AN INVESTIGATION OF THE INCREASE OF DIETARY IRON IN SCHOOL LUNCH PROGRAMS THROUGH THE ADDITION OF LIVER TO MEAT LOAF

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CHAPTER I

INTRODUCTION

Significance of the Problem

In spite of improved methods of nutrition education and progress in food science and technology, it has been found that many children show signs of malnutrition, especially in relation to iron deficiency. In the fall of 1967, Congress directed the Department of Health, Education, and Welfare to conduct a survey to assess the incidence and extent of malnutrition and related health problems in the United States. Schaefer and Johnson (1969) reported that in the first phase of the National Nutrition Survey, one-third of the children under six years of age in the sample had hemoglobin levels diagnosed as anemia. This biochemical finding was supported by the dietary data of the study which showed that the food eaten by these children contained considerably less than adequate amounts of iron. Emerson (1967) has stated that one of the most important nutritional problems of today is iron deficiency in youth and pregnant women.

In 1968, the Food and Nutrition Board of the National Academy of Sciences and National Research Council recommended that the daily allowance for iron be increased from 15 milligrams to 18 milligrams for females from the age of ten years through the childbearing years. Eighteen milligrams daily are also recommended for males during adolescence, ages 12 to 18 years. It is quite difficult to get this amount of iron in the diet unless liver is eaten. Although iron is widely distributed in foods, the amounts in commonly served portions of these foods are small. Eggs are considered to be a good source of iron, but it would be necessary for a person to consume 16 large eggs in order to obtain the same amount of iron present in an average serving (100 grams) of pork liver.

In a recent survey of food consumption of households in the United States by the United States Department of Agriculture (1968), it was found that only 11 percent of all households in the survey used liver. The average amount purchased weekly (by all households) was 2.72 ounces per household. These statistics indicate to the writer that, since liver is not an expensive meat, there must be other reasons that it is not widely used. Some of these reasons may be the texture, flavor, unfamiliarity (since it is served so seldom), or dislike of handling of liver by the person preparing the food.

During the fall semester, 1968, the writer conducted an experimental problem in a foods class to determine the acceptable level of ground liver in a beef loaf. Calculations during this study showed that the iron content of one serving of meat loaf may be increased over 50 percent by substituting ground pork liver for ten percent of the ground beef. The results of the experiment suggested that this method of increasing intake of iron would be acceptable to children who might otherwise reject liver when it is served in school lunch programs. It was further implied that this might be tested in a school lunch program.

During the school year 1968-69, over twenty million children were served lunches in schools in the United States, according to the United States Department of Agriculture (1970). This number suggests a tremendous opportunity for improving the nutritional status of young people during critical periods in their physical development by serving them nutritious and acceptable school lunches.

McWilliams (1967) states that one purpose of school feeding programs is to encourage children to eat a variety of foods. School lunch managers and cooks are urged through literature, workshops, and visits by state school lunch consultants to include in their menus nutritious foods that are unfamiliar to many of the students they serve. Information regarding the amount of liver consumed would indicate that it is such a food. Most cooks, however, are reluctant to serve liver because in their past experience it has been rejected by school children. The inclusion of liver in ground meat recipes could therefore be a means of increasing the iron content of food served and also be accepted more readily than liver alone.

Statement of the Problem

This study was an investigation of the acceptability of a liver-enriched meat loaf by the children in selected schools. The objectives of the study were:

I. to become familiar with research related to nutritional needs for iron and the extent to which these needs are being met,

II. to determine if school children will accept a liver-enriched meat loaf,

A. to determine if there is a difference in the acceptance by school children between a liver-enriched meat loaf as compared to the acceptance of a plain meat loaf,

B. to determine if acceptability of liver-enriched meat loaf varies when the proportion of liver is increased from five percent to ten percent, and

III. on the basis of the findings of the study, to draw implications and make recommendations to those involved in teaching ways to improve nutrition, such as school lunch personnel, vocational homemaking teachers, and extension home economists.

Assumptions

This study is based on the following assumptions:

1. Many teen-agers are consuming diets that are deficient in iron.
2. In order to obtain enough dietary iron, it is necessary for persons in this age group to include liver in their diet.
3. Liver often is not included in the diets because it is objectionable to some persons.
4. It is possible to serve liver in ways that will be acceptable by substituting it for as much as ten percent in ground meat dishes.

The Hypotheses

In order to reach the second objective and to analyze the data statistically, the null hypotheses can be stated as follows:

1. There is no difference between the acceptance by junior high school students in a school lunchroom of an all-beef meat loaf and a liver-enriched meat loaf.
2. There is no difference between the acceptance of a meat loaf in which five percent of the beef has been replaced by liver and a meat loaf in which ten percent of the beef has been replaced by liver.

Limitations

The study was limited in the following ways:

1. Only secondary school students at the junior high school level were included in this study because this age group was one of those for whom the Recommended Dietary Allowance for iron was increased in 1968.
2. The main dish that was used for testing was a meat loaf. More heavily spiced meat dishes, such as lasagne or chili con carne, may have shown more definite results, but the composition and shape of the servings of meat loaf were more suitable for the evaluation of the returned plate waste.
3. The findings were limited to testing the acceptability of one particular meat loaf recipe. Other recipes with fewer or different seasonings may not reflect the same acceptability.
4. Pork liver was to be used to increase the iron in the meat loaf because it contains 18.0 milligrams of iron per 100 grams, whereas beef liver provides only 6.6 milligrams of iron per 100 grams, according to Church and Church (1966). Furthermore, pork liver is less expensive than beef liver.

5. The amount of liver to be added during the study was not to exceed ten percent of the amount of beef on any day of observation, since through prior experimentation, it was shown that it was possible to detect more than that amount.
6. This investigation will not be concerned with differences in acceptance which might be related to dissimilarities in age, grade, sex, or family background.
7. This study was limited to two junior high schools in Oklahoma, chosen on the basis of established criteria. Thus the results cannot be said to be representative of all schools but rather to serve as a pilot study and to provide data that could be further tested on a representative number of schools and students.

Definitions

The National School Lunch Program provides federal funds for non-profit school lunch programs.

The Type A Lunch is a nutritional pattern used in the National School Lunch Program, and must include

1. One-half pint whole fluid milk,
2. Two ounces protein or its equivalent,
3. Three-fourths cups vegetables and/or fruit in at least two dishes,
4. One serving whole grain or enriched bread, and
5. One teaspoon butter or margarine.

Recommended Dietary Allowances (RDA) are the daily nutrient intakes judged to be necessary to maintain good nutrition in practically all healthy persons in the United States by the Food and Nutrition Board of the Natioanl Research Council-National Academy of Sciences (1968).

Secondary students are those in grades seven through 12.

The participation of a school refers to the number of students who eat in a school feeding program.

The term ADP refers to "average daily participation."

The effect on the results of the study which are caused by the order of administration of the recipe variations is called the order effect.

Procedure

In order to accomplish the objectives described on pages three and four, the following procedure was designed. A more detailed description of this procedure is found in Chapter III.

1. Related research was reviewed in order to determine the nutritional need for iron and the extent to which these needs are being met.
2. Schools were visited and two schools were selected on the basis of the criteria previously established.
3. The meat loaf recipe which was used in the research was based on the basic recipe which was used in the experimental foods project. On each of the test days, a different variation of the recipe was used. In one variation of the recipe, the meat was all ground beef; in the second variation, the meat was 95 percent ground beef and five percent ground liver; and in the third variation, 90 percent ground beef

and ten percent ground liver were used.

4. In one of the two schools, the variations of the amounts of liver would be in increasing order; in the other school, in decreasing order. It was hoped that in this way an order effect could be minimized if it was operational in this study.
5. The menu, which was the same on each of the observation days, was planned by the investigator and the school food service supervisor. It included meat loaf, mashed potatoes, cole slaw, hot rolls, butter, peach half, and milk.
6. A practice session was held for those who were to be checking the plate return. These included an area consultant for the School Lunch Division, State Department of Education, two senior high school vocational homemaking students, and the investigator.
7. Three observation days were scheduled at four-week intervals.
8. On the three observation days, the acceptance of the recipe variations was evaluated by checking and recording the amounts returned as plate waste by the students.
9. The results of the study were tested statistically to determine whether the observed differences were within the range which could have occurred by chance alone.
10. From the study, implications were drawn to recommend to school food service personnel, vocational homemaking teachers, and extension home economists acceptable methods of increasing dietary iron.

Organization of the Study

The report of this study has been organized into five chapters. Chapter I has presented the significance and background of the study, statement of the problem and objectives, assumptions, hypotheses, limitations, definition of terms, procedure, and organization of the study. In Chapter II a review of the literature upon which the study was based will be presented. The procedure, or the methods, used to reach the stated objectives will be discussed in Chapter III. In Chapter IV, the data and a discussion of the findings will be presented, and the summary, conclusions, and recommendations for further study will be given in Chapter V.

CHAPTER II

REVIEW OF LITERATURE

This chapter is concerned with the review of research related to the nutrient iron, and the role of school lunch programs in supplying foods which furnish adequate amounts of iron for school children. The areas reviewed were: the Recommended Dietary Allowances (1968) in relation to iron, the functions of iron in the body, the status of iron malnutrition, sources of dietary iron, enrichment and fortification of foods with iron, school lunch programs, food acceptance, and nutrition education.

Increase in Amount of Iron Recommended

In the last two revisions of the Recommended Dietary Allowances by the Food and Nutrition Board, National Academy of Sciences--National Research Council (1963, 1968), the amounts of iron have been increased for certain age groups. In 1963, the allowance for children from nine to 18 years was increased from 12 to 15 milligrams daily. Research conducted during the five years that followed indicated that this amount is not adequate during the rapid growth period of adolescence. For that reason, the Recommended Dietary Allowance was increased to 18 milligrams daily for males from 12 to 18 years, and for females from age ten through the childbearing years. The increase is necessary for females not only through the period of rapid growth, but also during the years during which menstruation increases the loss of iron periodically.

