pressure. It hisses (10:9) and rocks up and down at 5-, 10- and 15-pounds pressure (14:54-57, 7:86, 6:68) or back and forth at 15-pounds pressure. Pressure regulators which do not permit a choice of pressures are set to operate at 15-pounds pressure (3:48).

Electric pressure saucepans have a built-in heating element on the bottom of the pan and a thermostatically controlled probe connected to the element (6:69). The electric pressure saucepan is heavy and bulky (14:57). The nonelectric saucepan is dependent upon other equipment for heat.

After closing the lid the electric pressure saucepan is connected to the outlet or the nonelectric pressure saucepan is positioned on the surface unit of the range. The time to place the pressure regulator over the vent tube varies with the manufacturer. The temperatures for both pressure saucepans is reduced from high when the selected pressure is reached (13:66, 15:10, 10:51). The thermostat cycles the heat off and on to maintain the pressure (6:69).

The pressure regulator should "jiggle" in a slow rhythm; "jiggling" too fast allows the liquid to escape and may burn the food (6:67, 9:86, 5:13, 10:9). Conversely, "jiggling" too slow may reduce the pressure and produce undercooked food.

The temperature inside the pressure saucepans are 108.9°C at 5-pounds pressure, 115.6°C at 10-pounds pressure and 121.1°C at 15-pounds pressure (5:23, 6:68, 14:54, 9:86, 17:66). To maintain these internal temperatures at altitudes over 200 feet above sea level the pressure can be increased one pound for each 1,000 feet (5:21, 3:37). Higher temperatures reduce the cooking time which starts when the pressure is reached (13:66, 3:49, 15:7, 10:9).

The pressure saucepan should be removed from the heat immediately to prevent overcooking (15:11) and should not be opened before the pressure has dropped to zero. This can be achieved by allowing the pressure saucepan to cool gradually,

or placing the pressure saucepan in a pan of cold water (1:100) or running water over the sides and top of the pressure saucepan. Water should not run over the safety vent or safety fuse (15:7). Nudge the pressure regulator to be sure the pressure is reduced to zero (13:66, 9:86-87) before removing the pressure regulator and opening the pressure saucepan (14:55-56, 6:69, 10:9, 51, 15:7, 11, 16).

II. CARE

Remove, wash, dry and return the gasket each time (14:57); replace worn ones which no longer seal (13:67). Turn the vent tube toward the light to check opening; unclog with a pipe cleaner (15:14-15, 17:66, 10:10).

Wash pressure saucepans with warm soapy water and dry. Some pressure regulators are not washable (6:68-69); but others are. Follow the instructions that come with the saucepan. Remove stains with fine steel wool. Boil an acid food or a solution of water and vinegar or cream of tarter to remove alkaline stains (13:67). Use silver polish on the outside. Store lid upside down on pan (15:6, 14, 16, 17:66, 14:56, 9:86).

III. SAFETY

Some consumers say they cannot cook without a pressure saucepan; others allege they do not want one in their homes

(9:86). The latter have a fear of the pressure saucepan which has on rare occasions blown up. Usually it was being misused (3:44-45, 14:54).

According to Consumer Reports,

> None of the tested models was judged to present a hazard when used with reasonable prudence. (14:54)

A UL Seal of Approval stamped on the pressure saucepan assures the consumer the design is safe (9:86, 6:68-69), and the electric pressure saucepan was checked for fire hazards. This seal is not on every pressure saucepan (14:54, 57, 13:66).

Pressure regulators indicate when the heat should be reduced to control the pressure and reduce the possibility of running out of steam (5:13). Safety fuses melt if the pressure becomes excessive, safety vents blow out, and the metal plunger in the rubber bushing insert indicates the presence or absence of pressure (13:66, 6:68-69). Persons with "average strength" cannot remove the lid if internal pressure is present (14:55-56).

Soft foods that foam and overfilling the pressure saucepan may clog the steam vent. Foods such as pea soup, tomato soup, applesauce, split peas, cranberries, dried legumes and beans should not be prepared in the pressure saucepan (14:55, 6:68-69, 9:86, 13:67). The dome lid accommodates odd shaped or bulky foods, but the recommended

capacities are two-thirds (15:16) to three-fourths (10:8, 51).

IV. ADVANTAGES

The smaller quantities of liquids limit the loss of water soluble nutrients. Shorter cooking periods save time and energy, preserve the natural colors of the vegetables, reduce the oxidation of vitamins (13:66, 8:20, 1:31) and produce less room heat (5:21).

Electric pressure saucepans can double as a saucepan (5:21), deep fat fryer, steamer and Dutch oven. If it is preheated it can be used to pop corn or as a baking oven (3:50-51).

CHAPTER III

COLLECTION OF THE DATA

I. DESIGN OF EXPERIMENT

Experimental research was used to collect data for this study. Tap water was heated to 5-, 10- and 15-pounds pressure in the different saucepans—one thermostatically controlled electric saucepan and two nonelectric saucepans. The latter pressure saucepans were heated on two separate types of surface units—a tubular encased unit and a thermostatically controlled smooth-top unit. After each pressure was reached the three pressures were held for 5 minutes, 15 minutes and 25 minutes.

The following data were recorded for each test: initial and final room temperatures and relative humidity, beginning water temperature, pressure, preheating time and watt-hour consumption and energy used in watt-hours to hold each pressure for three different times. Three replications were performed on each of the pressure saucepans. The order in which the saucepans were used was randomly designed.

All experimentation was performed in an environmentally controlled laboratory. Other factors which were controlled were the amount of water, the voltage of the circuit, the size and position of the surface units on the electric

ranges, placement of the pressure saucepans on the surface units, the pressure and the holding time. Data were analyzed statistically.

