CONSUMER PREFERENCES FOR MECHANICALLY DEBONED

BEEF IN GROUND BEEF PATTIES

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CHAPTER I

INTRODUCTION

Statement of the Problem

The rate of population growth in the United States along with most
other countries is expanding, creating new challenges for food pro-
ducers. To meet the needs of a larger consuming public, food technolo-
gists are searching for more complete and efficient methods of using
our food resources. Protein is the most costly of the basic food
materials. Currently under investigation are alternate sources of
protein which can be combined with meat to stretch the meat supply.
One such development in recent years has been the use of textured soy
protein in meat products which has obtained moderate acceptance from
the American public. The meat industry is examining traditional methods
of removing meat from bone in an attempt to discover a better method.

The focus of this paper is on the attitude of older consumers
toward a new food product, mechanically deboned meat. With the use of
mechanical deboning equipment, one billion additional pounds of meat
can be recovered from animal carcasses each year (9). This method
could result in a substantial increase in the meat supply, which in
turn could bring positive economic consequences to consumers. The end
result of this new process is a ground meat containing finely ground
particles of bone and bone marrow which represent the added nutrients,

iron and calcium, compared with hand deboned meat or standard ground meat. In summary, the introduction of mechanically deboned meat to the American marketplace would mean the availability of an additional source of protein and other nutrients at a savings to the consumer.

Information is needed concerning the qualities and acceptability of mechanically deboned meat as a new source of protein in the American diet. Fried (18) states:

> It is mandatory that consumers, industry, academia, and regulatory agencies meet together, not as adversaries, but in a spirit of information exchange that will decide the ultimate utilization of mechanically deboned meat (p. 70).

It is hoped that the information received from the consumer testing of mechanically deboned meat will give adequate direction to food producers in the potential designing and marketing of the product.

Objectives of the Study

The general objective of this study was to determine consumer preferences of a new food product, utilizing mechanically deboned beef.

The specific objectives of this study were to:

1. determine preferences of older consumers for ground beef patties containing mechanically deboned beef;

2. determine if there were significant differences in preferences for ground beef patties containing mechanically deboned beef between college students and older consumers; and

3. make recommendations regarding the use of mechanically deboned beef in ground beef patties.

Hypotheses

The following null hypotheses were examined:

1. There is no significant difference in preference of ground beef patties containing mechanically deboned beef between older consumers and college students.

The following hypotheses were tested exclusively with the data obtained from the older persons:

2. There is no significant difference in consumer attitudes of overall preference for ground beef patties containing 0, 10, 20, and 30 percent mechanically deboned beef.

3. There is no significant difference in consumer attitudes of flavor for ground beef patties containing 0, 10, 20, and 30 percent mechanically deboned beef.

4. There is no significant difference in consumer attitudes of texture for ground beef patties containing 0, 10, 20, and 30 percent mechanically deboned beef.

5. There is no significant difference in consumer attitudes of juiciness for ground beef patties containing 0, 10, 20, and 30 percent mechanically deboned beef.

6. The characteristics of juiciness, flavor, texture, and the percent of mechanically deboned beef in the patty are not effective variables in making a prediction of overall preference ratings assigned by consumers to ground beef patties containing mechanically deboned beef.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The review of literature, in its four sections, deals with the area of consumer preference testing of food products. The opening section covers the meaning and importance of preference testing and identifies several types of techniques used prominently in the area of consumer product evaluation. The second area covered in the review of literature is devoted to the test product itself, mechanically deboned meat. The succeeding section details the precise methodologies applied in testing situations. A compilation of actual consumer food preference studies shows the utilization of the methodology in the final section.

Preference Testing Defined

The fate of a food product rests on its acceptance by the consuming public. Amerine, Pangborn, and Roessler (2, p. 540) define acceptance as "an expression or feature of experience characterized by a positive attitude." With their food dollars, consumers vote for the products which will be successful and thrive in the marketplace. Having the future of a new product at stake, food technologists and marketing researchers are extremely interested in the consumer's attitude toward

the product. Factors such as cultural background, standards of living, regional preferences, age, sex, intelligence, interest, and motivation of the consumer along with the cost and appearance of the product, influence its ultimate acceptance. More simply stated, acceptance is comprised of both an affective and a behavioral component.

One can estimate the degree of a product's acceptance by measuring either of its components. By measuring the frequency and the quantity of voluntary consumption of product utilization, the behavioral component is determined. This method of estimating acceptance is impractical considering the complexity of new product development and food production. As an alternative, food manufacturers measure the affective component by presenting new food products to consumers for evaluation. Subjective reactions of consumers are most commonly derived through preference testing.

Preference testing is the most important approach in sensory evaluation, since it represents the summation of all sensory perception and judgment evaluation on the consumer's part (14). Preference and acceptance are not the same. Amerine, Pangborn, and Roessler (2) have chosen to define preference in three ways:

1. An expression of a higher degree of liking,

2. The choice of one object over the others, and

3. A psychological continuum of effectivity, the degree of liking or disliking.

Preference is only part of acceptance, but remains a valuable indicator in predicting a product's success. The use of a psychological continuum of affective responses has been called the most efficient, most common, and probably the most reliable method of measuring the acceptability of

food (27).

The fact that preference tests are good predictors of the acceptability of the product has been established. The real significance of a preference, in practical terms, lies in what it discloses to food manufacturers about the future behavior of consumers toward the product. The manufacturer has four principal reasons for conducting a preference test. These include the introduction of new products, the determination of the market potential, the quality control of existing products, and the establishment of specific factors of importance to the consumer such as price, product availability, and package design. The benefactor of this method of research is the consumer, because his ideas and attitudes about the product are incorporated into the finished product.

Types of Preference Tests

The researcher has a choice among three broad forms of preference testing. The ranking method requires subjects to test several samples and rank them in order of preference on a simple scale. An advantage of this method is in its easy application and interpretation. However, it is less powerful than other tests since it does not measure the degree of preference between samples.

The second form, the paired preference test, is used to compare which of a pair of samples is the preferred one. This method is probably the most simple and easily administered.

The rating scale or the single stimulus method allows absolute judgment on the rater's part, since there is no external standard. Subjects rate the samples on a continuum of like and dislike. In a

study by Pilgrim and Wood (29) the rating scale and paired preference methods were compared for their sensitivity in determining differences in consumer preferences. The two methods were found to be equally sensitive whether the difference in preference was large or small. Another study showed the paired preference method to be less confusing than the rating scale technique (35).

Due to the nature of this research, a rating scale method was employed to gather data from test participants. Several techniques are widely used among food manufacturers; and new, more sophisticated ones are being developed and introduced. The concern is not with the rating scale per se, rather the extent to which the different rating scales allow discrimination between the samples being rated. The choice of one preference rating method over another is dependent upon the characteristics of the subjects being tested, the number of samples being rated, the product under investigation, and the specific type of information desired from the participants. Each technique has its own built-in advantages, and it is the researcher's task to select the one suitable to his work.

Rating Scales

The FACT Scale, also known as the Food Action Rating Scale, requires the individual to be very precise about the behavior he would take in terms of the number of times he would eat the product during a given period of time. The test form usually consists of nine such questions as, "I would eat this three times a week," or "I would eat this every day," and the subject designates the statement which most closely approximates his expected behavior toward the food. The FACT

Scale deals with a more realistic attitude toward product testing, therefore yielding a good overall measurement of food acceptability.

The Trend Rating Scale is concerned with consumer product satisfaction from continued use. The scale is structured with phrases such as, "The best a _____ could be" or "The worst a _____ could be." By using this type of terminology, more rating freedom is possible. Less freedom is allowed by scales composed of like and dislike terms, because a subject may have no special liking of a product category prior to testing.