The Need for Iron in the Body

Before considering the effects of iron deficiency in the body, it seems appropriate to review the function and metabolism of iron. This mineral is essential for the oxidative processes of the body and as such is found in all cells of the body, according to Robinson (1968). The total amount of iron in the body is estimated to be from three to five grams. Finch (1965) states that the body of the normal adult contains about 45 milligrams of iron per kilogram of body weight. Approximately 70 percent of this amount is found in hemoglobin, which is a complex substance composed of the protein globin, and an organic iron compound, heme. Hemoglobin, found in red blood cells, combines with oxygen in the lungs and is carried to the tissues in this form. In the tissues, the oxygen is released, where it is used in oxidative processes. Some of the waste product from respiration, carbon dioxide, is carried back to the lungs by hemoglobin, but most of the carbon dioxide is removed from the tissues by means of bicarbonate ions.

Proudfit and Robinson (1961) estimated that approximately five percent of the iron in the body is in the form of myoglobin, oxidative enzymes, and plasma iron. Myoglobin, found in the muscles, is another iron-protein complex. Catalase, cytochrome oxidase, and several other oxidative enzymes contain iron as an integral part of the molecule. Still other enzymes are activated in the presence of iron.

Approximately 25 percent of the iron in the body is stored in the liver, bone marrow, spleen, and kidneys. These stores of iron, as well as the iron released from the disintegration of red blood cells, are available to the body for hemoglobin synthesis. Hence, the iron actually used daily by an individual far exceeds that supplied by the dietary intake for the same period.

Some is lost from the body in the feces, urine, bile sweat, and desquamation of skin. The amount of loss is estimated to average one milligram each day from adult males, and two milligrams from women during their childbearing years.

The Absorption of Iron

Although the body is very conservative in its use of iron and losses from the body are quite low, one might question the amounts of iron required to meet the Recommended Daily Allowances (Food and Nutrition Board, 1968) which are ten grams for adult males and 18 grams for premenopausal females. These amounts are considered to be necessary because only a very small part of the dietary iron is retained. White and White (1968) states that although average absorption is usually assumed to be about ten percent, studies with radioactive iron have indicated that it may be less.

Research indicates that the rate of iron absorption varies under certain body conditions. Whenever there is a need for iron for erythropoiesis, iron absorption is increased. The mechanism which controls the absorption rate is not fully understood. Davidson, Passmore, and Orr (1966) report that it seems reasonable to assume that when the rate of red blood cell formation is increased, a signal is sent to the small intestine to allow more iron to be transported across the mucosal cells to the plasma.

Another theory, presented by Proudfit and Robinson (1961), is that iron combines with apoferritin, a protein in the intestinal wall, to form ferritin, an iron-protein compound. When the apoferritin is saturated, no more iron will be held. The amount of iron in the tissues also affects iron absorption. Since trivalent iron must be changed to the divalent state before absorption, the administration of ascorbic acid and protein may assist iron absorption because of their reducing properties. Another theory is that iron may be carried across the mucosal cells chelated to amino acids or to ascorbic acids.

Davidson, Passmore, and Orr (1966) theorize that there are at least two factors that inhibit the absorption of iron. Phytic acid and other phosphates form insoluble salts with iron which is then unavailable for absorption. This is important in areas of the world where there is a high consumption of undermilled cereals which contain iron but also much phytic acid.

There seems to be a relationship between hypochlorhydria (and achlorhydria) and iron deficiency anemia. Hydrochloric acid assists in the ionization of iron, making it more soluble. Most of the absorption of iron takes place in the duodenum and the upper jejunum, in which the medium is acid.

Certain digestive disturbances inhibit iron absorption. In cases of diarrhea, the food passes through the upper digestive system, where ionization and reduction of iron occur, too rapidly for these processes to take place. Absorption is also decreased when steatorrhea is present.

In reviewing the absorption of iron, Brown (1963) states:

> General agreement exists concerning the salient features of human iron absorption, namely, (1) iron absorption can occur at any level of the gastrointestinal tract from the stomach distally, although absorption is greatest in the duodenum and progressively less in a descending gradient; (2) divalent iron is better absorbed than the trivalent form; (3) iron uptake by the intestinal cell is unidirectional and is transported from the intestine via the bloodstream rather than lymphatics; (4) iron absorption increases under conditions of iron deficiency, advanced pregnancy, hemochromatosis and accelerated erythropoiesis; (5) iron absorption is often reduced in association with increased tissue iron stores, decreased erythropoiesis, diffuse malabsorption syndromes and increased dietary intake of phosphates and phytates.

Iron is absorbed into the blood stream, not into the lymph. In the blood it is bound to a protein known as transferrin. The transport system carries some 20 milligrams of iron daily which is liberated from broken-down erythrocytes and additional amounts of absorbed iron going to and from the cells and the storage depots. Although the daily turnover of plasma iron is about 35 milligrams, only a very small proportion of this iron originates from the diet, even when iron absorption is at a maximum. Iron is stored in the reticulo-endothelial systems, chiefly in the liver, spleen, and bone marrow as ferritin. This storage iron may be greatly increased. If so, the ferritin molecules become conglomerated and form the substance hemosiderin.

Anemia Caused by Iron Deficiency

The prevalence of anemia indicates that concern should be given to food selection to insure sufficient iron in the diet. Unless conscious effort is made, it is likely that certain groups of people will become iron deficient.

It is difficult to measure the prevalence of iron deficiency because definite symptoms do not appear until the shortage of this nutrient has caused iron deficiency anemia. However, the number of cases of anemia revealed by surveys indicate that the problem of dietary deficiencies of iron may be greater than clinical evidence shows. The reason for this is that most prevalence figures of iron deficiency derived from the medical literature are of limited value since they deal with iron deficiency anemia and not iron deficiency, and since most of the information is derived from patients rather than from representative populations, according to the Council on Foods and Nutrition of the American Medical Association (1968).

Iron deficiency is characterized by a low hemoglobin, giving less color than normal to the red blood cell (hypochromia). Red cells are in sufficient number, but are smaller than normal (microcytic) due to inadequate hemoglobin to fill the cell. Although it may be caused by poor absorption of iron from the intestinal tract or less of blood, it is most often caused by a diet inadequate in iron.

Some of the symptoms of hypochromic, microcytic anemia are general fatigue, breathlessness or exertion, giddiness, dimness of vision, headache, insomnia, skin pallor, anoxeria, and dyspepsia. The hemoglobin level commonly lies between 4.5 and 9 g./100 ml (30 and 60 percent), and the red cell count between 3 and 4.5 million. The anemia is often well advanced before significant symptoms are apparent.

The most common cause of hypochromic, microcytic anemia in adults is due to blood loss. This may be caused by accidental hemorrhage, chronic diseases accompanied by hemorrhage, parasitic infestation of the intestines, excessive menstrual losses, or too frequent blood donations. It is estimated that when a loss of one pint of blood occurs, the volume will be compensated in two or three days, but six to eight weeks are necessary to restore the quality of the blood. Certainly, necessary nutrients must be present if this restoration is to take place.

Iron deficiency anemia is likely to develop during rapid periods of growth, as during infancy, adolescence, and pregnancy. Howell (1968) states that the principal cause of anemia in infants from three months to two years of age remains that of out-and-out iron deficiency. This is especially true if the infant has been born prematurely, or born of a mother with depleted iron stores. Even the infant with adequate iron storage may become iron deficient if he is not given a diet containing adequate iron to maintain and increase the stores needed for red cell production.

Anemia may be caused by inadequate absorption of iron from the digestive system. The causes for malabsorption have been discussed earlier. An inadequacy of certain other nutrients may contribute to the development of hypochromic, microcytic anemia.

White and White (1968) state that one reason for decreased dietary intake of iron is partly due to a decrease in "contamination" of food products with iron. They cite the increase of stainless steel, aluminum, glass, and teflon-lined cookware as a reason for less contact of food with iron utensils; hence, food prepared in the more modern cooking utensils contains less iron than that prepared in iron vessels. Furthermore, more sanitary methods of food handling, preparation, and processing provide very little opportunity for food to acquire iron through contamination with soil.

Sources of Dietary Iron

Although iron is widely distributed in food, Chaney and Ross (1966) suggest that it is probably the most difficult of all nutrients to obtain in sufficient amounts in the daily diet. Three of the basic four food groups contribute significant and approximately equal amounts of iron, but milk, cheese, and ice cream are poor sources of iron (Robinson, 1968). It is possible for menus to fulfill the requirements of "A Daily Food Guide" (USDA, 1964), and still contain amounts of iron that are inadequate for certain groups of people in the population.

Three generalizations may be made concerning food sources of iron:

1. Animal sources usually contain more iron than vegetable foods. (Food and Nutrition Board, National Academy of Sciences--National Research Council, 1968).
2. Iron is relatively high in foods with low moisture content (Robinson, 1968).
3. Foods poor in iron have a noticeable lack of pigment (Mitchell et al., 1968).

A notable exception to the first of these general statements is milk. Chaney and Ross (1966) state that milk, the most complete single food, is low in iron. Mitchell et al. (1968) explain that the reason iron-rich foods are introduced early in the diet of infants is that milk is a poor source of iron.

The best sources of dietary iron are found in the meat, fish, poultry and egg group. Of the foods in this group, all varieties of liver are excellent sources of iron. Authorities differ slightly in their reports of iron values of liver as shown in Table I.

TABLE I

MILLIGRAMS OF IRON PER 100 GRAMS OF RAW LIVER FROM DIFFERENT ANIMALS

	Church and Church (1966)	Watt and Merrill (1963)
	Mg Iron Per 100 Gm Liver	
Beef Liver	6.6	6.5
Chicken Liver	7.4	7.9
Calf Liver	10.6	8.8
Pork Liver	18.0	19.2

Other animal sources that are good sources of iron are heart, kidneys, lean meat, shellfish, and egg yolk. In the vegetable and fruit groups, peaches, apricots, prunes, grapes, raisins, green leafy vegetables, and legumes are also good sources of iron. Whole grain and enriched cereals and bread, as well as dark molasses contribute small but significant amounts of iron to the diet. Foods which are high in iron are not among the most expensive foods. Probably the best food sources of iron are the organ meats which are usually less expensive than the more popular steaks and roasts. Pork liver, which is much higher in iron content than calf or beef liver, is usually less expensive than either of these.

The Status of Iron Malnutrition In the United States

Recent studies have shown that iron deficiency anemia is one of the major nutritional problems in the United States today. In 1959, Shulman reported:

> The exact incidence of anemia in infants in the United States is difficult to assess because it varies greatly with the population group studied, but it is apparent that frequency in underprivileged groups may reach alarming proportions.