II. PRETESTING

Preliminary experiments and investigations were conducted to (1) develop a methodology for testing pressure saucepans, (2) check the accuracy of pressure regulators, (3) become familiar with the equipment, (4) determine the quantity and hardness of water, (5) specify holding times, (6) establish a procedure to record data, (7) select the experimental design and (8) estimate the replications.

Pressure Saucepans

The accuracy of pressure regulators for two of the pressure saucepans was measured with the Presto Electric Testing Unit. Manufacturers' instructions were followed to produce steam in the testing unit. The pressure regulators or steam gauges were positioned on the vent tubes of the testing unit and the petcock was opened to allow steam to enter the regulator or gauge. The pressures were checked when the gauge of the testing unit indicated 5-, 10- or 15-pounds pressure. The lid of the Presto electric pressure saucepan was interchangeable with the nonelectric Presto pressure saucepan. Since one pressure regulator could not

be checked for accuracy on the testing unit, it was decided that a steam gauge was needed on the lid of the nonelectric Mirro-Matic pressure saucepan. (See Figure 1.)

Water

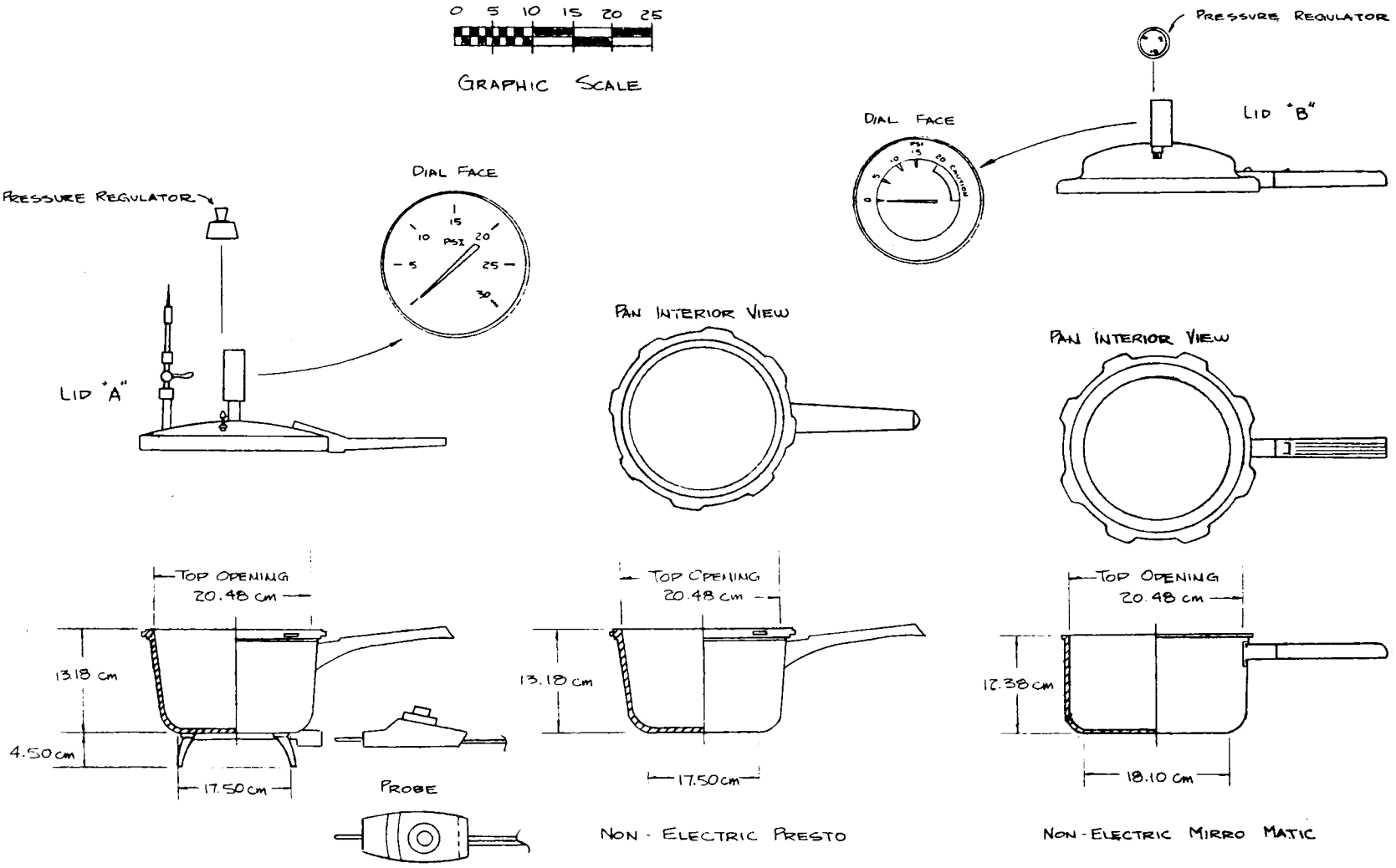
Manufacturers' recommendations for quantities of water ranged from 120 milliliters for most fruits and vegetables to 480 milliliters for some meats. Pretesting revealed that 120 milliliters was not enough water to hold 15-pounds pressure 25 minutes. For this reason, 500 milliliters was chosen as the quantity of water to be used.

The water for the experiment had a hardness of 99.7 parts per million or 5.8 grains of calcium carbonate. A grain has 17.1 parts per million (16:26). The pH was 8.35.