The Semantic Differential is a method which has no standard scale. Parallel lists of product-specific descriptors form the evaluative scale which must be adapted to each research problem. The following pair of descriptors was used in an attempt to determine what product-specific changes were needed in a particular brand of coffee in order to meet taste preferences (11):

| Lighter appearance in cup | __ __ __ __ __ __ __ __ __ | Darker appearance in cup |
| Lighter grounds in can | __ __ __ __ __ __ __ __ __ | Darker grounds in can |

The subject is asked to mark one of the nine blanks which best describes his perception of the characteristic of the product with the middle blank representing the "ideal" or "the brand I prefer to use." In addition to establishing preferences, this technique confirms the criteria important to consumers in identifying these preferences. Through this test, food marketers gain specific information on products, enabling them to centralize packaging design and advertising efforts on those product factors paramount to consumers.

The Eye Camera or Pupil Response Method uses the dilation and

contraction of the eye pupil to measure food preferences. In contrast with all other methods, the participant's response is involuntary, thus subject to none of the biases inherent in consumers' subjective evaluations. A visual stimulus is viewed through a screen in a box while the viewer's eye images are recorded by a camera. Dilation of the eye pupil indicates a pleasant reaction to the stimuli, where unpleasant reactions show up as eye pupil contraction. Changes in pupil size are very sensitive, thus revealing responses not apparent at the verbal level.

One of the biases of most consumer preference tests is associated with the semantics of the test form. Subjects may have differing opinions on what the wording in the form means. The Facial Hedonic Scale eradicates the problem of semantics by using faces which depict varying degrees of pleasure or displeasure. From five to nine faces are used, and the subject is instructed to mark the face which depicts how he feels toward the sample. Frequently, this method is used with those persons who have difficulty communicating such as young children and the ill. The Facial Hedonic Scale is a modification of the best known rating method, the hedonic scale.

The Hedonic Scale

The hedonic scale gets its name from the type of response it seeks to elicit; one derived from personal feelings. Its use dates back 150 years, preceding ranking and paired preference methods by 70 years. Initial documentation of its use was in the measurement of bath water temperature, wind velocity, and other weather phenomena. It was not until the decade of the 1920's that rating scales were used in food

evaluation. Today it is used extensively in personnel work, consumer research, and opinion research (28).

The scale is composed of several phrases (usually nine) arranged along a line, designed to suggest a single continuum. The subject is instructed to mark at the point on the continuum which most closely matches his personal feeling toward the sample. The instructions accompanying the scale have a dual purpose, that is, to encourage freedom of response and to describe the mechanism of the test. The intent is for the subject to answer on the basis of his first impression, because the hedonic scale is predicated on the belief that a direct answer, based on feelings, is a more valid predictor of behavior toward food than reasoned responses.

The hedonic scale has several advantages. Its simplicity makes it suitable with a wide range of populations. No previous experience is necessary for the subjects to respond meaningfully. The power of the scale is greater than most preference tests as seen in its being handled by the statistics of variables. Within broad limits, the results are appropriate for indicating general levels of preference.

Mechanically Deboned Meat

In its search for new and different methods of increasing the meat supply, the meat industry has developed a process referred to as mechanically deboning. The development of mechanically deboning equipment has been called the most promising innovation in recent years (18). The process involves the use of machines which render meat from animal carcasses. Traditionally, this has been accomplished manually and, to some extent, inefficiently due to the difficulty of removing

meat from the neck, rib, and back bones of animals. The increased

yield from the mechanically deboning process amounts to approximately

15 pounds per beef carcass and an additional three to four pounds per

pork carcass. The total quantity has been estimated at one billion

additional pounds of meat each year (18). The United States Department

of Agriculture (38, p. 17535) has defined mechanically deboned meat as

" . . . those products resulting from the sanitary, mechanical separa-

tion of meat from bone by approved machinery and conforming to the

parameters contained in Table I."

TABLE I

MECHANICALLY DEBONED PRODUCTS

Product	Protein Minimum (percent)	PER Minimum	Essential Amino Acids Minimum (percent)	Fat Maximum (percent)	Calcium Maximum (percent)
Mechanically deboned meat	14	2.5	32	30	0.5
Mechanically deboned meat for processing	10	2.5	32	60	0.75

Source: U. S. Department of Agriculture Animal and Plant Health
Inspection Service. Definition of meat and classes of meat,
permitted uses and labeling requirements. Fed. Reg.
41:17535, 1976.

The current study focuses on a product made from mechanically deboned red meat, therefore, the following discussion is limited to its qualities. The composition of mechanically deboned meat differs from hand deboned meat on several counts, because the former contains fine bone and bone marrow particles (0.46 mm in diameter) (17). The calcium content of mechanically deboned meat is substantially higher than that of standard meat. This new source of the nutrient is of potential dietary benefit in preventing calcium deficiency diseases which are quite common among older Americans. Mechanically deboned meat contains twice the iron of hand deboned meat as a result of bone marrow in the meat. Ascorbic acid, which is absent from standard meat, is found in significant amounts in mechanically deboned meat. Generally, mechanically deboned meat is lower in connective tissue. Consequently a greater percentage of the total amino acids are composed of the eight essential amino acids (17).

In a sensory capacity, mechanically deboned meat differs from standard meat in color, texture, and flavor. The color is more intense due to the additional heme pigments from the bone marrow. Because of less connective tissue, the texture is finer. In one study consumers judged the texture as having a mushy quality (8). The flavor of products containing mechanically deboned meat is dependent upon the percentage found in the finished product. Bolognas with a high percentage of this product were spicier than standard bologna. The distinct flavor of bone marrow was present in products with a high percentage of mechanically deboned meat (5).

The characteristics of mechanically deboned meat make it susceptible to potential problems. The microbiological quality is

jeopardized unless the bones and carcass parts are kept cold and deboned quickly after removal from the carcass. These parts are ideal media for bacterial growth. Once the deboning process has taken place, the finely-minced product is less stable than hand deboned meat and oxidation occurs more readily. Depending upon the amount of fluorides contained in the water and vegetation consumed by the animal, mechanically deboned meat may be high in this nutrient. Extremely high levels of fluorides may be toxic, while moderate amounts are beneficial in the prevention of tooth decay (17).

The government regulations concerning mechanically deboned meat have been established on an interim basis, pending further investigation. The maximum use level of this product is 20 percent of the content of formulated products such as ground beef patties, sausage products, luncheon meats, meat entrees, and canned meats (38). Ground beef and fabricated steaks are not included (17). A recent study also suggests that 20 percent mechanically deboned beef, mutton, or goat may be used in the manufacture of beef patties without seriously detracting from the palatability characteristics of the product (36).

Currently, food technologists are in the product development stage. Research is being conducted to determine the sensory acceptability of the product. There are many questions remaining for food marketers and manufacturers to deal with concerning labeling, adequate transport, and the economic consequences of introducing mechanically deboned meat to the public.

Methods of Research

Subject Criteria

The principal selection criterion for the participants in a consumer preference test is representativeness of some consumer population. The subjects are selected at random from a roster of all persons available for testing (1).

The importance of subjects being sensitive and reliable is stressed by Gruber and Lindberg (20, p. 235). They defined sensitivity as "the ability to detect differences in taste among products." Reliability is "the consistency of taste preferences based on repeated testing." The results of this study indicate a significant difference ($p < 0.001$) in preference between two products when only those deemed sensitive and reliable by prior testing are exclusively included in the sample. When all subjects are included in the sample, a difference of over $p < 0.25$ is found, which is clearly not statistically significant in product testing. Roper (32) warns against using discrimination tests of sensitivity and reliability as prerequisites for participation in a product taste test. One's failure to pass a discrimination test is not to be interpreted to mean that there is a lack of ability in exercising a preference based on taste in a real-life brand selection. Others agree with Roper that sensory training of subjects or repeated testing is antithetical to the purpose of consumer preference tests (13, 30, 34).