Ten years later, in discussing the National Nutrition Survey, Schaefer and Johnson (1969) state that the statistics from that phase of the survey which was conducted in Louisiana are accurate reflection of nutritional status of the people in the state's low-income areas. The results of the survey showed that 15 percent of the population studied had inadequate hemoglobin levels. Anemia was much more prevalent among children less than six years old. Of this group, one-third were anemic, and dietary data indicated that they were eating food containing considerably less than adequate amounts of iron.

In 1967, Owens et al., studied the nutritional status of preschoolers in Mississippi. They found that a majority of the children from the low income families studied were ingesting insufficient iron and that mild anemia was a common problem. A Public Health report (1968) indicates that a study of Negro children from low-income families in the District of Columbia showed that 133 of 460 had iron-deficiency anemia. Among the older children, incidence fell off rapidly, but levels often remained in the borderline range. A study of Corbett (1968) to determine the incidence and severity among the Indians on the Acoma Reservation in New Mexico, in 1966, revealed a high incidence of iron deficiency in infants and younger children.

White (1969) reported that in a study of forty-eight 24-hour weighed diets of high school girls and college women, the iron content of the diets averaged about 6.41 milligrams by analysis and 8.5 milligrams by calculation. These amounts are well below the 1968 Recommended Dietary Allowance of 18 milligrams.

Robinson (1969) indicates that iron deficiency anemia is relatively common in underweight, undernourished teenagers, especially in girls. She suggests that the likelihood is slim that the adolescent will ingest the recommended allowance of 18 milligrams of iron if his calorie intake is below 2000. Since many teenage girls are very weight-conscious, the foods they do consume should be selected with conscious effort to include iron-rich foods.

Currently much attention is being focused on the inadequacy of diets because of low income. It is extremely difficult to purchase foods to provide a diet which will meet the Recommended Dietary Allowances with the limited funds with which many people purchase food. However, affluence does not assure nutritional adequacy. In a United Press International news release, on April 12, 1969, Dr. Arnold E. Schaefer, Chief of the U. S. Public Health Service's Nutritional program said:

> Many affluent families are ignorant of their food needs and chose food simply because they are easy to prepare. These habits lead to anemia, obesity, and dental difficulty.

Schaefer made these remarks in testimony before the Food and Drug Administration's hearings on advertising and labeling of vitamins and minerals.

The United States Department of Agriculture had made five nation wide surveys of household food consumption. The objectives of these surveys, made in 1936, 1942, 1948, 1955, and 1965-66, have been to obtain information on the kinds and amounts of food used in American households. According to Swope (1969), analysis of the survey data indicated that diets of females between the ages of nine and 55, and of males, ages 12 to 18, did not contain iron in amounts sufficient to meet the recommended levels.

Enrichment and Fortification of Foods With Iron

Since some persons have difficulty obtaining sufficient dietary iron, it has been suggested that further enrichment and fortification of foods with iron should be required. Some nutritionists consider this action desirable while others feel that it would be preferable to increase dietary iron by improving food selection.

According to Michell et al. (1968), the enrichment of bread and flour with iron and three of the B vitamins was initiated during World War II, when it was realized that attempts to persuade people to use whole grains were unsuccessful. The modification of natural grains by milling did produce flour that had better keeping qualities and was more attractive in appearance to consumers, but the milling process reduced the content of iron, thiamine, riboflavin, and niacin in the flour. Standards for enrichment of various cereal products have been established by the Food and Drug Administration. These standards are to be used whenever claims for enrichment are made. By 1965, 30 states had passed enrichment laws. Most of the flour and bread sold today in the United States is enriched, although this is not mandatory in some states.

Questions concerning the availability of iron used in enrichment of cereal products have been raised by some nutritionists. In 1957, Harrill, Hoene, and Johnston reported a study which was conducted to measure the percentage of iron absorbed by human subjects from iron-enriched bread and to compare the biologic availability of the three iron preparations most commonly used for enrichment. The three preparations investigated were: reduced iron, ferric orthophosphate, and ferrous sulfate. Nine young women were maintained for four periods of 28 days each on a carefully controlled diet. The investigators concluded that all of the three preparations which were used for the enrichment of bread were poorly absorbed by the subjects, and that there was no difference in the amount of iron absorbed from the three iron preparations.

Elwood (1968) conducted a study of the problem of the availability of iron used in enrichment of flour since 1963. He reported that the form of iron used for enrichment at the time of the study was almost unavailable to volunteers when fed a "standard breakfast" which consisted of orange juice, bread, butter, marmalade, coffee and tea, and to fit local tastes, a boiled egg. Based on the results of the study, Elwood recommends that ferric ammonium citrate be used for the enrichment of bread and cereal products.

As the writer explained earlier in this chapter, the availability of iron in food varies considerably with the needs of the subjects and interaction of other food consumed. Elwood used the orange juice in his "standard breakfast" to provide ascorbic acid to facilitate the absorption of iron. His study revealed that when egg was added to the meal, the proportion of iron absorbed was greatly reduced.

A study by Callender and Warner (1968), in which bread was enriched with four different forms of radioactive iron, revealed that the iron was poorly absorbed from bread as compared with absorption from a standard dose of five milligrams of ^{59}Fe ferrous iron. Absorption was, however enhanced by giving orange juice with the bread. In the earlier discussion concerning iron absorption, mention was made that ferrous iron was better absorbed than ferric iron, and that ascorbic acid seems to increase the absorption of iron.

Even though the value of some of the products used for enrichment is questionable, enrichment and fortification of foods is recommended by some authorities as a method of increasing the intake of iron. Finch (1968) states that an otherwise adequate diet may be inadequate in iron for certain groups in the population. He suggests that the solution to this problem is the effective fortification of food with iron.

Voris (1968) recommends that females who consume 2000 or fewer calories per day will have difficulty obtaining 18 milligrams of iron per day from dietary sources without further fortification of foods.

Adelson (1968) reported that the survey of household food consumption in 1965-1966 showed an increase in the use of "snack food" items. Consumption of soft drinks increased during the ten-year period, 1955 to 1965, from five to nine eight-ounce cups per household per week. "Snack foods" have become such a large part of the American diet that Beutler (1969) suggested that soft drinks and potato chips might be fortified with iron to decrease the prevalence of iron-deficiency anemia.

The Food and Nutrition Board recommends that, in order to rectify the discrepancy between the average intake of 11 milligrams of iron and the 18 milligrams of iron recommended daily for some groups, the Standards of Identity for flour and bread enrichment be changed to permit the addition of no less than 40 milligrams or more than 60 milligrams per pound flour, and not less than 25 milligrams or more than 40 milligrams per pound bread, according to a report in the Journal of the American Dietetic Association (May, 1970). The Board further recommends that wherever technically feasible, enriched wheat flour be used for the preparation of bakery products, which are not now enriched. The Board does not support widespread enrichment or fortification of a large variety of different products. It believes that the increased iron enrichment of bread and flour described above could be expected to raise the amount of iron in the American diet by approximately five milligrams per day. This recommendation would improve the iron content of school lunches, since one component of the Type A lunch pattern is a serving of whole wheat or enriched bread.

School Feeding Programs

Although widespread school feeding operations are a recent development, the idea has existed for centuries that the health and well-being of children can be improved by serving food to them at school. It is said that Plato served dinner to his most prized students after their lessons in the Greek Academy. In 1790, Count Rumford started a school feeding program in Munich, Germany, as part of his campaign against vagrancy (Cronan, 1962). France, in 1867, encouraged the school canteen by granting it official recognition of the Ministry of Public

Education.

It took the great social forces of the 19th century in America to convert the dormant concept idea into a functioning reality. Mrs. Ellen H. Richards, recognized as a pioneer in the home economics movement in America, began school feeding in Boston in 1894. Other cities soon followed her example. Philadelphia school children could purchase a penny lunch in 1894. By 1909, New York was involved in school feeding operations and was taking food preferences of its ethnic groups into consideration in their menu planning. By 1912, Boston, the pioneer city of school lunches, was offering a greater variety of foods but at increased prices.

Nutrition became a concern of school feeding programs by 1910. Some of the early programs attempted to provide one-fourth of the daily nutritional requirements of their students. Special attention was given to milk and its place in a well-balanced meal.

In spite of the efforts of these early programs, it took a depression and national involvement in a World War to win recognition of the necessity of at least one good meal a day for school children. In 1946, Congress passed Public Law 396, the National School Lunch Act. This law outlined the structure of the National School Lunch Program, which remained much the same for the next twenty years.

The Child Nutrition Act of 1966 supplemented the National School Lunch Act of 1946 and provided pilot breakfast programs for needy children and children who traveled long distances to school. A nutritional breakfast pattern was stipulated for this program. Furthermore, money was provided for schools in needy areas to purchase basic equipment if local funds were not available for such equipment.

In 1968, an amendment to the National School Lunch Act was inaugurated. This amendment extended the provisions of the National School Lunch Program to certain day-care centers and recreational centers which provided services for children from low income areas or where there are many working mothers. Assistance from this amendment includes cash reimbursement from federal funds for food purchases, money for basic equipment, USDA donated foods, and technical assistance and guidance to establish and operate a school feeding program. Like other federally funded programs, a nutritional meal pattern and participation guidelines were stipulated.

Although there are large numbers of school children who receive meals at school, there are still some areas which offer no food service at school. Others offer only candy and soft drinks from vending machines. Reasons for this lack of school feeding programs are varied. Some of the older school buildings in inner cities of large metropolitan areas have no space available for lunchrooms. In other areas, the philosophy exists that children's meals should be prepared at home. The administration of these schools maintain that it is not the responsibility of the school to provide meals for the children.

Another theory is that school feeding programs are an integral part of the educational system. Nutritionists and many educators believe that a child cannot begin to achieve his potential unless his nutritional needs are met. Klausmeier and Goodwin (1966) cite the feeding of children at school as an example of the operation of Maslow's hierarchy of needs which states that the physiological needs, such as hunger, must be satisfied before the higher needs of safety, love, self-esteem, and self-actualization can be achieved. The writer predicts that because of current interest in social welfare, and the attention that has been drawn to hunger and malnutrition, the school feeding programs will be greatly expanded in the coming years.