III. GENERAL PROCEDURE

After the pretesting was completed three replications of the experiments were executed to collect the data. The testing procedure followed was:

1. The hygrometer chart was removed, the instrument was wound and a new dated chart was replaced.
2. The stop watches were wound and returned to zero.
3. The nonelectric pressure saucepan to be used was positioned on the source of heat or the electric pressure saucepan was placed on the work area.



NOTE : LID "A" FITS BOTH ELECTRIC PRESTO TESTING UNIT AND NON-ELECTRIC PRESTO.

Figure 1. Diagrammatic illustration of pressure saucepan used in this experiment.

4. The pressure saucepan lids were located near the pans and the pressure regulators were positioned.
5. The range or electric pressure saucepan was connected into the instrument panel.
6. The initial room temperature and relative humidity, time of day and watt-hour reading were recorded.
7. Five hundred milliliters of water were measured in a 500 milliliter graduated cylinder; the temperature of the water was measured and recorded.
8. The water was carefully poured into the pressure saucepan and the lid was locked into position.
9. The heat was turned to the highest setting and at the same time the stop watch was started.
10. The Variac was adjusted to maintain 115-volts for the electric pressure saucepan and 230-volts for the ranges.
11. The heat was turned off at the approximate pressure reading to avoid the pressure going above the one being tested.
12. The preheat time and watt-hour reading were recorded.
13. The heating element was turned on and the test pressure was maintained by adjusting the heat.
14. The watt-hour readings were recorded at the end of 5, 15 and 25 minutes holding times. A timer was used to assure accuracy of the recording times.

15. The final room temperature and relative humidity and time of day readings were recorded.

IV. INSTRUMENTS AND EQUIPMENT USED IN THE STUDY

Pressure Saucepans

Three 4-quart aluminum pressure saucepans were used in the experiment.

1. The Presto Electric Testing Unit Number 81121, rated at 1410 watts, 120-volts and 11.8 amperes was used. It was designed to be operated on 60 hertzs alternating current. The lid of this saucepan was equipped with a master steam gauge which registered steam pressure from 0 to 30 pounds.
2. The Teflon-lined nonelectric Presto pressure saucepan, model A403AT, had a contact diameter of 17.5 centimeters, a top opening diameter of 20.48 centimeters and a height of 13.18 centimeters. The shape and size of this saucepan is the same as the electric Presto; therefore, the same test lid was used with both saucepans.
3. The Mirro-Matic nonelectric pressure saucepan, model 394M, had a contact diameter of 18.1 centimeters, a top opening diameter of 20.48 centimeters, and a height of 12.38 centimeters. A Presto steam

gauge was added to the Mirro-Matic pressure saucepan to insure 5-, 10- and 15-pounds pressure.

Ranges

The large left-front smooth surface unit of a Corning Counter Range, model P30AB, with a calculated wattage of 1778 watts and the large right-front tubular encased unit of a Frigidaire, model RS-10P with a calculated wattage of 2400 watts were used to heat the nonelectric pressure saucepans. Both ranges were operated on 230-volts and 60 hertzs alternating current. The heat was reduced to maintain the various pressures for 5, 15 and 25 minutes.

Instrument Panel

A Variac, an indicating voltmeter and a watt-hour meter were contained in each of two panels. The Variac in the 115-volt panel maintained the voltage for the electric pressure saucepan and the 230-volt panel maintained the higher voltage for the ranges. The watt-hour meters measured the energy consumed.

Graduated Cylinder

A 500 milliliter Pyrex graduated cylinder was used to measure water.

Thermometer

A Southern Scientific Company 200 degree Celsius mercury-in-glass thermometer was immersed 7.62 centimeters to obtain the water temperature.

Stop Watches

Meylan stop watches, Brenet #25, were used to check the preheat and holding times to the nearest one-hundredth of a minute for each pressure saucepan.

Hygrometer

A Brown Instrument Company, hygrometer, model 616X21KL-X-84, with the self-contained thermometer was used to record temperature and relative humidity of the environmentally controlled laboratory.

Refrigerator

A General Electric refrigerator, model LB815CL, was used to store the tap water and graduated cylinder. The refrigerator's electrical requirements were 115-volts, 3 amperes, and 50/60 hertzs alternating current.

Timer

A Robertshaw Controls Company 60 minute Mirro timer, model G67T, was set to alarm just before the 5, 15 and 25 minute watt-hour meter readings were to be read and recorded.

V. ANALYSIS

The analysis of variance was applied to the experimental data to determine the .001 level of significance. Duncan's Multiple Range Test was completed to specify which pressure saucepans were significantly different from other saucepans.

CHAPTER IV

RESULTS OF TEST

I. PREHEAT TIME

At 5-, 10- and 15-pounds pressure the mean preheat times for the pressure saucepans were 6.72 minutes for the electric Presto, 6.87 minutes for the nonelectric Presto and 11.41 minutes for the nonelectric Mirro-Matic. At all pressures the nonelectric Mirro-Matic was slower to preheat than the nonelectric Presto on the smooth-top surface unit. On the tubular encased unit the Mirro-Matic heated more quickly at all pressures than the nonelectric Presto. According to the calculated wattage, the smooth-top unit was about three-fourths that of the tubular encased unit's wattage.

The analysis of variance data in Table I supported hypotheses 1, 2 and 3. At all pressures there were significant differences (probability < .001) in preheat time between the electric and nonelectric pressure saucepans and among the nonelectric pressure saucepans heated on smooth-top and tubular encased surface units.