Pleasant surroundings and a reward system are useful in properly motivating the subjects. Motivation is achieved by simply making the participant aware of the importance of any contribution. This is

accomplished by giving a brief, general description of the research and how the information will be used to the benefit of others.

In order to maintain optimal physiological sensitivity of the subjects, it is best to avoid conditions which interfere with the normal functioning of taste and odor senses. Adhering to the following rules set forth by the American Society for Testing and Materials, Committee E-18 (1) assures a safe degree of control:

1. Do not test one hour after meals.

2. Wait 20 minutes after smoking, chewing gum, or eating or drinking between meals.

3. Avoid eating highly spiced foods at the meal preceding testing.

4. Do not test panel members who are ill.

5. Wear no odorous cosmetics, lotions, or perfumes.

6. Allow rinsing of mouths prior to taste testing.

During a taste test, in order to eliminate the effects of the preceding sample, it is recommended that participants rinse with neutral, room temperature water.

The subject responds to the total situation, therefore, it is important to keep the testing environment constant by controlling the temperature, humidity, and lighting in the taste testing area. The psychological control of the subjects is taken into consideration when planning the mechanics of the test. Certain conditions may affect the responses of those being tested. However, by recognizing them in advance the test can be monitored to negate these effects.

The "contrast effect" occurs when a given sample is preceded by one of markedly different quality. For example, an average quality sample is rated low when preceded by a sample of good quality. The serving of

a series of low quality samples develops in the rater a low-preference attitude. This causes the better quality samples to be underrated and is known as the "contamination effect." The "position effect" is characterized by the higher ratings being given to those samples served first in a simultaneous serving situation. These effects are avoidable if one uses all possible orders of samples an equal number of times or randomizes the serving order.

The breadth of the sampling is important because it is related to the probability that the sample is representative of some population. Just how large the sample size is has been moderately established among researchers, but some disagreements do exist. Caul (4) suggests that from 25 to 100 consumers suffice for pilot-scale tests. Other authors (1, 30) recommend a sample size ranging from 50 to 100 persons for most problems handled in a controlled situation. In a study by Kramer et al. (22), whose purpose was to determine the number of tasters necessary to obtain a satisfactory estimate of consumer preference, the authors stated:

> . . . for accurate results with reasonably good precision, consumer preference panels of 40 to 80 tasters are sufficient. Large panels would be required only where very high precision is needed. Much important information on gross differences in consumer preferences may be obtained even with panels of only ten tasters (p. 91).

Because of the small sample size, it is necessary to control all procedures. This attitude is reflected in the philosophy of the method which states that when discrimination is possible, it can be measured through the use of a relatively small sample group provided extraneous variables are controlled.

Sample Criteria

Simplicity is the key in choosing a method of preparation for the samples. One selects a method that is typical of the normal use of the product. Recipes which entail frying or seasoning are best avoided, since they add flavor to samples. The subjects are allowed to make voluntary additions of salt and pepper, but only in uniform amounts on all samples (1).

The presentation of the sample is accomplished in a manner that the test subjects respond only on the basis of those factors intrinsic to the material tested. Samples are controlled for size, temperature, and the effects of appearance. Reduced illumination, the use of colored lights, and the addition of color normal for the product suffice in eliminating the effects of appearance.

The order of the presentation also affects the response of the subjects to the sample. The effects of the serving order on subject response are easily diminished by randomizing this process. Generally, differences in preference are more easily detected when samples are presented simultaneously as opposed to single stimulus presentation (2). Single stimulus presentation is the suggested serving procedure with the hedonic scale method. Samples are served individually in succession, rated, and eaten before the next is served. A rest period of at least 60 seconds between tasting of samples is provided during which time the subject is instructed to "take a drink of water" (28).

The sample is of sufficient size to allow three bites or tastes, except in tests which dictate trying the sample only one time. In the latter case, sample size is one-half ounce of fluid or one ounce of

solid material. For preference tests the amounts are doubled. Normal serving quantities are not recommended.

Whenever possible, the temperature of the sample approximates the room temperature. The normal serving temperature of food is used for preference testing. Cold drinks are served no lower than 40 degrees Fahrenheit, and hot foods, not above 170 degrees Fahrenheit. The sample containers and eating utensils are to be uniform within the same test and from one test to another.

In most situations the identity of the product is not disclosed to the participant during the test. As an aid to the researcher and the rater, samples are coded. Codes must be designed to give complete information to the experimenter, yet not be informative to the respondent. In order to avoid bias, certain coding techniques are recommended. A two or three digit code, derived from a table of random numbers, is most often cited and has been used successfully (1).

The number of samples influences the subject's reaction to the presentation of the samples. During a single testing session, three or four samples may be presented (1). It is generally believed that more than two samples tend to confuse the consumer. Multiple samples are more commonly used with laboratory taste panels and pilot-scale consumer studies. A maximum of six samples may be served during one testing session. A factor in determining the number of samples used during a single testing session is the sample intensity (34). The number of samples of products with high satiety value, strong or off flavor can be adjusted to avoid sensory fatigue of the taster.

The Preference Form

Since the questionnaire is the means of communication between the respondent and the experimenter, it is simple and unambiguous. The experimenter takes a realistic attitude when designing the answer form to be assured that it is appropriate to his objectives. Questions are brief and stereotype answers are avoided. To facilitate the tabulating of the data, the information received from the questionnaire is coded. Rating-type questionnaires are designed to create the impression of a continuum related to some unidimensional concept (liking or pleasure), and provide the subject with the means of locating an object in a relative position on the continuum.

The length of the answer form may vary providing it remains easily readable. Rating scales are divided into categories. Garner (19) undertook a study whose purpose was to show how information transmission and discrimination scales are used to determine the optimum number of categories. The study showed a small definite increase in discriminatory ability up to 20 categories. The best known rating scale is the hedonic scale which most commonly has nine categories. Variations of the nine-point hedonic scale are structured with five, six, seven, and eight categories; but these tend to be less sensitive to differences in preferences (15).

One important feature to be considered when choosing a questionnaire is its reliability. This refers to the reproducibility of the test results when all conditions remain constant. For the average rating of a food to vary only within a small range is not feasible due to three factors. Peryman and Pilgrim (28) identify these as the

judge-treatment interaction, the judge variation, and the session or group effect. The first factor is a measure of the disagreement among people as to which treatment is preferred over another and by how much. This is always present and usually minimal. The judge variation results from individual differences in liking foods and the way people express themselves. The session or group effect arises when sampling takes place under different environmental conditions, in different test situations, or by different populations. This variation can be much larger than from other sources. The results of actual consumer testing showed the hedonic scale's reliability to be highly significant (21) and adequate for evaluating food preferences under varying conditions (27).

A second relevant feature to investigate when selecting a questionnaire is its validity. How well does the questionnaire measure what it is supposed to measure? First is decided what one wants to measure. In this case, preference is to be measured. The hedonic scale is accepted as a measure of preference because it is obviously measuring that, and because there is no better measure against which to check it. The hedonic scale is also a measure through which acceptance, defined as consumption with pleasure, is predicted. In some studies the variance between preference and consumption was found to extend between +0.30 and +0.87 (28). From this it is concluded that over half of the variance in consumption is explainable by preference.

Conclusion

The application of research methodologies to specific problems takes many forms. Each endeavor in this area involves its own set of particular factors with which to be dealt. The type of product, the

available facilities, and the product information sought dictate the design of the study. The importance of and the individual implementation of the methodology in actual consumer testing is included in the following section.