Schools participating in the National School Lunch Program must serve lunches that meet the requirements of the meal-pattern stipulated by the United States Department of Agriculture, called the Type A lunch. This pattern, based on the Recommended Dietary Allowances, has been developed to provide one-third of the day's needs in one meal. Type A lunches have five components: meat or meat substitute, fruit and/or vegetables, bread, butter or fortified margarine, and whole grain or enriched bread. Serving a Type A lunch is one of the requirements which must be met by participating schools in order to receive federal reimbursement for lunches served.

Leverton (1967) states that, although the framework for the Type A lunch provides flexibility, it is not possible to allow reimbursement for certain modifications to meet the special dietary problems of some children. She further states that mass feeding programs are designed to provide the greatest good for the greatest number of children and that it is not practical or desirable to make changes for individual children with special problems.

In April, 1969, Leverton reported a study of the Type A school lunch, made in the fall of 1966. This survey was sponsored by the United States Department of Agriculture in order to determine whether the schools using the Type A pattern were meeting the nutritional goal of providing one-third of the Recommended Dietary Allowances for the children. Since the purpose of the study was to provide nutritive data on lunches as served, acceptance of the lunches was not observed.

Lunches were collected from four trays each day for five days and the contents were analyzed for a wide variety of nutrients. The results of this study reveal that on the average, the lunches reached the nutritional goal except for food energy, iron, and magnesium. More lunches were short in iron than in any other nutrient for which there are goals. Two-thirds of the schools served lunches that did not reach the goal for iron.

During the past decade much notice has been given to social problems. The social implications of hunger and malnutrition are provoking federal agencies to allocate more funds to programs which will provide more nutritious food for low income families. The Child Nutrition Act of 1966 and the 1968 amendment to the National School Lunch Act which have been described are two examples of such legislation. The allocation and distribution of funds at the federal level are subject to many kinds of pressure. The financial future of school feeding operations will be determined to a great extent by such pressures on Congress as military demands, welfare programs, the general economy of the nation, and interest shown by educators and nutritionists. Successful school feeding programs depend on enthusiastic support at all levels: family, local schools, state agency, United States Department of Agriculture, and Congress.

Food Acceptance

In order to improve the nutritional status of some persons, it may be desirable to change their habits of food acceptance. Lowenberg et al. (1968) define a food habit as:

> habits of a group that reflect the way a culture standardizes behavior of the individuals in the group in relation to food so that the group comes to have a common pattern of eating.

This definition could be applied to the family group from which children derive their individual habits of eating. Differences other than cultural, ethnic, and family may arise from many factors such as food allergies, past experiences with food, digestion and metabolism of food, and emotional habits.

Food acceptance and habits may be influenced by differences in taste sensitivity. Lowenberg (1959), a noted authority on child nutrition, has written that children in general have keener senses of taste and smell than adults. In another publication (Spock and Lowenberg, 1955), they state that research studies, as well as experience in watching children eat, point to the fact that children are more sensitive to strong flavors in foods than adults. However, in a more recent study, in which Lowenberg participated, (Feeney, Dodds, and Lowenberg, 1966), no evidence was found to support the view that children's taste buds are more sensitive than the adults' taste buds. In this study, solutions of four chemicals were used: sucrose (sweet), citric acid (sour), quinine sulphate (bitter), and sodium chloride (salty).

Korsland and Eppright (1967) studied a group of 25 preschool children to investigate taste sensitivity and possible relationships between taste sensitivity and eating behavior. The results of the study suggest that preschool children highly sensitive to one taste sensation were also highly sensitive to the other three taste sensations. Furthermore, those who had the lowest taste sensitivity tended to accept more foods and to have more enthusiasm for food than did those who had the highest taste sensitivity. Thus taste sensitivity may be a strong influence in both the formation and changing of food habits. The findings of this study might also indicate one of the reasons some persons find the flavor of liver objectionable.

The food habits of an adolescent reflect the total of experiences in eating from birth to his present age. In infancy, the response to his crying is often an offer of food. He is usually fed under conditions that provide comfort and security. It is not surprising that food is closely related to the emotional behavior of many persons.

An adolescent often uses food to identify with his parents. Allen, Patterson, and Warren (1970) studied the relationship of nutrition, dietary habits, and food attitudes to academic performance, work orientation, and vocational preparation of high school students. Family commensality was one of the factors studied. Webster defines the word "commensal" as "relating to those who habitually eat together." In this study, the term family commensality included meals eaten together by the whole family, attractiveness of the servings, appetite of the students, which family member did the cooking, and the quality of the cooking. The study indicated that an increase in family commensality was associated with an increase in food likes, dietary adequacy, and perceived health. Another finding of the study was that food likes had a significant relation to grade in school, which suggested to the authors the possibility of a maturation function in relation to food acceptance from the tenth to the twelfth grades.

Nutritionists, especially those who are involved in school feeding programs must be aware of the acceptance of the foods served. It may be said that the least nutritious foods served are those which are returned as plate waste.

Nutrition Education

Whatever the cause may have been, it is generally agreed that by the time boys and girls reach the teen years, they have usually developed many poor eating habits. These practices, which contribute to malnutrition, are carried into adulthood and frequently become family customs.

According to Mann (1969), nutrition education has traditionally been conducted in the home through the mother-daughter transfer of food choices and cooking skills, and in the family meal conclave which has transmitted customs of food selection and meal patterns. Factors that have disrupted this tradition in the past 25 years have been the use of vending machines, convenience foods, fear and repugnance of obseity, and excessive promotion of vitamins.

Todhunter (1969) has stated that nutrition education is universally needed regardless of income, geographic location, cultural, social, or economic patterns, or level of education, because man has no instinct that guides him to select those foods which meet the nutritional needs of the body, and knowledge is not inherited.

From a study of the influence of the male family head on the family eating pattern, Moore, Beasley, and Moore (1970) concluded that boys should become the focus for more and better nutrition education, since they will be potential family heads. The authors challenge nutrition educators not only to make their programs more exciting and vital, but also to offer this training to boys as well as to girls.

Lamb (1969) wrote that, in order to be effective in nutrition education, dietitians and nutritionists must understand why people eat as they do and why food is accepted or rejected. Good food habits should be initiated at birth, supported by the home, and extended at school by appropriate and effective learning experiences. In dealing with adults, the nutrition educator must realize that food aversions are deep-rooted and may require a team of experts a long time to help even one person. As with all health problems, food aversions need to be recognized as ones which are easier to prevent and control in the young than to correct in the adult population.

Changing Food Habits

Before attempting to change the food habits of any group of people, one must first understand the culture of these people, according to Niehoff (1969). This is particularly true in developing countries. In addition to this, the economical aspect of the diet must be considered, whether at home or abroad.

A study was conducted by Spindler and Acker (1963) in an effort to develop a method of obtaining information about some the attitudes and motivation forces behind the food habits of students after their exposure to a nutrition project. After experimentation it was decided to use group interviews rather than questionnaires to solicit this information. Factors that seemed to be important to the subjects were time, attitude toward food, approval of peer-group, and personal appearance.

In 1968, Hill stated that far too many administrators, teachers, parents, and community leaders look upon the school lunch as a midday filling station. The National School Lunch Program is a food distribution program for which the Type A pattern, based on solid, well-established research, was set as its nutritional goal. She further states that it is becoming increasingly evident to nutritionists and workers in allied professions that there is need for a sequential program of nutrition education in school programs, and that some feel that the school lunch offers promise in this area.

Robinson (1968) suggests that through the school feeding programs the pupil is helped to develop a liking for nutritious foods and thereby overcome food prejudices. She also states that the school lunchroom may serve as a laboratory for nutrition education as well as for many other subjects in school.

Studies of the relationship of values to food choices have been conducted, since values are considered to exert a strong influence on motivation. A recent study by McElroy and Taylor (1966) investigated the values which are considered important by boys when making decisions involving food choices. Twenty tenth-grade boys were given a values test. The mean score was obtained and values were ranked in the following order: health, money, sociability, enjoyment, independence, and status. The high rank given to health by the subjects in this study indicates a receptivity to nutrition education by students at this age. The writer suggests that well planned, well-presented lessons in nutrition would be acceptable to students at all levels.

Summary

A review of the research related to this study indicates that more attention should be given to increasing the iron content of school lunches, especially at the junior high school level. Reasons for this are (1) the Recommended Dietary Allowance for iron was increased for this age group in the 1968 revision, (2) the increase in iron is needed because of the rapid growth during adolescence, (3) surveys show deficiencies in dietary iron, and (4) school lunches should provide one third of the Recommended Dietary Allowances. A review of the literature indicated that of the sources of iron in food, pork liver is one of the best contributors of this nutrient.

Because of the increase in the amount of iron recommended for some groups of people, and because of the prevalence of iron deficiency anemia, some nutritionists have suggested more enrichment and fortification of foods. However, some studies cast doubt on the effectiveness of present enrichment procedures.

The areas of food acceptance and nutrition education were reviewed in order to learn more effective ways to change food habits.

CHAPTER III

PROCEDURE AND METHODS

This study was designed to accomplish three objectives, as stated in Chapter I. Evidence of the achieving of the first objective, a review of research related to the nutritional needs for iron and the extent to which these needs are being met, has been shown in Chapter II. This chapter will be concerned with the second objective of the study which was to determine whether junior high school students would accept a liver-enriched meat loaf served in a school cafeteria, and if so whether the meat loaf containing ten percent liver would be as acceptable as one which contained five percent liver. The acceptability was to be judged by a statistical analysis, followed by an interpretation of the analysis, which will be presented in Chapter IV. In order to accomplish this objective, the procedure and methods presented in this chapter will be used.

The main topics to be discussed are: pre-experiment with liver-enriched meat loaf in college foods class, selection of the group and the schools for testing acceptability of liver-enriched meat loaf, determinations of proportions of liver and ground beef in the recipes, planning the menu which was to be served with the meat loaf on the test days, the session for practice in judging amounts of returned meat loaf, collection of the data at the schools on the three days of observation, and a summary of the procedure and methods.