The individual means shown in Figure 2 and separated by Duncan's Multiple Range Test indicate the electric Presto preheated faster than the nonelectric Mirro-Matic and the

TABLE I. Mean Square and F Values from Analysis of Variance for Preheat Time and Watt-Hour Consumption for Pressure Saucepans

	Preheat Time		Preheat Energy		Holding 5 Min.		Holding 15 Min.		Holding 25 Min.	
	Mean Square	F Value	Mean Square	F Value	Mean Square	F Value	Mean Square	F Value	Mean Square	F Value
Between electric and nonelectrics	42.0	38.2***	20,715.2	218.0***	14,607.2	132.3***	20,394.5	123.8***	23,506.9	113.8***
Among nonelectrics	185.1	168.3***	4,246.7	44.7***	6,696.7	60.7***	12,469.4	75.7***	18.906.3	91.4***
Among surface units	498.9	453.5***	10,920.3	115.0***	7,832.3	70.9***	6,889.0	41.8***	13,650.0	66.1***

***Very highly significant at .001.

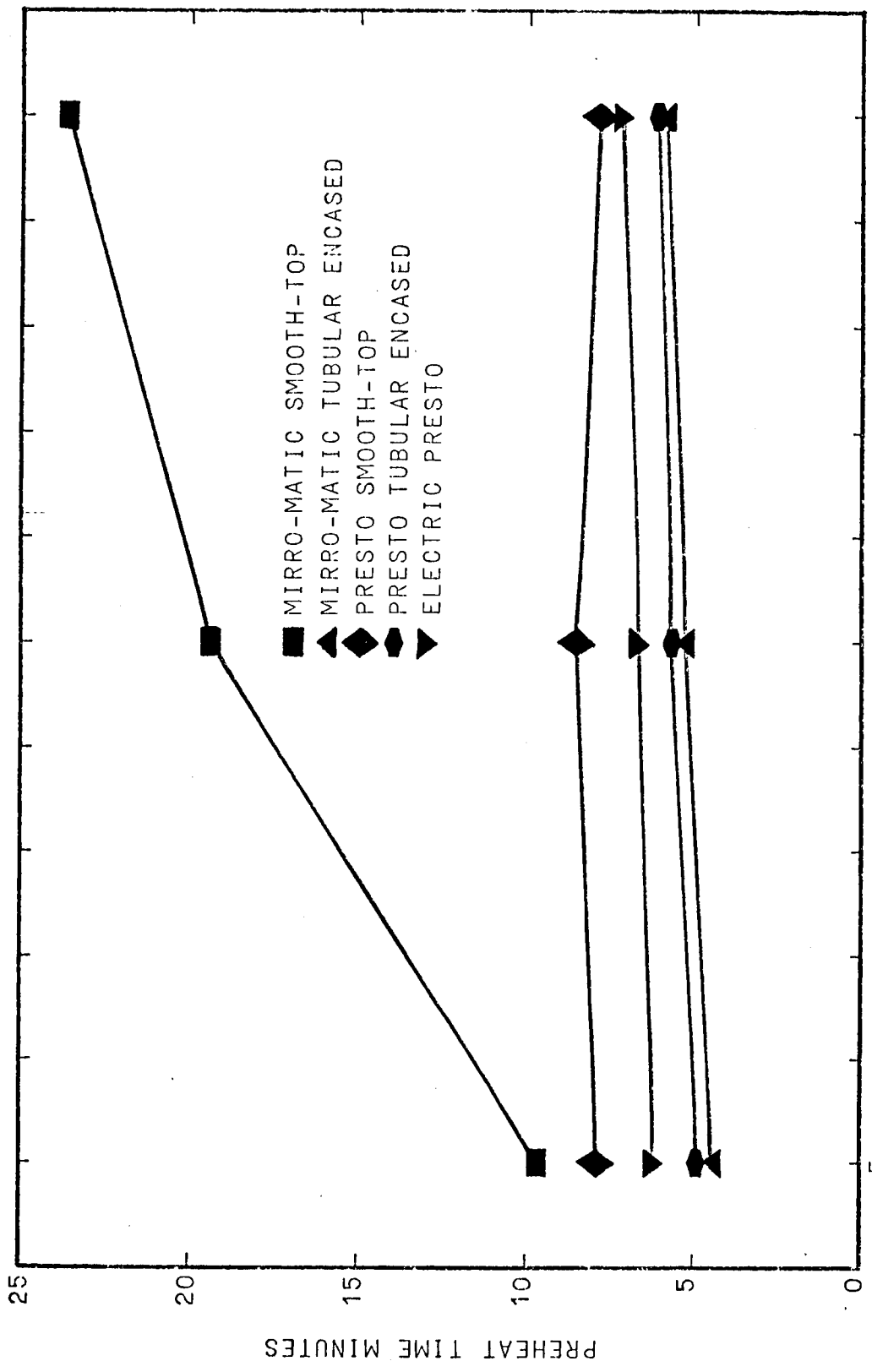


Figure 2. Mean preheat time for pressure saucepans at 5-, 10- and 15-pounds pressure.

nonelectric Presto at all pressures on the smooth-top surface unit (probability < .01). The electric Presto was slower at all pressures than the nonelectric Presto and Mirro-Matic heated on the tubular encased surface units.

The nonelectric Mirro-Matic preheated more quickly on the tubular encased than the nonelectric Presto at all pressures.

II. PREHEAT ENERGY

The preheat watt-hour consumption ranged from 94 to 184 at 5-pounds pressure, 131 to 211 at 10-pounds pressure and 143 to 231 at 15-pounds pressure. The electric Presto and the Mirro-Matic on the smooth-top surface unit used less energy than the Mirro-Matic on the tubular unit and the nonelectric Presto pressure saucepan on both units. The Mirro-Matic on the tubular encased surface unit required the most watt-hours at 10- and 15-pounds pressure. Hypotheses 4, 5 and 6 were accepted because the analysis of variance revealed significant differences at each pressure (probability < .001) in watt-hours consumed between the electric and nonelectric pressure saucepans on the smooth-top and tubular encased surface units.