Consumer Studies

Introduction

The number of new food products introduced in the United States is increasing at a rapid rate each year. Approximately 50 percent of all new products fail in the test market (25). Designing new food products successfully requires the input of two functional units within a food manufacturing company. Eastlack (11) identifies these units as production-oriented and marketing-oriented. The production-oriented unit focuses on factors in product development such as moisture content, coloring agents, additives, and chemical composition. Advertising approaches, packaging design, shipping schedules, consumer opinion, and customer service are priorities of the latter unit. The work of both units is essential for the formulation of a new food product's ultimate success. The fate of the food product rests on its acceptance by the consuming public according to Amerine, Pangborn, and Roessler (2).

As outlined by Engel, Kollat, and Blackwell (16), there exist three specific problems that have prompted marketing researchers to consider legitimate the concern about consumer reaction to new products. They include the following:

1. Economic waste. Nearly all estimates report that the majority of new products fail. From 58 ideas one successful product

emerges. A single failure costs from $75,000 to $20,000,000.

2. The desire to manipulate human behavior. The goal of some consumer-directed studies is to change behavior in a manner that it conforms to some norm of what is good for society. In some cases, contributions to health or increases in the economic efficiency of the consumer are company objectives in obtaining consumer acceptance.

3. The survival and growth of contemporary business firms. Organizations operate in an increasingly turbulent environment. In order to command better profit margins, companies need to introduce new and/or modified products that meet with success in the market.

The diffusion of consumer-oriented thinking into the actual planning of a product is achieved by utilizing the concept of consumer-oriented product testing. Through the use of various evaluative devices producers are better equipped to make the decisions involved in the introduction of new products. What price, package design, and distribution of the product sells most effectively? What are the quality standards that consumers demand? Kramer (23, p. 105) states: "In our democratic society, where the customer is always right, the quality of all commodities, including food, is geared to the satisfaction of the customer, who eventually is the user or consumer." The influence and magnitude of consumer opinion is recognized by such large consuming groups as the United States Army, the Kroger Foundation, and the General Foods Corporation, whose staffs of food technologists and market researchers are actively involved in the testing of products among the consuming public (2).

General Product Testing

A mixed model analysis of variance was used by Schutz and Lorenz (33) to determine the consumer acceptance of vegetables grown under "organic" and "commercial" conditions. A nine-point rating scale was developed from statements made by the 50 test subjects concerning the samples. The analysis of the data showed no significant difference in consumer acceptance of vegetables grown under different conditions, although there was a slight preference for the vegetables labeled "organic."

A study of individual consumer preferences toward yogurt was conducted to estimate the future of that commodity in the United States (24). One-hundred sixty-one yogurt-consuming households were polled by a telephone survey and asked both knowledge and preference-related information. The results were compiled by using percentage and frequency analysis.

In developing a snack food from grain sorghum that would be high in quality protein and low in fat content, three types of consumer tests were utilized (13). The facial hedonic scale measured the degree of pleasure or displeasure derived from sampling the grain sorghum wafers. A seven-point Food Action Rating Scale was helpful in identifying future product considerations associated with the marketing phase of product development. The wafers were compared with three other popular "chips" available on the market by using a rank order technique. Results showed that predicting eating frequency (the results of the Food Action Rating Scale) was highly correlated with how well the respondent "liked" (the results of the facial hedonic scale)

the wafers. Differences in preferences were attributable to the age, ethnic background, and the sex of the respondent.

The egg substitute, a product lower in cholesterol and calories than the standard, was the item under investigation in a study conducted among 30 home economists (26). Three types of egg substitutes and two types of whole eggs were rated on a nine-point preference scale before and after nutritional information on all five products was provided for the respondents. Whole fresh eggs were most preferred. The preference ratings for the other types of egg decreased after information was received, but the perceived nutrient value increased. This finding leaves the implication that nutrient value does not play a substantial role in product preference.

Food preferences of 50,000 college students were collected in a study conducted by Einstein and Hornstein (12). Over 200 college food-service menu items were rated on a three-point hedonic scale. The investigators wished to discover if there was a connection between food preferences and dietary deficiences of certain nutrients. The percentage of the Recommended Dietary Allowances of calcium, vitamins A and C, and iron were calculated for all of the foods. No clear cut relationship was established between food preference and vitamins A, C, or iron deficiences, however, the best sources of vitamin A were among the most disliked items in the survey.

Testing of Meat Products

Consumer testing of mechanically deboned beef in ground beef patties has been minimal. The use of this product in luncheon meats and frankfurters has been more adequately researched, therefore, this

information is useful as a guide in testing ground beef patties made from mechanically deboned beef. Also related to this area of interest is the testing of new or modified meat products. The procedures applied to investigations of fabricated or extended meat items are associated with the testing of mechanically deboned beef and provide a solid framework from which specific procedures are developed.

Cross and Stanfield (6) tested consumer product acceptance by varying two product characteristics. A questionnaire was used to determine the level of fat and the level of salt in restructured beef steaks most readily accepted by consumers. The beef steaks were scored on appearance, aroma, flavor, juiciness, ease of cutting (with a knife), tenderness, and overall acceptability. Analysis of variance and the mean separation technique were used in computing the data. Consumers showed the greatest preference for the restructured beef steaks with 30 percent fat and added salt. The author suggested that additional research is needed on consumer income level, sex, and ethnic background as they relate to product acceptability.

Grinding and flake cutting were compared as methods of comminuting meat for hamburger patties in a study by Randall and Larmond (31). A panel of 50 untrained consumers rated the patties on a nine-point scale. A level of 0.05 was used to determine if the results of the analysis of variance were significant. Both products were found acceptable, but the ground beef patty was given a significantly higher score. This was explained by the fact that consumers have preconceived ideas of what a "good" hamburger patty is and any alteration of this standard is considered in a negative manner. Much of the success of a modified product depends upon how closely it resembles or functions as its existing

standard.

Beef patties containing 20 or 30 percent textured soy protein were evaluated by a standard consumer panel and a family consumer panel (37). The consumer panel was tested under controlled, laboratory conditions and was able to discern a significant difference ($p < 0.05$) between patty types for all of the characteristics rated. The family panels were allowed to prepare the meat under normal household conditions using any condiments they wished. The families with yearly incomes of over $10,000 differentiated between the two formulations on four of the six characteristics, whereas those with incomes below $10,000 found no significant differences between the patties. A ground beef patty containing substantial amounts of textured soy protein would be most beneficial to the low income families who were most readily acceptable of the product. A level of 30 percent textured soy protein was found to be acceptable in beef patties. Problems with consumer acceptance of the product still exist because of a need to determine the proper level of fat in the formulation. Cross et al. (7) tested consumer preferences of ground beef patties formulated at two levels of fat and two levels of textured soy protein to determine the most desirable combination. The patties were rated for tenderness, flavor, aroma, appearance, juiciness, and overall acceptability.

Frankfurters made from mechanically deboned turkey frames were the subject of a study by Baker and Darfler (3). A taste panel of eight men and women rated frankfurters on the criteria of tenderness, juiciness, flavor, and overall acceptability using a nine-point rating scale. The samples were modified on two product characteristics; the level of fat and the level of protein. The use of animal fats in the

product increased the ratings of flavor, while the flavor evaluations were decreased when cottonseed oil was used. A protein level of 15 percent gained the highest overall rating.

A triangle test was used in conjunction with a paired preference test to elucidate taste preferences for bologna prepared with 30 percent mechanically deboned meat (5). When compared with standard bologna, the altered product showed a significantly higher level ($p < 0.01$) of grittiness, but no differences in flavor were reported. The increased grittiness of the product is partially due to the fact that mechanically deboned meat contains bone and bone marrow. A study conducted in 1975 investigated mechanically deboned meat from several different animals (36). It was reported that 20 percent mechanically deboned beef combined with ground beef had the most pleasing appearance and a higher textural desirability when compared with standard ground beef.