Pre-experiment of College Foods Class

The writer's experience in working with school lunch programs led her to choose the development of a liver-enriched meat loaf as an area of investigation for a class in experimental cookery in which she was enrolled during the fall semester of 1968. This experience included teaching workshops for school lunch cooks during the previous six years. In discussing the nutritive value of main dishes, the need for serving liver to increase the iron content of the lunches of the students had been emphasized. The usual reaction of the cooks was that the children who ate in their lunchrooms would not eat liver when it was served to them. It was suggested that ground liver could be added to certain, highly-seasoned ground meat dishes. Examples of such dishes were chili con carne, spaghetti with meat sauce, lasagne, pizza, barbequed ground beef on buns, and meat loaf. The meat usually used for such dishes in school cafeterias is ground beef, ground canned luncheon meat, or ground canned roast beef. The question of how much liver could be added without detection and rejection of the food by the students was often asked by the cooks. The instructor could only suggest that the cooks experiment on the basis that liver could be substituted for approximately five to 20 percent of the ground beef in the recipe. The writer felt that the cooks needed more definite information in order to enrich certain entrees with liver.

In the experimental foods class, one of the objectives was to become familiar with the scientific method as related to foods. In order to accomplish this objective, each student in the class was required to plan and carry out an independent problem in class. The independent problem chosen by the writer was to determine the proportion of liver that could be substituted for ground beef in a meat loaf recipe.

The recipe for the meat loaf was selected from Better Homes and Gardens New Cook Book (1968). The ingredients in the original were:

Favorite Beef Loaf

$1\frac{1}{2}$ pounds	ground beef
$\frac{1}{2}$ cup	medium bread crumbs
2	beaten eggs
1 8 oz. can	tomato sauce
$\frac{1}{4}$ cup	finely chopped onion
2 tablespoons	chopped green pepper
1 tablespoon	salt
Dash	thyme
Dash	marjoram

Minor changes in the ingredients of the recipe were made in order to make a meat loaf which the writer felt would better suit the purpose of the study and yet not be too different from the meat loaf usually served in school lunchrooms. Catsup was substituted for the tomato sauce; black pepper was added, and the thyme and marjoram were omitted since they are not commonly used and it was decided that their use might influence the results. The flavors of catsup and black pepper are more familiar to the students in the area.

The proportion of ground liver to ground beef varied. Six variations in all were used and these were numbered one through six. The differences in proportions of liver and ground beef in each variation are shown in Table II.

TABLE II

VARIATIONS IN THE PROPORTION OF LIVER TO BEEF IN THE MEAT LOAF RECIPES

Variation	Percent of Beef	Percent of Liver
1	100	0
2	95	5
3	90	10
4	85	15
5	80	20
6	75	25

Each recipe variation was evaluated by a taste panel composed of the investigator and three other class members. One of the criteria for the selection of a taste panel was that the food under investigation was acceptable to the taster. Therefore all the members had been selected because they liked liver. The results by the taste panel indicated that the meat loaf in which liver was substituted for 20 percent of the ground beef received the highest score on the basis of flavor, texture, aroma, appearance, and color. However this could be interpreted as biased because of the acceptability of liver to the members of the taste panel. The writer wanted to know how persons who did not like liver would accept foods which contained small amounts of liver added to ground beef or other kinds of meat. For this reason, the testing of acceptance by children of a liver-enriched meat loaf was undertaken.

Selection of the Group and the Schools

School children were chosen as the sample group for the study for at least two reasons. They provided a "captive" group, in a rather large number, for the study. A more important reason for the choice, however, was that school children comprised a target area for the study because of their need for iron during the years of growth. The writer's experience with school lunch work had caused an intense interest in the improvement of the nutritive quality of school lunches.

The writer visited three school systems in order to find two junior high schools which met the criteria which the investigator had defined. These criteria are listed below:

1. The two schools chosen should be participants in the National School Lunch Program. Such schools are required to serve lunches which meet the specifications of the Type A lunch pattern which has been defined on page 6. One of the specifications is that each student must be served all the components of that pattern. It is possible to allow the students some choice in the selection of their food, but to do this requires more equipment and personnel. Therefore most participating schools, to keep the price of the lunch as low as possible, serve a single menu, a plate lunch which

provides no choice by the students. By conducting the research in such schools, the investigator would be assured that the same kinds and amounts of foods would be served to all students.

2. The schools chosen should be junior high schools because it is at the beginning of adolescence that the Recommended Dietary Allowance for iron increases from ten to 18 milligrams.
3. The schools should be within a radius of 50 miles of the writer's home so that the writer could have ready access to spend the time required for carrying out the experiment.
4. The schools were to be large enough to provide sufficient data, yet small enough to permit the research to be conducted efficiently. This size was determined by the writer to be schools which served between 250 and 500 lunches daily.
5. The schools selected should be those in which the students do not leave the schools for lunch. This is identified as a closed lunch hour, in which all the students remain in the school building during the noon period. This criterion was selected in order to obtain a better sampling of the student body.
6. The school lunchroom should have the space, facilities, and arrangement to accommodate the research plan without causing congestion or confusion of the students during the serving of the meal.
7. The school personnel, that is, the school administration and school lunch workers, must show innovative and cooperative

attitudes toward school feeding programs in general, and more specifically, toward this research project.

8. Administrative approval for the research to be conducted would be granted.

The first school the investigator visited met all the stated criteria. However, the interview disclosed that because of a recent reorganization within the school district, only students from the seventh and eighth grades were served in that lunchroom. Since the writer knew of no other school in the prescribed area which had the plan, this school was rejected as a location in which the research could be conducted.

An interview with the food service manager of the second school revealed that the average daily participation of the school was over 500 students. This number was too large for the study which was planned.

In the third school visited by the writer, there were two junior high schools of similar size, each of which met all the stated criteria. After a conference with the vocational homemaking teacher and the superintendent of schools, it was agreed that the research could be done in this school system.

The two junior high schools, for the purposes of this study, shall be hereafter referred to as School A and School B. Both of these were housed in recently constructed buildings in a suburban area. Most of the patrons were employed in nearby metropolitan areas, and could be described as being in the middle socioeconomic class. Students in the seventh, eighth, and ninth grades attended these two schools. Since the towns where each of the junior high schools are located are small, the majority of the students come from the surrounding area.

Although absences from school would affect the results of the study to some extent, it was felt that the sample size was large enough that these absences would have a minimal effect on the results. The average daily participation at School A was estimated to be 325 students and at School B, 290 students.

The writer met with the superintendent of schools and the high school vocational homemaking teacher and explained in detail the purpose and plan of the investigation. A similar conference was held with the school food service supervisor and the principals of the two junior high schools. All these persons responded with interest and assurances of cooperation.

Determination of Recipe Proportions

As was stated previously, the recipes containing different proportions of liver for the meat loaf tested in the experimental foods class had been taken from a family-sized recipe, and served only eight persons. It was necessary to increase the recipe to serve 100 persons. In calculating the amounts of food needed to provide two ounces of lean meat or its equivalent for the Type A lunch pattern, six servings per pound of ground beef are allowed. One egg is considered a serving of protein-rich food for this requirement. Based on these standards, the investigator increased the amounts of the ingredients to yield 100 portions, using the basic recipe which was developed in the experimental foods class. (The recipe actually provides 102 portions according to the formula above. The extra two servings allow a margin of safety.) The basic recipe, showing the three variations, was:

Ingredients	Variation Number 1	Variation Number 2	Variation Number 3
Dry bread crumbs	1 lb.	1 lb.	1 lb.
Catsup	*2 qts., ½ c.	*2 qts., ½ c.	*2 qts., ½ c.
Salt	2 oz.	2 oz.	2 oz.
Onions, chopped	1 lb., 4 oz.	1 lb., 4 oz.	1 lb., 4 oz.
Green pepper, chopped	12 oz.	12 oz.	12 oz.
Eggs	18 large	18 large	18 large
Ground beef	14 lb.	13 lb., 5 oz.	12 lb., 9½ oz.
Ground pork liver	None	11 oz.	1 lb., 6½ oz.

*The measurement is stated as "2 qts., ½ c." rather than "2 1/8 qts." for accuracy and convenience.

Directions for Variation 1: Mix bread crumbs and catsup in mixer on low speed. To this mixture, add salt, onions, green peppers, and eggs (beaten slightly). Add ground beef to mixture. Mix well three minutes on low speed. Place equal amounts in two greased pans (about 12" X 20" X 2"). Shape mixture into two equal lengthwise loaves in each pan. Bake one hour, ten minutes at 375°F.

Directions for Variations 2 and 3: When a variation containing liver is used, add the ground liver to the catsup and mix well before combining with bread crumbs. This should be done to assure even distribution throughout the meat loaf without overmixing the ground beef.

Liver was substituted for no more than ten percent of the beef on any of the test days, since in the experimental class project some members of the taste panel found that the taste of liver was detectable when ground liver was substituted for 15 percent of the beef. Furthermore, in preparing meals for her family, the writer had added ground pork liver to certain ground meat dishes such as lasagne and chili con carne. Only ten percent liver was used in these recipes. The family members were not informed of the addition of liver. The food was well accepted each time, even though one of the family does not like liver.

In School A, a loaf in which the meat was all beef was to be served on the first test day. On the second day of observation, one month later, a meat loaf with liver substituted for five percent of the ground beef was served. A meat loaf using liver for ten percent of the ground beef was served on the third day of testing, which followed the second test day four weeks later. In School B, the order was reversed. In this way, it was hoped to minimize the effect of the order of administration on the participation in the school lunch program because of the passing of the school year.

Planning the Menu to Accompany Meat Loaf

At the time the research was conducted, the school system selected had five cafeterias. These lunchrooms were operated under the direction of one person, the Food Service Supervisor, who planned a single menu for the five schools. The investigator and the Food Service Supervisor planned a menu which would include the meat loaf to be used on the test days. Some of the factors considered in planning the menu were:

1. It should meet the Type A lunch requirements.
2. It should contain at least one food classified by USDA as a "good" source of Vitamin C.

3. The cost should be within the limits of the operating budget.
4. Variety in flavor, texture, color, temperature, and shape should be provided.
5. The food for this menu should be prepared by the regular staff, using the available equipment, in the time allowed.
6. The menu items should be familiar to the students, and should be those which have been found to be acceptable to them.
7. Seasonal foods should be avoided, since the study would cover a period of two months.

Considering these factors, the following menu was planned to be served on the testing days:

Meat Loaf

Mashed potatoes

Cole slaw

Hot rolls

Butter

Peach Half

Milk

Since the same menu was to be used on all observation days, it was the opinion of the writer that it should not be served more often than at four-week intervals. Monday was selected as the day of the week for testing, since on that day there are fewer activities which might interfere with lunch participation were scheduled. The dates for the three days of testing were set so that there would be no interruptions from holidays.