Duncan's Multiple Range Test and data from Table II, Appendix, as graphically shown in Figure 3, indicate the electric Presto was highly significant (probability < .01)

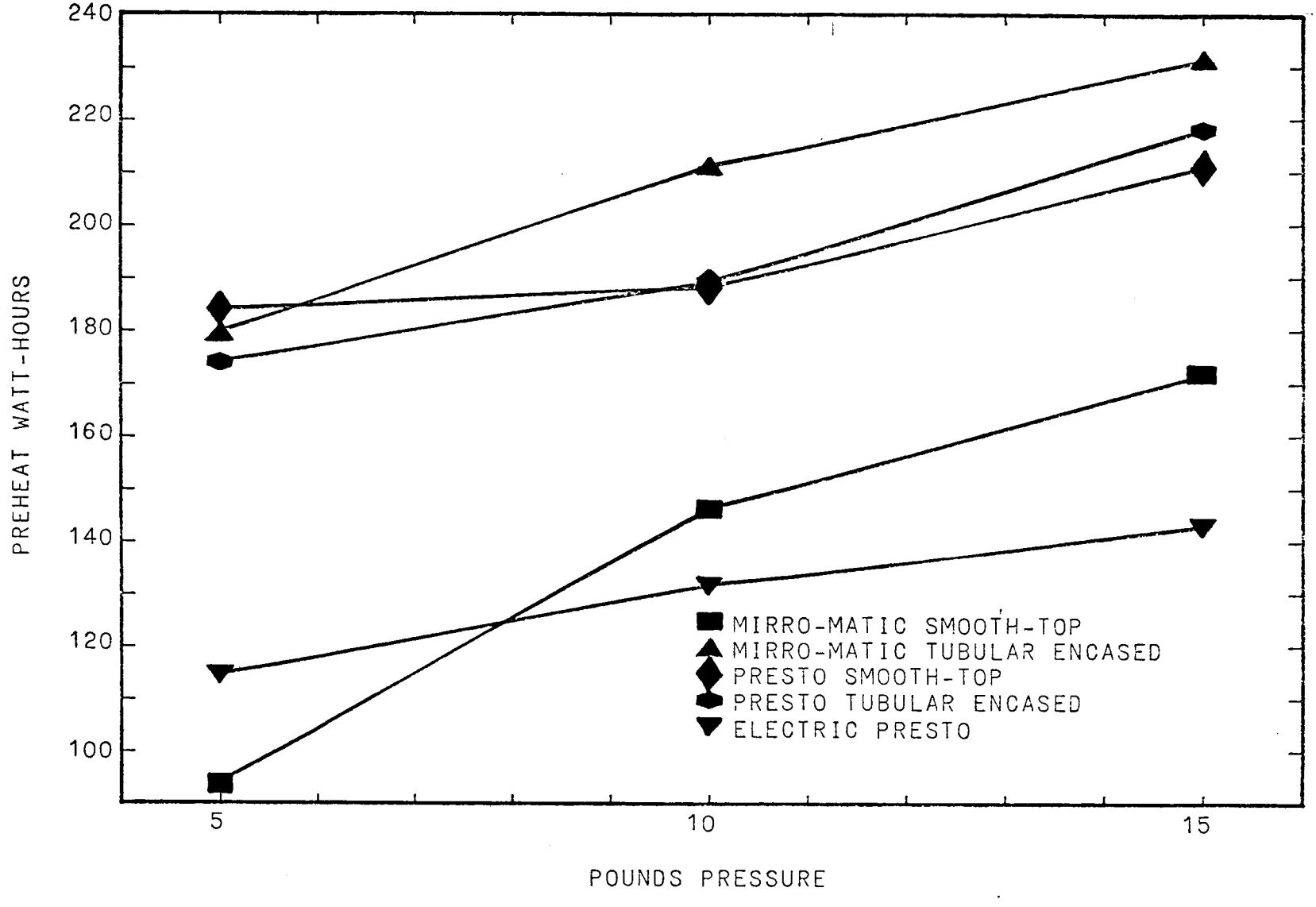


Figure 3. Mean preheat watt-hours for pressure saucepans at 5-, 10- and 15-pounds pressure.

from the nonelectric Mirro-Matic on the smooth-top surface unit at 15-pounds pressure. The Mirro-Matic on the smooth-top surface unit utilized significantly (probability < .05) fewer watt-hours at 5-pounds pressure than the electric Presto.

The energy consumption of the Electric Presto and nonelectric Mirro-Matic pressure saucepans on the smooth-top unit were highly significant from the remaining nonelectric pressure saucepan on other surface unit combinations. The nonelectric Presto on both surface units used less watt-hours than the nonelectric Mirro-Matic on the tubular encased surface unit except at 5-pounds pressure. At this pressure the nonelectric Presto on the smooth-top unit consumed slightly more energy than the Mirro-Matic.

The nonelectric Presto on both units used approximately the same watt-hours at 10-pounds pressure.

III. HOLDING WATT-HOUR CONSUMPTION

The electric Presto and the nonelectric Mirro-Matic on the smooth-top surface unit used the least amount of watt-hours (probability < .001). It was hypothesized the watt-hour consumptions would be significantly different at three pressures between electric and nonelectric pressure saucepans and among the nonelectric pressure saucepans when held for 5, 15 and 25 minutes. Hypotheses 7, 8 and 9 were accepted.