An eight-point hedonic rating scale was used by 77 consumer panelists to evaluate the effects of various levels of mechanically deboned meat on the palatability and cooking properties of ground beef patties (8). Seven formulations, extending from 0 to 30 percent mechanically deboned meat, were scored on appearance, flavor, texture, juiciness, and overall desirability. After being cooked to a "medium" degree of doneness, the patties' cooking loss varied from 36.1 percent for the ten percent type to 39.6 percent for the 20 percent formulation.

CHAPTER III

METHOD AND PROCEDURE

Characteristics of the Subjects

Selection of the Subjects—Older Persons

The subjects of this study were derived from two different sources.
The tasting and rating of ground beef patties made with varying percent-
ages of mechanically deboned beef was the task required of the test
participants. The first group of subjects was selected on a voluntary
basis from the participants in the Continuing Education Program of
Stillwater, Oklahoma, whose membership consists of retired, older per-
sons. The selection of these subjects was based on the fact that they
represent a potential target population of the product under investiga-
tion, mechanically deboned beef patties. There are three factors which
were prominent in choosing this age group as test participants. Mechan-
ically deboned beef, due to more efficient processing methods, is an
inexpensive source of protein. This cost savings, if passed on to the
consumer, is especially beneficial to older people who often survive on
restricted incomes. Trouble in chewing meat is a problem common to
many older Americans. The finely minced texture of this product aids
older people in its mastication and digestion. The calcium content of
mechanically deboned beef is of potential benefit to people over the
age of 50 in preventing the onset of calcium-deficiency diseases.

Fifty-four post-retirement age persons served as subjects from the Continuing Education Program.

A letter of introduction was sent to the director of this program to inform her of the research project and to inform her of the administrator's desire to use the program's members as subjects (Appendix A). Subsequent meetings were held with the director to finalize plans for the conducting of the taste test.

The test administrator visited briefly with the potential subjects from the Continuing Education Program one week before the actual testing took place. The purpose of this visit was to increase motivation to participate in this study by showing how their contribution would be of benefit to many people. During this visit, they were given an opportunity to volunteer for participation in the taste test and were given a general description of the test itself. Immediately preceding the test, the administrator read a brief statement which gave a general statement of the mechanics of the test and again stressed the importance of the participant's contribution.

Selection of the Subjects--College Students

The second group of subjects was derived from an undergraduate class of students from Oklahoma State University. Twenty-five students participated in the project. The two different age groups were chosen to determine if there was a significant difference in preferences for beef patties made from mechanically deboned beef due to the age of the consumer. A second objective of the test of the college students was to clarify the mechanics of the cooking and serving procedures and also to pre-test the preference form. The reliability of the study was

strengthened by performing the test with a second sample.

Subject Training

As is suggested for most types of consumer-oriented research, the participants received no training prior to testing. The administrator of the test simply described the test, avoiding attempts to alter the subjects' attitudes. Their ability to discriminate or perform other complex tasks was antithetical to the purpose of this study. Two FNIA graduate students aided in the serving of the samples. They were instructed to refrain from mentioning anything pertaining to the nature of the product and the purpose of the test, and to avoid any unnecessary communication with the test respondents.

Testing Procedures

The testing of the group from the Continuing Education Program took place in a dining hall of a local church. The testing room was not adjacent to the sample preparation area, hence no odors or outside distractions interfered. To assure acuity of the taste buds and proper appetite, the taste test was conducted at 11 o'clock on a weekday morning.

A dining area in the Home Economics building of Oklahoma State University was the site of testing for the college students. The preparation of the beef patties took place in a room adjacent to the serving area, but precautions were taken to keep communication between the two areas at a minimum. The college students were tested at 2:30 on a weekday afternoon.

The areas in which the taste tests were held were well lighted and

furnished with tables and chairs. No special lighting effects or test-
ing booths were employed. The temperature and humidity were controlled
to afford general comfort to the subjects. The test required approx-
imately 15 minutes to complete.

Characteristics of the Material Evaluated

The materials evaluated in the taste test were ground beef patties
containing 0, 10, 20, or 30 percent mechanically deboned beef. The
mechanically deboned beef was obtained from the Beehive Machinery
Company of Sandy, Utah. The ground beef, acquired from a retail source,
contained approximately 20 percent fat. The patties were formulated
with the varying percentages of mechanically deboned beef. For freezing
purposes, the patties were individually wrapped in foil and placed in
airtight, plastic bags. The patties remained frozen for one month
before they were tested. To facilitate the cooking, the patties were
allowed to thaw at a temperature of 40 degrees Fahrenheit for 36 hours
immediately preceding the test.

The preparation of the samples by broiling was selected so that no
foreign odors or tastes resulted. Four-ounce ground beef patties were
broiled on pre-heated portable electric broilers. The broiling rack
was placed two centimeters from the heating element. The patties were
cooked for eight minutes, turned over, and cooked for an additional
eight minutes, making a total cooking time of 16 minutes.

The cooked patty, weighing three ounces, was cut in thirds to
yield a one-ounce sample size. Each subject received four different
one-ounce servings, tasted, and rated each individually. Samples were
served on small, color-coded, disposable plates. To control the

identification of the samples, yet not influence the subjects, a color code was used. "Contrast" and "contamination" effects were minimized by presenting the samples in random order. The color code appeared on the sample plate and the rating scale form. The tables at which the participants were seated were pre-set with a preference form, a pencil, a cup of distilled water, a paper napkin, and a plastic fork. No salt or pepper were allowed to be added to the samples during the test.

The four samples were served individually in succession by trained volunteers. Each sample was tasted and rated before the next one was served. The volunteer servers cleared the plates after each sample tasting. A 60-second rest period was provided between samples, during which time the subject was instructed to take a drink of water. When the rating of the samples was completed, the test administrator made a brief statement of thanks and notified the participants that the test results would be made available to their group upon publication.

<div align="center">Instrument</div>

Preference ratings for ground beef patties containing 0, 10, 20, and 30 percent mechanically deboned beef were collected by using a nine-point hedonic rating scale (Appendix B). As its name suggests, the hedonic scale seeks to elicit an affective response; how one feels about the stimuli presented. The 12.8 cm (approximately five inches) vertical scale was structured with "like" and "dislike" terms evenly spaced along a continuum. The respondents were allowed to mark at any point along the scale continuum, not exclusively at one of the nine categories. The coding of the ratings was achieved by measuring, in centimeters, the distance from the bottom of the scale to the point

marked on the scale. Therefore, the scale values extended from 0.00 cm through 12.8 cm. Table II lists the nine categories of the preference form and gives their corresponding value in centimeters. Subjects rated each sample on its flavor, texture, juiciness, and overall preference. Since no reasoned judgments were involved, the subjects were encouraged to give free, uninhibited, responses. To negate the possibility of subjects giving a preferential response when they had none, a neutral category was included in the scale. The phrases along the continuum ranged from "like extremely" to "dislike extremely." Additional space was provided on the preference form for comments. Each sample was rated on one page of the four-page preference form. The pages were color-coded to match the coding on the sample plate.

TABLE II

SCALE VALUES OF THE NINE CATEGORIES
ON THE PREFERENCE FORM

Category	Scale Value (centimeters)
Like extremely	12.1
Like very much	10.7
Like moderately	9.2
Like slightly	7.8
Neither like nor dislike	6.4
Dislike slightly	5.0
Dislike moderately	3.5
Dislike very much	2.1
Dislike extremely	0.7

The subjects were seated at tables. Each person was provided with a set of printed instructions which were read aloud by the test administrator prior to the serving of the samples (Appendix B). Additional instructions were given verbally by the test administrator. The subjects were asked to avoid talking with other participants during the test. The chewing of gum or smoking were not permitted in the test situation. The participants were also directed to fill out the information pertaining to their age and sex prior to the start of the test.