Practice Session

A practice session was held, so that those checking plate returns would be in agreement as to how the returned amounts would be judged. With the cooperation of the vocational homemaking teacher of the senior high school in the selected school system, two senior homemaking students were selected to help with checking the tray returns. It was believed that more accurate results would be obtained if the investigator and the state school lunch consultant, who was to check plate returns in one of the schools, had someone to assist them on each test day. The assistants helped by directing the students toward the checker, and by making sure that the trays of all students were checked. The investigator thought that this assistance would allow the checker (1) to devote closer attention to the determination and recording of amounts of returned meat loaf on the plates, (2) to work more rapidly and therefore avoid detaining the students, and (3) to make certain no trays were missed.

The researcher, the school lunch consultant, the vocational homemaking teacher, and the two students selected as assistants attended the practice session which was held in the senior high school homemaking department. The writer had baked a meat loaf from which plates were served with pieces of varying sizes of meat loaf, which were to resemble returned servings. The plates used were obtained from the school cafeteria so that the servings would appear as much as possible like those which actually would be served.

Collection of Data

Before the actual investigation began, the writer and the state school lunch consultant who was to assist her, visited the cafeterias in which the research was to be conducted. The visit was made before and during a lunch hour in order to determine the details of the arrangement that would be best for checking the returned trays. Also, during this visit, rapport with the lunchroom personnel was established so that the work would be carried out in a pleasant atmosphere with good relationships among all those involved. The investigator felt that this was important since, in a sense, she and the ones who would assist her were "intruders" in the work area. School lunch workers take pride in their work and regard the kitchen as their particular domain.

All persons who assisted in the research were cautioned to keep the details confidential, so that the students would not have any information concerning the substitution of liver for part of the ground beef in the meat loaf. On the testing days, much interest in the research was shown by the students. Several asked questions concerning the work of the investigator and her assistant. They were told that the plates were being checked to determine which foods they liked. This answer seemed to satisfy their curiosity.

The investigator chose to purchase and prepare the liver that was to be used in the research. The reasons for doing this were:

1. to save time and labor for the cooks.
2. to be certain pork liver was used (in some areas, pork liver is not always available in grocery stores or from meat distributors).
3. to assure proper handling and cooking of the liver.

It is quite difficult to grind raw liver. It had been the experience of the writer that it should be cooked, chilled, and then ground, or it should be cut into finger-sized strips, frozen, and then ground. Because of the available equipment, the writer chose to grind the cooked, chilled liver. It is to be expected that if the liver-enriched meat loaf is found to be acceptable, school lunch cooks would need information concerning the preparation of the liver.

The writer worked at School A and the school lunch consultant from the State School Lunch Division, at School B on the test days. They arrived at the schools at seven-thirty each of those mornings. Each assisted in the mixing of the meat loaf to compensate for the extra time required to prepare the new recipe, and to insure that accurate proportions of liver and beef were used on the test days.

In mixing the meat loaf, it should be emphasized that it is important to follow the directions given in the recipe. The ground liver should be added to the catsup and mixed well before adding the other ingredients. This procedure is necessary to assure even distribution of the ground liver without overmixing the ground beef.

The preparation of the meat loaf was started soon enough to allow it to stand 30 minutes before slicing. This was essential since this particular recipe does not make a firm, compact loaf.

School lunch recipes furnished by both the school Lunch Division of the State Department of Education and the United States Department of Agriculture are written in amounts to provide 100 servings. For that reason the recipe for this research was written to provide 100 portions. The manager of each kitchen unit adjusted the amounts of the ingredients to the number of students she expected to serve on each day.

As was previously stated, a senior vocational homemaking student assisted in each school during the checking of the plate returns. The plates were checked to see how much, if any, meat loaf was returned. The detailed data which was collected at the two schools are shown in Appendix B. The following table illustrates the form used to tabulate the amounts of servings returned by the students.

TABLE III

FORM FOR RECORDING AMOUNT OF SERVING OF MEAT LOAF RETURNED AS PLATE WASTE

Students Who Returned				
None	1/4	1/2	3/4	All
𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 ||	𝍸 𝍸 𝍸 𝍸 𝍸 |||	𝍸 𝍸 𝍸 |	𝍸 𝍸 𝍸 𝍸 |||	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 |||
Total 97	28	16	23	33

Adult meals were not recorded, since they were not to be included in the study.

The chi square procedure was used to test the hypotheses. This analysis and its interpretation will be discussed in Chapter IV. The third objective was to draw implications and to make recommendations to persons involved in nutrition education. These implications and recommendations will be presented in Chapter V.

Summary

In Chapter III, the procedure and methods used for the study have been described. A problem in an experimental cookery class was investigated to determine the amount of liver which could be substituted for part of the ground beef in a meat loaf without affecting the flavor and texture of the product. In order to determine whether school children would accept a liver-enriched meat loaf, and if so, whether five or ten percent would be more acceptable, an investigation was planned and carried out in two junior high schools. The amounts of the ingredients in the basic recipe used for the project in the experimental foods class were adjusted to serve 100 portions. The manager in each school further adjusted the amounts of ingredients to the number of students in each school. The writer and the food service supervisor of the selected schools planned the menu to accompany the meat loaf. The vocational homemaking teacher of the senior high school in the selected school system selected two of her students to assist in the research. A practice session was held to assure uniformity and accuracy in judging the amounts of returned meat loaf. The data was collected on three days at one-month intervals.

The following chapter will present a discuss ion of the collection and statistical analysis of the data. Interpretation of the analysis in relation to the objectives of the study will then be discussed.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF FINDINGS

The purpose of this chapter is to present the analysis and discussion of the findings of the research which was an investigation of the acceptance of a liver-enriched meat loaf by junior high school students. The analysis of the data, which were collected on three observation days at intervals of four weeks, will first be presented, followed by a discussion and interpretation of the results of the statistical tests. A summary of the analysis and the interpretation of the results by the writer will conclude the chapter.

Statistical Analysis of the Data

As the writer described in Chapter III, the research was conducted to determine whether junior high schools would accept a meat loaf in which liver had been substituted for part of the beef in a school lunchroom. The investigation was made at two schools on three test days, at intervals of four weeks. On two of the test days, a liver-enriched meat loaf was served as the entree in the cafeterias of both schools. Liver was substituted for ten percent of the beef in the meat loaf on one of these days, and five percent of the beef had been replaced by liver on the second day. On the other day of observation in each school, an all-beef meat loaf was served. The plate return of the meat loaf from each child was visually checked and the fractional part of the returned serving of meat loaf was recorded on a form as shown in Chapter III, page 49.

Since the data which were collected during the investigation at the two junior high schools were nominal levels of measurement, the writer used the chi square test for the statistical analysis. This procedure was used to determine whether the observed differences were within the range which could have occurred by chance alone. This is one of the more powerful tests used for the nominal level of measurement and was deemed to be appropriate for this analysis. The .05 level of probability was used to judge the significance of statistical tests.

The chi square analysis of the number of students at School A who returned varying amounts of meat loaf as plate waste is shown in Table IV. The calculated chi square value of 36.51 exceeds the tabled chi square value of 15.51 at the .05 level of significance.

TABLE IV

CHI SQUARE ANALYSIS OF NUMBER OF STUDENTS RETURNING VARYING AMOUNTS OF MEAT LOAF AS PLATE WASTE AT SCHOOL A

	Number of Students Who Returned					
Percent Liver	None	1/4 Serving	1/2 Serving	3/4 Serving	All	Total Students
0	207	36	12	19	43	317
5	232	28	21	23	27	331
10	199	58	28	23	14	322

Chi Square: 36.51 df: 8 $p < .0005$

In Table V the chi square test of the number of students at School B who returned different amounts of plate waste is shown. The tabled chi square value of 15.51 at the .05 level of significance was exceeded by the calculated chi square value of 24.04.

TABLE V

CHI SQUARE ANALYSIS OF NUMBER OF STUDENTS RETURNING VARYING AMOUNTS OF MEAT LOAF AS PLAST WASTE AT SCHOOL B

	Number of Students Who Returned					
Percent Liver	None	1/4 Serving	1/2 Serving	3/4 Serving	All	Total Students
0	236	40	16	3	11	306
5	211	37	27	10	5	290
10	182	45	25	6	21	279

Chi Square: 24.04 df: 8 $.001 < p < .005$

The data from School A and School B were pooled and were analyzed by the chi square procedure. The calculated chi square value of 32.44 exceeded the tabled chi square value of 9.49 at the .05 level of significance, as shown in Table VI.

TABLE VI

CHI SQUARE ANALYSIS OF TOTAL NUMBER OF STUDENTS RETURNING VARYING AMOUNTS OF MEAT LOAF AS PLATE WASTE FROM BOTH SCHOOL A AND SCHOOL B

	Number of Students Who Returned					
Percent Liver	None	1/4 Serving	1/2 Serving	3/4 Serving	All	Total Students
0	443	76	28	22	54	623
5	443	65	48	33	32	621
10	381	103	53	29	35	601
Chi Square: 32.44			df: 8			$p < .0005$

The first hypothesis stated that there was no difference between the acceptance of an all-beef meat loaf and a liver-enriched meat loaf by junior high school students in a school lunchroom. Since the calculated chi square value exceeded the tabled chi square value in the statistical tests for each of the schools, and for the pooled data from the two schools, it was necessary to reject the first hypothesis. In other words, there was a difference in the acceptance of a meat loaf made from beef alone, and one in which part of the beef had been replaced by liver by the students in the two junior high schools in which the investigation was conducted.

The pooled data from the two schools were analyzed by the chi square procedure to test the second hypothesis which stated that there was no significant difference between the acceptance of a meat loaf in which five percent of the beef has been replaced by liver and a meat loaf in which ten percent of the beef has been replaced by liver. The results of the statistical test of this data are shown in Table VII. Since the calculated chi square value of 13.59 exceeded the tabled chi square value of 9.49, the second hypothesis was rejected. In other words, the statistical analysis of the five groups of students who returned varying amounts of meat loaf as plate waste at the two schools in the study indicated a difference in their acceptance of the two recipe variations for the meat loaf.