The data illustrated in Figures 4, 5 and 6 were separated by Duncan's Multiple Range Test. The energy consumption of the electric Presto and the nonelectric Mirro-Matic on the smooth-top surface unit were not significantly different when held at 10-pounds pressure for 5 or 25 minutes and at 15-pounds pressure for 15 or 25 minutes.

When held at 5-pounds pressure for 5, 15 or 25 minutes and at 10-pounds pressure for 15 or 25 minutes the watt-hour consumptions were not significant among the nonelectric Presto on either surface unit and the nonelectric Mirro-Matic on the tubular encased surface unit. The nonelectric Presto on the two surface units utilized the most watt-hours at 15-pounds pressure when held 5, 15 and 25 minutes.

IV. CONTACT SURFACE

The nonelectric Mirro-Matic has the larger contact surface. On the smooth-top surface unit the Mirro-Matic was slower to preheat but required fewer watt-hours for preheating to a given pressure and for holding that pressure. The nonelectric Presto on the smooth-top surface unit used the most energy. The analysis of variance indicated the contact surfaces were very highly significant (probability $< .001$) among the nonelectric pressure saucepans.

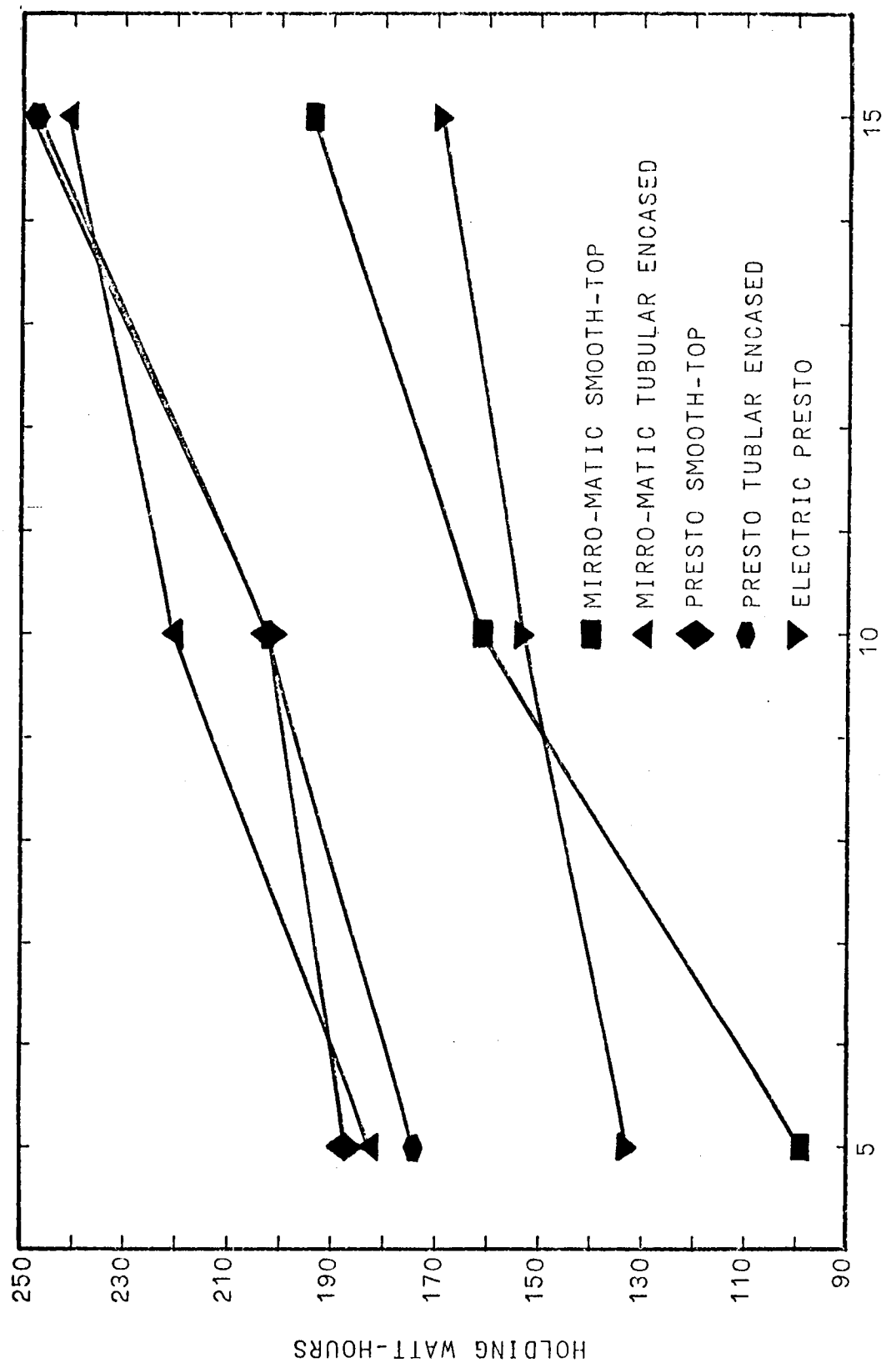


Figure 4. Mean watt-hour consumption of pressure saucepans held at 5-, 10- and 15-pounds pressure for 5 minutes.