Analyses of the Data

Since the level of measurement achieved was primarily of the interval nature, the data were analyzed by the appropriate parametric tests. A significance level of 0.05 was adopted in analyzing the data. The treatments of each hypothesis are explained below.

Hypothesis 1: The analysis of variance for two treatments was used to determine if there were significant differences in preference ratings for the ground beef patties between the older persons and the college students.

Hypotheses 2 through 5: A completely randomized, two-way analysis of variance was used to determine if older consumers gave significantly different preference ratings to the four formulations of ground beef patty on the characteristics of juiciness, flavor, texture, and overall preference. To test for differences between the mean values, Duncan's Multiple Range Test (10) was used.

Hypothesis 6: To elucidate whether juiciness, flavor, texture, and the percent of mechanically deboned beef in the patty were effective predictors of overall preference ratings, a regression

analysis was employed. The correlation coefficients for the three

product characteristics and overall preference were also tabulated.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

In this study the researcher attempted to test differences in consumer preferences toward a new food product, ground beef patties containing mechanically deboned beef. Two sample groups participated in a taste test of ground beef patty formulations. Preference ratings were acquired for the following characteristics: juiciness, flavor, texture, and overall preference. Every sample was rated on each of these four characteristics through the use of a hedonic scale preference form. The ratings were converted to numerical values in centimeters for use in the statistical analysis.

Characteristics of the Subjects

Two different groups were used as the subjects of this study. The subjects in the first group were members of the Continuing Education Program of Stillwater, Oklahoma. Of the 54 persons who participated in the taste test, 43 were female and 11 were male. These subjects ranged from 47 to 84 years of age with the mean age being 67.7 years.

The second sample, 25 college students, was composed of 7 females and 18 males. They ranged in age from 19 to 27 years of age with the mean age of 21.3 years.

Analyses of the Data

The analyses of the data is divided into three distinct areas. The first deals with the results of the comparison between older persons' and college students' preference ratings of the product. The second area involves how the older persons rated each of the four formulations. Also included in this area is a discussion of which formulation, 0, 10, 20, or 30 percent mechanically deboned beef, was most preferred, least preferred. The final segment focuses on the power of the characteristics in predicting overall preference ratings.

College Students vs. Older Persons

The two age groups were tested under similar conditions. The times of the taste tests were, however, different. The older persons were tested at 11 a.m., while the college students participated in the test at 2:30 p.m.

The purpose of the comparision between the two age groups was to determine if the age of the consumer affected his preferences of the product. Table III shows the mean scores of the pure ground beef patty. Ratings of this sample were very similar between the groups. The values assigned to this patty most closely corresponded to the phrase "like moderately" on the affective continuum. No significant differences in preferences were found for any of the four characteristics. It is interesting to note that the older persons gave consistently higher ratings for this patty.

In Table IV are given the mean scores of the ground beef patty containing ten percent mechanically deboned beef. The ratings for

TABLE III

MEAN VALUES FOR GROUND BEEF PATTIES CONTAINING
0 PERCENT MECHANICALLY DEBONED BEEF
BETWEEN TWO AGE GROUPS

	Product Characteristic			
Age Group	Juiciness	Flavor	Texture	Overall Preference
College students	8.74	8.68	8.69	8.60
Older persons	9.38	9.09	9.28	8.86

For scale values see Table II.

TABLE IV

MEAN VALUES FOR GROUND BEEF PATTIES CONTAINING
10 PERCENT MECHANICALLY DEBONED BEEF
BETWEEN TWO AGE GROUPS

	Product Characteristic			
Age Group	Juiciness	Flavor	Texture	Overall Preference
College students	7.24 *	6.81 *	6.52 *	6.83 *
Older persons	9.65	9.19	8.94	9.18

* = significant at the 0.0001 level.

For scale values see Table II.

juiciness, flavor, texture, and overall preference are each significantly different (p = 0.0001). The older persons had a decisively more positive reaction to the ten percent patty. Their ratings of this formulation corresponded to the phrase "like moderately" on the continuum. The college students rated the patty between the neutral category and the "like slightly" category.

Mean scores of the patty containing 20 percent mechanically deboned beef are given in Table V. The only significantly different responses to this patty were on the characteristic of texture. The college students preferred its texture significantly less than the older persons, giving it a rating of "dislike slightly." The older persons' rating of texture fell between the neutral category and "like slightly." The college students rated the juiciness higher than the older persons, but on the characteristics of flavor and overall preference higher scores were given by the older group.

Table VI shows the ratings given to the 30 percent formulation by the two age groups. As with the 20 percent patty, the only significant difference in the way the groups rated the patty was on its texture, where the older persons had a more positive reaction. Ratings for the remaining three characteristics were not significantly different between the groups, although the ratings of the older persons were consistently higher.

Of the four percentages tested, the highest ratings overall were assigned to the patty containing ten percent mechanically deboned beef. The pure ground beef patty, 20, and 30 percent formulations followed in that order of preference. The 30 percent patty was the least preferred.

In summarizing, two important points should be drawn out. First,

TABLE V

MEAN VALUES FOR GROUND BEEF PATTIES CONTAINING
20 PERCENT MECHANICALLY DEBONED BEEF
BETWEEN TWO AGE GROUPS

	Product Characteristic			
Age Group	Juiciness	Flavor	Texture	Overall Preference
College students	7.58	5.88	5.12	5.83
			*	
Older persons	7.32	6.93	6.84	6.63

* = significant at the 0.01 level.

For scale values see Table II.

TABLE VI

MEAN VALUES FOR GROUND BEEF PATTIES CONTAINING
30 PERCENT MECHANICALLY DEBONED BEEF
BETWEEN TWO AGE GROUPS

	Product Characteristic			
Age Group	Juiciness	Flavor	Texture	Overall Preference
College students	6.20	5.33	5.67	5.35
			*	
Older persons	6.40	5.59	7.03	5.65

* = significant at the 0.05 level.

For scale values see Table II.

the older persons found the patty containing ten percent mechanically deboned beef to be more acceptable than the college students. In fact, the older group rated the ten percent patty very close to the patty containing pure ground beef. The second point of interest concerns the ratings given to the textures of the patties with mechanically deboned beef. For the three formulations, 10, 20, and 30 percent, the older persons rated the texture higher than the college students. The older persons found the finely-minced texture of mechanically deboned beef more appealing than did the college students. After reviewing the data, to say that age did affect food preferences would be an over-simplification. The analysis revealed that the age of the consumer affected the ratings given to one product characteristic--texture.

Data From the Older Persons

This section of the analyses of the data deals with the ratings of the older group for the four formulations and their ability to discriminate between them. In the initial two-way analysis of variance test which was used to examine the data received from the older group, the subjects were treated as blocks and the percent of mechanically deboned beef as treatments. This analysis revealed the fact that significant differences in preference existed for each of the product characteristics (see Table VII). That is, the mean ratings for juiciness were significantly different among the four patty types; the mean ratings for flavor were significantly different among the four patty types; the mean ratings of texture were significantly different among the four patty types; and the mean ratings for overall preference were significantly different among the four patty types. The pairs of

percentages for which differences occurred are shown by the results of Duncan's Multiple Range Test in Table VIII. This test for finding significant differences between means handled all possible combinations of the four formulations. There were a total of six pairings which were: 0-10, 0-20, 0-30, 10-20, 10-30, and 20-30. On the characteristic of juiciness the respondents gave significantly different ratings to all percents except the pairing of the 0-10 percents. The older persons recognized significant differences in preferences of juiciness between all but one of the six combinations. They had no significant differences in preference for juiciness of the pure ground beef patty and the patty containing ten percent mechanically deboned beef.