TABLE VII

CHI SQUARE ANALYSIS OF NUMBER OF STUDENTS RETURNING VARYING AMOUNTS OF MEAT LOAF CONTAINING FIVE PERCENT AND TEN PERCENT LIVER AT SCHOOLS A AND B

	Number of Students Who Returned					
Percent Liver	None	1/4 Serving	1/2 Serving	3/4 Serving	All	Total Students
5	443	65	48	33	32	621
10	381	103	53	29	35	601
Chi Square: 13.59			df: 4		$.005 < p < .01$	

Upon further examination of the data, it was decided to apply chi square tests on a different basis. The students who returned one-half of the serving of meat loaf clouded the determination of acceptance or rejection of the food. If a student returned one-half of the serving, it could not be determined whether he accepted or rejected the food. Therefore the students in this group were considered as indecisive for the purpose of the study. The reasons a student may have eaten only one-half the serving could be other than not like the food, such as time, or lack of appetite. Table VIII shows a comparison of the values of protein and iron in a meat loaf made from all beef and from one in which liver was substituted for ten percent of the beef. The values are given for one serving and for one-half serving of the meat loaf. The size of the serving is that amount which would furnish two ounces of protein rich food as specified by the Type A lunch pattern.

TABLE VIII

COMPARISON OF VALUES OF PROTEIN AND IRON IN ALL-BEEF MEAT LOAF AND MEAT LOAF CONTAINING TEN PERCENT LIVER

	Meat Loaf Containing All Beef		Meat Loaf Containing 10% Liver	
	Protein gm	Iron mg	Protein gm	Iron mg
One serving	13.5	2.0	13.7	3.3
One-half serving	6.8	1.0	6.9	1.7

An examination of Table VIII indicates that if he ate only one-half of the liver-enriched meat loaf, there is a proportionate decrease in the amount of protein ingested, but the loss of iron intake is not significantly less than if he had eaten all the all-beef meat loaf served to him. Hence the students in the "1/2" category were deleted for the purpose of further analysis.

Furthermore, since students who returned only one-fourth of the serving of meat loaf could be considered as accepting the food, the groups of students who returned "None" and "1/4" of the meat loaf were combined. The students who returned three-fourths of the meat loaf served them were considered to have rejected the food; therefore those students in the group who returned "3/4" of the meat loaf served them were combined with those who returned "All" of the serving. Siegal (1956) states that adjacent classifications may be combined if such combining does not rob the data of their meaning. Because the writer wanted to generalize the findings of this investigation to other schools, only pooled data were used for further analysis.

After the above considerations, the chi square procedure was applied to the data relating to acceptance or rejection of the meat loaf. The calculated chi square value of .626 did not exceed the tabled chi square value of 5.99; therefore the first hypothesis could not be rejected on the basis of this test which indicated that the students showed no difference between their acceptance of an all-beef meat loaf and one in which liver had replaced part of the beef. The results are shown in Table IX.

TABLE IX

CHI SQUARE ANALYSIS OF NUMBER OF STUDENTS ACCEPTING OR REJECTING MEAT LOAF CONTAINING VARYING AMOUNTS OF LIVER AT SCHOOLS A AND B

	Number of Students Who Returned		
Percent Liver	1/4 or less	3/4 or more	Total
0	519	76	595
5	508	65	573
10	484	64	548
Chi Square: .626	df: 2		$.70 < p < .80$

The second hypothesis stated that there was no significant difference in the acceptance of a meat loaf in which five percent of the beef had been replaced by liver, and one in which liver had been substituted for ten percent of the beef. Again the students in the "one-half" groups were omitted, and the extreme categories were combined. The calculated chi square value of .007 did not exceed the tabled chi square value of 3.84 at the .05 level of significance. The experimenter failed to reject the second hypothesis as shown by the results in Table X.

TABLE X

CHI SQUARE ANALYSIS OF NUMBER OF STUDENTS ACCEPTING OR REJECTING MEAT LOAF CONTAINING FIVE PERCENT AND TEN PERCENT LIVER AT SCHOOLS A AND B

Percent Liver	Number of Students Who Returned		
	1/4 or less	3/4 or more	Total
5	508	65	573
10	484	64	548
Chi Square: .007	df: 1		$.90 < p < .95$

On the basis of the results of the chi square test applied to the combined extremes of the pooled date from Schools A and B, the investigator failed to reject either of the two hypotheses. It is concluded from these tests that there was no significant difference between the acceptance of an all-beef meat loaf and a liver-enriched meat loaf, or between the acceptance of a meat loaf in which liver had replaced five percent of the beef, and one in which ten percent of the beef had been replaced by liver.

Interpretation of the Findings

The chi square procedure for the statistical analysis of data indicates only whether the observed differences are within the range which could have occurred by chance alone. The tests do not show direction if such a difference exists. The analysis indicated that differences in acceptance of the meat loaf with varying amounts of liver did exist when the five categories of data were used. In order to interpret the direction, the numbers of students returning varying amounts of meat loaf as plate waste were converted to percentages of the total number of students served each day. These percentages are shown in Table XI for the two classifications "1/4 or less" and "3/4 or more." The rationale for the combinations of the groups into the categories is presented on page 57. It can be seen from Table XI that there is a consistent trend of acceptance at each school. It will be recalled that the recipe variations were served in opposite order at the two schools. That is, on the first test day, the meat loaf in which liver had been substituted for ten percent of the ground beef was served at School B. On the same day, a meat loaf made from all ground beef was served to students at School B. On the second test day, both schools served meat loaf which contained five percent liver, and on the third day of testing, students at School A were served the all-beef meat loaf, and meat loaf in which liver had replaced ten percent of the gound beef was served to students at School B. This procedure was followed to minimize the effect of order of administration.

TABLE XI

PERCENTAGES OF ACCEPTANCE OF MEAT LOAF BY STUDENTS, COMBINED INTO TWO CATEGORIES FROM SCHOOLS A AND B

Percent Liver	Percentages of Students Returning			
	1/4 or less		3/4 or more	
	School A	School B	School A	School B
0	76.7	90.2	19.6	4.4
5	78.6	85.6	15.1	5.1
10	79.8	81.3	11.4	9.7

The percentages shown on Table XI indicate that at School A the percentage of those returning one-fourth or less increased as the proportion of liver was increased. The percentages of the students at School A returning three-fourths or more decreased as the proportion of liver in the meat loaf was increased. Thus, the combined percentages reveal that at School A the acceptance was greater when the meat loaf containing more liver was served. An examination of the percentages for School B in Table XIII indicates trend in the direction opposite to that shown by School A. This effect can be interpreted as being related to the order of administration of the recipe variations of the meat loaf, since the order of the variations were reversed at both of the schools, as the writer explained in Chapter III.

Summary

The chi square procedure was used to analyze the data. When this statistical test was applied to the five categories of students who returned varying amounts of meat loaf as plate waste, significant differences in acceptance were found for School A, School B, and Schools A and B combined. A significant difference in acceptance of students returning varying amounts of meat loaf containing five percent and ten percent liver at Schools A and B combined was also found. When the number of students returning one-half of the meat loaf serving was interpreted as being indecisive and was deleted, no significant differences were found in the acceptance by the students between the all-beef meat loaf and a liver-enriched meat loaf. Furthermore no significant difference was obtained between the number of students accepting the meat loaf containing five percent liver and a meat loaf which contains ten percent liver, when the students who returned one-half the serving of meat loaf were omitted from the calculations.

When the data from the two schools were converted to percentages of the total number of students served on each day, an order effect was shown to be operational in the study. This effect was minimized by the use of two schools in the study, and reversing the order of administration of the recipe variations of the meat loaf.

In Chapter V, the research will be summarized and the conclusions that were reached will be stated. The implications for teacher education will be given and suggestions will be made for the use of the results of the study by school lunch personnel, vocational homemaking teachers, and extension home economists. The last part of the chapter will include recommendations for further research in food acceptance, especially as related to school feeding programs.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In this chapter, the research will be summarized and the conclusions will be given. The implications for teacher education will be discussed and suggestions will be made for the use of this information by vocational homemaking teachers, school lunch consultants and instructors, and extension home economists. Recommendations for further investigation will be given in the last part of the chapter.

Summary

Studies indicate that iron deficiency anemia is prevalent among certain groups in the United States, and surveys show that dietary consumption of iron is below the recommended allowances for both boys and girls during the early years of adolescence. Iron deficiency without anemia is difficult to diagnose, but many believe it is widespread because of the low intake of dietary iron and the prevalence of iron deficiency anemia.

In order to find a way to increase iron in the food, the writer developed a recipe for a liver-enriched meat loaf in a college class in experimental cookery. The results of that investigation led to the research to determine acceptability of a liver-enriched meat loaf by students in two selected schools.

The investigator also wanted to know if acceptability was indicated, whether a meat loaf in which liver had been substituted for ten percent of the ground beef was as acceptable as a meat loaf in which five percent beef had been replaced by liver. This study was not concerned with the effects of age, sex, or background of students on the acceptability of the meat loaf.

Junior high school students were chosen as the group to be tested because it is during the rapid growth period of adolescence that more iron is needed than in previous years. The research was conducted in two schools which met the criteria stated in Chapter III. Observations were made on three days at intervals of four weeks. The same menu was served on each test day in both schools. At School A, liver had been substituted for ten percent of the ground beef on the first test day. On the second day of testing five percent of the ground beef had been replaced by liver and an all-beef loaf was served on the third test day. At School B, the order of administration was reversed to minimize the order effect. On the days of testing, the plate returns were checked and record was made of the amount of the serving which was not eaten. The returned amounts were recorded as "none", "1/4", "1/2", "3/4", or "all".

The data were analyzed using the chi square procedure. Significant differences were found when the five categories listed above were used, therefore the hypotheses based on the original design of the research were rejected. However, examination of the data led the researcher to analyze the data further, omitting the "1/2" group. This analysis indicated that the students accepted the meat loaf containing liver as well as without liver, and that meat loaf which contained ten percent liver was as acceptable as one containing five percent liver.

Conclusions

If the group of students who returned one-half the serving of meat loaf are included in the statistical analysis, the two null hypotheses must be rejected. It must be concluded that there was a significant difference between the acceptance of an all beef loaf and a liver-enriched meat loaf, and between a meat loaf containing five percent liver and one in which ten percent of the meat was liver.