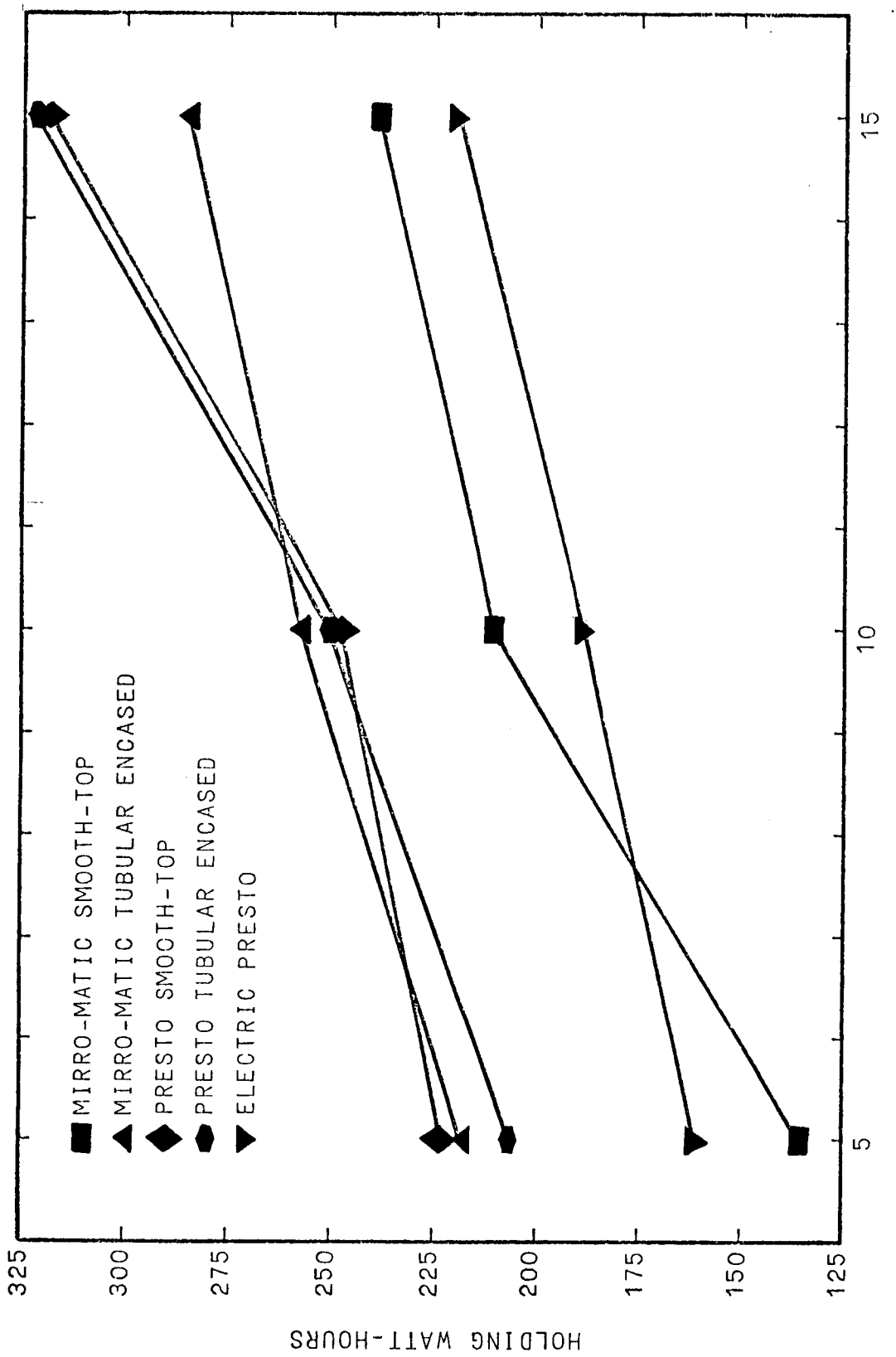


Figure 5. Mean watt-hour consumption of pressure saucepans held at 5-, 10- and 15-pounds pressure for 15 minutes.