TABLE VII

MEAN VALUES OF THE FOUR FORMULATIONS ON FOUR
PRODUCT CHARACTERISTICS AS ASSIGNED
BY THE OLDER PERSONS

Percent Mechanically Deboned Beef	Juiciness *	Flavor *	Texture *	Overall Preference *
0	9.38	9.09	9.27	8.86
10	9.65	9.19	8.94	9.18
20	7.32	6.93	8.84	6.63
30	6.40	5.58	7.03	5.65

* = significant at the 0.05 level.

For scale values see Table II.

TABLE VIII

RESULTS OF THE DUNCAN'S MULTIPLE RANGE TEST FOR
DIFFERENCES BETWEEN MEANS

	Product Characteristic			
Pairing	Juiciness	Flavor	Texture	Overall Preference
0-10	NS	NS	NS	NS
0-20	S	S	S	S
0-30	S	S	S	S
10-20	S	S	S	S
10-30	S	S	S	S
20-30	S	S	NS	S

NS = not significant.
S = significant at the 0.05 level.

The same results are seen for the product characteristics of
flavor and overall preference. Preference ratings assigned to the four
patty types were significantly different at a level of 0.05 for five of
the six combinations. They, however, did not find significant differ-
ences in preference for flavor and overall preference between the pure
ground beef patty and the ten percent patty.

The respondents showed more variation in preferences between the
four patty types on the characteristic of texture. The results of
Duncan's Multiple Range Test revealed that the mean scores of the 0-10
pairing and the means of the 20-30 pairing were not significantly
different.

The patty containing ten percent mechanically deboned beef was

most preferred of the four products, with its overall preference rating centering near the phrase "like moderately." The pure ground beef patty followed with a rating also near the "like moderately" category on the continuum. The overall preference rating of the 20 percent patty was slightly above the "neither like nor dislike" category, while the 30 percent patty's rating fell below this point.

It has been stated that as one grows older the activity of the taste buds and the sensitivity of other sensory receptors decreases. From this one could postulate that older persons would have a lack of ability to make preferences between the different samples on the basis of sensory characteristics. The data in this study showed that the older persons had definite differences in preference between the formulations, excluding the 0-10 pairing. On the basis of juiciness, flavor, and texture these patty types were equally preferred. The pure ground beef and the ten percent patties received ratings that were significantly different from the 20 and 30 percent patties on all four characteristics. Preferences of the 20 and 30 percent formulations were significantly different on three of the four product characteristics.

Estimating Overall Preference

The third area of the analyses of the data dealt with the effectiveness of the percent mechanically deboned beef in the patty, the ratings for juiciness, the ratings for texture, and the ratings for flavor in estimating overall preference. A regression analysis was applied to see how effective each of these variables was in predicting the overall preference. To show the relationship of the overall preference to the scores for juiciness, texture, and flavor individually, the

correlation coefficients for each were tabulated.

Initially, the regression analysis was run using the four variables listed above in the regression equation for predicting overall preference. In the presence of the other three variables, the percent mechanically deboned beef in the patty was decisively not effective in estimating overall preference. Therefore, this variable was dropped out of the equation to yield a clearer picture of the relationship between overall preference and the variables of juiciness, flavor, and texture. The results of the revised regression equation showed that all three variables were effective in estimating overall preference ($p = 0.0001$) with flavor being most effective. The regression equation was as follows: Overall Preference $= -0.67 + (0.23 \times Juiciness) + (0.54 \times Flavor) + (0.27 \times Texture)$. The R-square value for this regression equation was 0.856. Following flavor were the variables, texture and juiciness in order of their effectiveness as predictors of overall preference. The correlation coefficient of flavor-overall preference as shown in Table IX, was higher than that of either juiciness-overall preference or texture-overall preference. This lends support to the conclusion reached from the regression analysis that among the three variables, flavor is the most effective in predicting overall preference.

The flavor of ground beef patties containing mechanically deboned beef was the most prominent sensory characteristic in estimating overall preference. It is this characteristic that should be given priority in the development of products containing mechanically deboned beef, if the manufacturer wishes to adhere to consumer preferences.

TABLE IX

CORRELATION COEFFICIENTS BETWEEN PAIRINGS OF
THE FOUR PRODUCT CHARACTERISTICS

Product Characteristic Pairing	Correlation Coefficient
Flavor-Overall Preference	0.88
Juiciness-Overall Preference	0.80
Texture-Overall Preference	0.77
Juiciness-Flavor	0.76
Juiciness-Texture	0.68
Flavor-Texture	0.68

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Mechanically deboned beef is a new product, resulting from the development of equipment which more efficiently removes meat from animal carcasses. The product's nutritional and sensory qualities differ from those of standard beef due to the inclusion of microscopic particles of bone and bone marrow. Before the product can be successfully introduced in the marketplace, researchers must determine if consumers will accept the beef and in what form. The purpose of this study was to determine consumer preferences of older people for ground beef patties containing mechanically deboned beef. Four formulations of ground beef and mechanically deboned beef were tested. The patty types contained 0, 10, 20, and 30 percent mechanically deboned beef.

Consumer preferences of these products were collected with a hedonic scale rating form. The subjects rated each sample on four variables: juiciness, flavor, texture, and overall preference. Data were gathered from two sample groups. One group consisted of 54 volunteers from the Continuing Education Program of Stillwater, Oklahoma. The majority of these subjects were over 60 years of age. The other group of subjects was 25 volunteers from an undergraduate class at Oklahoma State University. Most of these participants were under 25 years of age. The purposes of using this second group were to pretest both the preference form and the serving and cooking procedures

involved in the test.

The data from the second group were also compared with that of the older persons to determine if significant differences in preference for the product existed between the two age groups. This comparison was made by utilizing the analysis of variance test for two treatments. To determine if the older consumers gave significantly different preference ratings to the four formulations of ground beef patty on the characteristics of juiciness, flavor, texture, and overall preference, a completely randomized, two-way analysis of variance test was used. Duncan's Multiple Range Test was used in testing for differences between the means. To determine whether juiciness, flavor, texture, and the percent of mechanically deboned beef in the patty were effective predictors of overall preference ratings, a regression analysis was employed. A summary of the findings is given below.

Summary of the Findings

In analyzing the data from the differing age groups, two clear differences were apparent. First, the older persons found the patty containing ten percent mechanically deboned beef to be more acceptable than the college students. The second point dealt with the ratings given to the texture of the patties containing mechanically deboned beef. The older persons rated the texture higher than the college students for the three formulations, 10, 20, and 30 percent.

The preferences of the older consumers for mechanically deboned beef were discussed. The data in this study showed that the older persons had definite differences in preference between the formulations, excluding the zero and ten percent patties. On the bases of juiciness,

flavor, and texture, these patty types were equally preferred. The order of preference for the four formulations was: First--10 percent, second--0 percent, third--20 percent, and fourth--30 percent. In most cases the differences in preferences between the samples were significant at a level of 0.05.

The results of the regression analysis showed that the characteristic of flavor was the most effective variable in estimating overall preference.

Conclusions

From this study these conclusions were made:

1. Generally, the two age groups did not give significantly different ratings to the products tested. In this study the age of the consumer did affect the preference ratings for the ground beef patties in two instances.

   a. The older persons had a more favorable attitude toward the texture of the patties containing mechanically deboned beef.

   b. This same group showed a significantly greater preference for the patty containing ten percent mechanically deboned beef.

2. Of all the patties, the ten percent formulation was the most preferred. The ratings of this patty were extremely similar to those of the pure ground beef patty. As was stated earlier, consumers hold a more favorable attitude for a new product which closely resembles a familiar product. The 20 and 30 percent formulations represented a less subtle modification

of a familiar product, hence they received lower preference
ratings.

3. The results of this study showed that the flavor of the
formulations was the most effective variable in estimating
overall preference. If the score given to flavor on a
particular sample was high, one could safely predict that the
overall preference score would also be high.