The group who returned one-half of the serving of meat loaf were noncommittal in relation to this study. Their reaction cannot be interpreted as acceptance or rejection of the meat loaf. Therefore the "1/2" category was dropped and the data were again analyzed. The investigator failed to reject either of the two null hypotheses on the basis of the latter test.

In this study, no evidence was found that it is not feasible to substitute liver for part of the beef in a meat loaf. There was no indication on the whole that children would reject foods in which liver replaced as much as ten percent of the beef. Therefore it is concluded that the addition of liver to certain ground meat dishes is an acceptable method of increasing dietary iron.

Implications for Teacher Education

The results of this investigation have shown a method by which dietary iron can be increased. This information can be disseminated by such areas in education as vocational homemaking teachers, school lunch consultants and instructors, extension home economists and program aides, and nutrition educators. The writer strongly believes that greater efforts and improved methods of informing the public of ways to improve the quality of their diet as well as the quantity of the food is necessary to alleviate the problems of malnutrition.

The writer suggests that school lunch workers instruct cooks and managers on the principle of liver-enrichment of certain entrees. This could be done through regular newsletters, routine reviews of school lunchrooms, training workshops, or at a meeting of the organization of school food service personnel. It is likely that the most wide-spread benefits will result from methods of instruction which include demonstration and "taste-sessions."

The role of vocational homemaking teachers in nutrition education offers tremendous opportunities. Well-planned lessons in foods and nutrition, presented in an effective manner can have a lasting effect on the nutritional well-being of her students and their families. Students are especially sensitive to good instruction at the secondary level, especially if it is presented with conviction and enthusiasm. If the teacher thoroughly explains the body's need for iron, and the prevalence of iron malnutrition, the students would be receptive to a laboratory lesson in the preparation of liver enriched foods. Among the high school students, entrees such as spaghetti with meat sauce, chili concarne, lasagna, pizza, and "sloppy Joes" would add variety and interest to the lesson. Since many of the girls in high school will soon be mothers, the importance of increased iron for their age group should be stressed so that the likelihood of iron deficiency at the time of conception will be lessened.

Extension home economists can present the principle of main dishes enriched with liver in at least three areas: extension homemaker groups, 4-H clubs, and program aides. A very interesting presentation, including a demonstration and "taste-session" could be developed for a regular meeting of the extension homemaker groups. Leaders in 4-H Clubs could suggest a demonstration which included the preparation of a liver-enriched ground meat entree. The subject lends itself to both action and information which could be provided for young people who are likely to need an increase in dietary iron.

Extension program aides are challenged to find ways to improve the diets of families who have low income. The program aides should help the homemakers in such families identify low-cost foods which will help supply the iron needs of the family. Adding ground liver to ground meat dishes may be suggested to the homemakers. A problem that may be encountered is the lack of equipment, such as a food chopper, to grind the liver. In any case, the program aide should encourage the homemakers to serve liver to their families. In terms of nutrients furnished, as well as price per pound it is less expensive than many other meats.

Care should be taken to give adequate information to cooks who will prepare liver for addition to ground meat dishes. One should not attempt to grind raw liver unless it has been first cut into finger-sized strips and frozen. Since liver defrosts quickly, it must be kept in the freezer until all the equipment for grinding has been prepared. If a freezer or freezer section of the refrigerator is not available, the liver should be cooked and chilled before grinding. Some cooks find the latter method more convenient than grinding frozen meat. Liver should be cooked by steam to preserve iron. If steam cooking is not possible, the cook should use as little water as possible in cooking to avoid iron loss.

The writer has suggested three areas in which the principle of adding ground liver to certain ground meat dishes could be effectively taught. As with all teaching, the effectiveness of the instruction will depend on the training, conviction, and enthusiasm of the person who presents the lesson.

Recommendations for Further Study

1. The principle of adding ground liver to ground meat dishes should be further explored. The effect of order could be investigated by conducting the research in one school over a longer period of time, reversing the order in that school. To be more exact, data might be collected in five days, at intervals of four weeks, in which the recipe variations are presented in one order for the first three test days, and reversed for the last two days. Thus the order might be (in relation to percentage of liver in the meat loaf) ten percent, five percent, all-beef, five percent, and ten percent. This design would allow further testing of the effect of order of administration.
2. This investigation has attempted to measure acceptance of a liver-enriched food. The writer would prefer that children would learn to eat liver as such, rather than combined with other foods. Further research might be conducted in one of the few schools where liver is accepted to determine which methods of preparation are most acceptable to the students.
3. Investigation into the effect of the environment on food acceptance might reveal useful information for nutritionists. A study of the

effect of such factors as the decor of the cafeteria and the size, shape, and arrangement of the tables on the acceptance of the food which is served in the lunchroom would be helpful to those in charge of the planning, equipping, and use of these facilities. The influence of the personality and attitude of school food service personnel on the kinds and amounts of food which the students accept is an area which could be investigated.

4. Since the nutritional well-being of children is presently the focus of widespread attention, school lunch should evaluate more carefully the acceptance of the kinds and amounts of food by the students whom they serve. Effective nutrition education programs should be based on the results of research in the area and should result in improved eating habits. This is the goal of nutrition education.

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APPENDIX A

October 11, 1969
11212 Greystone
Okla. City, Okla.

Dr. L. W. Westfall
Superintendent of Schools
Choctaw, Oklahoma

Dear Dr. Westfall:

As a doctoral student in Home Economics Education at Oklahoma State University, I have proposed to conduct research in two junior high schools, to provide information for the nutritive improvement of school lunches. The criteria for the selection of these two junior high schools are:

a) A school which has adequate space and facilities for the research to be done;

b) Administrative permission for the research;

c) School lunch personnel and home economics teacher who show innovative and cooperative attitudes;

d) Lunch schedule that will accommodate research plan.

The two junior high schools in the Choctaw school system meet these criteria, and I would like to request administrative permission to conduct this research in these two schools.

Yours very truly,

Hilda Jo Jennings

HJ/mm

CHOCTAW PUBLIC SCHOOLS
Office of Superintendent
Choctaw, Oklahoma
October 14, 1969

Hilda Jo Jennings
11212 Greystone
Oklahoma City, Oklahoma 73120

Dear Mrs. Jennings:

I have conferred with our two junior high school principals, Mrs. Fitzgerald, who is our school lunch superintendent, as well as Mrs. Hedger, our Home Economics instructor. They have all agreed to cooperate with you in your study.

We will be more than happy to assist you in any manner we can during the course of your study. Anytime we may be of help please feel free to call on us.

Sincerely

L. W. Westfall

LWW/djw

APPENDIX B

TABLE XII

DATA COLLECTED FROM SCHOOL A ON FIRST TEST DAY

Lunch Period	Number of Students Who Returned None	1/4 Serving	1/2 Serving	3/4 Serving	All	Total Students
11:15	102	28	15	13	5	163
12:15	97	30	13	10	9	159
Total	199	58	28	23	14	322

TABLE XIII

DATA COLLECTED FROM SCHOOL B ON FIRST TEST DAY

Lunch Period	Number of Students Who Returned None	1/4 Serving	1/2 Serving	3/4 Serving	All	Total Students
11:15	158	28	11	3	11	211
12:15	78	12	5	0	0	95
Total	236	40	16	3	11	306

TABLE XIV

DATA COLLECTED FROM SCHOOL A ON SECOND TEST DAY

	Number of Students Who Returned					
Lunch Period	None	1/4 Serving	1/2 Serving	3/4 Serving	All	Total Students
11:15	126	8	8	12	10	164
12:15	106	20	13	11	17	167
Total	232	28	21	23	27	331

TABLE XV

DATA COLLECTED FROM SCHOOL B ON SECOND TEST DAY

	Number of Students Who Returned					
Lunch Period	None	1/4 Serving	1/2 Serving	3/4 Serving	All	Total Students
11:15	147	24	16	5	2	194
12:15	64	13	11	5	3	96
Total	211	37	27	10	5	290

TABLE XVI

DATA COLLECTED FROM SCHOOL A ON THIRD TEST DAY

Lunch Period	Number of Students Who Returned					
	None	1/4 Serving	1/2 Serving	3/4 Serving	All	Total Students
11:15	111	15	6	8	16	156
12:15	96	21	6	11	27	161
Total	207	36	12	19	43	317

TABLE XVII

DATA COLLECTED FROM SCHOOL B ON THIRD TEST DAY

Lunch Period	Number of Students Who Returned					
	None	1/4 Serving	1/2 Serving	3/4 Serving	All	Total Students
11:15	126	31	18	4	17	196
12:15	56	14	7	2	4	83
Total	182	45	25	6	21	279

VITA

Hilda Jo Jennings

Candidate for the Degree of

Doctor of Education

Thesis: AN INVESTIGATION OF THE INCREASE OF DIETARY IRON IN SCHOOL LUNCH PROGRAMS THROUGH THE ADDITION OF LIVER TO MEAT LOAF

Major Field: Home Economics Education

Biographical:

Personal Data: Born in Mansfield, Arkansas, November 20, 1920, the daughter of Joe and Ruth Strobel.

Education: Graduated from high school in Paris, Arkansas in 1939; received the Bachelor of Science degree from Northeastern State College, Tahlequah, Oklahoma, with a major in Home Economics, in August, 1943; received the Master of Teaching degree from Northeastern State College, in August, 1958; completed the requirements for the Doctor of Education degree at Oklahoma State University, Stillwater, Oklahoma, in July, 1970.

Professional Experience: Dietitian, Northeastern State College Tahlequah, Oklahoma, 1943-1946; elementary teacher, Bixby, Oklahoma, Public Schools, 1948-1949; teacher of home economics and science, Owasso, Oklahoma Public Schools, 1950-1953; teacher of home economics and science Liberty Public Schools, Mounds, Oklahoma, 1953-1960; teacher of biology, East Central High School, Tulsa, Oklahoma, 1960-1962; teacher of home economics, Northwest Classen High School, Oklahoma City, Oklahoma, 1962-1968; Lecturer, Central State College, Edmond, Oklahoma, 1969-1970.

Professional Organizations: Oklahoma Education Association, National Education Association, Oklahoma Home Economics Association, American Home Economics Association, Oklahoma School Food Service Association, American School Food Service Association, Delta Kappa Gamma, Omicron Nu, and Phi Upsilon Omicron.