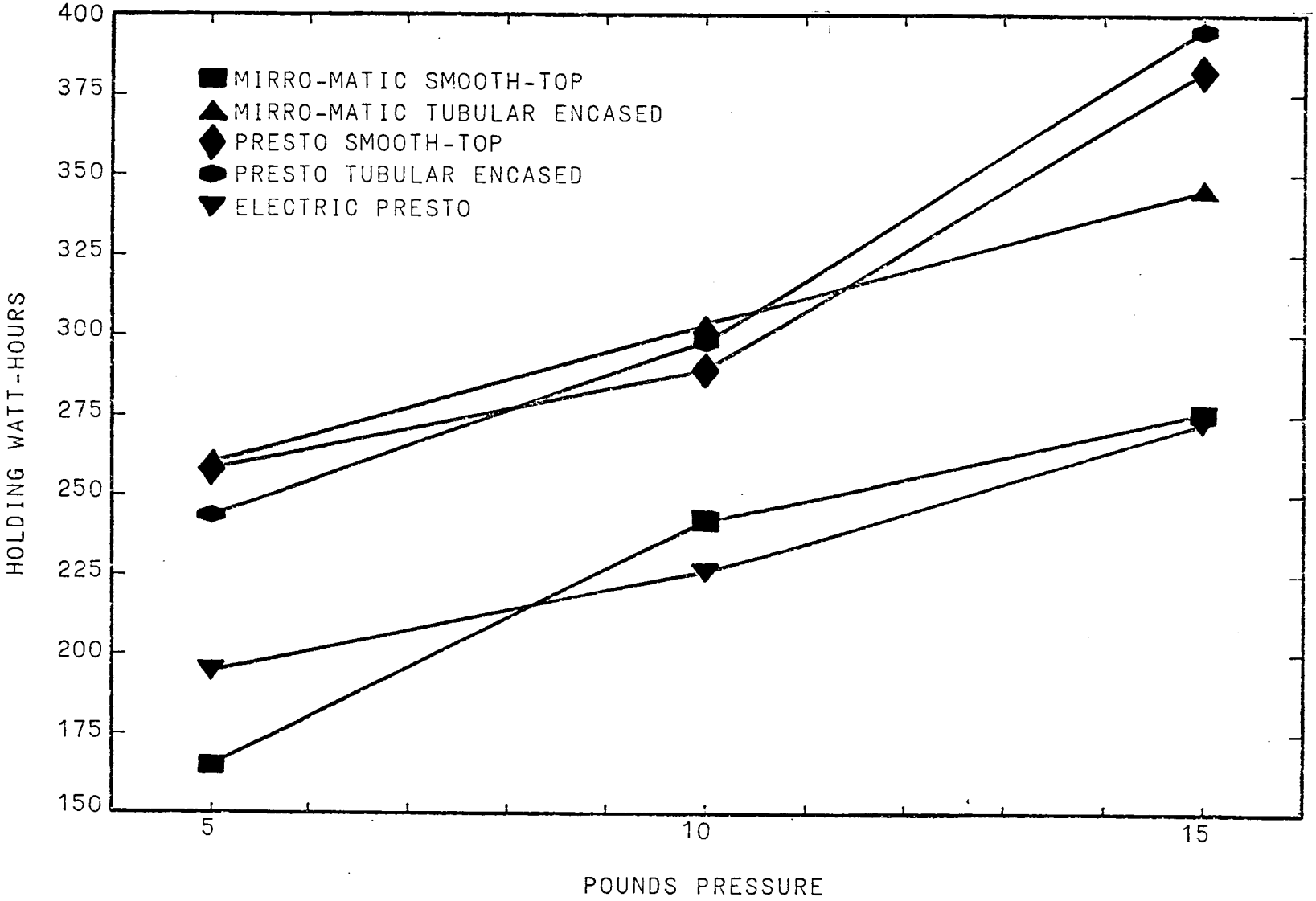


Figure 6. Mean watt-hour consumption of pressure saucepans held at 5-, 10- and 15-pounds pressure for 25 minutes.

CHAPTER V

SUMMARY AND CONCLUSIONS

This experiment was designed to determine the preheat time and watt-hours consumed in heating 500 milliliters of tap water to 5-, 10- and 15-pounds of pressure in three pressure saucepans—one electric and two nonelectric. Smooth-top and tubular encased surface units were used to heat the nonelectric pressure saucepans.

The experiments were conducted in an environmentally controlled laboratory. Controlled variables were (1) quantity and hardness of water, (2) voltage of circuit, (3) size and position of the surface unit on the range, (4) placement of the pressure saucepans on the surface units and (5) holding time.

It was hypothesized there would be significant differences at 5-, 10- and 15-pounds pressure in preheating time between electric and nonelectric pressure saucepans heated on smooth-top and tubular encased surface units. Significant watt-hour consumption while preheating and holding the pressures for 5, 15 and 25 minutes were also hypothesized. The analysis of variance revealed differences in each assumed factor at the 99.9 percent level of significance and dictated acceptance of the nine hypotheses.

Duncan's Multiple Range Test separated the significant means and disclosed the time and watt-hour consumptions. The nonelectric Mirro-Matic had the larger contact diameter and preheated in the least time on the tubular encased unit. There was no significance in preheat time between the nonelectric Mirro-Matic and Presto on the tubular encased surface unit. The nonelectric Mirro-Matic on the smooth-top surface unit was the slowest of the saucepans to preheat.

The electric Presto and nonelectric Mirro-Matic on the smooth-top surface units required less energy and were significant (probability < .001) from the Mirro-Matic or nonelectric Presto on the tubular encased surface unit and the Presto on the smooth-top surface unit. The electric Presto consistently required the least watt-hours at 5-10-pounds pressure.

Additional research is needed to determine the energy consumption of the pressure saucepans when various foods are prepared. A thermocouple could be inserted (6:340) to evaluate the internal temperature of the pressure saucepan and food.

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APPENDIX

TABLE II. Mean Time and Watt-Hour Consumptions of Pressure Saucepans at 5-, 10- and 15-Pounds Pressure

Pressure	Heat Source	Saucepan	Preheat Time	Preheat Energy	Holding		
					5 min.	15 min.	25 min.
		Electric	minutes	watt-hours			
5		Presto	6.21	114.7	132.7	161.7	194.7
5	S-top*	Presto	7.91	184.3	187.3	223.3	258.3
5	Tubular**	Presto	4.93	174.3	174.3	206.7	243.7
5	S-top	Mirro	9.67	94.0	99.0	135.7	165.0
5	Tubular	Mirro	4.45	180.0	182.7	218.3	260.3
		Electric					
10		Presto	6.71	131.7	153.0	188.7	226.0
10	S-top	Presto	8.58	188.3	202.3	247.7	289.3
10	Tubular	Presto	5.71	189.3	202.7	250.7	298.0
10	S-top	Mirro	19.41	146.3	161.0	210.7	242.0
10	Tubular	Mirro	5.30	211.3	220.7	257.7	303.3
		Electric					
15		Presto	7.24	143.0	169.0	219.7	272.7
15	S-top	Presto	7.93	211.0	248.3	319.0	382.3
15	Tubular	Presto	6.18	218.3	247.0	322.3	395.3
15	S-top	Mirro	23.68	172.0	193.7	238.7	275.7
15	Tubular	Mirro	5.93	231.6	241.3	285.3	345.7

*Smooth-top surface unit.

**Tubular enclosed surface unit.

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