Recommendations

1. Ground beef patties containing ten percent mechanically
deboned beef are recommended for use by older persons. As the
consumer buys and consumes this product, tolerance of the
sensory characteristics of mechanically deboned beef may in-
crease and eventually lead to acceptance of higher percentages
of this product in ground beef patties.

2. Consumer preference tests of mechanically deboned beef should
be expanded to home use studies. This would enable consumers
to prepare the patties using condiments and also to eat them
under normal conditions. Allowing the person to add such
items as ketchup, mustard, pickles, etc., to the product would
possibly increase the preference for the flavor of the patty.
From the results of this study, one could estimate that if
flavor ratings increased, so would the ratings of overall
preference.

3. Finally, it is recommended that older people be used more
extensively in consumer preference tests. They represent an

expanding segment of our society, which has different needs
and taste preferences from other age groups.

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APPENDIX A

CORRESPONDENCE

December 20, 1977

Dear Mrs. Harrison:

The Department of Food, Nutrition and Institution Administration of Oklahoma State University is currently participating in a research project involving a new type of beef. Preliminary tests have been conducted at this institution with small taste panels to determine the sensory characteristics and the overall acceptability of this product. My objective is to learn how potential consumers feel toward this new beef product. Would this beef be acceptable to older Americans who serve as probable consumers and benefactors of this product?

I would like to invite the members of the Continuing Education Program to participate in the preliminary consumer testing of the product. I feel that this could be a fine learning experience, since the methods of testing are very similar to those used by manufacturers of new food products. The consumer testing of a new product is an important phase of the marketing cycle which products pass through before reaching their ultimate destination, the retail market shelves.

Before discussing this project with the members of the Continuing Education Program, I would like to go over the details with you and determine the feasibility of using the group as judges and the facilities which might be available. I will be in touch with you by telephone to set a meeting time during the first week of January.

Yours truly,

Ruth Smircich
Dr. Esther Winterfeldt,
  FNIA Dept. Head

APPENDIX B

THE PREFERENCE FORM

INSTRUCTIONS:

YOU WILL BE GIVEN 4 SAMPLES OF GROUND BEEF
PATTY, ONE AT A TIME. YOU ARE ASKED TO
SAY ABOUT EACH HOW MUCH YOU LIKE OR DISLIKE
ITS JUICINESS, FLAVOR, TEXTURE, AND OVERALL
PREFERENCE. USE THE 4 SCALES--JUICINESS,
FLAVOR, TEXTURE, AND OVERALL PREFERENCE--
TO INDICATE YOUR ATTITUDE BY MARKING AT THE
POINT WHICH BEST DESCRIBES YOUR FEELING
ABOUT THE FOOD. EACH SAMPLE WILL HAVE A
COLOR CODE ON THE PLATE. RATE THE SAMPLE
ON THE PAGE WITH THE MATCHING COLOR CODE.
KEEP IN MIND THAT YOU ARE THE JUDGE. YOU
ARE THE ONLY ONE WHO CAN TELL WHAT YOU LIKE.
NOBODY KNOWS WHETHER THESE FOODS SHOULD BE
CONSIDERED GOOD, BAD, OR INDIFFERENT. AN
HONEST EXPRESSION OF YOUR PERSONAL FEELING
WILL HELP US DECIDE. TAKE A DRINK OF WATER
AFTER YOU FINISH EACH SAMPLE AND THEN WAIT
FOR THE NEXT.

Sex: Male_____
      Female_____

Age:_____

SAMPLE CODE:

Note: Be sure to mark in each of the four columns.

JUICINESS	FLAVOR	TEXTURE	OVERALL PREFERENCE
Like Extremely	Like Extremely	Like Extremely	Like Extremely
Like Very Much	Like Very Much	Like Very Much	Like Very Much
Like Moderately	Like Moderately	Like Moderately	Like Moderately
Like Slightly	Like Slightly	Like Slightly	Like Slightly
Neither Like Nor Dislike	Neither Like Nor Dislike	Neither Like Nor Dislike	Neither Like Nor Dislike
Dislike Slightly	Dislike Slightly	Dislike Slightly	Dislike Slightly
Dislike Moderately	Dislike Moderately	Dislike Moderately	Dislike Moderately
Dislike Very Much	Dislike Very Much	Dislike Very Much	Dislike Very Much
Dislike Extremely	Dislike Extremely	Dislike Extremely	Dislike Extremely
Comments:	Comments:	Comments:	Comments:

SAMPLE CODE:

Note: Be sure to mark in each of the four columns.

JUICINESS	FLAVOR	TEXTURE	OVERALL PREFERENCE
Like Extremely	Like Extremely	Like Extremely	Like Extremely
Like Very Much	Like Very Much	Like Very Much	Like Very Much
Like Moderately	Like Moderately	Like Moderately	Like Moderately
Like Slightly	Like Slightly	Like Slightly	Like Slightly
Neither Like Nor Dislike	Neither Like Nor Dislike	Neither Like Nor Dislike	Neither Like Nor Dislike
Dislike Slightly	Dislike Slightly	Dislike Slightly	Dislike Slightly
Dislike Moderately	Dislike Moderately	Dislike Moderately	Dislike Moderately
Dislike Very Much	Dislike Very Much	Dislike Very Much	Dislike Very Much
Dislike Extremely	Dislike Extremely	Dislike Extremely	Dislike Extremely
Comments:	Comments:	Comments:	Comments:

SAMPLE CODE:

Note: Be sure to mark in each of the four columns.

JUICINESS	FLAVOR	TEXTURE	OVERALL PREFERENCE
Like Extremely	Like Extremely	Like Extremely	Like Extremely
Like Very Much	Like Very Much	Like Very Much	Like Very Much
Like Moderately	Like Moderately	Like Moderately	Like Moderately
Like Slightly	Like Slightly	Like Slightly	Like Slightly
Neither Like Nor Dislike	Neither Like Nor Dislike	Neither Like Nor Dislike	Neither Like Nor Dislike
Dislike Slightly	Dislike Slightly	Dislike Slightly	Dislike Slightly
Dislike Moderately	Dislike Moderately	Dislike Moderately	Dislike Moderately
Dislike Very Much	Dislike Very Much	Dislike Very Much	Dislike Very Much
Dislike Extremely	Dislike Extremely	Dislike Extremely	Dislike Extremely
Comments:	Comments:	Comments:	Comments:

SAMPLE CODE:

Note: Be sure to mark in each of the four columns.

JUICINESS	FLAVOR	TEXTURE	OVERALL PREFERENCE
Like Extremely	Like Extremely	Like Extremely	Like Extremely
Like Very Much	Like Very Much	Like Very Much	Like Very Much
Like Moderately	Like Moderately	Like Moderately	Like Moderately
Like Slightly	Like Slightly	Like Slightly	Like Slightly
Neither Like Nor Dislike	Neither Like Nor Dislike	Neither Like Nor Dislike	Neither Like Nor Dislike
Dislike Slightly	Dislike Slightly	Dislike Slightly	Dislike Slightly
Dislike Moderately	Dislike Moderately	Dislike Moderately	Dislike Moderately
Dislike Very Much	Dislike Very Much	Dislike Very Much	Dislike Very Much
Dislike Extremely	Dislike Extremely	Dislike Extremely	Dislike Extremely
Comments:	Comments:	Comments:	Comments:

VITA $\mathscr{L}$

Ruth Ann Smircich

Candidate for the Degree of

Master of Science

Thesis: CONSUMER PREFERENCES FOR MECHANICALLY DEBONED BEEF IN GROUND
         BEEF PATTIES

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Biographical:

   Personal Data: Born in Oklahoma City, Oklahoma, April 9, 1954,
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   Professional Experience: Dietetic Technician, Presbyterian
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